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The Lithics of Grub-Kranawetberg I and II, Lower Austria: A Raw
Material Perspective

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Abstract

Silexrohmaterialien und ihre Quellen sind ein guter Indikator für die Mobilität und Landschaftsnutzung urgeschichtlicher Jäger*innen und Sammler*innen, unabhängig davon, ob wir direkte (*direct*), eingebettete (*embedded*) oder indirekte (*indirekt*) Beschaffungsstrategien annehmen. In einer Fallstudie an den gravettienzeitlichen (mittleres Jungpaläolithikum) Fundstellen Grub-Kranawetberg I und II, Niederösterreich, untersuchen wir den Wandel in der Silex-Rohstoffwirtschaft zwischen der Hauptbesiedelungsphasen vor etwa 30.000 bis 28.000 Jahre vor heute.

Bei den beiden Fundstellen Grub-Kranawetberg I und II handelt es sich um Freilandfundstellen in der Nähe der March an der Grenze zwischen der Slowakei und Österreich. Durch Ausgrabungen von 1993 bis 2011 (Grub-Kranawetberg I) und seit 2021 (Grub-Kranawetberg I und II) wurden an beiden Fundstellen umfangreiche lithische Inventare in mehreren archäologischen Horizonten (AH) ergraben. In Grub-Kranawetberg I wurden fünf AHs dokumentiert und in Grub-Kranawetberg II wurden bei den neuen Grabungen seit 2022 mindestens sieben AHs identifiziert. Während für Grub-Kranawetberg II derzeit keine absolut-chronologische Altersbestimmungen vorliegen, werden die beiden Haupthorizonte, AH 3 und AH 4, in Grub-Kranawetberg I auf eine Zeitspanne zwischen 30.000 bis 28.000 Jahre vor heute datiert.

In der vorliegenden Arbeit wird gezeigt, dass sich die beiden fundreicheren archäologischen Horizonte in Grub-Kranawetberg I, AH 3 und AH 4, in der Verwendung des lithischen Rohmaterials unterscheiden. Wir zeigen, dass AH 4 von patiniertem Flint dominiert wird, während in AH 3 Radiolarit das häufigste lithische Rohmaterial ist, wie bereits in früheren Studien erkannt wurde. Durch den Vergleich mit Referenzproben, die mit Hilfe eines Auflichtmikroskops untersucht wurden, können wir die Herkunftsgebiete oder -regionen des Rohmaterials eingrenzen. Patinierter Flint kommt in sekundären Quellenaufschlüssen in Südpolen, Nordböhmen und Nordmähren in einer Entfernung von mindestens 150 km (Mährische Pforte) von den Fundstellen vor. Radiolarit-Varianten, wie sie in Grub-Kranawetberg I AH 3 gefunden wurden, kommen im Donauschotter (30 km), im St. Veiter Klippengürtel (50 km), in den Karpaten (130 km) und möglicherweise im Bakony-Gebirge (150 km) vor.

Interessanterweise zeigen in Grub-Kranawetberg II die beiden bisher fundreichsten AHs, AH Michi und AH Luc, ein ähnliches Muster. In dem unteren AH Luc ist patinierter Flint verbreitet, während in dem darüber liegenden AH Michi Radiolarit das häufigste lithische Rohmaterial darstellt.

Während eine direkte Korrelation von AH 3 und AH 4 (Grub-Kranawetberg I) mit AH Michi und AH Luc (Grub-Kranawetberg II) beim derzeitigen Stand der Forschung am Grub-Kranawetberg II verfrüht ist, ist es interessant, dass es an beiden Fundstellen eine ganz erhebliche Veränderung von Flint zu Radiolarit als dominierenden Rohstoff geschieht. Der Großteil der lithischen Rohstoffe in den unteren Horizonten wurde mindestens 150 km weit transportiert (Ferntransport/Austausch), während in den oberen Horizonten der Großteil mindestens 30 km weit transportiert wurde (regionaler Transport). Dies deutet auf unterschiedliche Territorien und/oder Landschaftsnutzung der jungpaläolithischen Bewohner*innen hin.

Abstract

Lithic raw materials and their sources are good indicators of past hunter-gatherer mobility and landscape use, regardless if we assume direct, embedded or indirect procurement strategies. In a case study on the Gravettian (mid-Upper Palaeolithic) sites Grub-Kranawetberg I and II in Lower Austria, I examine change in lithic raw material economy between the main archaeological horizons between 30,000 and 28,000 years ago.

Grub-Kranawetberg I and II are open-air sites located close to the Morava (March) River at the border between Austria and Slovakia. Through excavations from 1993 to 2011 (Grub-Kranawetberg I) and ongoing since 2021 (Grub-Kranawetberg I and II) extensive lithic collections have been recovered at both sites in several archaeological horizons (AH). At Grub-Kranawetberg I at least five AHs have been documented and at Grub-Kranawetberg II at least seven AHs have been identified in the new fieldwork since 2022. While there are no chronometric ages available for Grub-Kranawetberg II at the moment, the two main AHs at Grub-Kranawetberg I, AH 3 and AH 4, are dated between 30,000 and 28,000 years ago.

Here we show that at Grub-Kranawetberg I the two richer archaeological horizons, AH 3 and 4, differ in the usage of the main lithic raw material. We show that AH 4 is dominated by patinated flint, while in AH 3 radiolarites are the main lithic raw material, as already recognised in earlier studies. Comparing them to comparative samples using reflecting-light microscopy we can constrain raw material source areas or regions. Patinated flint occurs in secondary source outcrops in southern Poland, northern Bohemia and northern Moravia, at a minimum distance of 150 km (Moravian Gate) from the Grub-Kranawetberg sites. Radiolarite variants as identified in AH 3 at Grub-Kranawetberg I occur in the Danube River gravel (30 km), the St. Veit Klippen Belt (50 km), the Carpathians (130 km) and potentially in the Bakony Mountains (150 km).

Interestingly, at Grub-Kranawetberg II the two up to now richest AHs, AH Michi and AH Luc, show a similar pattern. In the lower AH Luc patinated flint is common, while in the overlying AH Michi radiolarites are the most common lithic raw material.

While a direct correlation of AH 3 and AH 4 at Grub-Kranawetberg I with AH Michi and AH Luc at Grub-Kranawetberg II is premature at the present stage of research at Grub-Kranawetberg II, it is interesting that at both sites there is a quite substantial shift from flint to radiolarites as the dominating raw material. The majority of lithic raw materials in lower horizons was transported at least 150 km (far-distance transport/exchange), while in the upper horizons the

majority was transported at least 30 km (regional transport) suggesting different territories and/or landscape use.

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1. Introduction

Understanding patterns of human behaviour through the analysis of material culture remains a central objective in archaeological research, particularly in relation to mobility, raw material procurement, and technological adaptation. In this thesis the material culture and raw material usage of the Gravettian sites Grub-Kranawetberg I and II will be analysed to get new data on raw material procurement strategies, mobility and movement patterns that is happening in the Gravettian in Central Europe.

The Gravettian is a technocomplex that is situated in Southern, Western, Central and Eastern Europe. At the time of its greatest expansion, the area stretched from Portugal to Central Europe (Lower Austria, South Moravia, etc.) to the Black Sea with sites in Romania (e.g. Mitoc-Malu Galben) and Ukraine (e.g. Molodova V) and to the plains of Russia (e.g. Kostenki, Sungir). Important to note for the Gravettian technocomplex is that there are many possible sub-groups or similar complexes through time, like Pavlovian, Kostienkian and Bayacian (e.g., Otte & Noiret, 2004; Pesesse, 2013).

In Central Europe the Middle Danube region – stretching from the Wachau in Lower Austria to Eastern Slovakia and extending to South Moravia – is especially rich in sites, including for example Krems-Wachtberg (Einwögerer et al., 2006; Thomas et al., 2023), Willendorf II (Felgenhauer, 1957; Nigst et al., 2014), Dolní Věstonice II (Svoboda, 2016) and Pavlov I (Svoboda, 2010).

A notable area in the Middle Danube region is located around Stillfried and Grub in Lower Austria (Fig. 1, Fig. 2). This area has been a focus of research for a long time with focuses on different periods (Palaeolithic, Bronze Age, Medieval Period, etc.) (see, e.g., chapters in Felgenhauer, 1978) and disciplines (e.g. Geology) (e.g., Frank & Rabeder, 1999; Riegler & Peticzka, 2004). Stillfried has been eponymous for the “*Stillfrieder Gruppe*” (Graf Wurmbrand & Much, 1888), and the geological soil formation called Stillfried A and B (Brandtner, 1951, 1956; Fink, 1956, 1961). The Gravettian site Grub-Kranawetberg I was discovered in 1993 and has been excavated until 2011 by Walpurga Antl-Weiser (Natural History Museum) (Antl, 1997, 1998, 1999, 2001, 2006, 2008, 2011, 2011, 2012; Antl & Fladerer, 2002, 2004a; Antl-Weiser, 1994, 1996). Since then, many interdisciplinary studies in fields like sedimentology, botany, palynology, malacology, mineralogy and anthropology were conducted (for a summary see, e.g., Antl-Weiser, 2017). Two main areas were excavated through the years.

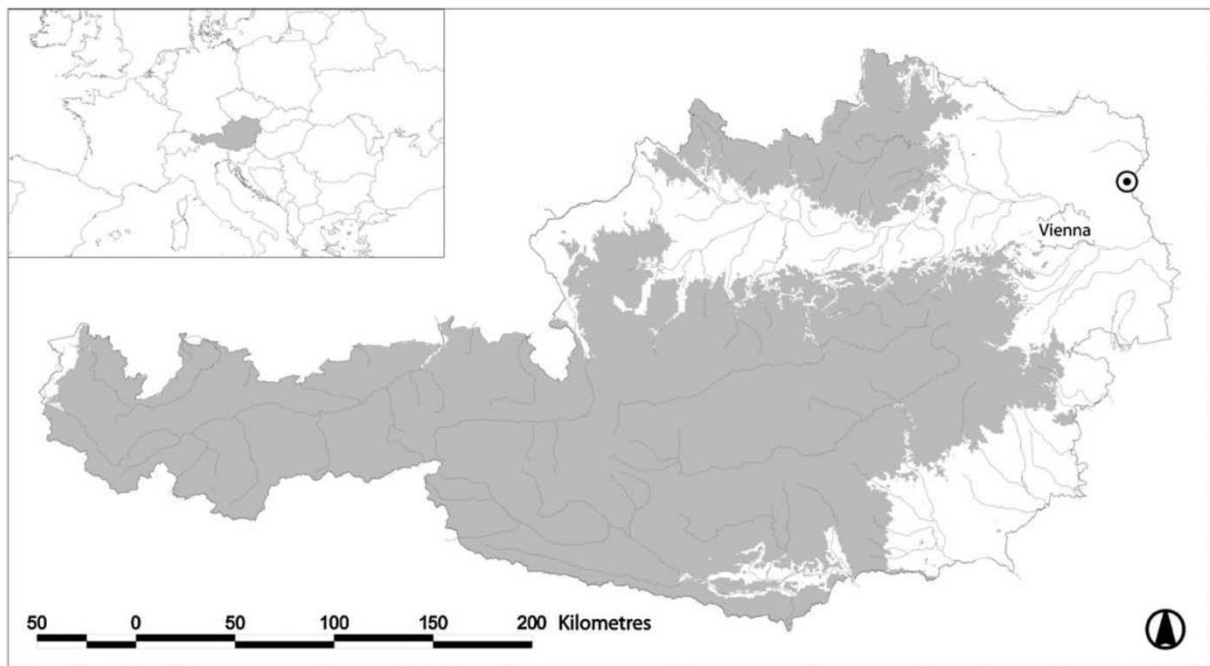


Fig. 1: Location of Grub-Kranawetberg I and II (Bosch et al., 2012, Fig. 1).

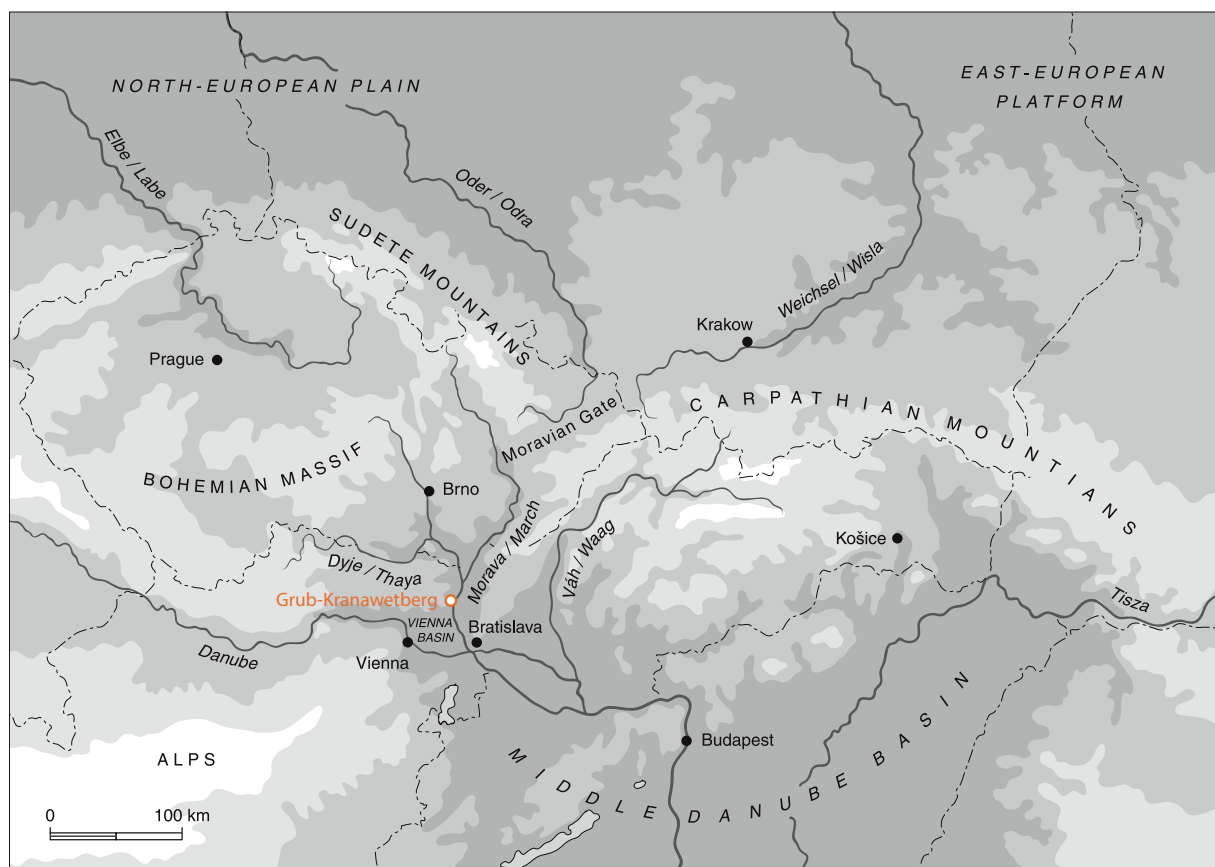


Fig. 2: Location of Grub-Kranawetberg in Central Europe (Verpoorte, 2001, Fig. 2.1, edited by Samuel Kasemann).

First, the '*bone accumulation*' and then an area that is interpreted as a campsite (Fig. 5). Although both areas are separated by approximately 20 m it was possible to connect them by re-articulation of two mammoth molars belonging to the same jaw (Bosch, 2009). In the campsite area several archaeological horizons (AH) could be identified. It was clear since the beginning that the main two AHs are different in many ways. They differ in the tendency of hunted game (Antl-Weiser, 2013; Antl-Weiser et al., 1997), in types of ornaments (Antl-Weiser, 1999, 2013, 2019; Antl-Weiser & Bosch, 2015), the presence of possible structures (Antl-Weiser, 2008; Antl-Weiser et al., 1997; Nigst, 2003) and in the tendency of the use of lithic raw materials (verbal communication W. Antl-Weiser and P. R. Nigst [August 2022]). In 2021, Walpurga Antl-Weiser, Philip R. Nigst and Marjolein D. Bosch continued the excavation in Grub-Kranawetberg I for one year (Antl-Weiser et al., 2021b). In 2022, Philip R. Nigst and Marjolein D. Bosch started a new excavation on the Kranawetberg (Bosch et al., 2025a, 2025b). Being separated to the older excavations, this site is referred to as Grub-Kranawetberg II (GK II), while the site excavated from 1993-2011 and in 2021 is referred to as Grub-Kranawetberg I (GK I). During the excavation, starting in 2022, it was recognised that the archaeological horizons of GK II seem quite similar to the campsite area of GK I (verbal communication with P. R. Nigst [August 2022]). Similarly to GK I, the two richest AHs at GK II differ in several ways. One big difference is that the two main AHs from each site appear to be different in the utilised lithic raw material. Although this was clearly visible there were no raw material analyses conducted at both sites.

One aim of archaeology is to reconstruct the movement and behaviour of hominins in the past. Due to different conservation factors influencing the preservation of archaeological finds, it is difficult to do so. This is especially true the further you look into the past. However, if there are materials preserved one can try to analyse their source, i.e., geographical origin. Geographical traceable materials include stones, clay objects and shells (e.g., Féblot-Augustins, 2008). Due to their good preservation and identifiable geographic origin, these materials are well-suited for provenance studies. Provenance studies aim to identify the spatial relationship between artifacts and its raw material sources. It is used to reconstruct the mobility and the subsistence territories of people in the past, the distribution and exchange of raw materials and to trace possible exchange of technological knowledge (Féblot-Augustins, 2008, 2009; Moník et al., 2025b; Vukosavljević & Perhoč, 2017). Here, comparisons are made with present-day hunters and gatherers in order to

obtain references for the size of exploited territories and distances travelled. It is visible that the abundance and accessibility of resources influences directly the subsistence strategies of hunter-gatherers in terms of different patterns and distances of movement (Féblot-Augustins, 2009).

Lithics are particularly suitable for provenance studies. The identification of lithic raw materials and detection and mapping of lithic raw material sources can be used to identify resource management strategies. Furthermore, it can help to answer questions on “*procurement, processing and distribution of lithic raw materials*” (Brandl, 2016, 145), show potential migration routes, possible networks and exchange systems and can give us an insight into individual and group mobility. In combination with typology, it may assist also to distinguish between different groups or cultures with unique technologies and strategies (Brandl, 2016; Féblot-Augustins, 2008, 2009; Moník, et al., 2025b; Vukosavljević & Perhoč, 2017). For the determination of the raw materials of the lithic artifacts different methods can be used. Most commonly are petrographic technics and chemical analysis. The same methods are used for analysing and characterizing lithic raw material sources. Moreover, comparative databases are used to gain insights on raw material procurement. Several provenance studies have been conducted on Gravettian sites in the Middle Danube region (see Brandl et al., 2014; Kaminská, 2016; Moník, et al., 2025b; Moreau, et al., 2016a; Moreau, et al. 2016b; Moreau et al., 2019; Schmid et al., 2019; Thomas et al., 2023; Vukosavljević & Perhoč, 2017).

The general aim of this thesis is to conduct provenance studies on lithic materials from the Gravettian sites Grub-Kranawetberg I and II to get an insight in procurement strategies and raw material economy. The research objectives are the general recording of the artifacts and their attributes (see Chapter 4.2.3) and a raw material determination of all piece-plotted lithic artifacts (see Chapter 7) with a cut-off size of 5 mm. Furthermore, the identification of potential raw material sources (see Chapter 6.4) and a possible assignment of lithic artifacts to those sources. With the achievement of these research objectives there will be new insight on possible changes in raw material economy, procurement strategies, migration, movement patterns and usage of different raw materials for different technologies through time. Through the analysis of the lithic material, both sites are integrated into the broader cultural and geographical setting of Central Europe.

As a first step, I will provide an overview of the lithic assemblages including a quantification of counts and weight and compare these between sites and AHs. Then, I will attempt a determination of potential raw material sources of the raw material groups identified in the assemblages. Based on that I divide them in local, regional, intermediate and exogenous sources. Then, in turn, I use the ratio of local to non-local materials to assess whether there are significant differences in terms of the local vs non-local raw material supply between the two sites, between the AHs within each site and between the AHs of both sites. This thesis aims to connect potential raw material sources in Austria, the Carpathians, in Moravia and in Southern Poland to the sites of Grub Kranawetberg I and II. Likewise, based on attribute and raw material analysis, it will be explored whether the use of raw materials for different tool types or technological categories varies between sites and/or AHs.

For analysing the lithic artifacts and achieving the research objectives several methods had been used. At first, the lithic artefacts were described using attribute analysis to record their technological and typological features. To determine the raw materials, artefacts were examined under a reflecting light microscope using water immersion, allowing for a more accurate identification of their microfossil inclusions. These observations were then compared with a reference collection of lithic raw materials from potential sources. Descriptive statistics and exploratory data analysis were applied to describe the materials of Grub-Kranawetberg I and II and to put them into a broader context. Statistical tests were used to assess whether the observed differences between assemblages are significant.

In the next chapter (Chapter 2) of this thesis I present an introduction to the site. This includes the history of research, a general overview on the local geology and topography and a short summary of the flora and fauna. This chapter will be finished with a potential classification of GK I and II due to its location, based on Šída (2009a). In the following Chapter 3, GK I and II will be positioned within the timeframe of many contemporaneous sites in Austria (e.g. Langenlois), Czechia (e.g. Dolní Věstonice II) and Slovakia (e.g. Trenčianske-Bohuslavice), based on relative and absolute dating, offering a broader regional perspective. Chapter 4 present the methods used during my research.

The core of the thesis focuses on the lithic assemblages (Chapters 5, 6 and 7). Chapter 5 gives an overview of the lithic assemblages. This is followed by an overview on the raw

materials groups that are present in the assemblages and a listing of potential sources (Chapter 6). Differences in raw material units between AHs of each site are analysed in Chapter 7. For discussing questions around raw material procurement, I provide a basic introduction of hunter-gatherer mobility with a focus on defining possible transfer distances in Chapter 8. I discuss the patterns in raw material use at the Grub-Kranawetberg sites in the later parts of the same chapter.

2. Background

2.1. History of Research

The region around Grub and Stillfried has an almost continuous occupation since the Upper Palaeolithic (e.g., Antl, 2007; Antl-Weiser, 1995b). The name Stillfried has been used to describe research in different research fields. The soil formation complexes “*Stillfried A*” (“*Stillfried Komplex*”) and “*Stillfried B*” are named after the village (Antl, 2007) and gained its recognition through intensive geological research by Fink (Fink, 1956, 1961) and Brandner (Brandtner, 1951, 1956) in the 1950s (Antl, 2007).

Stillfried has also been eponymous for the “*Stillfrieder Gruppe*” (Antl, 2007). Being dated into the Urnfield culture of the Late Bronze Age, the cemetery at Stillfried, gave the archaeological group its name. It was first published in 1888 by Graf Gundacker Wurmbrand und Matthäus Much (Graf Wurmbrand & Much, 1888). In addition to the Bronze Age finds, Palaeolithic artifacts are also known from early on. The first known Palaeolithic finds were made in 1879 during the construction of a cellar. This area called “*Wallplateau*” was excavated by Matthias Much in the same year.



Fig. 3: The excavation area on an aerial photograph of the Kranawetberg II (GIS & Graphic: P. R. Nigst & D. M. Bosch).

In the next two years, Palaeolithic artifacts were found during the construction of the railway station. More finds were made during the end of the 19th and in the first half of the 20th century (Weiser, 1978). Although it is possible that the first finds from the Kranawetberg were made by K. Moßler in 1933 (Antl-Weiser, 1995a) the site Grub-Kranawetberg itself is securely known since 1972, by surface collections by J.-W. Neugebauer (Antl-Weiser, 1995a; Nigst, 2003). The distribution of finds extend from the *Kranawetberg* (KG Grub) to the *Hönigsberg* (KG Stillfried) (Antl-Weiser, 1995a; Antl-Weiser et al., 1997). In older literature the area was also called '*Kranebitter*' (Antl-Weiser, 1995a). During his excavations starting in 1969, F. Felgenhauer discovered the Stillfried-Steinschlägeratelier, which dates to the Gravettian period and was located beneath the Urnfield rampart (Antl-Weiser, 1995b). It was excavated from 1974 to 1979. An antler with a half-finished piece of lithic still stuck inside and several other semi-finished and finished stone tools were found (Antl, 2007; Antl-Weiser, 1995c).

In 1993 the local collector H. Preisl (Antl-Weiser et al., 1997) reported finds that were made while a vineyard on the south slope of the Kranawetberg was uprooted (Antl-Weiser, 2013; Antl-Weiser et al., 2010). After the notification Walpurga Antl-Weiser started an excavation (on cadastral parcel 145) (Antl-Weiser, 1994). In the next year a long-term research project was started by the Natural History Museum (NHM) in Vienna (Antl-Weiser et al., 2010). The excavations between 1996 to 1998 were funded by a grant from the '*Fond zur Förderung der wissenschaftlichen Forschung*' (FWF-Projekt P 11.140 GEO) (Antl & Fladerer, 2004b). The excavations on this site (GK I) continued (except 2003, 2006 and 2008) until 2011 (Antl, 1997, 1998, 1999, 2001, 2006, 2008, 2011, 2012; Antl & Fladerer, 2002, 2004a; Antl-Weiser, 1994, 1995a, 1996). During the fieldwork in 1993 and 1994 an area of roughly 90 m² was excavated. This area was "*characterized by deposits of big bones from mammoth and rhino*" (Antl-Weiser, 2013, 104). Since 1995 the focus of the fieldwork was on an area approximately 20 m to the east of this bone accumulation. In this trench the excavators discovered two hearths and several pits with a high find density in the surrounding area (Antl-Weiser, 2013).

The bone accumulation was situated in *Trench 1, Area A* and *Area B*. *Trench 2* had no finds and in *Trench C south* one lithic artefact was found. Otherwise, no archaeological horizon could be identified in both trenches. The biggest trench was *Trench 3* together with *Area C*. This part contained the hearths and pits (Fig. 4, Fig. 5) (Nigst et al., 2004).

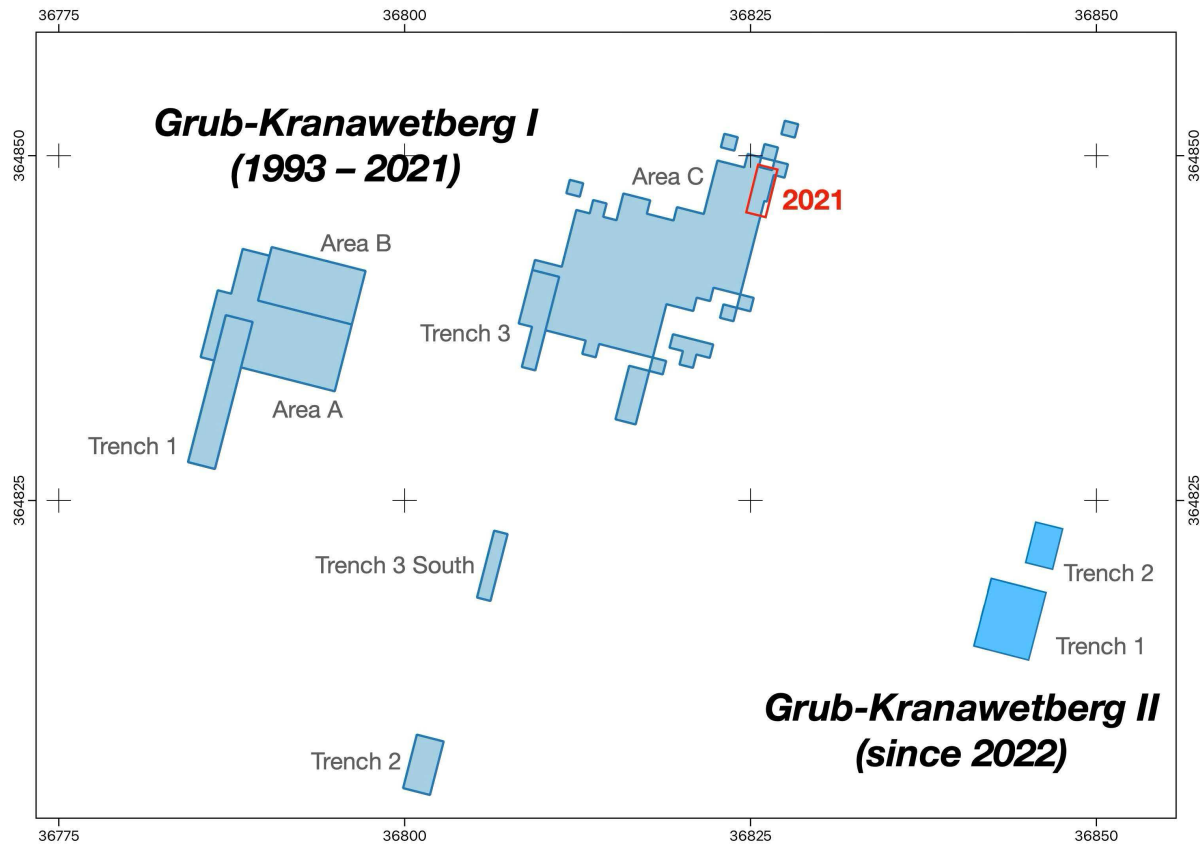


Fig. 4: Trenches and Areas of the excavation from 1993-2011 (Nigst & Antl-Weiser, 2011, Fig. 2).

As part of a field school from the University of Vienna lead by Walpurga Antl-Weiser (NHM), Philip R. Nigst (University of Vienna) and Marjolein D. Bosch (Austrian Academy of Sciences) a survey took place in 2021 on the Kranawetberg (Fig. 6) (KG Grub an der March, KG Stillfried) (Antl-Weiser et al. 2021c; Nigst et al., 2024a, 2024b). As part of the same program an excavation in the northeastern corner of the earlier excavations by Antl-Weiser was carried out, pushing back the exposed east and north sections to collect lithic and faunal samples as well as various samples for environmental reconstruction, dating and site formation studies (micromorphology) (Antl-Weiser et al., 2021a).

The following year a prospection by coring was conducted on the parcels 130 and 131/4 (Bosch et al., 2025b; Bosch et al., 2025c). On the basis of these drillings a new, a still on-going excavation started approximately 30 m southeast of the previous ones (Fig. 3, Fig. 4) (Bosch et al., in press; Bosch et al., 2025a).

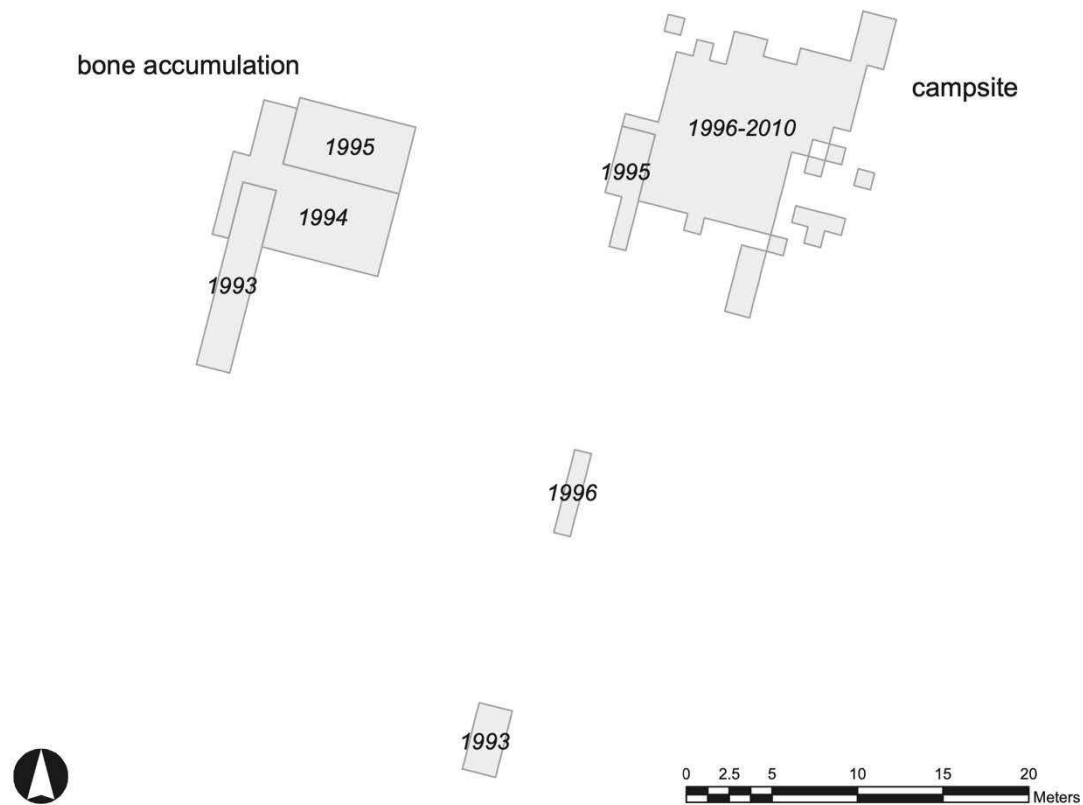


Fig. 5: Map of the excavation trenches/areas 1993-2011 (Bosch et al., 2012, Fig. 2).

2.2. Topography

The sites of Grub-Kranawetberg I and II are situated on a west-northwest to east-south-east running ridge. At the eastern end of it the village Grub an der March is situated. North and south of the about 1,200 m long ridge are valleys that confine the width to approximately 180 m. The sites are located on the south facing slope of this modern ridge which is between 185 m to 205 m above sea level (Nigst et al., 2024a; Schilt et al., 2017) and the north and south sides are sloping down with a gradient of between 3% and 7% (Antl-Weiser et al., 1997). GK I and GK II are about 35 m above the village Grub an der March and about 50 m above the talweg of the Morava River. Due to this elevation difference these sites have an ideal outlook over the river valley and the plain towards the Carpathian Mountains (Antl-Weiser, 2013, 2017). In contrast to this wide eastward view, hills with similar heights as the Kranawetberg are blocking the lookout to the south, north and west. To the best of our knowledge, no detailed studies have been carried out to reconstruct the palaeorelief or palaeotopography surrounding the sites. However, two key observations

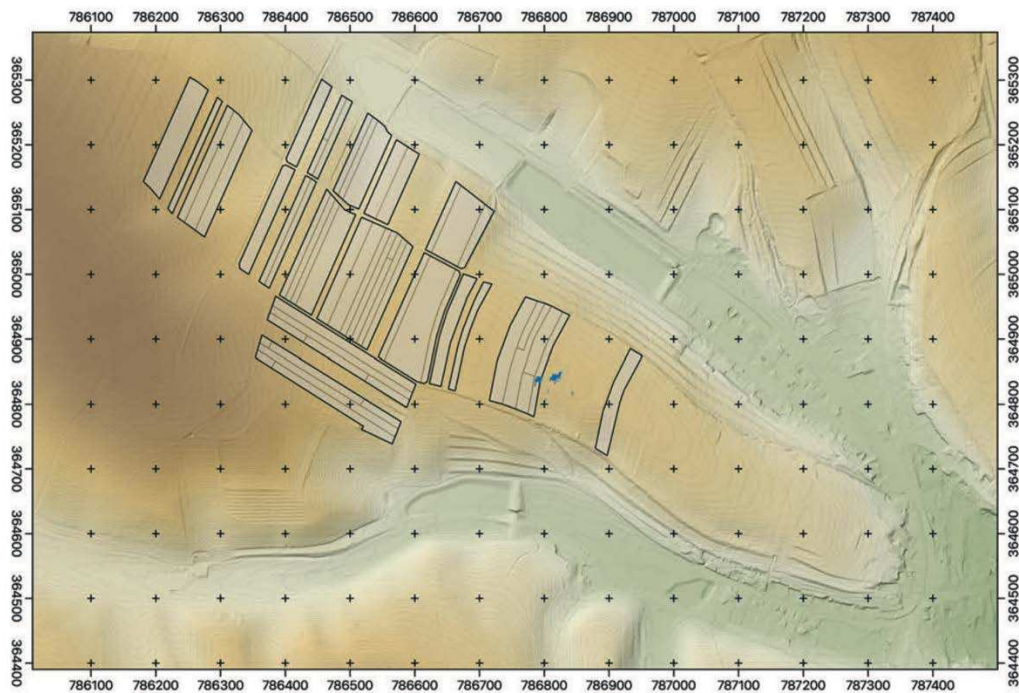


Fig. 6: Topographical map showing the in 2021 surveyed area. Excavated area of Grub-Kranawetberg I and II (blue) (Nigst et al., 2024a, Fig.5).

suggest that the current slope likely differs from its configuration during the Late Pleistocene. More specifically, these observations indicate that the present-day slope inclination deviates from that of the Gravettian landscape. First, in the southern part of Trench 1 (GK I), the cultural layer emerges along the modern slope and shows signs of disturbance and destruction caused by ploughing (Antl-Weiser, 1994). Second, the inclination of the archaeological horizons within the excavation trenches does not correspond to the current slope of the terrain (Antl-Weiser, 1994, personal observations).

2.3. Geology in the area of Grub-Kranawetberg

The villages Grub and Stillfried are located in the central part of the northern Viennese Basin. It was formed in the middle Miocene during the Alpine-Carpathian Mountain build up. The filling of this basin in the area of the site reaches a thickness of approximately 3,000 m. Above several layers of gravel, sand, and clay marl sits a thick layer of loess in which the archaeological horizons (AH) of Grub-Kranawetberg I and II are embedded. Loess is an aeolian sediment consisting of a large proportion of coarse silt and a varying carbonate content. The loess deposits are formed during cold periods (Krammer, 2008).

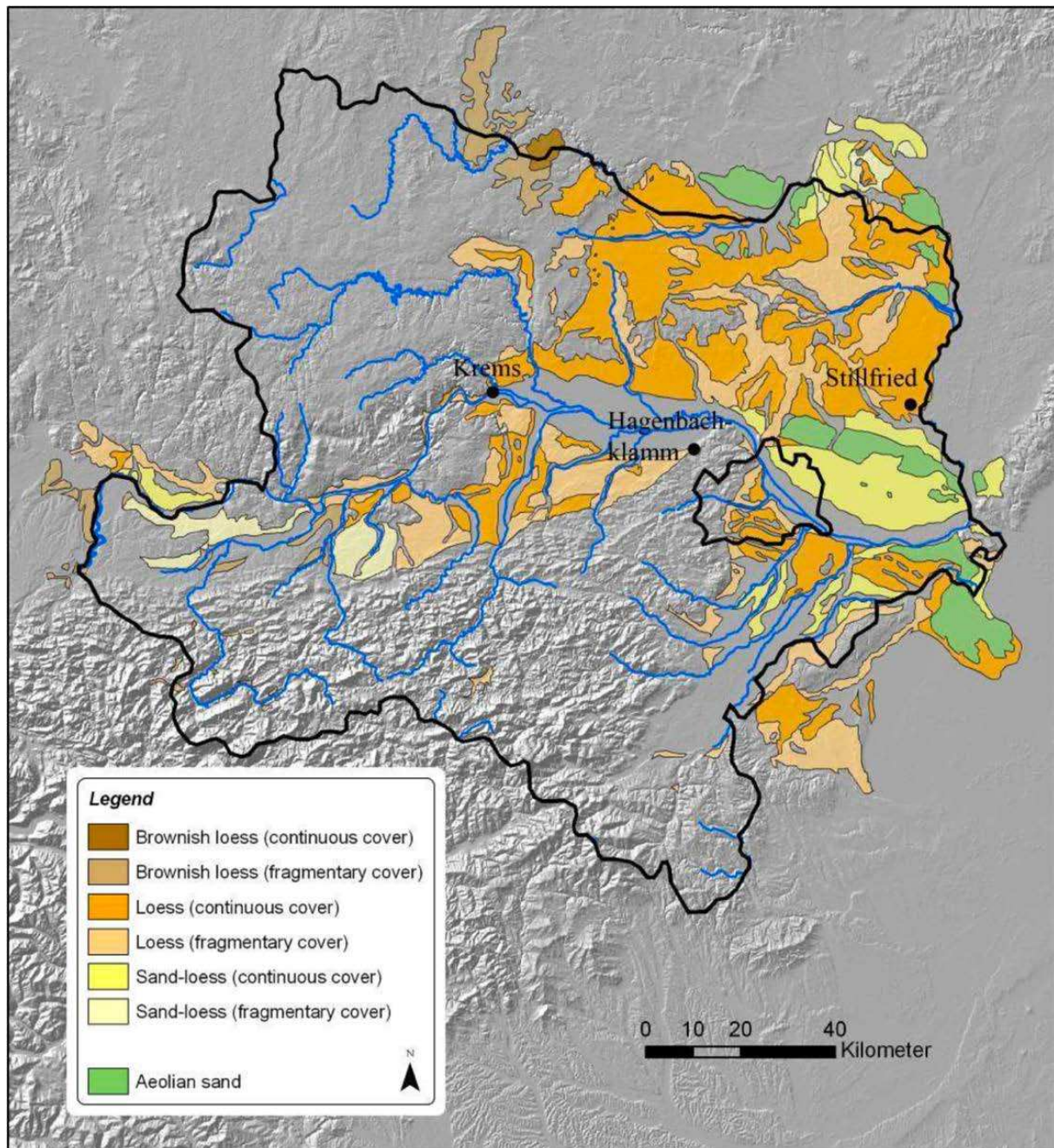


Fig. 7: Modern loess distribution on Lower Austria (Peticzka & Terhorst, 2008, Fig. 5).

During these also dry periods, loess was blown out of vegetation-free areas near glaciers and riverbeds and was deposited elsewhere. Originally, vast areas in Lower Austria were covered by loess. Over time, the loess eroded at higher elevations, leaving only loess deposits in sheltered valleys and basins (Fig. 7). In the interstadial periods between the stadial periods, soils develop.

Brown or reddish-brown horizons were interpreted as potential remains of forest soils. They are situated between the yellowish loess horizons (Frank & Rabeder, 1999). The loess

deposits in this area are characterized by the soil formation complexes that are known as “*Stillfried A*” and “*Stillfried B*”. *Stillfried A* is a pedocomplex that contains several soils and is dated to the Last Interglacial-Early Glacial. *Stillfried B* is a soil that formed in one (or more) interstadial(s) of the last Glaciation (Rögl & Summesberger, 1978). This is based on radiocarbon dates ($28,120 \pm 200$ BP and $27,990 \pm 300$ BP) on charcoal found a few centimetres above the *Stillfried B* complex the early 1960s (Riegler & Peticzka, 2004). These ages make the formation of the soil a bit older than GK I (see Chapter 3).

2.4. Fauna and Flora

Malacological investigation on GK I indicate a range of a rather open landscape of a dry loess tundra type with only a few herbaceous, individual bushes and trees (Antl-Weiser et al., 1997) to a herb-rich grass steppe with some bushes, shrubs and trees (Antl, 2007). A large number of bones larger than 30 cm were found within the bone accumulation (Fig. 5), even though the size of the majority of the fragment's lays between 5 and 30 cm. The faunal parts found in this accumulation had partly traces of fire (Antl-Weiser et al., 2010). *Mammuthus primigenius* is the dominant animal within the faunal assemblage of the bone accumulation. In addition to that there are also remains of *Coelodonta antiquitatis* (woolly rhinoceros), *Equus sp.* (wild horse), *Rangifer tarandus* (Reindeer), *Megaloceros giganteus* (giant deer), *Canis lupus* (wolf), *Ursus cf. arctos* (brown bear) and *Lepus cf. timidus* (hare) (Antl-Weiser, 2017; Antl-Weiser et al., 1997, 2010; Bosch et al., 2012). Some pieces of the faunal parts, especially mammoth and rhino were found in partly articulated positions (Antl-Weiser et al., 2010). On the basis of skeletal parts of mammoth that are present and the sparseness of lithic artefacts, W. Antl-Weiser and F. Fladerer interpret this area of the bone accumulation as a dump zone for the finished remains of the carcasses (Antl & Fladerer, 2004b; Antl-Weiser, 2008; Bosch et al., 2012). Furthermore, M. Bosch propose that the humans were the first to have access to the carcasses since carnivore gnaw marks are absent, indicating game hunting by humans (Bosch et al., 2012).

In contrast to the bone accumulation, the faunal remains recovered in the area of the “*Campsites*” (Fig. 5) comprise abundant, highly fragmented specimens. Based on preliminary spatial analysis, we can distinguish two different zones within this area. Inside the tent structures many small bone fragments were found (Antl-Weiser, 2017; Antl-Weiser et al., 1997). However, the main activity zone was between both dwellings. Here a high

density of stone tools and bone fragments (Antl-Weiser et al., 2010) of mammoth, wild horse and reindeer were documented. Furthermore, remains of arctic fox, arctic hare, birds and eggshells of the ptarmigan and the sandpiper were discovered (Antl-Weiser, 2017; Antl-Weiser et al., 1997). Antl-Weiser et al. (2010) suggest that the mammoth was the main source of food for humans during the time period of AH 4. The situation is different in AH 3, where significantly fewer mammoth bones were found. With this in mind it is assumed that during this occupation the mammoth no longer had the same importance in the diet of the humans as before (Antl-Weiser, 2017; Antl-Weiser et al., 1997).

2.5. Settlement type

The location of the GK I and II is ideal for a camp site that overlooks an advantageous hunting area. The elevated location provides a good overview of the plain from the Morava river to the Carpathian Mountains (Antl-Weiser, 2013, 2017) making it ideal for hunting seasonally migrating herd animals. Depending on hunting strategies and seasonal changes through the year, hunter-gatherers used different settlement locations. Šída (2009) proposes five different types of landscape that were used for settlements in the Bohemian environment. He describes them as following types (A, B, C, D, E):

- A) “Settlements along the bank of a bigger river near a valley bottom, providing sufficient shelter from bad weather [...].
- B) Settlement near a confluence of brooks in a lateral valley near a big river with shelter from bad weather [...].
- C) Settlement in an exposed location in a smaller valley on the edge of, or directly on, a plateau [...].
- D) Settlement in an exposed location over a valley of a river or brook, providing a long distance view [...].
- E) Cave find site, unidentified form [...]” (Šída, 2009, 23)

Šída (2009) sets transient hunting sites, which utilize a combination of an increase of the terrain and a river that forms a natural barrier, in Type D environments. Looking at the geographical attributes of the sites Grub-Kranawetberg I and II, they can be assigned to Šída’s Type D.

Based on faunal remains of arctic hare, a mammoth tusk of a neonate, eggshells and birds (see Chapter 2.4) found in GK I, it is possible to say that the site was occupied from winter to early summer. The presence of many different species suggests that the GK I site is a main camp, where already processed game were brought to (Antl & Fladerer, 2004b; Antl-Weiser, 2017). Antl and Fladerer (2004b) suggest that the faunal remains of the “campsite” show primarily waste from food preparation/consumption, craftworks and secondary refuse while the area of the bone accumulation was used as a dump zone. The waste removal strategy that is proposed by Bosch et al. (2012) for this area consists of waste removal by burning. Such a waste removal strategy speaks for the use as main camp as it shows a “*substantial investment in the site infrastructure consistent with a relatively long occupation time*” (Bosch et al., 2012, 119).

2.6. Excavations on Kranawetberg

2.6.1. Grub-Kranawetberg I, excavation 1993-2011

2.6.1.1. Bone Accumulation

This area (Fig. 5) that is characterized by a cluster of large bones (Antl-Weiser, 2013) also contained 30 lithics, 20 stones, two pieces of red ochre, 14 molluscs, and 14 pieces of charcoal (Bosch et al., 2012). Furthermore, traces of fire in form of lenses of burnt sediment described as containing charcoal and ash were discovered (Antl-Weiser, 2013).

2.6.1.2. 'Campsite'

Approximately 20 meters to the east of the bone accumulation is an area that is characterized by abundant archaeological materials and small pits and combustion features (Fig. 5) (Antl-Weiser et al., 1997, 2010; Nigst & Antl-Weiser, 2012; Schilt et al., 2017). In this area a total of 4 archaeological horizons could be determined.

- AH 1
- AH 2
- AH 3
- AH 4

Before being named archaeological horizons in 2010 the layers were called “*Hauptschicht*” (AH 4), “*Oberschicht*” (AH 3), “*OOS*” (AH 2) and “*OOOS*” (AH 1) (Antl, 2011). Both AH 1 and AH 2 contain only a few lithic artefacts and bone fragments (Antl-Weiser, 2013). They are located approximately 5-10 cm above AH 3 (Schilt et al., 2017). Within AH 3 there is no evidence of human made structures. However, there are traces of fire in the form of big pieces of charcoal, burnt bones and to some extent burnt sediment. Altogether the horizon is up to 16 cm thick and spans over the whole excavated area. In the northeastern part the layer splits into two horizons and in square M21 at least three occupation events are evident (Antl-Weiser, 2013). Even though they are clearly separated by loess, there are only 8-10 cm between AH 3 and AH 4 (Antl, 2013). Being the lowermost horizon, AH 4 is the remain of the first phases of occupation. In contrast to the upper layers with no evidence of structures, this horizon provides several pits and two hearths (Fig. 13). The latter are 7.5-8 m apart, and each is surrounded by different kinds of said pits. Many of those had stones or bigger tools at the base. By surrounding each hearth they form a circle with a diameter of approximately 5-6 m (Antl-Weiser, 2013). The area between Hearth I and II shows a high density of finds. Thanks to the individual measured finds Philip R. Nigst could analyse the find density of one part of the site. He was able to show that the distribution of finds is corresponding to the man-made structures in AH 4 and could even divide the area into different spaces of intrasite spatial organisation (Nigst & Antl-Weiser, 2011; Nigst, 2003). In some parts of AH 4, the horizon splits into two layers that are separated by a layer of loess and thus indicates at least two phases of occupation. In the hearths you can even recognise up to 4 different layers that are parted by loess (Antl, 2013).

Based on micromorphology sampling, F. Schilt suggests a formation model with five phases for GK I. The sediment of Phase 1 consists of homogeneous loess, that was relatively fast deposited during a “*typical periglacial environment with dry and windy conditions*” (Schilt et al., 2017, 158). Dominated by west winds the aeolian sediment was deposited depending on the flora and topography. During Phase 2 humans were occupying the area. There is a large amount of anthropogenic input consisting of lithic remains and rests of human-induced combustion like charred floral and burnt faunal remains. During the entire period deposition of loess is happening. This is indicated by multiple thin layers and lenses of clean loess. In Phase 3 the site is deserted by humans. The surface that has

been fertilized by human impact could have stimulate the growth of a diverse vegetation. It is further characterised by extensive bioturbation and soil formation. In Phase 4 the whole site was covered in loess. After the covering by loess the Holocene soil was formed in Phase 5 (Schilt et al., 2017).

2.6.1.2.1. Connecting the bone accumulation with the 'Campsite'

Since the area with the bone accumulation and the area with the dwelling structures are not connected by a trench (see Fig. 5), we could not tell if both are connected to each other. This changed in 2009 when Marjolein D. Bosch found evidence that linked both areas by re-articulating two molars coming from the same mammoth (Bosch, 2009). *“Evidence for this association involves an upper left first molar of mammoth found in the AH 4 which belongs to the same maxilla as a right upper first molar found at the bone accumulation”* (Bosch et al., 2012, 111). This re-articulation shows that the bone cluster is contemporaneous to the occupation time of AH 4.

2.6.1.2.2. Differences between AH 3 and AH 4

As already mentioned in Chapter 2.6.1.2 only a relatively thin layer of loess is separating AH 3 and 4. The radiocarbon dating (see Chapter 3.1.1) shows that both horizons are close in time and the dates do overlap. Antl-Weiser concludes from this that the two occupation phases are perhaps only several decades apart (Antl-Weiser, 2017). However, despite being this close the difference between both AHs that can be observed is immense. The first time described in 2001, a difference in the lithic raw material could be recognised during the excavation in 1999 (Antl, 2001). Furthermore, there has also been a change in the tool types and there is no evidence of human made structures. There is a clear difference in adornments and the mammoth is no longer as important a hunting animal as in AH 4 (Antl-Weiser, 2017). This difference will be analysed in Chapter 7.1.

2.6.2. Grub-Kranawetberg I, excavation 2021

During the excavation in 2021 the previous trench of Ant-Weiser was opened, and parts of the norther and eastern section were pushed back while excavating. This happened in the squares P20, P21 and O22 (Fig. 13). Within those five archaeological horizons (AH 1,

AH 2, AH 3, AH 4 and AH 5) (Fig. 8) were identified (Antl-Weiser, Bosch, Pirson, et al., 2021a). The first four AHs were the same as in the previous excavations by Antl-Weiser. In addition to those a fifth AH (AH 5) was identified. However, only one find (lithic) was documented here and further analyses will show whether this is in fact a separate AH (Antl-Weiser et al., 2021a).

2.6.3. Grub-Kranawetberg II, excavation 2022-2023

After prospecting by drilling, a 4 by 5 m trench (Trench 1) was opened in 2022. In 2023 a second trench (2 by 3m, Trench 2) was opened north of Trench 1. The following archaeological horizons (Fig. 8) were defined for Trench 1 (Fig. 4) (Bosch et al., 2025a, verbal communication P.R. Nigst [March, 2025]) and for Trench 2 (Fig. 4) (opened in 2023) (Bosch et al., in press, verbal communication P.R. Nigst, [March 2025]).

- Trench 1:
 - AH Above Chase
 - AH Chase
 - AH Michi
 - AH Luc
 - AH Morgan
 - AH Kristof

Trench 2:

- AH Jorge
- AH Frido
- AH Mario

The find complex is dominated by lithics and charcoal. However, faunal remains are also present, as well as red ochre and stones. Molluscs found in AH Michi are particularly noteworthy. A statement on the relationship between the layers from Trench 1 and Trench 2 is currently not possible due to the missing connection (Bosch et al., in press; Bosch et al., 2025c).

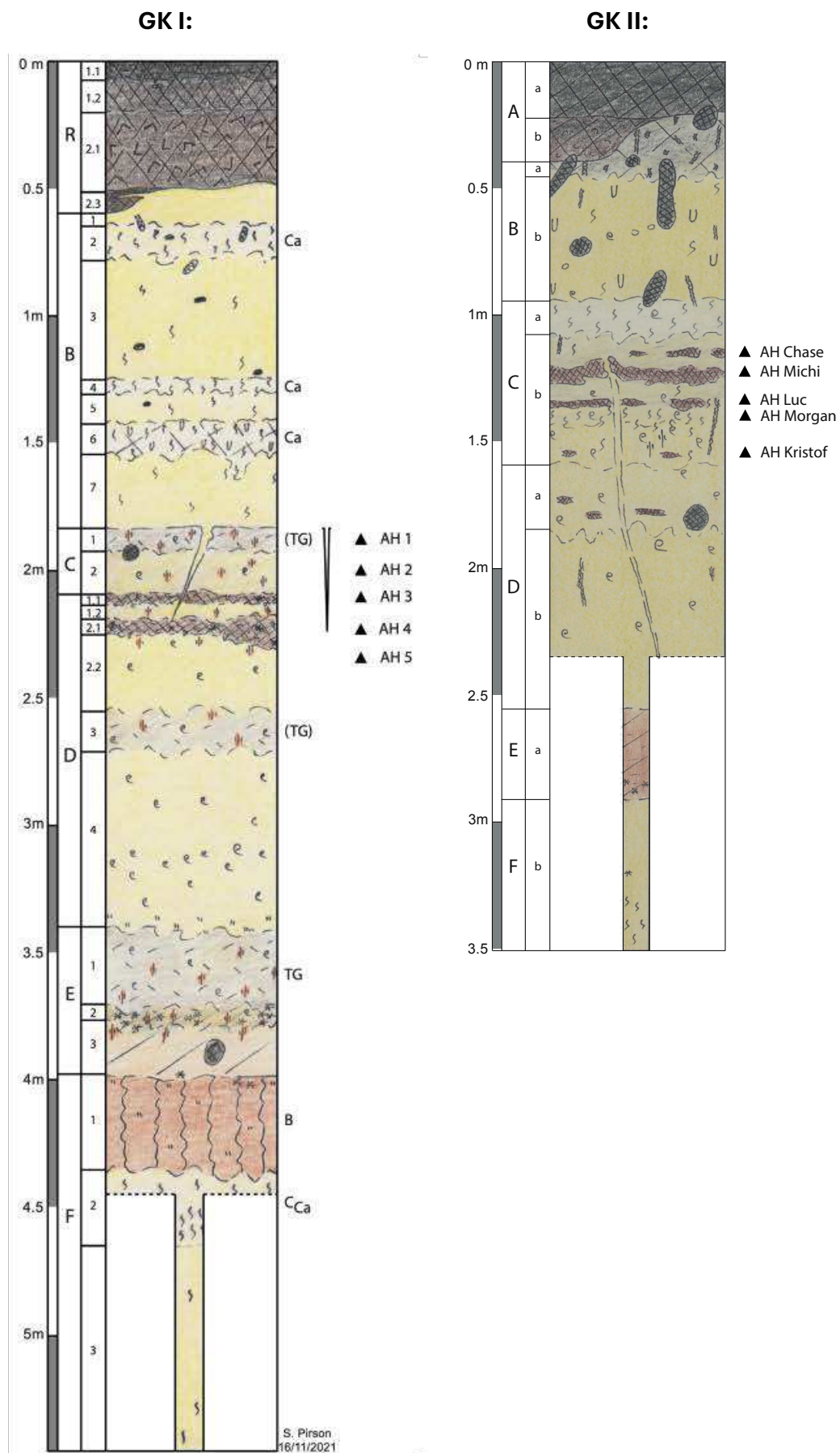


Fig. 8: Section Drawings of GK I and II (Trench 1) (drawings and graphic by S. Pirson).

2.6.3.1. Difference between AH Michi and AH Luc

Similar to GK I there is a difference between the two main Horizons. Said difference is so far only recognisable in the lithic assemblage and can be seen in the difference in the lithic raw materials. (personal observation during fieldwork and verbal notification by P.R. Nigst, [August 2022]) This difference will be analysed in Chapter 7.1.

3. Chronology

3.1. Dating

3.1.1. Relative and absolute Dating

Several Palaeolithic sites and surface collections in the area of Grub and Stillfried that were discovered before excavation of GK I have only been dated relatively. A few pieces of this material could be dated on the basis of the lithic technology and they belong to the Gravettian technocomplex (Weiser, 1978). Also the flintknappers workshop underneath the Urnfield Rampart brought tools from the Gravettian to the surface (Antl-Weiser et al., 2010).

Already in the first year of excavation in 1993, some finds, such as a Gravettian point, indicated a dating into the Gravettian (Antl-Weiser, 1994). This allocation was strengthened over the next few years (Antl, 1997, 1998, 1999, 2006, 2008, 2011; Antl-Weiser, 1995a, 1996). Based on several backed pieces, which Floss (2012) defines as typical for the Gravettian period, in the assemblage of the excavation of 2021 all other finds within AH 3 and 4 of the 2021s excavation could be dated to the Gravettian technocomplex. While the artifacts coming from AH 3 and 4 are datable, the finds from AH 1, 2, 3a and 5 are not determinant (Fig. 8) (Antl-Weiser et al., 2021a). The same situation occurs in GK II. Finds in the AHs *Above Chase*, *Chase*, *Below Luc* [later AH Morgan, AH Kristof - authors note] (Fig. 8) and AH Chris are not determinant, whereas the AHs *Michi* and *Luc* are also placed into the Gravettian find complex due to the presence of backed pieces (Bosch et al., 2025a).

AH	material	pre-treatment	lab.nr.	¹⁴ C date	1 sigma	reference
AH3	charcoal	ABA	GrA-28183	24,780	+/-140 BP	ANTL-WEISER ET AL., 2010
AH3	charcoal	ABA	GrA-28184	25,640	+/-160 BP	ANTL-WEISER ET AL., 2010
AH3	charcoal	ABA	GrA-28185	25,010	+/-150 BP	ANTL-WEISER ET AL., 2010
AH4/hearth I	charcoal	ABA	GrA-9066	24,830	+/-230 BP	ANTL-WEISER ET AL., 2010
AH4/post hole	charcoal	ABA	GrA-9065	24,930	+/-240 BP	ANTL-WEISER ET AL., 2010
AH4	charcoal	ABA	GrA-9063	24,620	+/-230 BP	ANTL-WEISER ET AL., 2010
AH4	charcoal	ABA	VERA-364	25,300	+/- 90 BP	ANTL-WEISER ET AL., 2010

Fig. 9: Radiocarbon Dates of GK I (Antl, 2013, Tab. 1).

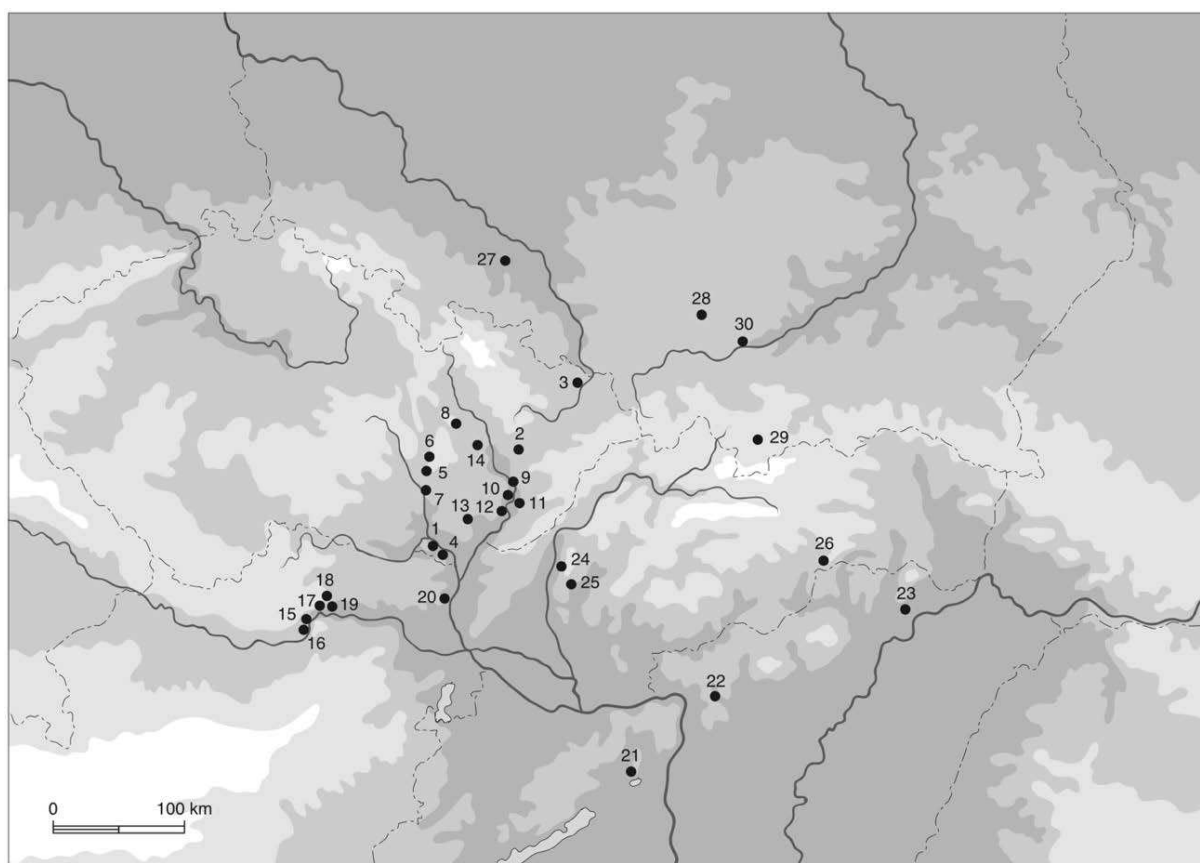


Fig. 10: Gravettian sites in Central Europe mentioned in the text. 1– Dolní Věstonice-Pavlov; 2– Předmostí; 4– Milovice; 15– Willendorf; 16– Aggsbach; 17–Krems-Wachtberg & Krems-Hundsteig; 19–Langenlois; 20–Grub-Kranawetberg and Ollersdorf/Heidenberg; 24– Moravany-area (Verpoorte, 2001, Fig. 2.7).

Based on lithic technology (Microgravettes and microliths) Antl-Weiser (2013) attributed AH 4 as Gravettian Stade II proposed by Otte & Noiret (2004). The radiocarbon dates (25,640 to 24,620 BP) puts AH 3 and AH 4 at the end of Stade II (Pavlovian) and the beginning of Stade III (Willendorf-Kostenkian) (Antl-Weiser, 2013).

The bone accumulation was dated on charcoal and dates to 25,220 ±250 BP (GrA- 9062). In the area of the dwelling structures only the AH 3 and 4 were dated. All dating were done on charcoal. The dates are presented in (Fig. 9).

There are no radiocarbon dates for GK II at the moment.

3.1.2. Grub-Kranawetberg I and II in relation to Palaeolithic sites in Central Europe

Having no radiocarbon dates for GK II up to now, it is not possible to compare it with other sites based on the radiocarbon dating. However, it seems very likely that the

archaeological horizons of GK I and GK II correlate with each other and are presumably contemporaneous. Thus, we can assume that everything that applies to GK I will also apply to GK II.

3.1.2.1. Austria

3.1.2.1.1. Ollersdorf-Heidenberg

Ollersdorf-Heidenberg is just 2-3 km away from Kranawetberg (Fig. 11). Its radiocarbon date lies within the range of the Grub-Kranawetberg data. (Antl-Weiser, 2013).

VERA 366 25,450 ±90 BP

3.1.2.1.2. Willendorf II

Grub-Kranawetberg is not only typologically comparable to Layers 5-9 of Willendorf II (Antl-Weiser, 1995a), but the radiocarbon dates of AH 3 and 4 at GK I fall in the range of the dates of Layers 8 and 9 of Willendorf II (Haesaerts et al., 1996).

Layer 9:

(Haesaerts et al., 1996)

GrN-21898	23,860 ±270 BP	(long bone, brown part (fraction 1))
GrN-22208	24,370 ±290 BP	(long bone, brown part (fraction 2))
GrA-5006	24,910 ±150 BP	(long bone, white part)
GrA-5005	23,180 ±120 BP	(mammoth scapula)

Layer 8:

(Haesaerts et al., 1996)

GrA-894	24,710 ±180 BP	(Charcoal)
GrN-17801	25,230 ±320 BP	(Charcoal)
GrN-17802	25,660 ±350 BP	(Charcoal)
GrN-21690	25,400 ±170 BP	(bones)
GrN-20767	25,440 ±170 BP	(bones)
GrN-11191	25,800 ±800 BP	(Charcoal)



Fig. 11: Grub-Kranawetberg and its surrounding Palaeolithic sites (Antl-Weiser, 2008, Fig.1).

3.1.2.1.3. Aggsbach

Discovered in 1883 (Felgenhauer, 1951) Aggsbach dates between 26,800 and 22,670 BP. (Verpoorte, 2009)

GrN-1327	22,670 ±100 BP
GrN-1354	25,760 ±170 BP
GrN-2513	26,800 ±200 BP

3.1.2.1.4. Langenlois

Radiocarbon dates, together with the characteristics of the lithic technology, place the Langenlois within the Gravettian period (Einwögerer, 2019).

(Verpoorte & Einwögerer, 2002)

GrN-25603	25,700 ±400 BP	(Charcoal)	Langenlois A
GrA-16564	25,340 ±170 BP	(Bone)	Langenlois A
GrA-16565	27,250 ±200 BP	(Bone)	Langenlois B

3.1.2.1.5. Krems-Wachtberg

The Gravettian site Krems-Wachtberg, known above all for the twin burial (Einwögerer et al., 2006), dates earlier than GK. The radiocarbon dating was carried out partly on bone and partly on charcoal.

(Einwögerer et al., 2009)

VERA-3933	27,190 +240/-230 BP	(Charcoal)	AH 4.11, above Burial 1
VERA-3819	26,520 ±210 BP	(Charcoal)	AH 4.3, Burial 1
VERA-3925	27,220 +230/-220 BP	(Charcoal)	AH 4.4, hearth
VERA-3937	28,240 +270/-260 BP	(Charcoal)	AH 4.4, Pit 3
VERA-3938	27,000 ±220 BP	(Charcoal)	AH 4.4, Pit 3
VERA-4532	26,840 ±220 BP	(Charcoal)	AH 4.4, <i>living flour</i>
VERA-3939	28,750 ±270 BP	(Charcoal)	AH 5, layer below AH 4
VERA-3940	28,470 +280/-270 BP	(Charcoal)	AH 5, layer below AH 4

(Händel, 2017)

OxA-18529	26,980 ±210 BP	(Mammoth Bone)	AH 4.3, cover of Burial 1
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3.1.2.1.6. Krems-Hundsteig

Similar to Krems-Wachtberg, Krems-Hundsteig dates a little bit earlier than GK. All radiocarbon-dates were taken on charcoal samples.

(Wild et al., 2008)

VERA-2291	27,200 +240/-230	Cultural layer; AH 3,21
VERA-2293	28,550 +250/-240	Hearth A; AH 3,51
VERA-3281	27,970 +270/-260	Hearth B; AH 3,21
VERA-3282	28,360 +280/-270	Hearth C; AH 3,54
VERA-3279	27,940 ±250	Hearth D; AH 3,22

3.1.2.2. Czech Republic

With a lot of Palaeolithic sites from the Gravettian period (Šída, 2009b; Svoboda & Klíma, 1996; Svoboda, 1996; Svoboda & Sedláčková, 2004; Verpoorte, 2001; Wilczyński et al., 2020a), the Czech Republic is one of the most important areas for comparing Grub-Kranawetberg I and II.

3.1.2.2.1. Lubná VI

The Lubná VI site is a Late Gravettian site in Bohemia that dates a little earlier than Grub-Kranawetberg (Wilczyński et al., 2021; Wilczyński et al., 2020a).

(Wilczyński et al., 2020a)

Poz-107228 23.010 ±140 BP (Bone, Rangifer tarandus) Square D5, Archaeological layer (2018)

Poz-107229 23.260 ±130 BP (Bone, Rangifer tarandus) Square E7, Archaeological layer (2018)

3.1.2.2.2. Dolní Věstonice II

The radiocarbon dates from Dolní Věstonice II range from 27,660 ±80 BP to 23,540 ±180 BP (Verpoorte, 2009). Some dates being contemporaneous with Grub-Kranawetberg. However, most of Dolní Věstonice II dates earlier than Grub-Kranawetberg (see Damblon et al., 1996; van der Plicht, 1997; Verpoorte, 2009).

(Damblon et al., 1996; van der Plicht, 1997; Verpoorte, 2009)

GrN-15277 25,740 ±210 BP (Charcoal) 1st settl. sq. A/18-22, (II-2D) hearth D close to DV XVI

GrN-15276 25,570 ±280 BP (Charcoal) 1st settl. sq. A/18-22, (II-I), male burial, DV XVI, 1987

ISGS-1616 24,000 ±900 BP (Charcoal) Hearth close to triple burial

ISGS-1617 24,970 ±920 BP (Charcoal) Hearth close to triple burial

3.1.2.2.3. Pavlov I

Radiocarbon dating from Pavlov I is overlapping with Grub-Kranawetberg, but it is mostly older (see Svoboda et al., 2016).

(Damblon et al., 1996; J. Svoboda, 2005; J. Svoboda et al., 2016; van der Plicht, 1997; Verpoorte, 2009)

GrN-22305 25,840 ±290 BP (Charcoal) Southeast, 1954/3

GrA-192 25,530 ±110 BP (Charcoal) Southeast, 1953, cultural layer

GrN-22304 25,160 ±170 BP (Charcoal) Southeast, 1954/1

GrN-1325 25,020 ±150 BP (Charcoal) Southeast, cultural layer

3.1.2.2.4. Pavlov VI

There is also a radiocarbon date in Pavlov VI, which is a little bit older than the ones from GK I.

(Verpoorte, 2009)

GrA-37627 25,950 ±110 BP

3.1.2.2.5. Předmostí Ib upper

Excavated in 2006, a burnt bone from the upper layer was dated and was put into the Willendorf-Kostenkian period by Svoboda (2008).

(Verpoorte, 2009)

GrA-32641 24,340 ±120 BP (Burnt bone)

3.1.2.2.6. Předmostí II

From Předmostí II a mammoth bone that was excavated in 1992 from Layer 4 was dated. Svoboda (2008) places it into the Pavlovian.

(Verpoorte, 2009)

OxA-5971 25,040 ±320 BP (Mammoth bone)

3.1.2.2.7. Milovice

A Charcoal pieces from around the hut structure was dated in Milovice and places it contemporaneous to Grub-Kranawetberg (Oliva, 2009).

(Verpoorte, 2009)

GrN-22105 25,570 ±170 BP (Charcoal)

GrN-14824 25,220 ±280 BP (Charcoal)

GrN-22106 24,710 ±300 BP (Charcoal)

GrN-22104 24,530 ±300 BP (Charcoal)

3.1.2.3. Western Slovakia

3.1.2.3.1. Dzeravá Skala

After Ollersdorf/Heidenberg, Dzeravá Skala is the closest Gravettian site with an approximate distance of 38 km to Grub-Kranawetberg.

(Verpoorte, 2009)			(Davies & Hedges, 2005)
GrA-22756	25,050 ±540/510 BP	(Bone)	layer 3
GrA-22758	24,800 ±130 BP	(Bone)	layer 4
(Davies & Hedges, 2005)			
OxA-13861	24,760 ±130 BP	(bone)	layer 5

3.1.2.3.2. Trenčianske Bohuslavice

The Layers A2-3 of Trenčianske Bohuslavice, dated by charcoal, was occupied in the same period as Grub-Kranawetberg.

(Verpoorte, 2009)			(Wilczyński et al., 2020b)
GrA-16162	25,650 ±160 BP	(Charcoal)	layer A2-3
GrA-16163	25,130 ±170 BP	(Charcoal)	layer A2-3

In summary, even though no radiocarbon dates are currently available for GK II, the typological and stratigraphic evidence strongly suggests that the archaeological horizons of GK I and GK II are contemporaneous. GK I itself is radiocarbon dated to between 25,640 and 24,620 BP, placing it firmly within the Gravettian. Several other well-known sites from Austria, the Czech Republic, and Western Slovakia show overlapping radiocarbon dates, supporting this chronological positioning. These include Ollersdorf-Heidenberg, Willen-

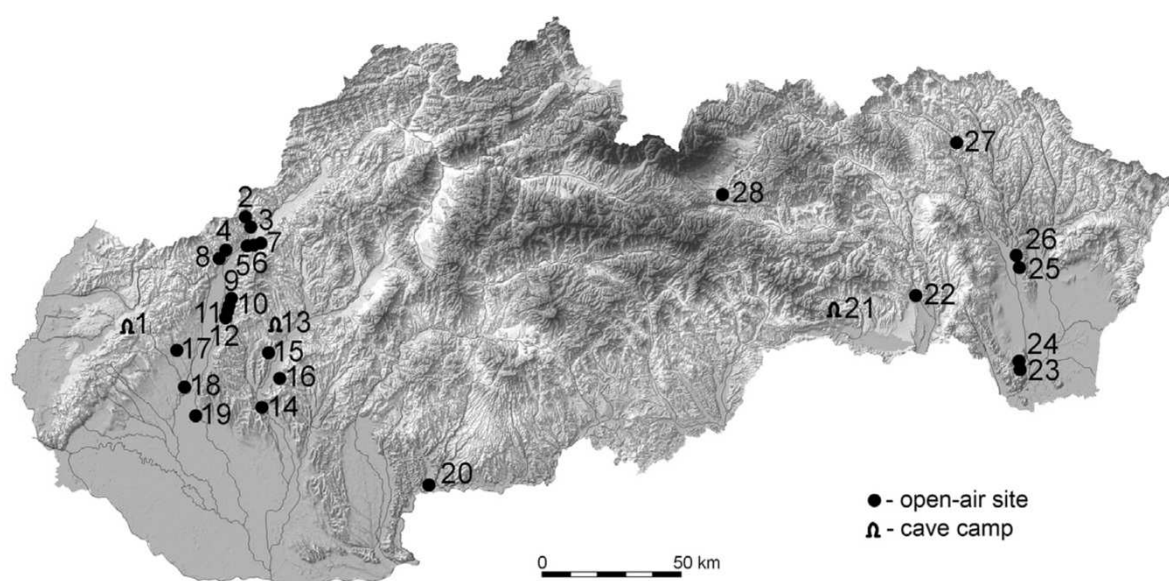


Fig. 12: Gravettian sites in Slovakia, 1 – Dzeravá Skala; 4 – Trenčianske Bohuslavice (Kaminská, 2016, Fig. 1).

dorf II (Layers 8 and 9), Aggsbach, Langenlois A, Dolní Věstonice II (male burial, hearth close to triple burial, hearth close to male burial), Pavlov I (cultural layer) and VI, Předmostí II, Dzeravá Skala as well as Milovice and Trenčianske Bohuslavice. Their radiocarbon dates fall within or very close to the range of GK I, suggesting a broad contemporaneity across these regions.

However, other sites such as Krems-Wachtberg and Krems-Hundsteig date slightly earlier. These older phases likely represent earlier episodes of Gravettian occupation in the region, prior to the period represented by Grub-Kranawetberg, while younger sites like Lubná VI might represent younger episodes.

Taken together, these chronological comparisons underline the importance of Grub-Kranawetberg within the broader framework of the Central European Gravettian. They demonstrate not only its close alignment with several key sites but also help situate it within a wider temporal sequence of Gravettian occupation in the region.

4. Methods

4.1. Excavation methods

4.1.1. Grub-Kranawetberg I, excavation 1993–2011

Through the years an area of approximately 243 m² were excavated. The trenches were split into square metres within a grid that was defined by letters on one axis and numbers on the second axis (see Fig. 13). All excavated sediment was collected and wet-sieved with a grid size of 1 mm. For better location of the wet-sieved finds each unit (square) were divided into four sub-squares. Since the beginning of the excavation in 1993 all finds that were larger than 5 mm were piece plotted, except by charcoal where a cut-off size of 2 cm was applied due to its great abundance. In the first years of excavation (1993-2001) this was done on hand-drawn plans on scale of 1:5 and 1:10. Furthermore, for each point the z-coordinate was measured and added to the plan. In addition, the inclination and its dorsal or ventral position were recorded. Since 2002 a new system of digital measuring were implemented. Measured with a Tachymeter the 3D information for each find, evident structure and stratigraphic unit was now documented by a digital documenting system developed by Philip R. Nigst and T. Bence Viola on basis of the ArcDig-extension by Michael Doneus (Antl-Weiser et al., 2010). The *unique ID* of each find was composed by the site code (*GK*), the last two digits of the year of excavation (e.g. 02), a hyphen and the continuous number of the year's excavation (*1 to n*).

4.1.2. Grub-Kranawetberg I, excavation 2021

For the excavation in 2021, the grid from the previous excavation by Walpurga Antl-Weiser was used (Fig. 13). The system for assigning of the Unique ID was also adopted. It consists of the site code (*GK*), the last two digits of the year of excavation (21), a hyphen and the continuous number of the year's excavation (*1 to n*). Finds, that positions are measured but are not kept due to their size, are getting a random letter code instead of the continuous number (Antl-Weiser et al., 2021a). The excavation method follows the methods used previously at Ollersdorf-Heidelberg (Antl-Weiser et al., 2019) and Willendorf II (Nigst et al., 2014) (Antl-Weiser et al., 2021a). All finds that were bigger than 5 mm were single or multiple point measurements that were documented with the Tachymeter, including

charcoal. For a more detailed description of the excavation method see (Antl-Weiser et al., 2021a).

4.1.3. Grub-Kranawetberg II, excavation 2022–2023

After removing the topsoil, the trenches were started being excavated in a chessboard pattern. This allows to get four sections for each square and no find is more than 50 cm away from a profile. This helps the assignment of the finds to the different AHs. The excavation method follows the methods used previously at Ollersdorf-Heidelberg (Antl-Weiser et al., 2019) and Willendorf II (Nigst et al., 2014). For this new site a new grid was established. This grid was 1 by 1 m and is composed by an axis that is labelled by letters starting

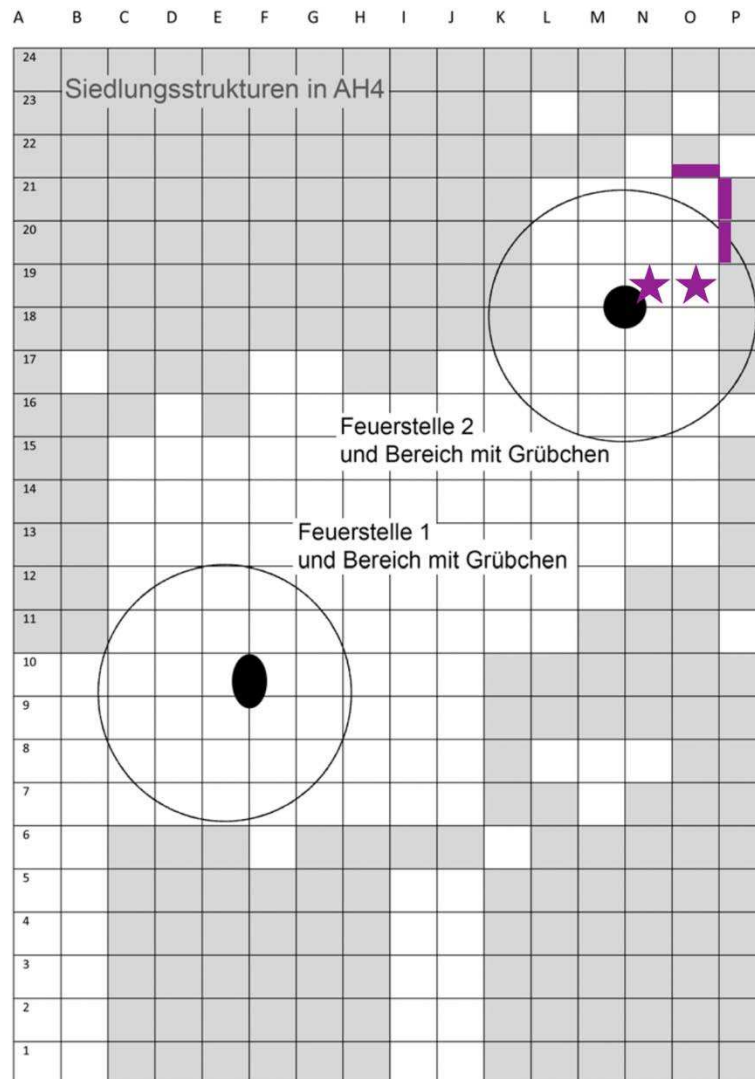


Fig. 13: Excavation plan of Trench 3/ Area C; asterisk – Assemblage GK I (1993-2011); beam – Assemblage GK I (2021); Graphic: (Antl-Weiser, 2019, Fig. 2, edited by Samuel Kasemann).

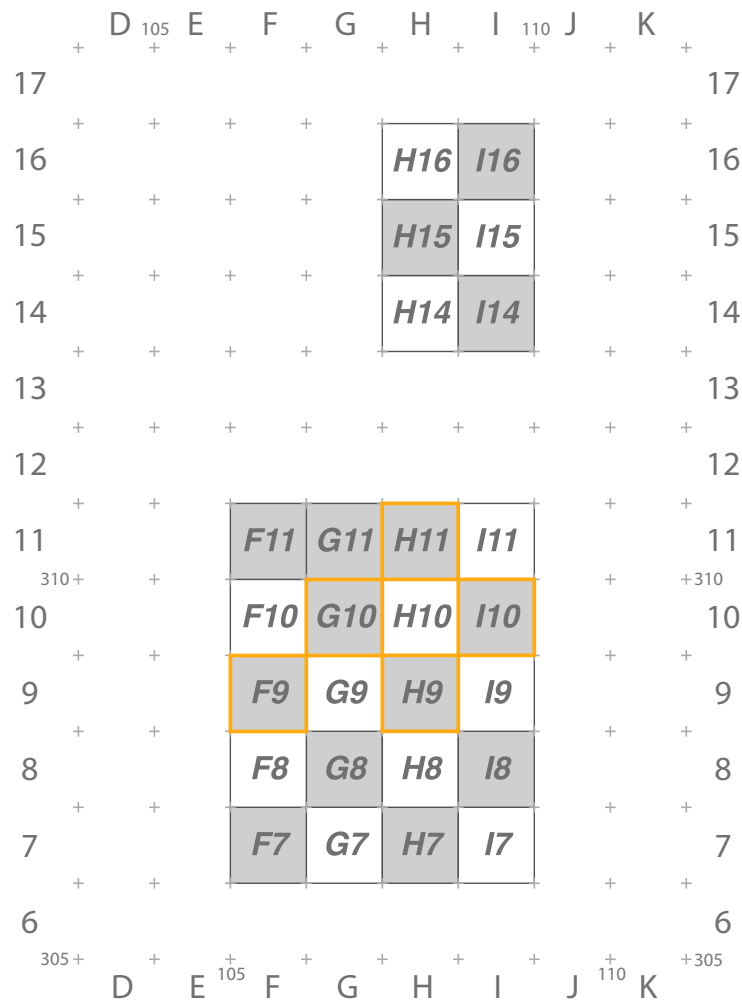


Fig. 14: Grid system of GK II; marked in orange is the assemblage of GK II; (GIS & Graphic: P. R. Nigst & D. M. Bosch, edited by Samuel Kasemann).

with A and one axis that is labelled by numbers starting with 1. The excavated area ranges from F7 to I11 (Fig. 14). In 2023 a second trench was opened two meters north of Trench 1. Trench 2 covers the squares H14 to I16 (Fig. 14). The assignment of the Unique ID is as follows. It consists of the site code (GK), the last two digits of the year of excavation (22 or 23), a hyphen, the square (H9), a hyphen and the continuous number of each square. An example for a Unique ID could be GK23-H9-23 (Bosch et al., in press; Bosch et al., 2025a).

4.2. Data recording

4.2.1. Tools

For the attribute analysis several tools were used. The weight of each artifact was recorded in grams using a digital scale (Kern TCB 200-1, Max = 200 g, d = 0.1 g). In cases where

the scale indicates the weight of the artefact as 0.0 g, a weight of 0.1 g was entered in the database. All measurements of dimensions were done in millimetres with a digital calliper (Mitutoyo Cooperation, Absolute AOS Digimatic Calliper CD-6" AX). The digital calliper was connected with the computer via a USB-cable. To analyse the lithic raw materials, two magnifying glasses were employed (Eschenbach Germany 10x/40 and Eschenbach Germany achromatic 20x), allowing for magnifications of 10x and 20x, respectively. Furthermore, a reflected light microscope (Motic K700, magnification range: 6x to 31x) was used for a more detailed examination. To enhance the visibility of fossil and non-fossil inclusions within the raw material, the water immersion method was applied, a technique that improves surface contrast and detail recognition (Brandl, 2016).

4.2.2. Software

For the data acquisition the software E4 (Version 4.7) programmed by Shannon P. McPherron and Harold L. Dibble (McPherron & Dibble, 2002, <https://old-stoneage.com/osa/tech/e4/>) was used. The structure of the database and field definitions are defined using a configuration file (CFG-file). I used a CFG-file provided by Philip R. Nigst (see, e.g., Nigst, 2012) that was adapted to the needs of the analyses (*gk2022_lithics.cfg*). Due to practical reasons the raw material information was documented separately with an adapted CFG-file (*gk2022_lithics_rawmaterial.cfg*). The output are two Microsoft Access databases with all recorded information of each lithic artefact (*gk2022_lithics.mdb*, *gk2022_lithics_rawmaterial.mdb*). These databases were then merged into one Access database by using a query (*GK_Zusammenführung.mdb*).

4.2.3. Attribute Analysis

An attribute analysis is based on the systematic description of attributes of lithic artifacts. Each artifact has a series of different attributes that vary from lithic to lithic. On the basis of those we can analyse, discuss and answer certain research questions. The main aim is to look if there are “*quantifiable trends in lithic artifacts*” (Nigst, 2012, 50). Attribute analysis has been used for the analysis of tool types (e.g., Hahn, 1977; Movius et al., 1968) as well as lithic blank production (e.g., Dibble, 1995; Hahn, 1988; Nigst, 2012). While attribute analysis commonly includes all lithics, many researchers use a cutoff size that

correlates with the maximum size of the chips, i.e. 10 or 12 mm (cf. Nigst, 2012). In this dissertation, all lithics that have been piece-plotted, i.e. 5 mm, and where the raw material could be identified, were included. Therefore, a better picture on the raw material procurement can be drawn, since then all stages of the reduction sequence will be included. The (idealized) reduction sequence describes “*the raw material reduction process, the blank production, and tool production process*” (Nigst, 2012, 37), while it also helps “*to compare the patterns observed in the assemblage*” (Nigst, 2012, 37).

The attribute analysis was done on three different assemblages from three different excavations. The first assemblage is from Grub-Kranawetberg I and is coming from the excavations from Walpurga Antl-Weiser between 1993 and 2011. The second is also from GK I but from the excavation in the year 2021 by Marjolein D. Bosch, Walpurga Antl-Weiser and Philip R. Nigst. The last assemblage is from the excavation by Marjolein D. Bosch, Walpurga Antl-Weiser and Philip R. Nigst on the site Grub-Kranawetberg II from the years 2022 to 2023. For all three assemblages the same attribute catalogue was used. The following also includes attributes that will not be analysed in this thesis but were record, nevertheless. The format and definitions of the catalogue is based on the work of Nigst (2012). However, not all attributes were adopted due to the absence of said attributes. In some cases, new attributes were added if necessary. The overall morphology and the raw material were recorded separately in two different databases. This was done due to workflow related adaptations. The morphological attributes are shown in Annex 1 (Chapter 11.1) and the raw material attributes are shown in Annex 2 (Chapter 11.2).

4.2.3.1. Morphology

The first information that is recorded for each artifact is the *artifact ID*, the *inventory*, the *site name* and the *archaeological horizon* (if possible). Furthermore, it is marked if the artifact is part of a refit group and if so, which group it belongs to. The recording of the morphological attributes was done for each artifact. These attributes can be separated into different groups. The grouping follows Nigst (2012):

Group A	Raw material (not documented here, but in 2 nd recording)
Group B	Joint plane, alterations (patina, calcareous sinter, thermal alteration)
Group C	Dataclass, basic technology, cortex position
Group D	Basic measurements (length, width, thickness, weight)
Group E	Fragmentation
Group F	Platform and related attributes (platform types, dorsal thinning, etc.)
Group G	Attributes of the ventral face (bulb, scar, lip, etc.)
Group H	Attributes of the dorsal face (distal end and scars, orientation of scars, etc.)
Group I	Edge damage
Group J	Modification
Group K	Core attributes

For all artifacts attribute Groups A to D are recorded. For unretouched lithics Groups E to I and for tools Groups E to J are added. For cores Group K is recorded. All measurements and orientations are based on the definitions of Nigst (2012). Orientation is particularly important here, as the descriptions of left (sinistro) and right (dextro) are based on it. All artefacts are positioned with the proximal/ platform end up (Fig. 15).

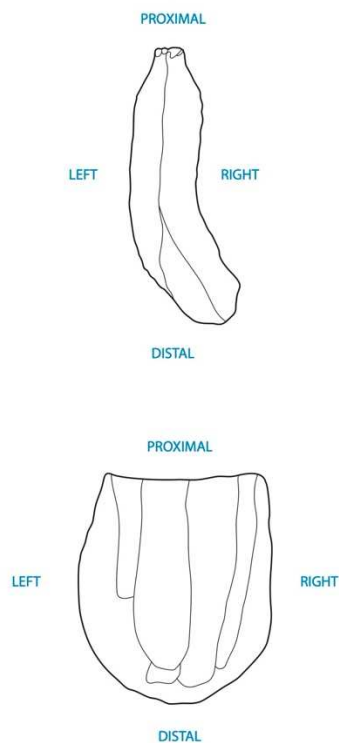


Fig. 15: Orientation of thedebitage and cores with the proximal side on top and labelling of the different areas of the Objects (Nigst, 2012, Fig. 8).

4.2.3.1.1. Group A- Raw material

Attributes of Group A will be documented as seen in Chapter 4.2.3.2.

4.2.3.1.2. Group B – Joint plane and alterations

In Group B alterations and joint planes are recorded. These contain alterations like patination, thermal alterations and the presence of calcareous sinter as well as if there are joint planes within lithic. Thermal alterations can happen when a stone is exposed to temperature fluctuations. Possible outcomes of thermal alterations are colour change, craquelation, shell spellings and irregular breakages (Hahn, 1991).

Patina	Yes No n/a
Calcareous sinter	Yes No
Joint plane	Yes No
Thermal alteration 1	Yes No n/a
Thermal alteration 2	Colour change Craquelation Shelled spallings Irregular breakage surface Colour change + craquelation Colour change + irregular breakage surface Colour change + craquelation + irregular breakage surface Colour change + shelled spallings Colour change + irregular breakage surface + shelled spallings Colour change + craquelation+ shelled spallings Shelled spallings + irregular breakage surface Craquelation + irregular breakage surface + shelled spallings Craquelation + shelled spallings Craquelation + irregular breakage surface Colour change + craquelation + irregular breakage surface + shelled spallings n/a

4.2.3.1.3. Group C - Dataclass and basic technology, cortex position

The dataclass describe the basic classification of the lithic artifact and is for characterising the basic technology and morphology of the objects. For the main definitions of the different dataclasses the given definitions of Nigst (2012) who based his work on Hahn (1977, 1991) and Tixier et al. (1980). For some dataclasses Nigst (2012) uses different definitions. Bladelets are blades with a width of less than 10 mm and chips are flakes that are less than 10 mm long.

Dataclass	Flake Blade Bladelet Chip Burin spall Core tablet Core Crested bladelet Crested blade Frost spalling Shatter Core shatter Thermal shatter Potlid Burin bladelet n/a
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The basic technology is used to describe the core reduction strategy for the related lithic. For burin spalls the basic technology is burin is used.

Basic technology	Flake/normal Blade Bladelet Burin Resharpening n/a
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The cortex attributes only address the dorsal side of all lithics that fall in the category of debitage and for all other artifacts the whole surface is looked at. As a result, the position of the cortex is only documented for debitage categories.

Cortex coverage	0% 1-33% 33-66% 66-99% 100% n/a
Cortex position	Distal Proximal Sinistrolateral-complete Sinistrolateral -partial Dextrolateral-complete Dextrolateral-partial Middle/centre 100%cortex Distal + proximal Dextro- + sinistrolateral Dextro + distal Sinistrolateral + distal Sinistrolateral + distal + dextrolateral Proximal + dextrolateral Proximal + sinistrolateral Proximal + sinistrolateral + distal Proximal + dextrolateral + distal Proximal + dextrolateral + sinistrolateral Middle + distal Sinistrolateral + distal + middle Distal + dextrolateral-complete + proximal-dextrolateral + sinistrolateral -distal Distal + dextrolateral-partial n/a

4.2.3.1.4. Group D - Basic measurements

The basic measurements are done with digital calipers and a digital scale (see Chapter 4.2.1). Length, width and thickness are documented in millimetre and the weight is recorded in grams. The measuring for debitage and cores are shown in Fig. 16 and Fig. 17.

Length	in mm
Width	in mm
Thickness	in mm
Weight	in g

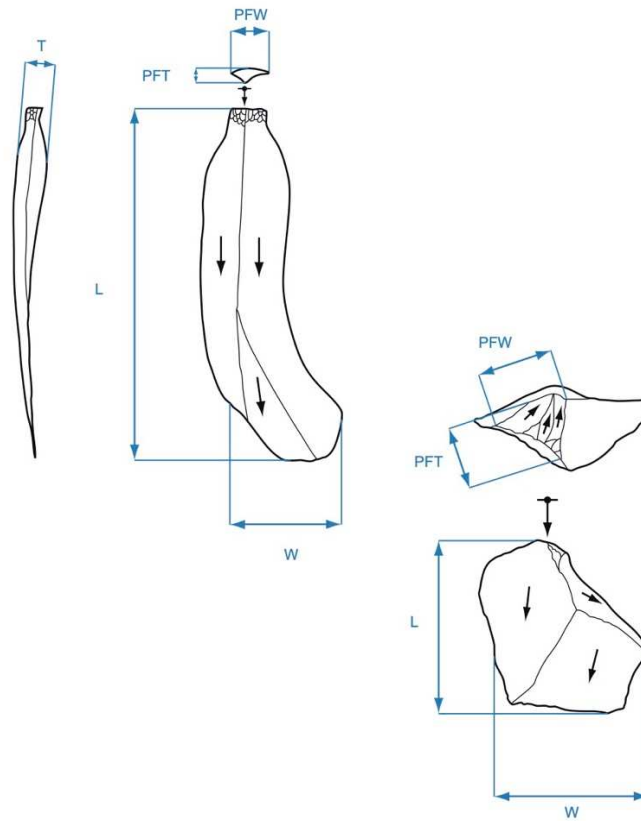


Fig. 16: Measuring of blanks, length (L), width (W), thickness (T), platform width (PFW), and platform thickness (PFT) (Nigst, 2012, Fig. 10).

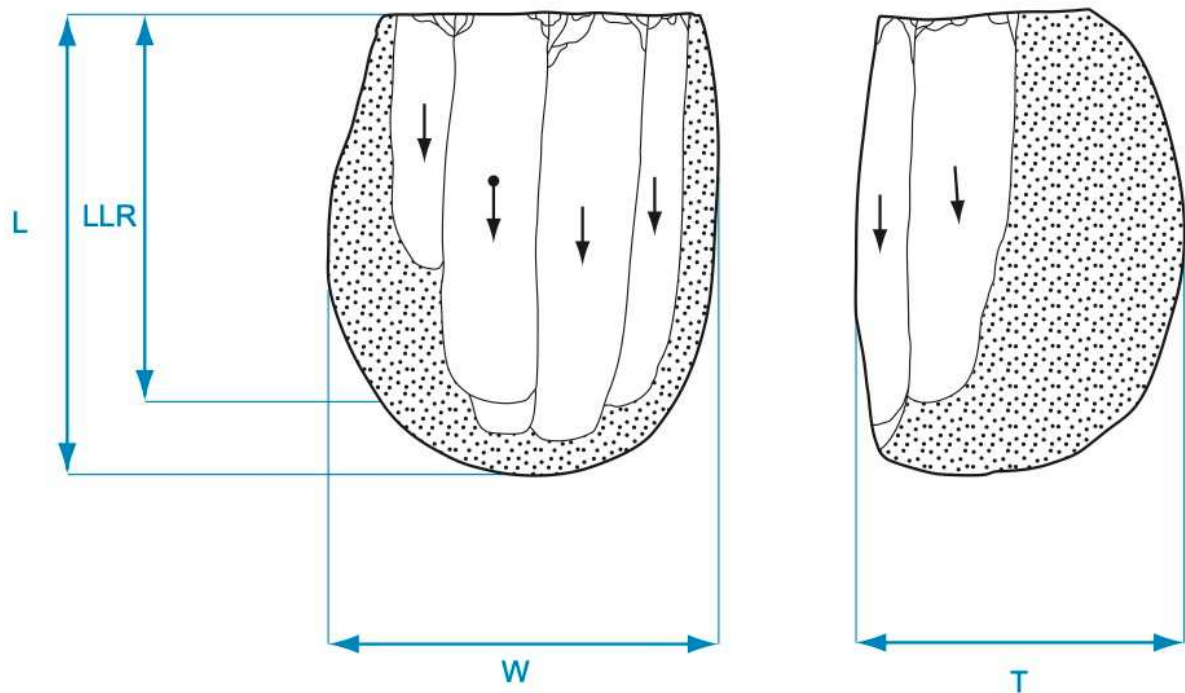


Fig. 17: Measuring of cores, length (L), width (W), thickness (T), and length of last removal (LLR) (Nigst, 2012, Fig. 9).

4.2.3.1.5. Group E – Fragmentation

This attribute is recorded for all objects that are fragmented. However, the blank and length preservation is only documented for debitage categories. If the artifact is fragmented in length, it means it is broken on the long axis. If the artifact is fragmented in width, it means it is broken on the transverse axis (Nigst, 2012).

Fragmentation	Yes No n/a
Fragmentation of the blank	Length Width Thickness Length + width Length + thickness Width + thickness Length + width + thickness n/a
Preservation of the length	All Proximal Medial Distal n/a

4.2.3.1.6. Group F - Platform and related attributes

The attributes of the platforms are only recorded on pieces with preserved platforms. The platform type and dorsal reduction gives us information on the core/platform preparation. The platform is recorded as *splittered out* when parts of it has vanished by splintering. In this case, the shape was recorded as *not fully preserved*. When the platform is no longer visible due to the aggregation of sinter it was documented as *covered with sinter*. The attribute *semicircle* is used for all platforms in the shape of a semicircle.

Platform type	Cortical Joint surface Plain Faceted Linear Ridge Dihedral Punctiform Chapeau de gendarme
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	Indeterminable Splittered out Covered with sinter n/a
Platform shape	Oval Linear ridge Punctiform Triangular Irregular Winged Chapeau de gendarme Ventrally splitted out Indeterminate Trapezoidal Not fully preserved Semicircle n/a

The width and thickness of the platform is measured in millimetre and are recorded with a digital caliper. The measurements are shown in Fig. 16.

Platform width	in mm
Platform thickness	in mm

Dorsal reduction/ thinning is a possibility to prepare the edge of the platform priors to flaking.

Dorsal reduction/ thinning	Yes No
Dorsal reduction/ thinning details	Pointed scars Hinged scars Abraded Pointed scars + hinged scars Pointed scars + abraded Hinged scars + abraded Hinged scars + abraded + pointed scars n/a

Exterior platform angle	in degrees
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4.2.3.1.7. Group G - Attributes of the ventral face

The following four attributes are influenced by the knapping technique and are defined by Hahn (1991) and Tixier et al. (1980). Ventrally splitted out describes that there is a part that is splitted out on the ventral side at the proximal end and thus it is no longer possible to determine one of the attributes.

Lip	Yes No Ventrally splitted out n/a
Cone	Yes No Ventrally splitted out n/a
Bulb	Yes No Ventrally splitted out n/a
Bulb scar	Yes No Ventrally splitted out n/a

4.2.3.1.8. Group H - Attributes of the dorsal face

The definition of the distal end in dorsal and lateral view follows Hahn (1991). For pieces with a straight distal end that derive from a joint or an old ventral side the attributes *straight- joint surface* and *straight – old ventral side* were added.

Distal end – dorsal view	Pointed Concave Convex Straight Irregular n/a
Distal end – lateral view	Pointed Rounded Hinged Step Plunging Straight- joint surface Straight – old ventral side n/a

The definitions of the dorsal scar patterns follow Nigst (2012) with a few additions. If the dorsal side is *covered with sinter* and no statements can be done it is recorded respectively. For the single case of a potlid and a dorsal scar on one lithic the attribute *potlid and one scar* was added.

Dorsal scar number	1 2 ...
Dorsal scar orientation regarding dorsal scars	Cortex Unipolar Bipolar Opposed Intersecting Not intersecting but different direction indetermined Potlid Joint plane Covered with sinter Potlid and one scar n/a
Dorsal scar orientation regarding blanks flaking direction	Cortex Same direction Opposed direction Bipolar Across one side Across two side Same direction + across Opposed direction + across Bipolar + across Concentric/ centripetal Irregular Indetermined Joint plane n/a

The attribute *cross section* describes the section at the middle of the blank or at the surface of the fragmentation in length. Here the attribute *semicircle* was added to the cross section.

Lateralisation	No Left Right n/a
----------------	----------------------------

Torsion	Yes No n/a
Curvature	Rectilinear Curved Irregular Indeterminate n/a
Cross section	Triangular Trapezoidal Lenticular Irregular Indetermined Semicircle n/a

4.2.3.1.9. Group I - Edge damage

The attribute *edge damage* and *type* describe all damage that is visible on the edges of the lithic. For definitions and differences see Nigst (2012).

Edge damage	Yes No n/a
Edge damage type	Damage/use Rounding/natural Modern n/a

4.2.3.1.10. Group J – Modification

In this attribute group the chronological most recent modifications are recorded as *modification 1* and *modification 2*. If there are more than two modifications all additional modifications were entered into the remarks field. Modifications were counted as separate if there were not continuous and thus isolated.

Modification	Yes No n/a
Number of modification	1 2 More

The definitions for the positions and locations of the modifications follow Nigst, (2012). In addition, several combinations of the locations were added. The attribute values for the modification type follows the definitions of Hahn (1977), Inizan et al. (1999), Nigst (2012) and Tixier et al. (1980).

Position of 1 st Modification	Dorsal Ventral Dorsoventral Bifacial n/a
Location of 1 st Modification	Proximal Distal Sinistrolateral – proximal Sinistrolateral – medial Sinistrolateral – distal Sinistrolateral – complete Dextrolateral – proximal Dextrolateral – medial Dextrolateral – distal Dextrolateral – complete Distal + sinistrolateral – complete Sinistrolateral – dextrolateral Dextro + sinistrolateral + distal Dextrolateral – proximal + middle Dextro + distal Proximal – dextro + dextrolateral – proximal Distal and sinistrolateral – distal Distal and dextrolateral – distal n/a
Type of 1 st Modification	fine/sharp fine/edgeless intense backed scaled stepped denticulated facial bifacial burin endscrapercap borer saw n/a

Shape of 1 st Modification	Convex Oblique - convex Concave Oblique – concave Straight Oblique – straight Convex – concave irregular
Length of 1 st Modification	in mm
Height of 1 st Modification	in mm

The same procedure is done for the 2nd modification.

Most of the tool types were taken from Nigst (2012) and for the definitions common standards were used (e.g. Debénath & Dibble, 1994; Demars & Laurent, 1992; Hahn, 1977, 1991, 1993).

Tool type	Endscraper Carinated endscraper Nosed endscraper Burin Dihedral burin Edge retouch Borer Scraper Truncation Backed bladelet Gravette-point Microgravette-point saw Borer + edge Retouch Backed piece Burin -on -truncation Saw + backed n/a
Tool fragmentation	Yes No n/a
Tool fragmentation – details	Length Width Thickness Length + width Length + thickness Width + thickness Length + width + thickness

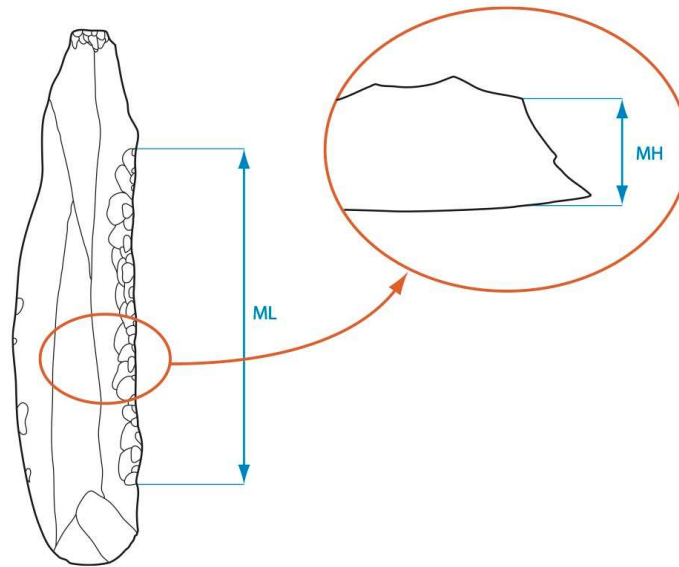


Fig. 18: Measuring sections for modifications, length (ML) and height (MH) (Nigst, 2012, Fig. 11).

4.2.3.1.11. Group K – Core attributes

Both *original core form* and *core type* is based on the definitions given by Nigst (2012).

Original core form	Nodule Slab Flake n/a
Core type	Type A – initial core Type B – inclined core Type C – parallel core Type D – platform core Type E – carinated core Type F – multidirectional core Type G - other

Angle between surface and platform	
------------------------------------	--

The *orientation* of the scars helps to reconstruct the last removals and steps of the core reduction. The *core platform type* uses the same attributes as the *platform type* and describes the platform. The last two attributes give us the information if the core has dorsal *reduction* or *faceting*.

Orientation of the scars	parallel concentric n/a
Core platform type	Cortical Plain Facetted Joint surface n/a
Dorsal reduction/ thinning	Yes No n/a
Faceting	Yes No n/a

The following three attributes are used to characterise the core.

Number of platforms	1 2 ...
Number of surfaces	1 2 ...
Relation of platform edges	Opposed Rectangular n/a

The morphology of the last removal is recorded and measured with a digital caliper (see Fig. 17).

Morphology of the last blank	Flake Blade Burin spall n/a
Length of the last blank	in mm

The following attributes describes the core and its preparation. The definitions of Nigst follow Ott (1996).

Lateral parts	Cortex Joint surface Scars Preparation Cortex + joint surface n/a
Back of core	Cortex Joint surface Scars Preparation No back Ventral Scars + joint surface n/a
Core base	Cortex Joint Surface Preparation Old platform Old reduction surface Break n/a

The attributes that could be the reason for the discard of the core are *dimension*, *raw material quality* (e.g. many joint plains) and *hinged scars* (as last removals).

Factors for the end of exploitation	Dimension Raw material quality Hinged scars n/a
-------------------------------------	--

This field is for additional remarks.

Remarks	For additional remarks
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4.2.3.2. Raw material

As stated above the raw material information was entered into a separate database. The attributes and attribute values used in this study will be listed and defined. Before attributes of each lithic is documented, the basic information of each artifact is recorded (*artifact ID, inventory, site name, archaeological horizon*). After that all attributes are recorded as followed:

Attribute	Attribute Values
RMU/ Raw Material Unit	1, Chert 1.1, Radiolarite 2, Flint 3, Obsidian 4, Quartzite 5, Quartz
RMS/ Raw material Source	Erratic Flint Morava Danube Old Danube Gravel Carpathians Bakony North Alpine South Moravia n/a
Patina	Yes No n/a
Cortex	0% 1-33% 33-66% 66-99% 100%
Remarks	For additional remarks

4.2.3.3. Refitting Analysis

No systematic refitting studies have yet been carried out on the material from GK I and GK II. However, while recording the assemblage of GK I and GK II two pieces could be refitted. The IDs of these lithics are GK21-321 and GK21-322 and are part of the refit-group GK21-01. The refit-type is a *breakage refit (Aneinanderpassung)*, which means it is one lithic broken in two pieces. Furthermore, both were excavated right next to each other.

4.3. Statistical methods

Statistical tests are essential for drawing trustworthy conclusions from data and distinguishing random variations from true differences or relationships. They help objectively evaluate hypotheses and determine the probability that an observed effect is real. Without statistical tests, patterns in data could be misinterpreted as significant, or true relationships might be overlooked.

For statistical analysis the program R (Version 4.4.1) (R Core Team, 2024a) - using R-Studio (Version 2024.12.0+467) as graphical user interface - was used. Furthermore, the following extensions were used: *ggplot* (Wickham, 2016), *gcookbook* (Chang, 2018), *RcolorBrewer* (Neuwirth, 2022) and *patchwork* (Pedersen, 2024) for graphics; *readxl* (Wickham & Bryan, 2015) for importing and reading excel files; *WriteXLS* (Schwartz & file. vafPmile, 2024) for exporting excel files; *tidyr* (Wickham & Vaughan, 2024) *tibble* (Müller & Wickham, 2023), *dplyr* (Wickham et al., 2023), *plyr* (Wickham, 2011) and *reshape2* (Wickham, 2007) for data processing. The statistical test used for significant differences of the raw material groups between the AHs of each site and the younger and older sites of both sites was a Chi-square test with Monte Carlo simulation of the p-value (10.000 replicates) (R Core Team, 2024b).

5. The Lithic Assemblages: Composition and Technological Attributes

In this dissertation lithic artifacts from three assemblages from GK I and II were analysed. All together a total number of 2,201 lithic artifacts were studied. This sample contains only piece-plotted lithic artifacts but does not contain lithics from wet-sieving (normally < 0.5 cm).

		n	%
GK I (1993-2011)	AH 1	0	0.0%
	AH 2	30	2.5%
	AH 2?	9	0.8%
	AH 3	304	25.5%
	AH 4	840	70.5%
	AH 4?	7	0.6%
	AH 5	0	0.0%
	krotovina	2	0.2%
	sub-total	1192	100.0%
GK I (2021)	AH 1	4	2.5%
	AH 2	5	3.2%
	AH 3	53	33.8%
	AH 4	94	59.9%
	AH 5	1	0.6%
	n/a	0	0.0%
	sub-total	157	100.0%
GK I	total	1349	
GK II	AH above Chase	7	0.8%
	AH Chase	36	4.2%
	AH Michi	742	87.1%
	AH Luc	44	5.2%
	AH Morgan	8	0.9%
	AH Kristof	1	0.1%
	AH Chris	11	1.3%
	krotovina	3	0.4%
	total	852	100.0%

Tab. 1: Analysed assemblages from Grub-Kranawetberg I and II (Table: Samuel Kasemann).

		n	%
GK I (1993-2011)	AH 3	304	26.6%
	AH 4	840	73.4%
	sub-total	1144	100.0%
GK I (2011)	AH 3	53	36.1%
	AH 4	94	63.9%
	sub-total	147	100.0%
GK I	total	1291	
GK II	AH Michi	742	94.4%
	AH Luc	44	5.6%
	total	786	100.0%

Tab. 2: In this thesis analysed assemblages from Grub-Kranawetberg I and II (Table: Samuel Kasemann).

5.1. Lithic assemblage of Grub-Kranawetberg I, excavation 1993-2011

The lithic sample of GK I (excavation years 1993 to 2011) for this thesis is from the squares N19 and O19 (Fig. 13). Those squares were chosen because in SW quarter of N19 one of the combustion features is present and O19 is located next to N19 (Fig. 19). In both squares AH 2, AH 3 and AH 4 (from top to bottom) can be found. In total, the combined assemblage of these two squares contains 1,192 lithics. However, since this thesis concentrate on the two main archaeological horizons, AH 2 will not be include in the following analysis. In addition, two finds were found in krotovinas, and 16 pieces could not be assigned to any AH with certainty (Tab. 1). They were therefore not included in the further analysis. All in all, the final number of lithics that were analysed from AH 3 (n=304) and AH 4 (n=840) is 1,144 (Tab. 2).

5.1.1. Lithic assemblage of AH 3

In AH 3 20 elongated blanks (blade: n=5, 1.6%; bladelet: n=15, 4.9%) were found. More than the half of lithic artifacts in this AH were flakes (n=161, 53.0%) and more than a quarter were chips (n=83, 27.3%). Three burin spalls (1.0%) could be identified. For 37 (12.2%) lithics no dataclass could be identified. These include shatters (n=29, 9.5%), one core shatter (n=1, 0.3%), thermal shatters (n=6, 2.0%) and one potlid (n=1, 0.3%). The latter two are the result of thermal alterations. Only 11.8% (n=36) of the lithics of AH 3 are thermally altered. There are 25 retouched lithics comprising three backed bladelets and 22 (84.6%) edge retouched pieces. The majority of lithics (n=278, 92.4%) remain unmodified. With 219 (72.0%) pieces the majority of lithics in AH 3 is fragmented. Only 48 (15.8%) pieces remain complete/unfragmented. 174 (57.2%) lithics are edge damaged while 129 (42.4%) do not show traces of edge damage and for one (0.4%) lithic it is uncertain if the edge is damaged.

5.1.2. Lithic assemblage of AH 4

There were 68 elongated blanks (blade: n=9, 1.1%; bladelet: n=58, 6.9%; crested blade: n=1, 0.1%) found in AH 4. A total of 366 lithics (43.6%) are flakes and 298 pieces (35.5%) are chips. There is also two burin spalls (0.2%) present. There is one core (0.1%) in AH 4 and 72 shatters (8.6%). Signs of thermal alterations in 104 (12.4%) lithics are found of

which 32 pieces (3.8%) only remained as thermal shatters and one as a potlid (0.1%). This low number is somewhat surprising giving the presence of a combustion feature within one of both excavated squares. While 767 pieces (91.3%) are unmodified, 73 lithics (8.7%) are. The largest group within the modified pieces are 53 edge retouched pieces (72.5%). There are five backed bladelets (6.8%), two backed pieces (2.7%), seven Gravette/Microgravette points (9.6%), and two endscrapers (2.7%). The majority of lithics with a number of 608 pieces (72.4%) are fragmented and 465 lithics (55.4%) are edge damaged, while 126 stones (15.0%) remain whole and 375 (44.6%) are undamaged.

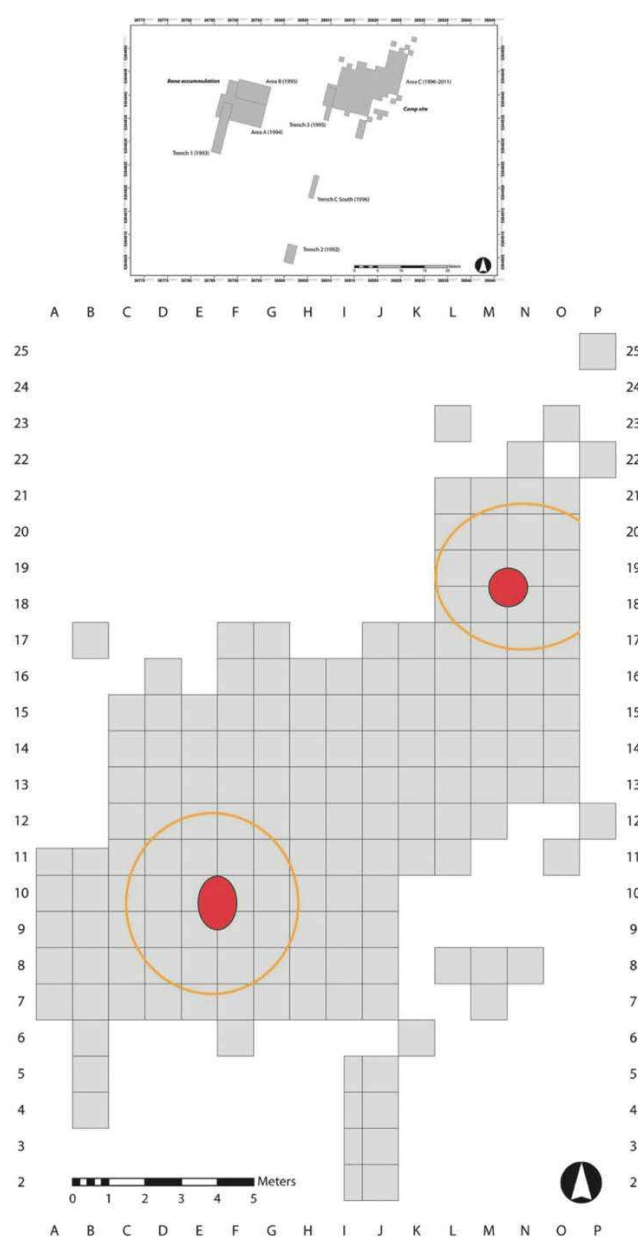


Fig. 19: Excavation 1993-2011 with both combustion features (Antl-Weiser & Bosch, 2015, Fig. 2).

5.2. Grub-Kranawetberg I, excavation 2021

A total number of 157 lithics were found (Tab. 1). However, the analysis will only be done on the two main archaeological horizons. Furthermore, the number of lithics do not surpass the amount of five in the AH 1, AH 2 and AH 5 (10 pieces in total) and no significant statistical analysis can be made on them. The remaining 147 lithics are from AH 3 (n=53) and AH 4 (n=94) (Tab. 2).

5.2.1. Lithic assemblage of AH 3

In AH 3 only 6 elongated pieces (blade: n=1, 1.9%; bladelet: n=5, 9.4%) were found. More than three quarter of the lithics are flakes (n=18, 34.0%) together with chips (n=23, 43.4%). Furthermore, one burin spall (1.9%) was found. There is one core (1.9%), one core tablet (1.9%) and three shatters (5.7%) present. Only two pieces (3.8%) in AH 3 show signs of thermal alterations. 30 lithics (56.6%) are only fragmented preserved and 11 pieces (20.8%) have edge damage while 19 (35.8%) are unbroken and from 42 (79.2%) the edges are not damaged. Although it is not sure if 23 (43.4%) pieces are modified it is clear that 23 lithics (43.4%) are unmodified and only seven (13.2%) are modified. From these seven pieces five (71.4%) are edge retouch and two (28.6%) are backed bladelets.

5.2.2. Lithic assemblage of AH 4

8 elongated blanks (blade: n=7, 7.4%; bladelet: n=1, 1.1%) were found in AH 4, while 53 flakes (56.4%) and 23 chips (24.5%) were found. Five burin spalls/bladelets (5.3%) are in the assemblage of AH 4 present. Even one resharpening chip could be identified. Beside that there are four shatters (4.3%) and one thermal shatter (1.1%). The thermal shatter is one of four pieces (1.1%) that shows thermal alteration. In AH 4 62 pieces (65.9%) are fragmented while 29 lithics (30.9%) are not. The edges of 40 artefacts (42.6%) in this AH are damaged while 54 (57.4%) remain undamaged. There are only two (2.1%) modified lithics in AH 4 while 67 (71.3%) are unmodified and 25 pieces (26.6%) are uncertain.

5.3. Grub-Kranawetberg II, excavation 2022-2023

For this work only finished (status 2023) squares were analysed. These squares are F9, G10, H9, H11 and I10 and all are situated within Trench 1 (Fig. 14). For this work I will only

look at the main archaeological horizons (AHs *Michi* and *Luc*). Finds from the *krotovina* and AH *Chris* will not be included, since the finds were moved in the sediment. Moreover, the AHs *above Chase* and *Morgan* will not be looked at also owing to the sample size. Although having a similar size to AH *Luc*, AH *Chase* will also not be included. Within these squares a total number of 852 lithics were documented (Tab. 1). Coming from AH *Michi* (n=742) and AH *Luc* (n=44) 786 lithics were analysed (Tab. 2).

5.3.1. Lithic assemblage of AH Michi

There are 61 elongated blanks (blade: n=11, 1.5%; bladelet: n=50, 6.7%) present in AH Michi. A little more than three quarter of the lithics are flakes (n=240, 32.3%) together with chips (n=325, 43.8%). There are four burin spalls (0.5%) and two core tablets (0.3%). Two pieces (0.3%) were not identifiable. In AH *Michi* 61 (8.2%) lithics are modified while the majority with 681 (91.8%) are not. 348 (46.9%) of the pieces of this AH have received *edge damage* and 475 (64.0%) finds are fragmented. The majority (n=697; 93.9%) of the lithics are not *thermally altered* while 43 (5.8%) pieces are. Within the AH one saw (1.6%), one saw with backed parts (1.6%) and one borer with edge retouch (1.6%) are present. There are two (3.3%) backed pieces and eight (13.1%) backed bladelets. The biggest group of modification is the edge retouching. In total 43 (70.5%) pieces fall into this category.

5.3.2. Lithic assemblage of AH Luc

In AH *Luc* 17 (38.6%) flakes and 10 (22.7%) chips were found. There are 15 elongated blanks (blade: n=7, 15.9%; bladelet: n=8, 18.2%) present. Only one burin spall (2.3%) and one thermal shatter (2.3%) were documented. 25 Pieces (56.8%) received edge damage and 31 lithics (70.5%) are fragmented. Only two pieces (4.5%) were thermally altered. In contrast to AH *Michi* there are only two (22.2%) pieces that are edge retouched. There are two (22.2%) backed pieces and five (55.6%) Gravette/Microgravette points.

5.4. Gravette/Microgravette points and Backed Bladelets

In this thesis Gravette points and Microgravette points will be put into one category because there seems to be no clear definition of what criteria distinguish them. Moreover, the aim of this works is not defining what the differences of those two point-types are.

However, Moreau (2012) draws our attention to a pattern, which shows that there is a larger number of Microgravette points than Gravette points. It is also clearly evident in GK I and GK II that there is a tendency towards smaller and thinner backed points as there is only one point that is longer than 35 mm and with a max. width of < 4 mm. Interestingly, the width of this Gravette/Microgravette point blends in with the width of the others. Furthermore, these backed points are only present in AH 4 and AH Luc (see Chapters 5.1, 5.2, 5.3) and are only made of erratic flint. There are 12 Gravette/Microgravette points in total in the analysed assemblages (GK I (1993-2011) = 7, GK I (2021) = 0, GK II = 5). At this point it should be briefly noted that a Gravette/Microgravette point was also documented in AH 2 within the analysed quadrants O19/N19. Klaric et al. (2009) record the presence of Gravette/Microgravette points in an older phase of the site Peyrugues (France). Those points vanish in the younger AHs and instead other backed elements emerge. They argue that this supports the claim of an earlier phase of the Late-Gravettian, that is characterised by Gravette/Microgravette points and a second phase, which is characterised by backed bladelets. GK shows a similar pattern. Gravette/Microgravette points are only present in the older AHs, i.e., AH 4 and AH Luc, while backed bladelets are present in both younger, i.e., AH 3 and AH Michi, and older AHs. Furthermore, while Gravette/Microgravette points are solely made from erratic flint, backed bladelets are made from various materials (chert, radiolarite and flint). Interestingly all backed bladelets that were made out of flint were found in AH 4 and AH Luc and all made out of chert – except GKII-F9-578, which was found in AH Luc – and radiolarite were found in AH 3 and AH Michi.

6. Raw materials at Grub-Kranawetberg I and II: Definitions and potential source areas

6.1. Raw material database

For analysing the raw material composition of my samples, I built up a catalogue consisting of microscopic photographs of the comparative lithic raw material collection of Michael Brandl at the Austrian Archaeological Institute/ Austrian Academy of Sciences (ÖAI/ÖAW). These photographs were taken in the Lithic Lab of the ÖAI/ÖAW with a camera (Axiocam 305 color camera) attached to a reflecting light microscope (Zeiss SteREO Discovery V20 with 20- 150x magnification) with a magnification of 20x and 40x. The collection contained raw materials from different sources in Europe. Based on the expertise of M. Brandl I looked at ten different raw material sources spanning from Poland to Austria. These included erratic flint (Brandl, 2014; Kaminská, 2016; Moník et al., 2025b; Moreau et al., 2016b; Sobkowiak-Tabaka et al., 2016; Thomas et al., 2023), Krakow flint (Moník et al., 2025b; Přichystal, 2013) and chocolate flint (Moník et al., 2025b; Přichystal, 2013) from Poland, radiolarites from the Carpathians (Brandl et al., 2014; Elekes et al., 2000; Moník et al., 2025b; Moreau et al., 2016b; Přichystal, 2013; Thomas et al., 2023) and cherts from Krumlovský les (CZ) (Brandl et al., 2015; Kaminská, 2016; Moník et al., 2025b; Moreau et al., 2016b; Přichystal, 2013; Thomas et al., 2023), Olomučany (CZ) (Moník et al., 2025b; Moreau et al., 2016b; Přichystal, 2013) and Stránská Skála (CZ) (Moník et al., 2025b; Moreau et al., 2016b; Přichystal, 2013; Thomas et al., 2023). Furthermore, Austrian outcrops included gravels of the Danube and Morava rivers and the old riverine gravel from northern Lower Austria (Donaultschotter) (Brandl et al., 2015; Moník, et al., 2025b; Přichystal, 2013; Thomas et al., 2023).

6.2. Raw material groups

Based on my raw material database and in correspondence with Michael Brandl and based on his work (Brandl, 2010, 2014, 2016, 2023; Brandl et al., 2014), I defined six raw material groups. The biggest three groups are chert, radiolarite and flint. Although radiolarite and flint are in its basis cherts I separated them from chert due to the distinct characteristics (see Sub-Chapters 6.2.2 and 6.2.3). The further raw material groups are obsidian, quartz and quartzite. The latter three groups consist of only a few pieces each.

6.2.1. Chert

Chert is a crypto- to microcrystalline rock (Fig. 20) that occurs as nodules, concretionary masses and as layers in a tabular form. The basic component of chert is SiO_2 and has a hardness of 7 on the Mohs Scale. The genesis of this material can happen in different environments. There are marine and lacustrine cherts. Through time several marine environments (e.g. Tethyan domain) occur where chert was formed. The first step in this process is the dissolution of organic remains due to pressure. With time and the right temperature, a recrystallization process forms a SiO_2 modification, rich in water called amorphous opal-A. Through a dissolution process, the opal-A is transformed into small beads of the crystalline opal-CT. The latter process is depending on temperature, burial depth and time. With time the coarseness of the microstructure enlarges resulting in a macroscopic quartz and indicating the beginning of the rock metamorphosis. Additional factors during this process are the pH-value of the environment, the presence of clay minerals and organic matter and the chemistry of the fluid in the pores (Brandl, 2014).

To differentiate between several groups of cherts Brandl (2010) suggest using the so called “*index fossil*”. This is the fossil that makes up the dominating part of the fossil content in the chert. Possible fossil skeletal remains are sponge spicules, sponge remains or radiolarians and determine if the rock is a spiculite, a spongiolite or a radiolarite (Fig. 20) (Brandl, 2016, 2023).

A problem for identifying and comparing lithics within the chert group is that fossil remains may be present in some parts of the stone while they can be absent in a different part of that same stone (Brandl, 2014). Since it is difficult to distinguish between spiculite and spongiolite I grouped them into the raw material group chert. However, radiolarite is easier to identify thus will be treated separately (see Chapter 6.2.2).

6.2.2. Radiolarite

Radiolarite is one of the most important lithic raw material types of the Upper Palaeolithic (Anghelinu et al., 2021; Brandl et al., 2014; Brandl, 2023; Elekes et al., 2000; Faragó et al., 2022; Kaminská et al., 2005; Moník, et al., 2025a). Radiolarite is a chert which was formed during the Jurassic age (Brandl, 2010). The “*index fossils*” are the skeletal remains of microorganisms called radiolarians (Fig. 20). This unicellular organism lived exclusively in marine environments and varied between 10 and 100 μm in size. These remains

accumulate at the bottom of the ocean and below the “*carbonate compensation depth*”, where almost no other marine fauna and no carbonate rock is found radiolarites were forming. This diagenesis happens in a very slow rate (1 cm rock per one million years) within a radiolarian silt. Beside radiolarians radiolarite can contain remains of various marine fauna and minerals. Thanks to the variety of different elements within the matrix, the radiolarite comes in many different colours, from green to red, bluish, orange to yellow and even black to dark brown variations (Brandl et al., 2014; Elekes et al., 2000).

6.2.3. Flint

Flint has a special place within the chert-group. The term itself is used for various varieties of chert using different kinds of attributes. Beginning with geographical regions (e.g. Baltic flint), appearances (e.g. Black flint) and ending with geological epochs (e.g. Danian flint) (Brandl et al., 2014). Brandl (2015) suggest parameter to help solving this problem.

The parameters are proposed as followed:

1. *Spatial frame: The occurrence of “flint” is broadly confined to Europe north of the Alps and especially to northern Europe, with flint bearing formations extending from France to the Ukrainian territory.*
2. *Timeframe: “Flint” is strictly bound to Cretaceous chalk sediments. As stated above, one position is to limit flint exclusively to Maastrichtian and Danian chalk formations. However, this seems too restrictive, since e.g. the Belgian Obourg or Nouvelles formations which are of Campanian age would then be excluded. Thus, a consensual solution would include the entire Upper Cretaceous stage (referred to as Senonian in the broader sense, encompassing all geological stages from the Cenomanian to the Danian).*
3. *Genesis environment: Flint deposits are exclusively placed within chalk or similar limestone formations containing corresponding fossil faunal remains.*
4. *Consolidation: Bringing all defining parameters together, the geographical position, the host rock formations and fossil inclusions must correspond to parameters 1–3.*

(Brandl, 2014, 42)

Material	Index fossils	Terminology	Type	Petrological genesis	Structure
Chert	radiolarians	radiolarite	rock	biochemical sedimentary	(crypto-) micro- crystalline
	sponge spicules	spiculite		Precambrian -	
	sponge remains	spongiolite		Neogene	
	forams, echinoderms, others	<i>chert</i>		ca. 3.5 Myr – 10 Ma	
Flint	Cretaceous marine organisms	(Baltic/ Scandinavian) <i>flint</i>	rock	biochemical sedimentary Upper Cretaceous including Danian 100.5 – 61.6 Ma	crypto- micro- crystalline

Fig. 20: Terminology of the chert-group (Brandl, 2016, Tab. 1).

Fossil remains in flint, as indicated above need to be cretaceous marine organisms (Brandl, 2016, 2023) (Fig. 20). In contrast to the alpine cherts flint forms in chalk environments. This soft environment results in less fissures and clefts due to much less tectonic stress (Brandl, 2014).

6.2.4. Obsidian

Obsidian is a volcanic glass that formed out of acid lava. For obsidian to form the lava need to be cooled rapidly. Due to this fast cooling an amorphous structure occurs and almost no crystalline structure is built up. On the Mohr Scale it lays between 5 and 6 making it softer than chert. The main components are SiO_2 and Al_2O_3 and can also contain traces of other chemical elements (e.g. K, Na, Ca, Fe). Furthermore, it can contain quartz, feldspar and mica. However, no organic matter is inside an obsidian. There are several variations of obsidian. In some variations band like structures of different colour occurs as a result of the flowing of the magma while cooling. If there were gases trapped within

the obsidian while cooling small bubbles can form within the structure (Brandl, 2014; Hahn, 1991; Thorpe, 1978).

6.2.5. Quartzite

This very hard rock forms either by a sedimentary or metamorphic diagenesis. It is built up from small quartz grains, CaCO_3 , a small amount of mica, opaque minerals and iron oxides. The inorganic rock comes in various colours (yellow, brown, grey, green-grey). Due to its rather rough structure the shell fracture is not as pronounced as with chert (Brandl, 2014; Hahn, 1991).

6.2.6. Quartz

Quartz is a mineral that is composed of SiO_2 . In contrast to other SiO_2 variations, quartz has a pure crystalline structure and is contrary to chert variations inorganic and can have an igneous, metamorphic or sedimentary petrological genesis. It comes in different colours and is as hard as the other variations. However, due to its crystal structure it does not have a clear shell fracture (Brandl, 2014; Hahn, 1991).

6.3. Alterations

6.3.1. Patination

Patination is the chemical altering of the stones surface due to aggressive environments. Depending on the surrounding different patination like white patina, desert varnish and gloss patination can occur. These can happen through mechanical and chemical weathering (Brandl, 2014). An important factor in patination is the pH-value. Rottländer (1975) shows that in an alkaline solution with a pH-value that exceeds 10 a white patina is formed. Within this solution the outer, few μm thick grains are attacked. From there on the patination continues inward using the newly formed microfissures (Rottländer, 1975). This white patination is the most important variety for Grub-Kranawetberg since the greater part of the flint is patinated.

		GK I (1993-2011)				GK I (2021)				GK II			
		AH 3		AH 4		AH 3		AH 4		AH Michi		AH Luc	
Patinated	Yes	84	27.6%	601	71.5%	4	7.5%	66	70.2%	39	5.3%	34	77.3%
	No	216	71.1%	224	26.7%	49	92.5%	24	25.5%	687	92.6%	8	18.2%
	n/a	4	1.3%	15	1.8%	0	0.0%	4	4.3%	16	2.2%	2	4.5%
	Total	304	100.0%	840	100.0%	53	100.0%	94	100.0%	742	100.0%	44	100.0%

Tab. 3: Absolute and relative frequency of patinated and non-patinated pieces in the assemblages GK I (1993-2011), GK I (2021) and GK II (Table: Samuel Kasemann).

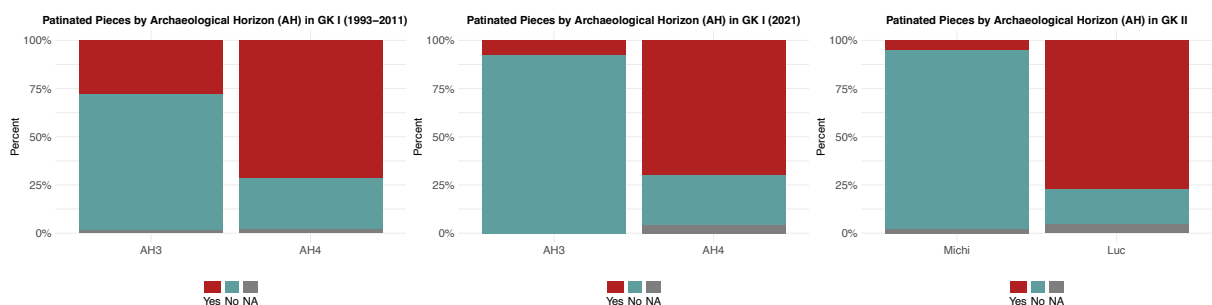


Fig. 21: Relative frequency of patinated and non-patinated pieces in the assemblages GK I (1993-2011), GK I (2021) and GK II (Graphs: Samuel Kasemann).

6.3.1.1. Patination in Grub-Kranawetberg I and II

In the assemblages of Grub-Kranawetberg I and II there is a clear tendency in the distribution of patinated raw material. As shown in the Tab. 3 there are clearly more patinated pieces in AH 4 (1993-2011: 73,6%, 2021: 70,2%) than in AH 3 (1993-2011: 27,8%, 2021: 7,5%) in GK I and more in AH Luc (77,3%) than in AH Michi in GK II (5,3%). Vice versa there are more non patinated lithics within AH 3 (1993-2011: 70,5%, 2021: 92,5%) than in AH 4 (1993-2011: 24,8%, 2021: 25,5%) and more in AH Michi (92,6%) than in AH Luc (18,2%).

6.4. Raw Material sources

There are four different kinds of lithic raw material sources. When the raw material is still in its original bedrock (in situ) the source is called a primary deposit. Sub-primary deposits are right next to the primary sources. Here the lithic raw material is naturally or artificially removed from the primary source. In the cases in which the material is in situ, but the host rock is geologically transformed it is called residual deposits. When the material is relocated by water or ice away from the original source it is called a secondary deposit. This relocation can happen over several kilometres. Based on the cortex of the material it

is possible to distinguish between those deposits (Brandl, 2023) (see Chapter 6.5). For Grub-Kranawetberg many different raw material sources have to be considered. In the following possible sources are listed.

6.4.1. Bohemian Massif

The Bohemian Massif is a wide area stretching from the Bohemian Forest to Bavaria and the Ore Mountains. It includes the *Waldviertel* in Lower Austria and Moravia. With the *Dunkelsteinerwald* the Bohemian Massif has an extension south of the Danube. Important raw materials in this region are chalcedony, jasper, rock quartz and quartzite (Brandl, 2023).

6.4.2. Northern Limestone Alps

This part of the Alps spans from Bavaria to eastern Austria where they dive underneath the Viennese Basin. With a size of approximately 50 by 500 km it is the biggest raw material source region south of the Danube (Brandl, 2023). Within the northern Limestone Alps (Fig. 22) one can find different kinds of Cherts like spiculite and radiolarite. Passing through this part of the Alps, the Danube receives those raw materials and transport them down the stream (Brandl & Trnka, 2014).

6.4.3. Flysch Zone

Laying north of the Northern Limestone Alps and south of the Danube the Flysch Zone contains limestones, quartzites and rarely even cherts and add them to the repertoire of the gravel of the Danube (Brandl, 2023).

6.4.4. St. Veit Klippen Belt

Within the Klippen Zone there are limestone formations that are connected to the Flysch Zone. Being located at the eastern end of the Wienerwald the St. Veit Klippen Zone is only about 50 km away from the Grub-Kranawetberg (Brandl, 2023; Brandl et al., 2014; Brandl & Trnka, 2014). This Klippen Zones are seen as “*extending elements of the pienidic Klippen of the western Carpathian Mountains*” (Brandl et al., 2014, 151). However, new geochemical analyses show that radiolarites from the St. Veitner Klippen Belt are more related to

the radiolarites of the Northern Alps rather than to the Pieniny Klippen Belt. Parts of the St. Veitner Klippen Belt formation contain Jurassic and Cretaceous cherts and radiolarites. Those radiolarites come in green, black, grey to brownish and red colours. (Brandl, 2023; Brandl et al., 2014; Brandl & Trnka, 2014).

6.4.5. Carpathians

The most important source area in the Carpathians is the Pieniny Klippen Belt (Fig. 22). This mountain formation is approximately 600 km long and reaches from the Viennese basin to Poland. It holds all sources within the Carpathian Mountains. In the Middle to Upper Jurassic rock formations different variations of radiolarite of highest quality can be found. The variations ranging from red to green radiolarites (Brandl, 2023; Brandl et al., 2014). Possible deposits of this region (e.g. Nemšová Kamenice, Vlára Bolešov, Vršatské Podhradie) (Brandl et al., 2014) are approximately in a distance of 130 km to Grub-Kranawetberg.

There are three obsidian outcrop regions within the Carpathians where one can find suitable obsidian for stone tool production. One of those is in the northeast of Hungary, one is in the Eastern Slovakia and third one is in the western Ukraine. All three sources lay in an area with a diameter of approximately 100 km and the nearest outcrop is about 350 km away from Grub-Kranawetberg (Hughes et al., 2018).

6.4.1. South Moravia

Southern Moravia (Fig. 22) is home to several Jurassic cherts and is about 50-80 km away from Grub-Kranawetberg. These cherts occur mainly in Cretaceous gravel and residual weathered loam, deriving from Jurassic limestone formations (e.g. Krumlovský les, Stránská skála, Olomučany) (Brandl, 2023). Within the local Miocene gravels in South Moravia one can also find radiolarites (Moník, et al., 2025b).

6.4.2. Morava gravel

Being the nearest raw material source to Grub-Kranawetberg I and II, the Morava River is rather important. Verpoorte (2001) states that the Morava gravel contain some flints that have been reworked into it. Interestingly within the comparative collection of Michael

Brandl, which he collected north of Grub near Dürnkrot, only cherts can be found. In consultation with Michael Brandl and Oliver Schmitsberger (both ÖAI/ÖAW) it could be clarified that this is not a collection bias. However, it is a relatively small sample at only one location. Also, Antonín Přichystal (Masaryk University, personal communication March 2025) confirmed that there are no radiolarites within the Morava River gravels. To get a more detailed picture of the raw material of the Morava River, more surveys need to be done

6.4.3. Danube gravel

The Danube is an important raw material source for lithics. Starting in Germany it cuts through raw material rich mountain formations (Bohemian Massif) and receives a diverse set of raw materials from bordering geological areas through the riverine system (Flysch Zone, Molasse Zone, Northern Limestone Alps and Bohemian Massive) (Brandl, 2023). The nearest point of the Danube to Grub-Kranawetberg is at a distance of about 30 km.

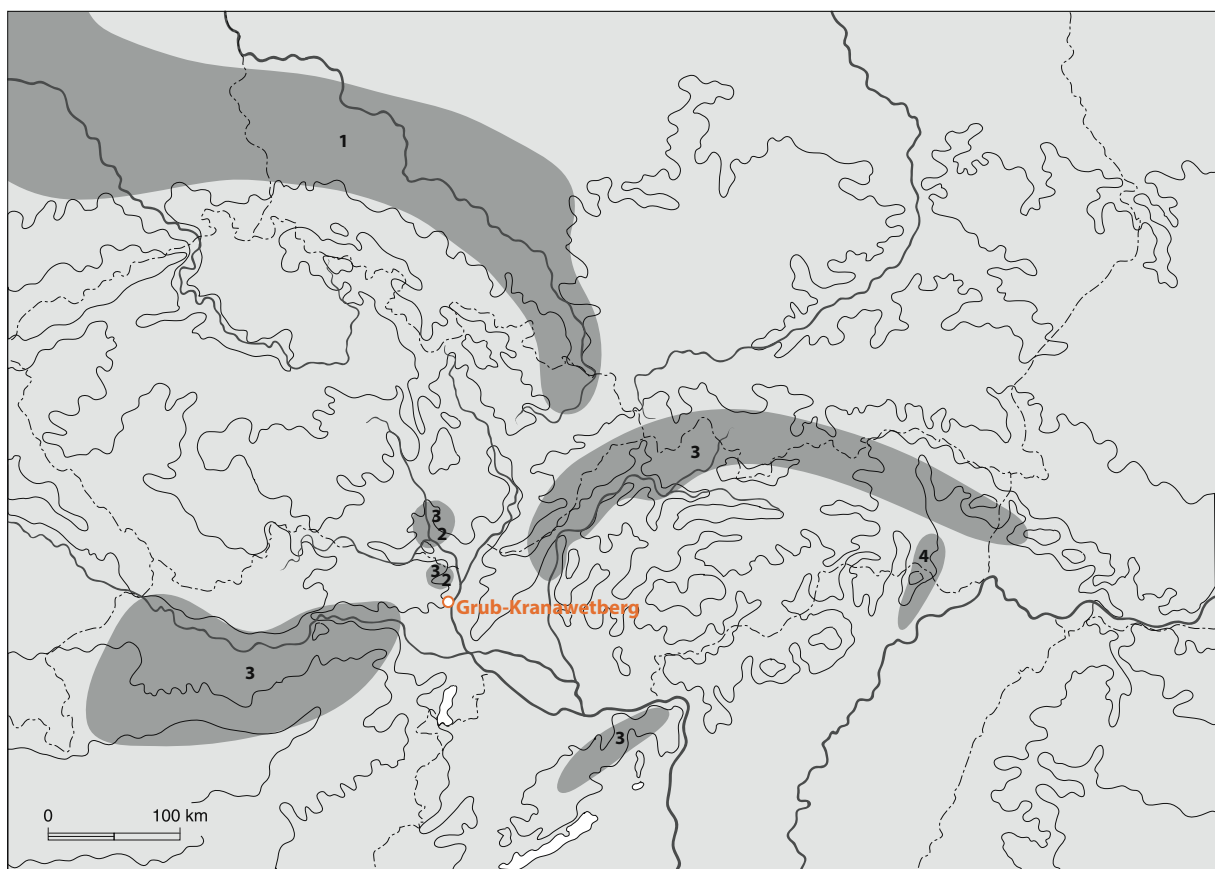


Fig. 22: Distribution of potential raw material sources important for Grub-Kranawetberg; 1= Flint, 2= chert, 3= radiolarite, 4= obsidian (Verpoorte, 2001, Fig. 2.8, edited by Samuel Kasemann).

6.4.4. Old riverine gravel in northern Lower Austria

In northern Lower Austria gravel bodies (Fig. 22) occur that are rich in SiO₂ materials. Within these are many cherts that look very similar to cherts from Southern Moravia. Unfortunately, the raw material sources within the northern Austrian old riverine gravel deposits are not studied very well, making detailed comparison difficult. Possible gravel deposits in this region are the *Hollabrunner-Mistelbach* formation (*Donaultschotter*) and the *Laa* formation (Brandl, 2023; Mateiciucová et al., 2006; Wessely, 2006). Furthermore, radiolarites are also found within those formations. This is shown by the comparative collection of Michael Brandl (ÖAI/ÖAW). This raw material source is located approximately 20 km northwest of Grub.

6.4.5. Bakony

Being approximately 150 km away from Grub-Kranawetberg, locations within the Bakony Mountains (e.g. Szentgál, Városlőd and Lókút) (Fig. 22) are known for radiolarite workshop sites (Elekes et al., 2000). Although these workshop sites date to the Neolithic (Biró & Regenye, 2003) the deposits were still used as raw material source in the Palaeolithic (Moník, et al., 2025b). Being composed of Mesozoic sedemantary rock it houses a wide variaty of siliceous rock like chert, radiolarite and flint (Biró & Regenye, 2003) (not flint according to the parameters suggested by Brandl (2014), see Chapter 6.2.3). There are few pieces in the collections of GK I and GK II that could come from the Bakony Mountains. However, this classification has only been made microscopically and should be treated with great caution. In order to assign these artefacts to this area, chemical analyses should be carried out.

6.4.6. Glacial deposits

6.4.6.1. Flint

As already specified in the parameters of defining flint, the main occurrence of it is north of the Alps in Europe (Fig. 22). However, flint sources can be found from France to the Ukraine (Brandl, 2014). The most important flint source for central Europe was formed by Pleistocene glacial activity. Massive ice sheets from the Saale and Elster glaciation pushed rock from several different locations in northern Europe south towards southern

Poland, northern Bohemia and northern Moravia (Brandl, 2023; Sobkowiak-Tabaka et al., 2016). The flint-bearing moraine deposits contain flint variations from different areas of northern Europe. However, due to this variation it is nearly impossible to determine the primary sources (Sobkowiak-Tabaka et al., 2016). The nearest place to Grub-Kranawetberg where this southwards pushed flint occurs is in the Moravian Gate (Verpoorte, 2001), at more than 150 km distance from the Grub-Kranawetberg.

6.5. Natural surfaces

Cortex is the natural surface of silicites and indicates the transition area between the siliceous rock and the carbonated rock (Brandl, 2010, 2023). For primary deposits a cortex with no rounding is characteristic and no rounding to little rounding is present at sub-primary sources. Cortex in residual deposits also has no to little rounding, while secondary deposited raw material has different kind of abrasion depending on the medium that moved it. Relocation by water or ice results in cracks, scratches and polishing of the cortex. However, cortex that was reworked by glaciers have a finer result called glacial scratches (Brandl, 2023).

Within the 2,201 lithics in this analysis only 167 pieces with natural surfaces occur (Fig. 24). In Tab. 4 the pieces with natural surfaces are presented by AH. On four of those pieces a natural surface deriving from moraine environment could be identified. All of them are erratic flint (Fig. 24: 6-9) and were excavated 2021 from AH 4. On ten pieces natural surfaces coming from riverine environments are present (Fig. 24: 1-5). One of those lithics is from AH 3 (excavated 2021) and the rest is from AH 4 (excavated 1993-2011, 2021).

Pieces with natural surfaces are relatively rare across the different raw material groups (Fig. 24). Tab. 5 and Tab. 6 show the presence of them for the three main raw material groups and for each AH. Among 458 chert artefacts, only 73 (15.9%) retain parts of their natural surface (Fig. 24: 1-5). For radiolarite, 18 (2.7%) out of 660 pieces still show traces of natural surfaces, while flint (Fig. 24: 6-9) shows 68 (8.5%) such examples out of a total of 797 artefacts. In the assemblage of GK I the percentages of lithics with natural surfaces vary between 0% and 33.3% (Tab. 5). The highest percentage comes from radiolarite of AH 4 of GK I (2021). However, this has to be considered carefully since there are only three radiolarites present in AH 4 (GK I (2021)). After that, the next highest percentages of present natural surfaces are all on chert (Fig. 24: 1, 2, 3, 4, 5) (1993-2011: AH 3: 12.1%; AH 4:

		GK I (1993-2011)				GK I (2021)				GK II			
		AH 3		AH 4		AH 3		AH 4		AH Michi		AH Luc	
Natural Surfaces	Yes	20	6.6%	115	13.7%	4	7.5%	11	11.7%	14	1.9%	3	6.8%
	No	282	92.8%	720	85.7%	49	92.5%	83	88.3%	722	97.3%	41	93.2%
	n/a	2	0.7%	5	0.6%	0	0.0%	0	0.0%	6	0.8%	0	0.0%
	Total	304	100.0%	840	100.0%	53	100.0%	94	100.0%	742	100.0%	44	100.0%

Tab. 4: Absolute and relative frequency of cortical and non-cortical pieces in the assemblages GK I (1993-2011), GK I (2021) and GK II (Table: Samuel Kasemann).

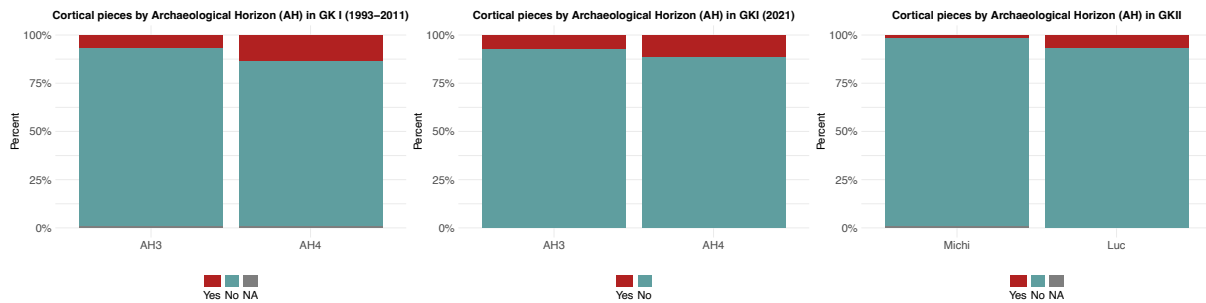


Fig. 23: Relative frequency of cortical and non-cortical pieces in the assemblages GK I (1993-2011), GK I (2021) and GK II (Graphs: Samuel Kasemann).

		GK I (1993-2011)						GK I (2021)						Total		
		AH 3			AH 4			AH 3			AH 4			Sum		
		n total	n natural surface	% natural surface	n total	n natural surface	% natural surface	n total	n natural surface	% natural surface	n total	n natural surface	% natural surface	n total	n natural surface	% natural surface
Natural Surfaces	Chert	66	8	12.1%	192	54	28.1%	10	1	10.0%	28	7	25.0%	296	70	23.6%
	Radiolarite	130	6	4.6%	11	1	9.1%	40	3	7.5%	3	1	33.3%	184	11	6.0%
	Flint	83	6	7.2%	589	56	9.5%	2	0	0.0%	60	3	5.0%	734	65	8.9%

Tab. 5: Cross-Table showing the count and percentage of lithics with natural surface for each of the main three raw material units Chert, Radiolarite and Flint per AH for GK I. The total count differs from the overall total count, as only pieces with identified RMU were used for this table (Table: Samuel Kasemann).

		GK II						Total		
		AH Michi			AH Luc			Sum		
		n total	n natural surface	% natural surface	n total	n natural surface	% natural surface	n total	n natural surface	% natural surface
Natural Surfaces	Chert	141	3	2.1%	4	0	0.0%	145	3	2.1%
	Radiolarite	422	7	1.7%	2	0	0.0%	424	7	1.7%
	Flint	12	0	0.0%	33	3	9.1%	45	3	9.1%

Tab. 6: Cross-Table showing the count and percentage of lithics with natural surface for each of the main three raw material units Chert, Radiolarite and Flint per AH for GK II. The total count differs from the overall total count, as only pieces with identified RMU were used for this table (Table: Samuel Kasemann).

28.1%; 2021: AH 3: 10.0%; AH 4: 25.0%) of GK I (1993-2011 & 2021). Natural surfaces on radiolarite in GK I vary between 0.0% and 9.1% (excl. AH 4 of the assemblage of 2021, see above). On flint (Fig. 24: 6-9) it varies between 0.0% and 9.5%. In the assemblage of GK II the percentages of present natural surfaces vary between 0.0% and 9.1% (Tab. 6). In AH

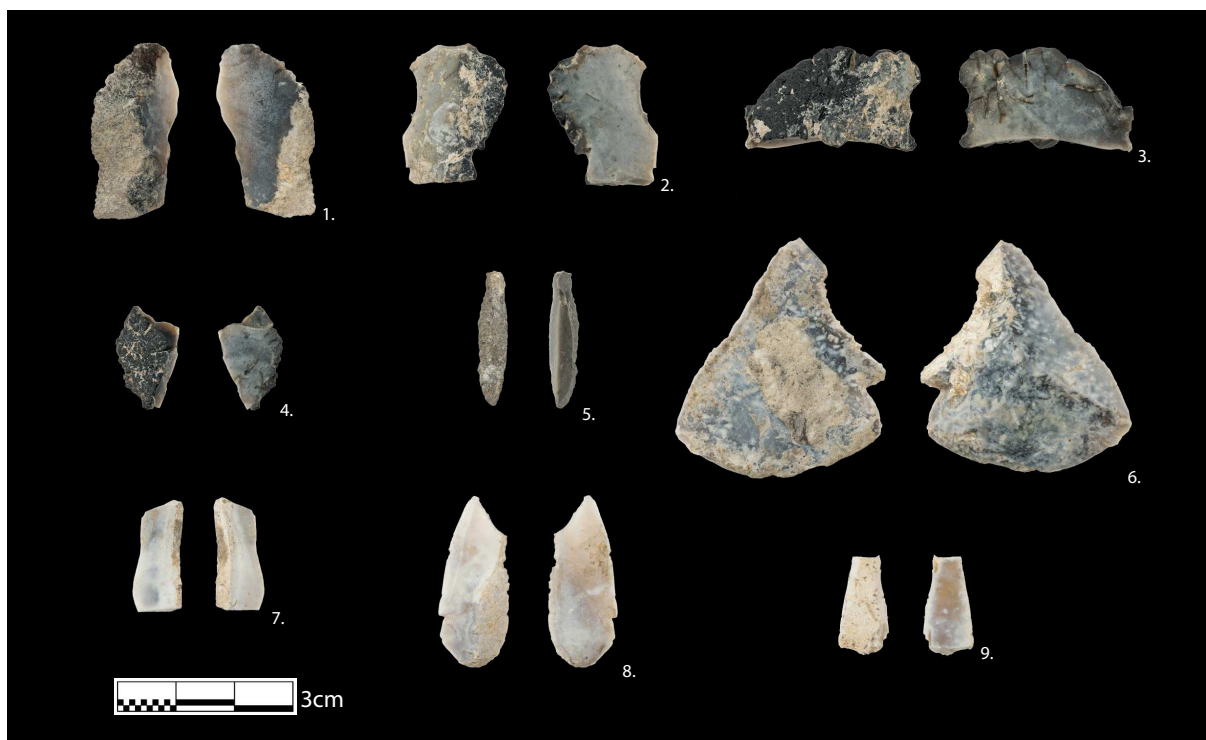


Fig. 24: Lithics with natural surfaces in Grub-Kranawetberg I & II; 1: GK21-37, 2: GKII-G8-969, 3: GKII-G8-744, 4: GKII-G8-1042, 5: GKII-G8-570, 6: GKII-H9-615, 7: GK21-43, 8: GKII-H9-544, 9: GKII-H9-603 (Photos: Christoph Bieber).

Michi there are no natural surfaces present on flints and only very little on cherts ($n=3$, 2.1%) and radiolarites ($n=7$, 1.7%). Natural surfaces are found exclusively on flint in AH Luc ($n=3$, 9.1%).

6.6. Problems and Future

Although determining the raw materials is relatively easy when using water emersion under the reflecting light microscope there are still some problems with associating the artifacts to the raw material sources.

If we look at secondary raw material sources there is, for example, a wide variety of different raw materials within the river gravel assemblages. As we see in the Chapter 6.4.3, the Danube has a very large input area. Within the Danube we find diverse radiolarites, cherts and many other raw materials coming from Bavaria, Upper and Lower Austria. The Morava River also collect many different variations of chert on its way from its source. To distinguish if the source of the lithic is secondary or from its primary source one needs to analyse cortex. However, in the assemblages of Grub-Kranawetberg I and II are very few

cortical pieces as shown in Chapter 5 and, therefore, it is hard to differentiate if a radiolarite/chert is from a primary or secondary (e.g., river gravels) source.

Furthermore, there can be variation in a raw material within a source (e.g., Delage, 2003; Luedtke, 1992; Speer, 2014; Turq, 2005) and even within one nodule. Some radiolarites in the reference collection have both red and green parts within the same nodule and also many cherts have a heterogeneous colouration and therefore probably different chemical inclusions.

Another problem with many archaeological assemblages is that a substantial part of the lithics is smaller than 10 mm. On basis of the above-mentioned potential variation within a raw material source it is not advisable to assign lithics smaller than 10 mm to specific sources (verbal conversation with Michael Brandl [March 2025]).

Chemical solutions for assigning lithic artifacts to lithic raw material sources have been provided and tested by many researchers in the last years (Brandl, 2014; Brandl et al., 2014, 2015; Brandl, 2016, 2023; Elekes et al., 2000; Gauthier et al., 2012; Hughes et al., 2012; Milne et al., 2009; Moník, et al., 2025a; Moník, et al., 2025b; Moreau, et al., 2016a; Moreau et al., 2019; Olofsson & Rodushkin, 2011; Rácz et al., 2016; Shackley, 2008; Sobkowiak-Tabak et al., 2016). Michael Brandl developed the *multi-layered chert sourcing approach (MLA)*, which combines macroscopic and stereomicroscopic micro-facies-analysis with the chemical method LA-ICP-MS (Laser Ablation-Inductively Coupled-Plasma Mass Spectrometry). This approach should help to determine the raw material by analysing the main-, trace- and ultra-trace elements of the lithics. When comparing it to samples of known lithic sources we ideally can assign it to its source. These methods are all non- or minimally destructive and thus are suited for analysing archaeological artifacts. Due to the heterogeneity of the raw materials mentioned above at least three measurements in three different areas on each lithic need to be done (Brandl, 2016, 2023; Brandl et al., 2016, 2018). However, as Moník et al. (2025b) rightfully point out, the chemical provenance analysis remains problematic due to secondary occurrences within Tertiary gravels or riverine deposits.

Unfortunately, in the course of this master thesis I could not undertake chemical analysis owing to time and funding restrictions. Therefore, my analyses are limited to macro- and microscopic analysis of the lithic material. However, chemical analyses will be part of future research of the lithic assemblage of Grub-Kranawetberg I and II.

7. Raw material analysis

Raw material analysis is a key component in lithic studies, offering insights into procurement strategies, mobility patterns, and technological choices of past human groups. By identifying and characterizing the types of stone used, we can reconstruct aspects of resource selection and cultural practices. Below I present my analysis of raw materials in the assemblages of GK I and II. A special focus is on the statistical analyses of the significant differences in raw material presence between both sites and the AHs. In the following Chapter 8, I will review the theoretical background of raw material procurement and interpret the results concerning raw material types and their potential sources within a behavioural context.

7.1. The raw materials in Grub-Kranawetberg I and II

7.1.1. Grub-Kranawetberg I, excavation 1993-2011

The distribution of the six raw material units chert, radiolarite, flint, obsidian, quartz and quartzite in AH 3 and AH 4 is shown in Tab. 7 and visualized in Fig. 27. Both assemblages do not differ substantially in the relative amounts of cherts (AH 3: 21.7%, n=66; AH 4: 22.9%, n=192), while obsidian, quartz and quartzite are represented by individual pieces only. The two most numerous raw material groups are radiolarite and flint. Within AH 3 radiolarite is the raw material of 42.8% (n=130) and flint of 27.3% (n=83) of the entire assemblage. The radiolarites of AH 4 make up only 1.3% (n=11) of that assemblage, while the flint is dominating with 70.1% (n=589).

Tab. 8 summarizes the distribution of the raw material units based on their weight. The biggest raw material group in AH 3 is radiolarite (51.1%, 97.0 g) followed by flint (23.5%, 44.3 g) and chert (19.2%, 36.1 g). Lithics made on unidentified raw material amount to 5.4% and quartzite is only present with 0.5% (1.0 g). This raw material distribution by weight for AH 3 is similar to the distribution based on count. The situation is different for AH 4. While flint is the dominating raw material group based on count, chert (47.6%, 238.7 g) is the biggest group based on weight. Flint follows closely with 43.2% (216.9 g). Radiolarite is only present with 4.3% (21.5 g). Obsidian represents 0.04% of the total weight, quartz 0.1% (0.4 g) and quartzite 1.1% (5.7 g), each represented by just individual pieces.

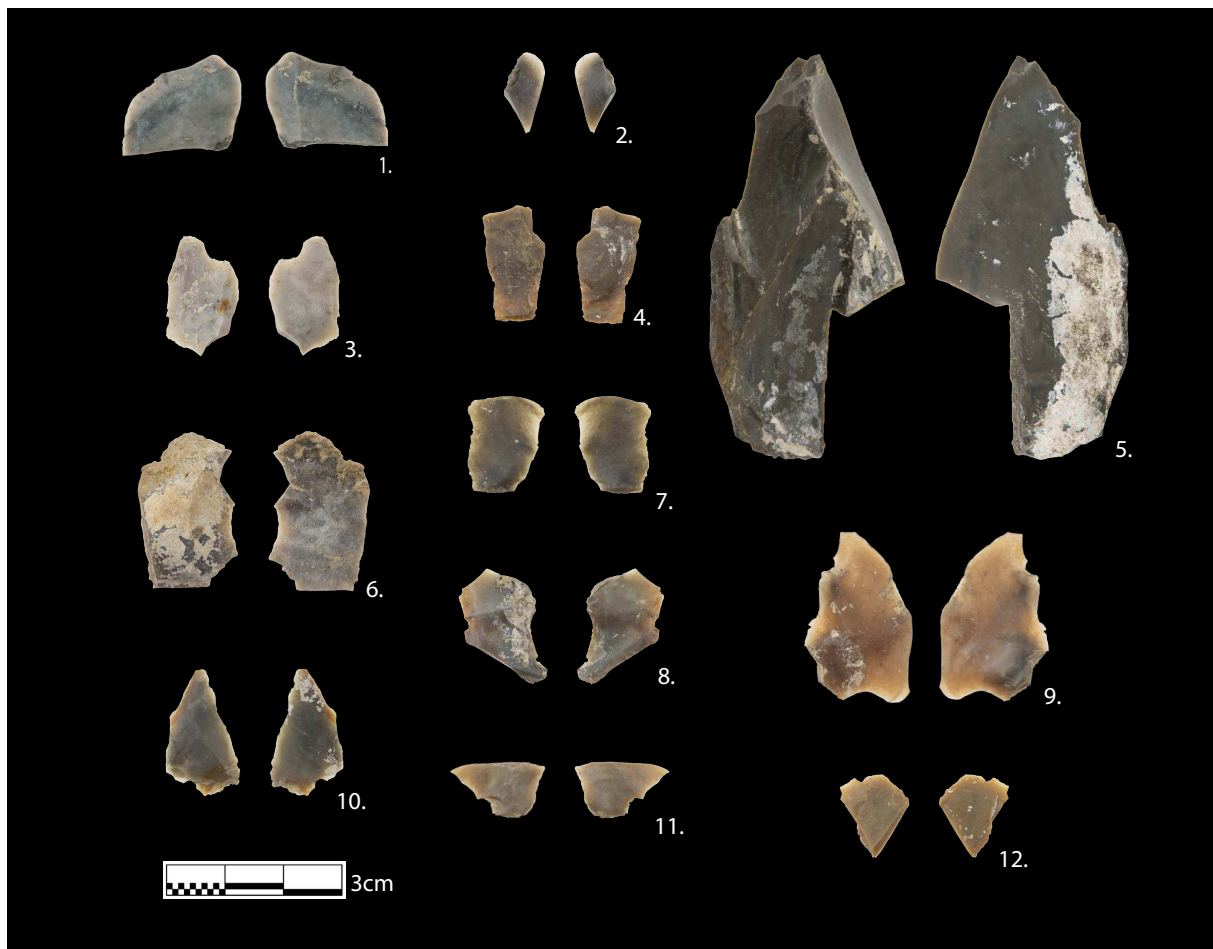


Fig. 25: Cherts in Grub-Kranawetberg I & II; 1: GKII-H9-548, 2: GKII-I10-195, 3: GKII-F9-562, 4: GKII-F9-323, 5: GKII-H11-269, 6: GKII-F9-472, 7: GKII-H11-267, 8: GKII-I10-362, 9: GKII-H9-601, 10: GKII-F9-331, 11: GKII-I10-222, 12: GKII-I10-166 (Photos: Christoph Bieber).

7.1.1. Grub-Kranawetberg I, excavation 2021

As seen in Tab. 7 and Fig. 27, a similar picture to the one described for the excavation 1993-2011 assemblages at GK I emerges in the assemblages of the excavation in 2021. Cherts are present in both AHs (AH 3: 18.9% n=10; AH 4: 29.8%, n=28). There are 40 (75.4%) radiolarites in AH 3, but in contrast, only three (3.2%) pieces of this material were found in AH 4. While there are only a few pieces of flint in AH 3 (3.8%, n=2) there are a lot more in AH 4 (63.8%, n=60). This shows that the focus is clearly on flint in AH 4 (Fig. 29; 2-6). In contrast to the previous excavation, neither obsidian, quartz nor quartzite was found here. Only one artefact (1.9%) from AH 3 and only three (3.2%) lithics from AH 4 could not be determined. Tab. 8 summarizes the distribution of the raw material units based on their weight for the assemblage of 2021. 81.1% (34.7 g) of the total weight is represented by radiolarite within AH 3, while flint is only present by 0.5% (0.2g).

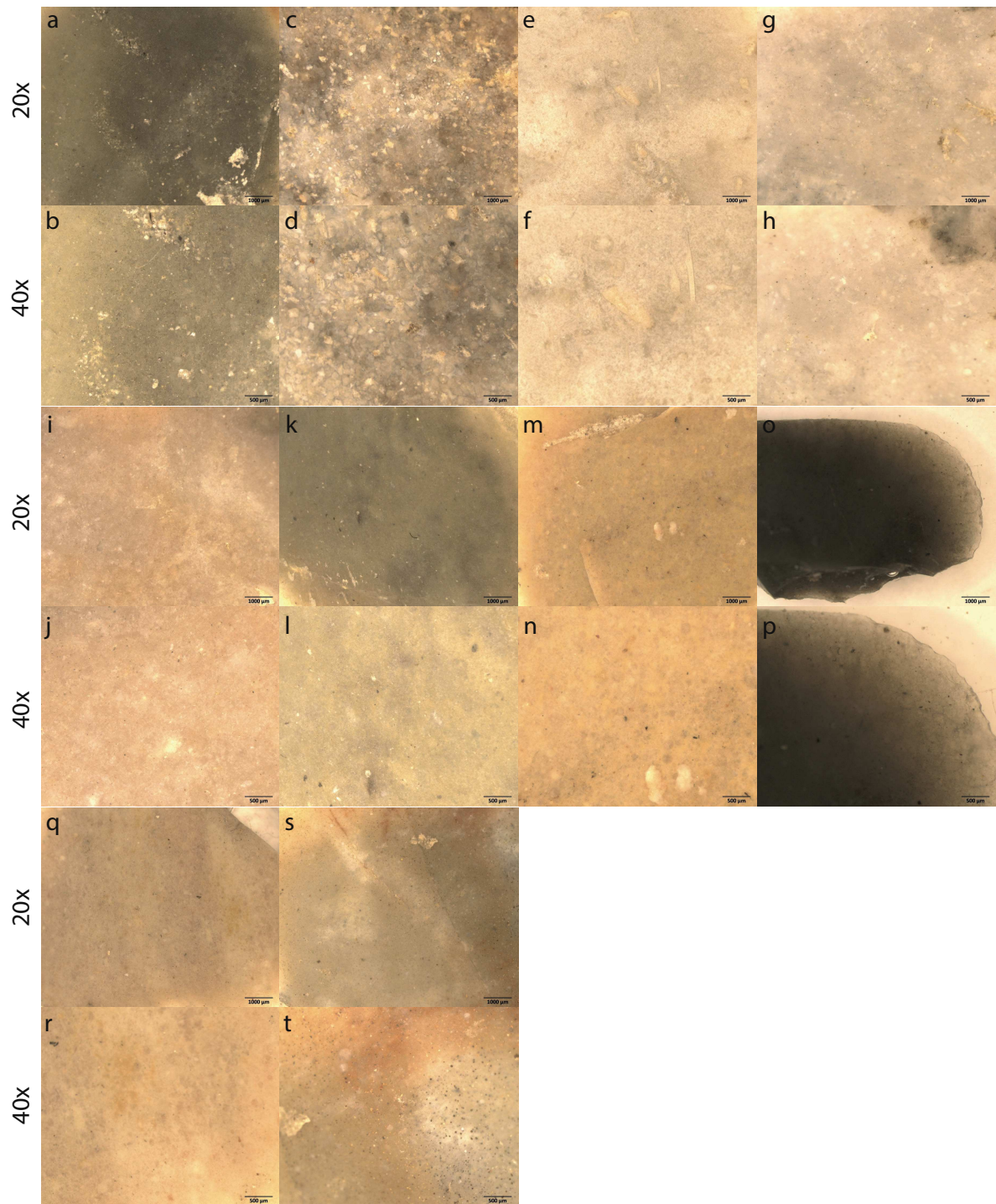


Fig. 26: Microscope photos of cherts from GK II; a-b: GKII-F9-331, c-d: GKII-F9-472, e-f: GKII-F9-562, g-h: GKII-H9-548, i-j: GKII-H9-601, k-l: GKII-H11-267, m-n: GKII-I10-166, o-p: GKII-I10-195, q-r: GKII-I10-222, s-t: GKII-I10-362 (Photos: Samuel Kasemann).

Chert is the second biggest group with 16.7% (7.1 g). This distribution reflects the distribution of raw material based on count within AH 3. Similar to the 1993-2011 assemblage the weight distribution differs to the count in AH 4. While the raw material group flint has

		GK I (1993-2011)				GK I (2021)				GK II			
		AH 3		AH 4		AH 3		AH 4		AH Michi		AH Luc	
Raw Material	Chert	66	21.7%	192	22.9%	10	18.9%	28	29.8%	141	19.0%	4	9.1%
	Radiolarite	130	42.8%	11	1.3%	40	75.5%	3	3.2%	422	56.9%	2	4.5%
	Flint	83	27.3%	589	70.1%	2	3.8%	60	63.8%	12	1.6%	33	75.0%
	Obsidian	0	0.0%	2	0.2%	0	0.0%	0	0.0%	1	0.1%	0	0.0%
	Quartz	0	0.0%	1	0.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Quartzite	3	1.0%	8	1.0%	0	0.0%	0	0.0%	8	1.1%	1	2.3%
	n/a	22	7.2%	37	4.4%	1	1.9%	3	3.2%	158	21.3%	4	9.1%
	Total	304	100.0%	840	100.0%	53	100.0%	94	100.0%	742	100.0%	44	100.0%

Tab. 7: Absolute and relative frequency of raw materials in the assemblages GK I (1993-2011), GK I (2021) and GK II
(Table: Samuel Kasemann).

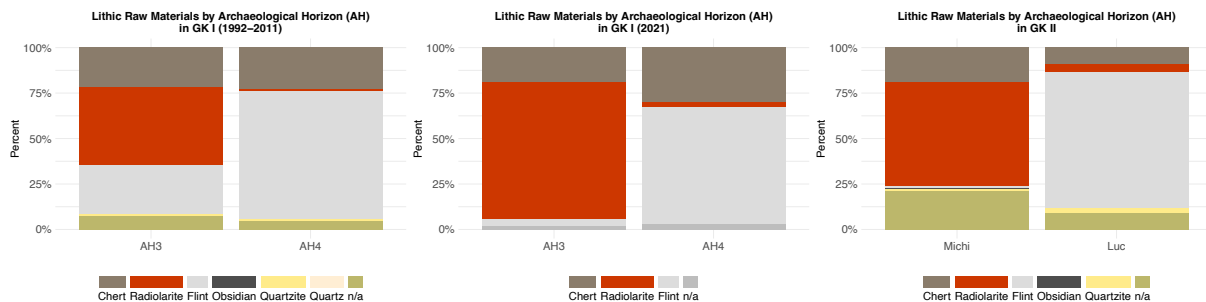


Fig. 27: Relative frequency of raw materials in the assemblages GK I (1993-2011), GK I (2021) and GK II
(Graphs: Samuel Kasemann).

		GK I (1993-2011)				GK I (2021)				GK II			
		AH 3		AH 4		AH 3		AH 4		AH Michi		AH Luc	
Raw Material	Chert	36.1	19.2%	238.7	47.6%	7.1	16.7%	19.7	43.5%	52.5	16.6%	2.7	4.5%
	Radiolarite	97.0	51.5%	21.5	4.3%	34.7	81.6%	2.4	5.3%	212.6	67.2%	0.2	0.3%
	Flint	44.3	23.5%	216.8	43.2%	0.2	0.5%	20.3	44.8%	8.4	2.7%	56.9	94.2%
	Obsidian	0	0.0%	0.2	0.0%	0	0.0%	0	0.0%	0.1	0.0%	0	0.0%
	Quartz	0	0.0%	0.4	0.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	Quartzite	1.0	0.5%	5.7	1.1%	0	0.0%	0	0.0%	1.1	0.3%	0.2	0.3%
	n/a	10.1	5.4%	18.6	3.7%	0.5	1.2%	2.9	6.4%	41.5	13.1%	0.4	0.7%
	Total	188.5	100.0%	501.9	100.0%	42.5	100.0%	45.3	100.0%	316.2	100.0%	60.4	100.0%

Tab. 8: Absolute and relative weight distribution in the assemblages GK I (1993-2011), GK I (2021) and GK II
(Table: Samuel Kasemann).

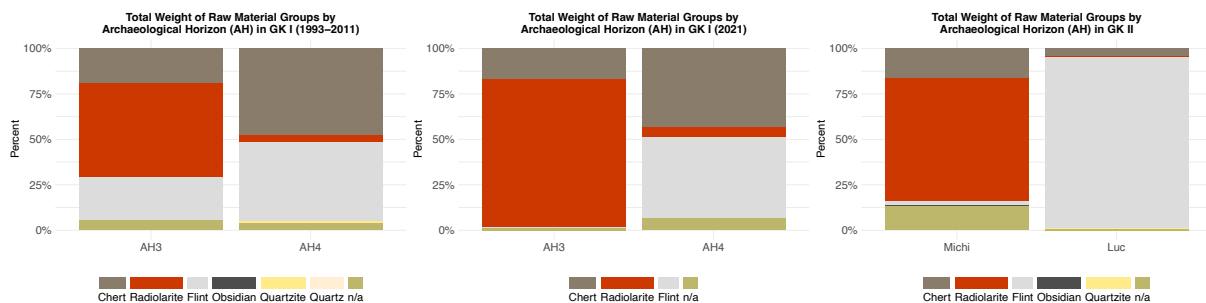


Fig. 28: Relative weight distribution in the assemblages GK I (1993-2011), GK I (2021) and GK II
(Graphs: Samuel Kasemann).

the highest number (44.8%, 20.3 g), it exceeds chert (43.5%, 19.7 g) only by 1.3% based on weight.

7.1.2. Grub-Kranawetberg II, excavation 2022-2023

Tab. 7 shows that in AH *Michi* 5 of the described raw materials can be found. The biggest group with 422 (56.9%) pieces is radiolarite, followed by cherts (Fig. 25) with 141 lithics (19.0%). Three rather small groups are flint with 12 (1.6%), obsidian with only one (0.1%), and quartzite with eight (1.1%) pieces. In contrast to that only four (9.1%) cherts and two (4.5%) radiolarites were found in AH *Luc*. One (2.3%) piece is a quartzite and four (9.1%) lithics could not be assigned to a raw material group. The biggest part of the finds in this AH is flint (75.0%, n=33).

As can be seen in Tab. 8, the biggest group within AH *Michi*, based on weight, is radiolarite (67.2%, 212.6 g). The next most represented group is chert with 16.6% (52.2 g), while flint is only present with 2.7% (8.4 g). The eight pieces of quartzite is represented only by 0.3% (1.1 g) and the only piece of obsidian by 0.03% (0.1 g). Flint (94.2%, 56.9 g) is by far the biggest group in AH *Luc* when it comes to weight. Chert is represented by 4.5% (2.7 g) and radiolarite by 0.3% (0.2 g). One quartzite is presented by 0.3% (0.2 g).

7.1. Significant differences in raw material use

To determine that the to date observed differences of the present raw material between AH 3 and 4 and between AH *Michi* and *Luc* is given, Chi-square tests were conducted. These were based on count data of artifacts for each raw material group. In addition, observed trends between the AHs of the two sites were also analysed. Since some of the analysed counts are relatively small, a Chi-square test with Monte Carlo simulation of the p-value (10.000 replicates) was performed in R (see Chapter 4.3). For the following test the two assemblages of GK I (1993-2011, 2021) were merged and were treated as one assemblage (Tab. 9, Tab. 10). Two sets of data formed the basis for the analysis: first, the total count of artifacts per raw material group. Second, the relative weight distribution of each group was looked at to analyse substantial differences. Four different aspects were tested on their significant differences.



Fig. 29: Flints in Grub-Kranawetberg I & II; 1: GKII-G10-893, 2: GK21-240, 3: GK21-108, 4: GK21-43, 5: GK21-214, 6: GK21-124 (Photos: Christoph Bieber).

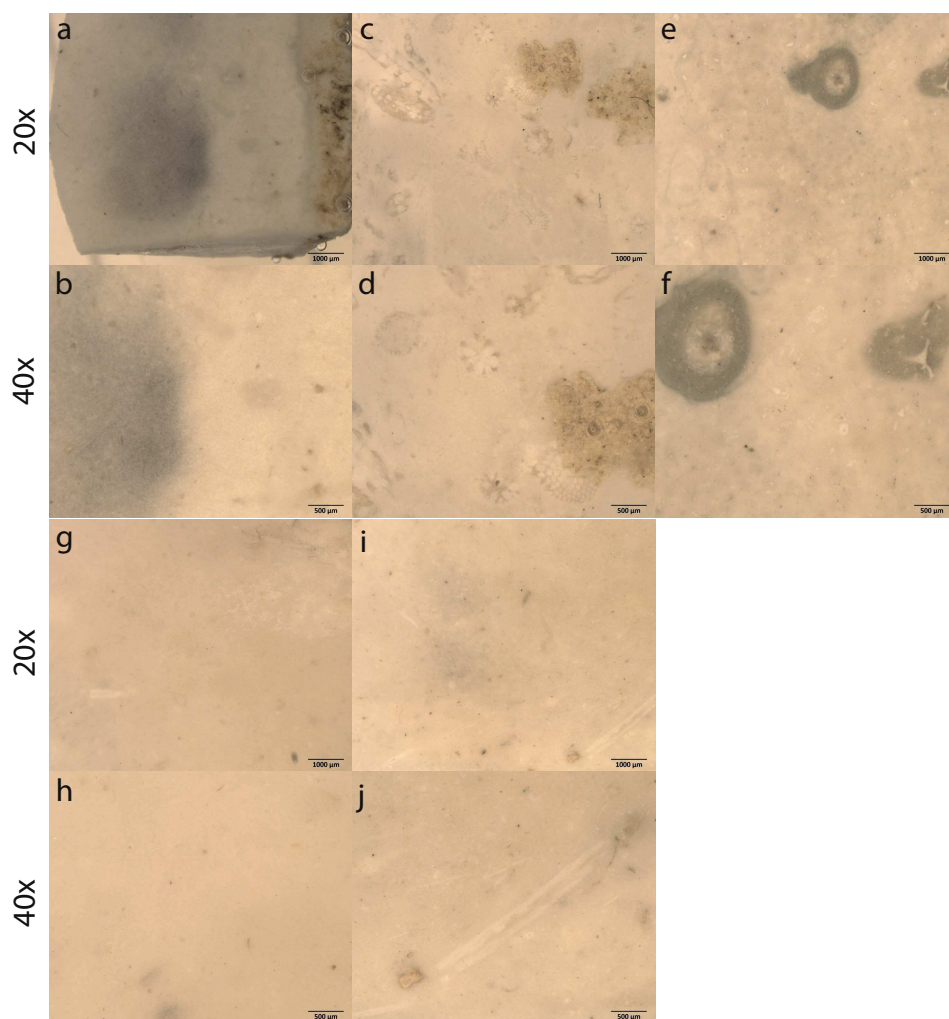


Fig. 30: Microscope photos of flints from GK I: a-b: GK21-43, c-d: GK21-108, e-f: GK21-124, g-h: GK21-214, i-j: GK21-240 (Photos: Samuel Kasemann).

		GK I				GK II			
		AH 3		AH 4		AH Michi		AH Luc	
Raw Material	Chert	76	21.3%	220	23.6%	141	19.0%	4	9.1%
	Radiolarite	170	47.6%	14	1.5%	422	56.9%	2	4.5%
	Flint	85	23.8%	649	69.5%	12	1.6%	33	75.0%
	Obsidian	0	0.0%	2	0.2%	1	0.1%	0	0.0%
	Quartz	0	0.0%	1	0.1%	0	0.0%	0	0.0%
	Quartzite	3	0.8%	8	0.9%	8	1.1%	1	2.3%
	n/a	23	6.4%	40	4.3%	158	21.3%	4	9.1%
	Total	357	100.0%	934	100.0%	742	100.0%	44	100.0%

Tab. 9: Absolute and relative frequency of raw materials in the assemblages GK I (merged) and GK II
(Table: Samuel Kasemann).

		GK I				GK II			
		AH 3		AH 4		AH Michi		AH Luc	
Raw Material	Chert	43.2	18.7%	258.4	47.2%	52.5	16.6%	2.7	4.5%
	Radiolarite	131.7	57.0%	23.9	4.4%	212.6	67.2%	0.2	0.3%
	Flint	44.5	19.3%	237.1	43.3%	8.4	2.7%	56.9	94.2%
	Obsidian	0	0.0%	0.2	0.04%	0.1	0.03%	0	0.0%
	Quartz	0	0.0%	0.4	0.1%	0	0.0%	0	0.0%
	Quartzite	1.0	0.4%	5.7	1.0%	1.1	0.3%	0.2	0.3%
	n/a	10.6	4.6%	21.5	3.9%	41.5	13.1%	0.4	0.7%
	Total	231.0	100.0%	547.2	100.0%	316.2	100.0%	60.4	100.0%

Tab. 10: Absolute and relative weight distribution in the assemblages GK I (merged) and GK II
(Table: Samuel Kasemann).

First, the distribution of the raw material units, based on count, between AH 3 and AH 4 of GK I was compared. A Chi-square test with Monte Carlo simulation of the p-value (10.000 replicates) suggests a significant difference ($X^2 = 484.96$, $df = NA$, $p\text{-value} = 9.999e-05$). Also, between AH Michi and AH Luc a test suggests a significant difference ($X^2 = 367.2$, $df = NA$, $p\text{-value} = 9.999e-05$) of the raw material units, based on count. Both results confirm the observed but never quantified difference in raw material usage between the younger (AH 3 and AH Michi) and older AHs (AH 4 and AH Luc).

As can be seen in Tab. 7, there are trends that are striking. For example, if you look at AH 3 and AH Michi, you can see a similar percentage of chert present. Furthermore, there is a clear tendency in both AHs with regard to the use of radiolarites. However, the p-value ($X^2 = 125.03$, $df = NA$, $p\text{-value} = 9.999e-05$) shows that there is a significant difference between the raw material use of both horizons. Trends can also be observed in AH 4 and AH Luc. These tendencies, visible in Tab. 9, show that significantly more flint was utilised than radiolarite. Chert is also present in both AHs. Nevertheless, the p-value ($X^2 = 6.6287$,

df = NA, p-value = 0.0475) also shows us a significant difference between the two horizons of the two sites.

In a second analysis, the focus lies on the total weight of the raw material groups in order to assess potential differences between AHs. The same four aspects as in the previous



Fig. 31: Radiolarites in Grub-Kranawetberg I & II; 1: GKII-H11-248, 2: GKII-H11-286, 3: GKII-I10-356, 4: GKII-H11-84, 5: GKII-I10-254, 6: GKII-H11-285, 7: GKII-H11-111, 8: GKII-H11-263, 9: GKII-I10-437, 10: GKII-H11-254, 11: GKII-I10-431, 12: GKII-I10-457, 13: GKII-I10-358, 14: GKII-I10-330, 15: GKII-H9-433, 16: GKII-G10-276, 17: GKII-G10-314, 18: GKII-G10-731 (Photos: Christoph Bieber).

analysis were examined for substantial differences. First, differences between the two main AHs of GK I were investigated. Looking at the weight distribution of the raw material groups in GK I the percentages also indicates a substantial difference between AH 3 and AH 4 (Tab. 10). Next, the variation between AH Michi and AH Luc, the two main AHs in GKII,

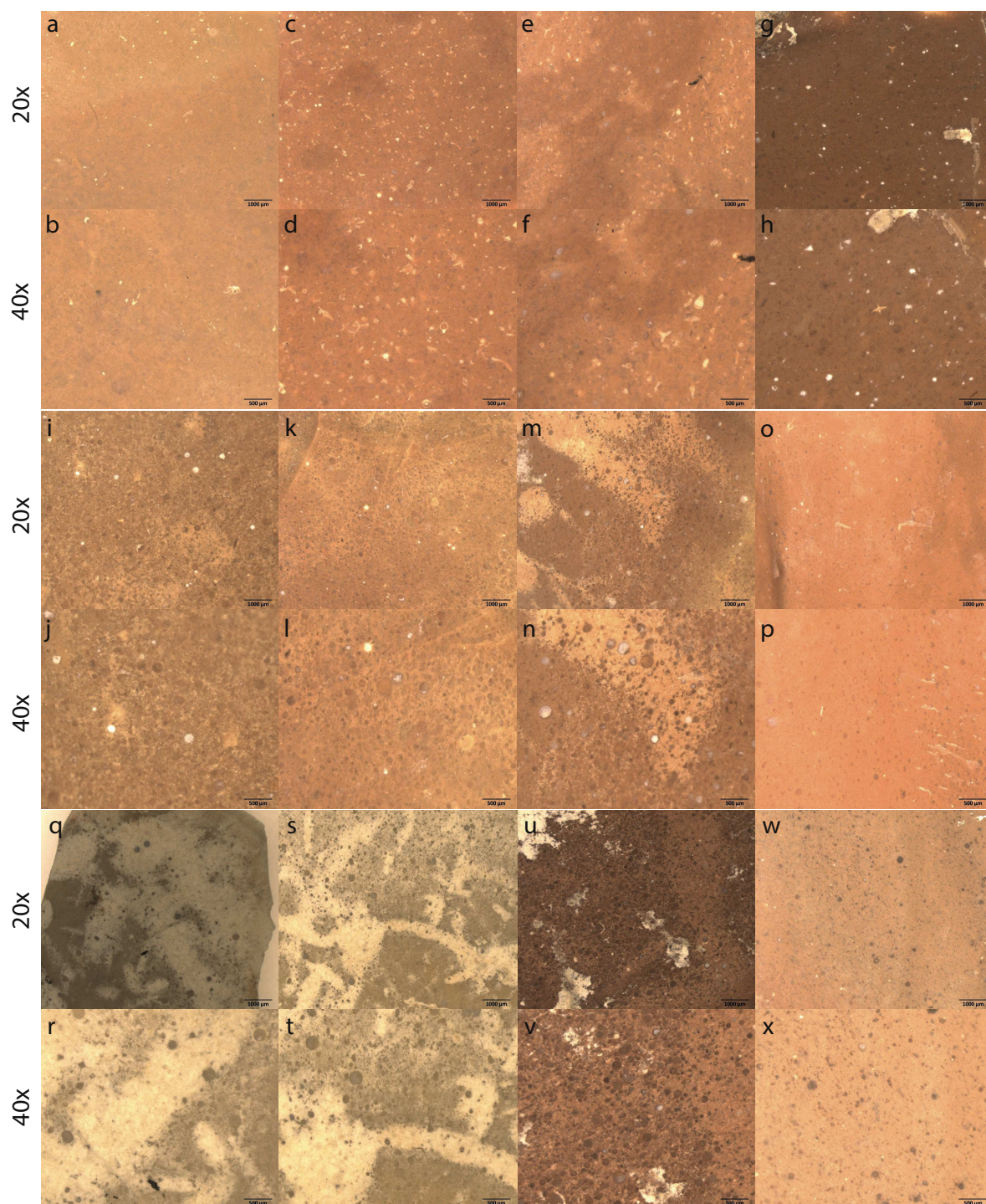


Fig. 32: Microscope photos of radiolarites from GK I: a-b: GKII-G10-276, c-d: GKII-G10-314, e-f: GKII-G10-731, g-h: GKII-H9-433, i-j: GKII-H9-400, k-l: GKII-H11-84, m-n: GKII-H11-111, o-p: GKII-H11-248, q-r: GKII-H11-254, s-t: GKII-I10-437, u-v: GKII-H11-263, w-x: GKII-H11-285 (Photos: Samuel Kasemann).

was analysed. The percentages show, as already in the previous analysis, a substantial difference in the raw material weight distribution. This confirms the long-suspected variation between AH Michi and AH Luc. Additionally, when comparing the raw material weight of both sites, a substantial difference was found. The percentages show a substantial difference between AH 3 and AH Michi. Similarly, the comparison between AH 4 and AH Luc revealed a substantial difference, indicating that the differences in raw material weights between the two horizons are statistically important. Furthermore, the analysis of the relative weight distribution confirms the previous tests.

8. Raw material procurement

8.1. Theoretical background

Raw material analysis is a helpful tool to acquire information on mobility of past human groups. The advantage of stone artefacts over organic materials is that normally their preservation is much better and, therefore, the state of preservation does not bias raw material composition. By mapping potential raw material sources and allocating the lithic artifacts to them, it is possible to gain an insight into landscape use and mobility patterns. Many scholars have studied this field, both in social anthropology and archaeology (Binford, 1980, 1982; Floss, 1994; Helbling, 1987; Higgs & Vita-Finzi, 1972; Kuhn, 1989; Montet-White & Holen, 1991; Valoch, 1986; Vita-Finzi et al., 1970; Weniger, 1990). Especially the work of Floss (1994) and Féblot-Augustins (1997) have influence the field of raw material procurement studies in Central Europe. Floss (1994) assumes that organic tools or parts of tools were more valuable than the lithic parts of them due to greater investment in production. He also suggests that these products or semi-finished products were transported in the same way as the stone artefacts and were used as objects of exchange. However, lithic material preserves better than organic material. The determination of lithic raw material sources gives us an insight on movement patterns. On account of it, we can assume that the bearer of the lithic or the person who exchanged it was once at the source. However, it tells us nothing about the type of procurement. There are different possibilities of obtaining raw material. Floss (1994) distinguishes between five different categories of behavioural patterns regarding raw material procurement.

- 1) *“Procurement and transport of raw material contingents, basic forms and tools integrated in travelling movements when changing camp location*
- 2) *Procurement of raw materials during day-to-day activities in the vicinity of a camp site*
- 3) *Expeditions carried out specifically to procure raw materials, within or beyond the usual radius of activity of a campsite.*
- 4) *Unsystematic exchange of raw materials and individual devices when different groups/individuals meet*
- 5) *Systematic trade in raw materials”*

(Floss, 1994, 321, translated by author aided by deepl.com)

Floss (1994) is convinced that the majority of lithic raw material procurement was done within the territory in which the groups moved. These acquisitions were always embedded in different activities and were carried out starting from the respective camp. He also assumes that exchange contacts and *special procurement expeditions* were rather rare and that there was no *systematic trade* in the Palaeolithic.

The basic behaviours of hunters and gatherers serve as foundation for these considerations. Most hunter-gatherers are non-sedentary, i.e., change the location of their camp several times during the year. This mobility is based on the seasons and the resources available in the vicinity of the camp. When these resources, mostly floral and faunal in nature, are almost or completely exhausted, the group moves on. In addition, the duration of settlements can also depend on the migratory movements of herd animals. As a result of these factors, the lifespan of a camp varies greatly and also the group size can differ greatly from camp site to camp site during the year. Based on modern-day seasonally migrating herd animals, it is assumed that animals, such as certain species of reindeer, migrated over several hundred kilometres in the Palaeolithic (Floss, 1994). However, further analyses are necessary in order to be able to make statements about GK I and GK II based on the faunal remains. However, even without the migratory movements of herd animals, hunter-gatherers changed the location of the camp several times a year. Floss (1994) uses the widely transported raw materials in the Neuwieder Basin (Rheinland-Pfalz, Germany) from the Upper Palaeolithic as an indication for this, as at this time there was already territorial game in the faunal remains and, therefore, human movements due to migrating animals was not necessary.

There are two different kinds of human mobility that we need to differentiate. First is the “*residential mobility*”. Here, the resources are brought to the camp. When the surroundings are exploited the whole camp, and its inhabitants move from one locality to another. Second is the “*logistical mobility*”, in which special task trips start from the main camp and possible smaller camps can be used for these trips. In contrast to *residential mobility* the resources are not brought to the camp, but the people move to the resources. The radius in which those movements happen is the so called “*foraging radius*”. The area within this radius is called “*site territory*” or “*camp range*” and they are differently sized in *residential* and *logistical mobility*. There are different types of camps in the *logistical* system. Central camps are referred to as “*residential camp*” or “*home base*”. All day-to-day

activities start from there. When a task takes more than a day and one or more nights are spent outside of the camp, “*occasional sites*” are used. The distance travelled from the *residential camp* to the *occasional camp* is referred to as “*logistical radius*”, while the area covered by it is known as the “*extended*” or “*logistical range*” or “*site catchment*”. The moving of the central camp itself is termed “*residential move*”. These *residential moves* can happen several times a year. The area covered by these residential moves is called “*annual territory*” or “*annual range*” and differs in the *residential* and *logistical mobility* systems (Binford, 1980, 1982; Floss, 1994; Habu & Fitzhugh, 2002; Higgs & Vita-Finzi, 1972; Kuhn, 1989; Vita-Finzi et al., 1970). According to ethnological sources, the distances covered by hunter-gatherers during *residential moves* can be several hundred kilometres. This applies to both tropical and subarctic hunter-gatherer groups. Floss (1994) suggests that, even if one has to be careful with the transfer of this model to the Palaeolithic, it can probably still apply to the Gravettian.

Another important aspect is the determination of the size of the *site territory*. This gives us a point of reference for distinguishing between raw materials brought in during the *residential moves*, special raw material procurement trips beyond the usual foraging radius, exchange or trade and those collected during day-to-day activities within the *foraging radius* (Floss, 1994). Ethnographic examples show us different sizes of this radius. Documented distances are 10 km (Binford, 1982; Higgs & Vita-Finzi, 1972), 12 km (Montet-White, 1991) and 20 km (Weniger, 1990). According to Helbling (1987), a *foraging radius* of 15 km is rarely surpassed by hunter-gatherers. However, hunting trips of 25 km are documented in recent hunter-gatherers (Floss, 1994; Helbling, 1987). Floss (1994) suggests setting the maximum *foraging radius* of the Gravettian to a distance of about 20 km around the camp. Using this threshold, we can assume that the raw materials collected within these 20 km were either sourced when the area was first visited or were procured with trips starting at the camp. Floss (1994) argues that the latter are more likely. He calls the raw materials that can be found within these 20 km “*local raw materials*”. Furthermore, he defines raw material found within 1 km of the camp as “*Allerweltsmaterial*”, meaning that those raw materials are available all the time (Floss, 1994, 323). However, since there is no consistent definition for *local* and *non-local* raw material distance classes, many publications use their own or adapted systems. Nigst (2012) divides the distances of possible raw material sources into four radii. He calls the first distance section “*local*” and

the second “*regional*”. Based on Floss, Nigst defines *local* raw materials as materials within a radius of 1 km. Thus, Nigst also sees *local* materials as always available and is of the opinion that these raw materials require neither transport costs nor logistical organisation. He limits *regional* materials to a distance of 20 km around the camp and also sees the procurement within this radius as embedded in day-to-day activities. The other distances are “*intermediate*” and “*exogenous*”. The first is put between 20 and 60 km while everything beyond 60 km falls into *exogenous* (Nigst, 2012). This 60 km threshold is based on the work of Baales (2002). Brandl (2023) terms *local material* where the sources of it are within a radius of 0-5 km around the camp. Here *regional material* can be found within a radius of 6-70 km. Brandl thus summarises *regional* and *intermediate* distances in his definition of *regional*. However, he defines the *exogenous* distance of Nigst into two separate classes. At a distance of 80 to 100 km, he speaks of “*inter-regional*” (“*überregional*”, translated by author, (Brandl, 2023, 50)) and anything over 200 km he describes as “*far distance*” (Brandl, 2023, 50). Similar to Brandl, Uthmeier (2004) defines *local* material as sources that are within a radius of 5 km around the camp. His border of *regional* correlates with Floss and Nigst at 20 km distance to the campsite. Everything beyond 20 km is called “*inter-regional*” (“*überregional*”, translated by author, (Uthmeier, 2004, 335)). Uthmeier uses the definitions of Geneste (1988, 449-450) (“*d’origine locale*”, “*d’origine voisine*”, “*d’origine éloignée*”). Geneste (1988) uses raw material from the site of *La Grotte Vaufray* to give examples for the source distances. *Local (locale)* raw material comes from a distance of 1 km and *neighbouring (voisine)* material from approximately 5 km. Examples for *distant (éloignée)* raw material are coming from 30 and 40 km away. Also Vukosavljević and Perhoč (2017) group raw materials based on the source distance to *Kopačina Cave* within the groups *local*, *regional* and *extra-regional*. However, here *local* means 0 to 20 km, *regional* means 20 to 50 km and *extra-regional* means more than 50 km. Moreau, et al. (2016) divide their raw materials into *local* and *non-local*. They draw the line at 10 km. For materials originating from distances of 20 km or more, Floss (1994) assumes that they were brought along on residential moves or at the first visit. Binford (1979) refers to acquisitions, for which no extra expeditions are launched, and which are integrated into everyday activities, as “*embedded procurement*” (Binford, 1979, 257). The other possibility to obtain raw materials would be “*direct procurement*” (Binford, 1979, 257) expeditions. This pattern is often generally accepted, especially for these long-transported materials.

However, Floss (1994) tends to exclude *direct procurement* of lithic raw materials and argues that these long-distance procurements are very rarely documented in ethnological records. He sees the use of *direct procurement* more in the acquisition of jewellery raw materials, delicacies or raw materials for ceremonial appliances (Floss, 1994).

Clear is that the *residential move* is based on several factors. It is possible that lithic raw material procurement is one of those factors. However, it is also plausible that the procurement of lithic raw materials plays a subordinate role in the choice of the camp location and that the acquisition of these is rather a result from mobility driven by other factors. Floss (1994) sees the limit of transported lithics at around 200 km. Anything less is considered part of the annual mobility. He uses the Nordic hunters of the Nunamiut as a comparison, as their annual mobility is around 200 km. Furthermore, ethnographic sources often report that hunter-gatherers transported lithic raw materials on their residential moves. Since the sources of these raw materials are located within the annual range of those groups, there is no reason to assume that these materials came into the camp through exchange contacts (Floss, 1994).

The situation is different with materials coming from a distance over 200 km (Fig. 33). Floss (1994) sees here the possibility of exchange contacts as part of *unsystematic exchange* between groups or individuals. An additional possibility for raw material to be brought into a site from afar is what Binford (1979, 269) calls “*curated technology*”. Here, a tool is used over a long period of time and is continuously repaired and maintained. Ethnological sources speak of periods of up to 100 years, including inheritance. Whilst this time span cannot be applied simply to the Gravettian, it does show one way in which raw material from considerable distances can end up in an assemblage (Floss, 1994). According to Bamforth (1986) and Binford (1979), assemblages produced by curated technologies tend to be “*technologically sophisticated and probably formally distinct, with individual tools used for a variety anticipation purposes*” (Bamforth, 1986, 38). The opposite of *curation* is *expediency*. Here an assemblage formed by *expediency* tend to be “*technological simpler and formally less patterned*” (Bamforth, 1986, 38) due to ad hoc production of needed tools.

8.1. Raw material transfer distances

One key factor in understanding raw material procurement strategies is the distance between archaeological sites and sources of lithic raw materials. By examining how far certain materials had to be transported, we can gain insights into mobility patterns, exchange networks, and resource management in Palaeolithic contexts. Categorizing these distances helps to reconstruct the range and complexity of human behaviour related to raw material acquisition.

To investigate raw material procurement at Grub-Kranawetberg I and II, the distance between the site and various raw material sources was considered. Each raw material group can be divided into several sub-groups, each originating from distinct geological sources. Drawing on the literature and information provided in Chapter 8.1, four distance-based categories were defined. Based on the work of Floss (1994) and Nigst (2012), the *local* category includes sources located within approximately 1 km of the site and *regional*

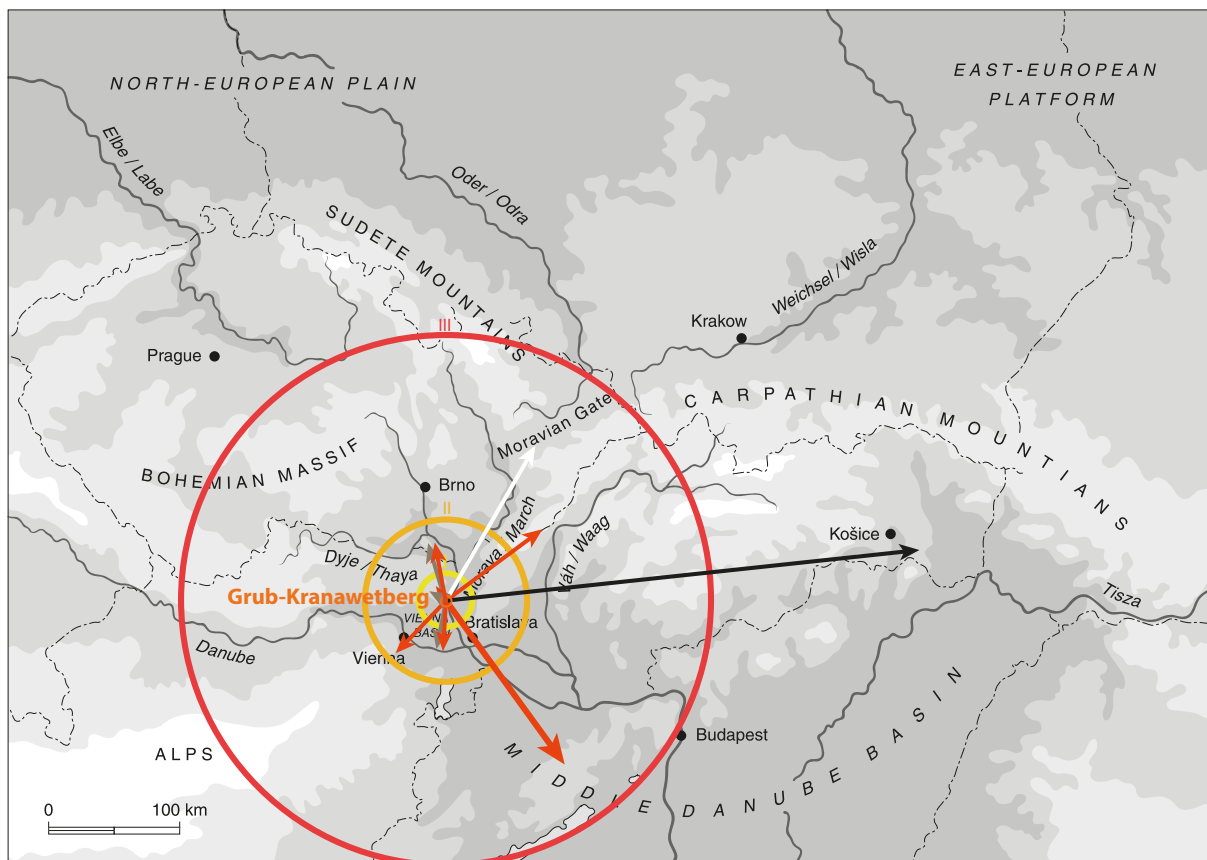


Fig. 33: Distances of raw material sources to GK I and II and distance categories used in this thesis; I= regional (20 km), II= intermediate (60 km), III= (200 km), arrows: green =chert, red = radiolarite, white = flint, black = obsidian (Verpoorte, 2001, Fig 2.1, edited by Samuel Kasemann).

		GK I (1993-2011)				GK I (2021)				GK II			
		AH 3		AH 4		AH 3		AH 4		AH Michi		AH Luc	
Distance	local	66	21.7%	192	22.9%	10	18.9%	28	29.8%	141	19.0%	4	9.1%
	regional	130	42.8%	11	1.3%	40	75.5%	3	3.2%	422	56.9%	2	4.5%
	intermediate	3	1.0%	9	1.1%	0	0.0%	0	0.0%	8	1.1%	1	2.3%
	exogenous	83	27.3%	591	70.4%	2	3.8%	60	63.8%	13	1.8%	33	75.0%
	n/a	22	7.2%	37	4.4%	1	1.9%	3	3.2%	158	21.3%	4	9.1%
	Total	304	100.0%	840	100.0%	53	100.0%	94	100.0%	742	100.0%	44	100.0%

Tab. 11: Absolute and relative frequency of raw materials by count based on the distance of the raw material sources to GK in the assemblages GK I (1993-2011), GK I (2021) and GK II; local: <1 km, regional: 1-20 km, intermediate: 20-60 km, exogenous: >60 km (Table: Samuel Kasemann).

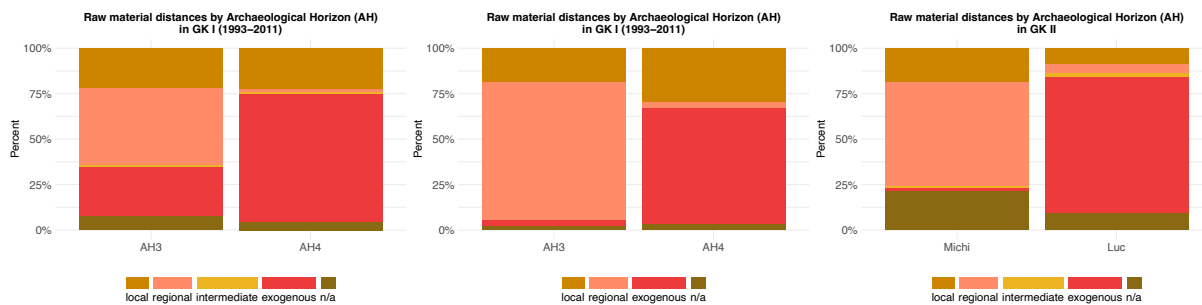


Fig. 34: Relative Frequency of raw materials by count based on the distance of the raw material sources in the assemblages GK I (1993-2011), GK I (2021) and GK II (Graphs: Samuel Kasemann).

		GK I (1993-2011)				GK I (2021)				GK II			
		AH 3		AH 4		AH 3		AH 4		AH Michi		AH Luc	
Distance	local	36.1	19.2%	238.7	47.6%	7.1	16.7%	19.7	43.5%	52.5	16.6%	2.7	4.5%
	regional	97.0	51.5%	21.5	4.3%	34.7	81.6%	2.4	5.3%	212.6	67.2%	0.2	0.3%
	intermediate	1.0	0.5%	6.1	1.2%	0.0	0.0%	0.0	0.0%	1.1	0.3%	0.2	0.3%
	exogenous	44.3	23.5%	217.0	43.2%	0.2	0.5%	20.3	44.8%	8.5	2.7%	56.9	94.2%
	n/a	10.1	5.4%	18.6	3.7%	0.5	1.2%	2.9	6.4%	41.5	13.1%	0.4	0.7%
	Total	188.5	100.0%	501.9	100.0%	42.5	100.0%	45.3	100.0%	316.2	100.0%	60.4	100.0%

Tab. 12: Absolute and relative weight distribution of raw materials based on the distance of the raw material sources to GK in the assemblages GK I (1993-2011), GK I (2021) and GK II; local: <1 km, regional: 1-20 km, intermediate: 20-60 km, exogenous: >60 km (Table: Samuel Kasemann).

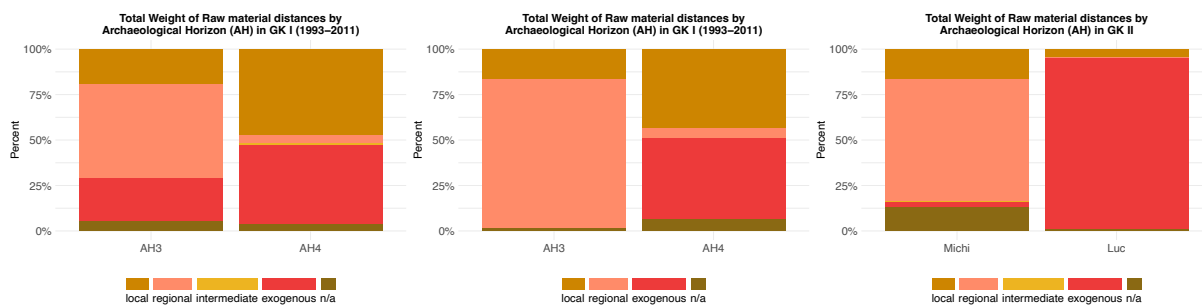


Fig. 35: Relative weight distribution of raw material based on the distance of the raw material sources to GK in the assemblages GK I (1993-2011), GK I (2021) and GK II (Graphs: Samuel Kasemann).

sources fall within a 20 km radius, while *intermediate* sources are located between 20 and 60 km away. All sources beyond 60 km are considered as *exogenous* (see Fig. 38). The only local source identified is the Morava River; its gravels contain cherts that were certainly used at both sites. Some outcrops of ancient riverine gravel banks in Lower Austria fall into the regional category, yielding both cherts and radiolarites. Within the intermediate range, at least three distinct sources have been identified: the gravels of the Danube (about 30 km away), which contain both cherts and radiolarites; the region of Southern Moravia (minimum distance 50 km away), known for its wide variety of cherts; and the St. Veit Klippen Belt, also about 50 km distant, which provides various radiolarites. Two exogenous raw material sources were certainly exploited by the inhabitants of GK I and GK II: the moraine gravels at the Moravian Gate (> 150 km), which yield flint and represent the closest flint-bearing source to the site, and the obsidian outcrops in eastern



Fig. 36: Radiolarites (RMU 1.1.7) of possible Bakony Mountains origin; 15: GKII-H9-433, 16: GKII-G10-276, 17: GKII-G10-314, 18: GKII-G10-731 (Photos: Christoph Bieber).

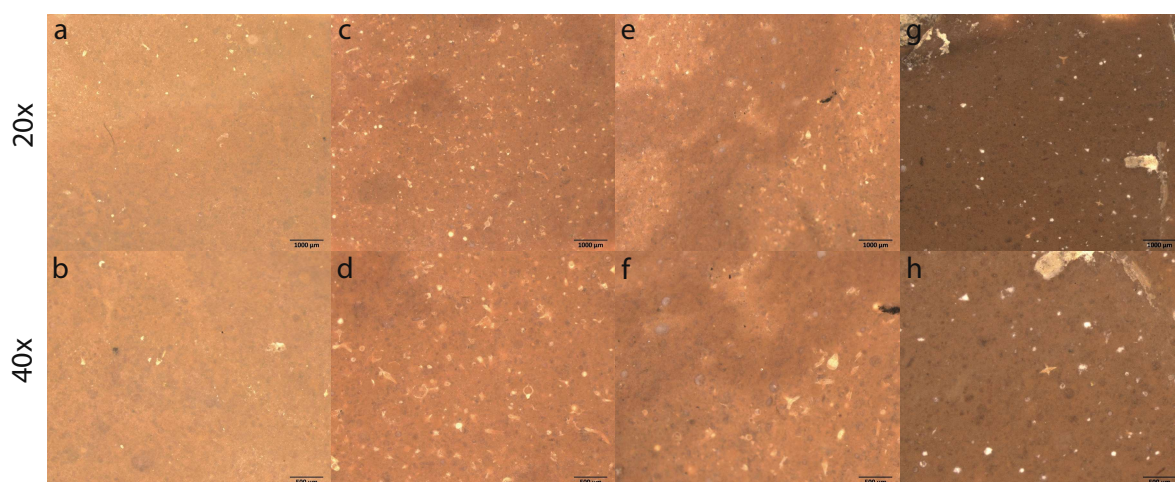


Fig. 37: Microscope photos of radiolarites (RMU 1.1.7) of possible Bakony Mountains origin; a-b: GKII-G10-276, c-d: GKII-G10-314, e-f: GKII-G10-731, g-h: GKII-H9-433 (Photos: Samuel Kasemann).

	distance	group	source	Min. distance to GK
local	~1 km	chert - group 1	Morava	~1km
regional	~20 km	chert - group 2	Old riverine gravel (Hollerbrunner Schotterkegel, etc.)	20 km
		radiolarite – group 1	Old riverine gravel (Hollerbrunner Schotterkegel, etc.)	20 km
intermediate	20-60 km	chert - group 3	Danube	30 km
		- group 4	South Moravia	50 km
		radiolarite - group 2	Danube	30 km
		- group 3	St.Veiter Klippen Belt	50 km
exogenous	>60 km	flint- group 1	Moravian gate	150 km
		radiolarite - group 4	Carpathians	130 km
		- group 5	Bakony Mountains	150 km
		obsidian - group 1	Carpathians (Eastern Slovakia, Western Ukraine, Northern Hungary)	350 km

Fig. 38: Possible raw material sources and their distances to GK (Table: Samuel Kasemann).

Slovakia (> 350 km). While chemical analysis is still needed to confirm the provenance of the obsidian found at GK I and GK II, these outcrops remain the most likely source.

Additionally, microscopic analyses suggest that some radiolarites (Fig. 36) may originate from the Carpathian radiolarite outcrops, while others could come from the Bakony Mountains in Hungary. Due to the uncertainty in source attribution, each raw material group was assigned to the most likely closest source for the purposes of the distance analysis. As a result, the values presented in Tab. 11 and Tab. 12 should be considered preliminary. Future research and more precise provenance analyses may lead to adjustments in these classifications.

8.2. Discussion

As elaborated in Chapter 8.1 there are different possibilities how certain raw materials could be brought into the site. When analysing the raw material procurement, we also must be aware of the fact that we can never say with certainty how an artefact was brought to the site. As far as we know, it could be a collection during a relocation of the camp or during a day-to-day trip. However, it could also be a combination of different systems. If we look at the assemblages of GK I and GK II with these possibilities in mind, we can make potential statements about the procurement of raw materials of the different

AHs. As mentioned in Chapter 6.6 geochemical analyses are needed to get more reliable results for assigning lithics to their source. However, some stones could be assigned to some of these raw material sources, based on comparisons. For others, the material could at least be narrowed down to possible sources, or some sources could be excluded.

Chert is present in every archaeological horizon, with its proportion varying from 9.1% to 29.8% based on artifact count (Tab. 7) and from 4.5% to 47.6% based on total weight (Tab. 8). Sources of chert are known both close to and far from the GK I and GK II sites. Such potential sources for chert are the gravels of the Morava and Danube rivers, and old riverine gravels of Lower Austria and South Moravia. Due to the proximity (Morava gravel (~1 km), Danube gravel (min. distance 30 km), old riverine gravel in northern Lower Austria (min. dist. ~20 km)) are the most probable sources for cherts.

Lithic artifacts in the GK I (2021) assemblage that are made on raw materials that were most likely collected from gravels of the Danube, or the old Danube gravels northwest of Grub are for example GK21-404 and GK21-96. Furthermore, some lithics (e.g., GK21-165) could be positively assigned to the old Danube gravels. Raw materials coming from these relatively close sources were most likely collected during residential moves or daily activities in the site catchment area. It is unlikely, that those materials were brought into the camp by some kind of exchange system. However, it is conceivable that some of the lithic material was collected opportunistically during longer expeditions on the way back.

Being in 50 to 80 km distance to Grub, raw material from South Moravia is not as accessible as the closer sources. We can assume that the raw material originating from those sources was either procured during residential moves or during day-to-day trips starting from camps in Southern Moravia. That would mean that the material was potentially picked up within the site catchment of other camps. An interesting observation is that the majority of the lithics that could be assigned to Southern Moravia is coming from AH 4. This could mean that the groups that settled in Grub-Kranawetberg I during the occupation of AH 4 either came from Southern Moravia or went by Southern Moravia and picked up lithic raw materials there when coming from the Moravian Gate (see later in this chapter).

The closest sources for radiolarites are the Danube gravels (min. distance 30 km) and the old riverine gravel in northern Lower Austria (min. distance ~20 km). Radiolarite from

Danube gravels can be found in AH 3 (e.g., GK21-340, GK21-348) and AH 4. Coming mainly from AH 3 radiolarites (e.g., GK21-165, GK21-384) from the old riverine Gravels are also present. Similar to cherts from the same sources we can assume that these radiolarites were collected while moving the camp or during logistical moves. The next possible primary outcrop for radiolarites is the St. Veit Klippen Belt (distance ~50 km). These radiolarite sources could be reached relatively easy and thus could have been visited during *residential movements*. Unfortunately, it was not possible to assign lithics to St. Veit Klippen Belt sources with certainty. In contrast to regional and some intermediate sources for radiolarite, exogenous sources were not visited during daily activities. The procurement of radiolarites from the Carpathians (distance ~130 km) and the Bakony Mountains (distance ~150 km) would have been outside of the assumed foraging radius of 20 km and even outside of the intermediate distance. This lets us suggest that they were no longer a short task but needed more planning and most likely also more energy input due to the increased transport distance. However, these sources were still within the assumed *annual range* of the hunter-gathers occupying GK I & II, making the most likely scenario that those radiolarites were brought to the site while moving the camp. This residential move could have happened from a camp location in the proximity of those sources. Thus, this procurement has probably happened with no extra expedition to the Carpathians or Bakony mountains. There are at least three lithics (GK02-7306, GK07-2115, GK21-156; Fig. 31, Fig. 36) that are potentially originating in the Bakony Mountains. All of them were found in AH 3. 51 pieces could be assigned to a potential Carpathian origin (e.g., GK21-156, GK21-419, GKII-H11-111, GKII-H9-386, GKII-F9-174, GKII-G10-298, GK02-3444, GKII-H9-433, GKII-G10-276, GKII-G10-314, GKII-G10-731; Fig. 31). The majority of potential Carpathian radiolarites are coming from AH Michi, then AH 3 and with only one piece from AH Luc. This could point towards a potential residential move by the inhabitants of AH 3 and AH Michi to or from the Carpathian Mountains or with them as an intermediate stop. The closest flint deposits in the Moravian gate area have a distance of approximately 150 km to Grub-Kranawetberg I & II – comparable to that of the radiolarite occurrences in the Carpathian and Bakony Mountains. A similar procurement pattern is the most likely scenario. The majority of lithics made out of flint were found in AH 4 (e.g., GK02-6781, GK21-267) and AH Luc (e.g., GKII-F9-556, GKII-G10-893). Especially for these AHs, we can assume that the raw material was brought along during residential moves. With

contemporaneous sites in Moravia, Lower Austria and Western Slovakia, it is imaginable that the groups that camped in GK I and GK II also settled there, having their annual range in this region. Analysing Gravettian sites from Slovakia, Kaminská (2016) paints the picture of hunter-gatherer groups moving between the Krakow region (Poland) and the Váh region (Slovakia). She assumes that those groups transport raw materials in both directions. This is visible by flints of Polish origin in Slovakian sites and radiolarite of Slovakian origin in Polish sites. Although we only have one side of such a migration route in GK I and II, we can assume that a similar scenario could have played out here.

With the closest source of obsidian about 350 km away from GK I & II the procurement is linked to quite some effort. This source fits the *far distance* category and outside of the usually estimated *annual range*. It is debatable whether the procurement of obsidian over this distance was still carried out by the same group or whether it was procured through certain exchange mechanisms with other groups. Féblot-Augustins (2008) proposes that items further away than 300 km (long distance) are most probably a result of a *down-the-line* trade. Furthermore, she writes that these materials are only present in very small quantities of end-products. Even though the obsidian pieces in GK I and II are no end-products it is possible that this reasoning can also apply here and that those pieces are a result of unsystematic exchange.

Looking at the distances of the raw material sources to GK I and II there are some clear patterns visible. By grouping the total count of the lithics within the raw material groups it is visible that in GK I, AH 3 relies predominantly on *local* and *regional* sources, while AH 4 includes a greater share of *exogenous* materials, suggesting a shift in mobility. The presence of more exogenous materials indicates a more far-reaching procurement in the older AH 4. At GK II, AH Michi is largely composed of locally and regionally sourced materials, reflecting a more localized approach. In contrast, AH Luc displays a more diverse composition that includes *exogenous* materials which also suggests a more far-reaching procurement.

However, when looking at the weight distribution of the raw material groups it shows a potentially different picture. While the younger AHs (AH 3, AH Michi) show a similar pattern to the count, the older AHs (AH 4, AH Luc) show a more differentiated picture. While exogenous materials dominate in terms of artifact count, the distribution of weight in GK I shifts towards a more balanced ratio between exogenous and local raw materials. In

contrast to AH 4, the weight distribution of AH Luc in GK II reveals an even stronger dominance of exogenous materials.

This pattern is further shown in the statistical analysis. The Qui-square tests presented in Chapter 7.1, based on artifact counts show a highly significant difference between AH 3 and 4 in GK I (p-value = $9.999\text{e-}05$). This result is echoed in the weight-based analysis (p-value = $9.999\text{e-}05$), confirming significant differences in raw material use between the two occupation phases. The comparison between AH Michi and AH Luc in GK II also revealed significant differences in both artifact counts (p-value = $9.999\text{e-}05$) and raw material weight (p-value = $9.999\text{e-}05$), further supporting the hypothesis that these two horizons represent distinct occupational phases. Furthermore, this change in raw material use between the older and the younger AHs also indicate a change in the mobility patterns. The lower quantity of exogenous material within AH 3 and AH Michi could suggest a lower mobility and also a potentially smaller annual range of those groups in contrast to the groups of AH 4 and AH Luc.

During the excavations of GK II, it seemed that certain AHs, based on lithic raw materials are correlating to certain AHs in GK I. For example, both AH 3 and AH Michi show comparable proportions of chert and a similar trend in the use of radiolarites. However, statistical testing again revealed significant differences: the count-based analysis (p-value = $9.999\text{e-}05$) and the weight-based comparison (p-value = 0.0164) both show that, despite apparent trends, the differences are statistically significant. The final comparison, between AH 4 and AH Luc, also revealed similar tendencies in material composition—both horizons show a dominance of flint over radiolarite and the presence of chert. Yet here too, the differences were significant: in terms of artifact counts (p-value = 0.0475) and weight distribution (p-value = 0.0109).

To sum thing up, there might be a movement of the occupants of AH 3 and AH Michi from the Carpathians to Grub-Kranawetberg visible, while the data of AH 4 and AH Luc points more to a movement from the Moravian Gate to Southern Moravia and then to Grub-Kranawetberg. Here we grasp a possible change in the orientation and routes of residential moves. We also see a change in the procurement distance from a long-distance procurement in the older AHs, AH 4 and AH Luc, to a middle-distance procurement in the younger AHs, AH 3 and AH Michi. While the importance of local material stays constant in GK I,

the importance of local raw materials seems to grow between AH Michi and AH Luc in GK II.

Another pattern that is visible is the change of tools and the raw materials they are made of. All Gravette/Microgravette points originate from the older AHs, AH 4 and AH Luc, and were made of flint. The production of this tool type seems to stop between AH 4/ AH Luc and AH 3/ AH Michi. Instead, there is the continuation of backed bladelets from the older AHs to the younger AHs. This pattern is also shown in other assemblages (e.g., Peyrugues, France) and could speak for the hypothesis of two separate phases in the later Gravettian – one with Gravette/Microgravette points and another with no Gravette/Microgravette points but backed bladelets (Klaric et al., 2009). Interestingly, this seems to go hand in hand with the tendency of the use of flint in AH 4/ AH Luc and the use of radiolarite in AH 3/ AH Michi. Furthermore, in GK I and II there is a clear preference for the use of specific raw materials for Gravette/Microgravette points and backed bladelets visible. While in AH 4/ AH Luc flint is mainly used to produce those two tools, radiolarite is the preferred raw material for backed bladelets in AH 3/ AH Michi.

The low number of pieces with natural surfaces suggests that decortification was, with only a few exceptions, not done at the sites GK I or GK II, or at least not in the excavated and analysed areas. This indicates that much of the raw material was already partially or fully decorticated before being brought to the site. This is true for raw material from local, regional, intermediate and exogenous sources. It is likely that the initial stages of raw material preparation took place elsewhere, and only pre-selected or pre-processed pieces were transported to the settlement areas for further use. As elaborated in Chapter 6.5 and as can be seen in Tab. 5 and Tab. 6 chert has the biggest percentage of present natural surfaces of all raw materials. Since chert is the only raw material unit that is locally available in the Morava River, it seems plausible that the most near raw material has the highest percentage of remaining natural surfaces. Interestingly to note is that in AH Luc of GK II flint is the only raw material of this AH that has remains of natural surfaces. However, since there are only 6 pieces of non-flint artifacts (Tab. 6), this observation needs to be taken carefully.

The low number of cores suggests that almost no blank production took place in GK or that they were further transported to another location. The two analysed cores are radiolarites. This means that tools made from other raw material groups (chert and flint) were

probably not manufactured here. A huge amount of chips made of chert, radiolarite and flint shows that finished or semi-finished tools were retouched and resharpened and that there were potential core preparation happening locally.

9. Summary

This thesis focuses on the analysis of the lithic materials from the two Gravettian sites Grub-Kranawetberg I and II, located near Stillfried in Lower Austria. The region around Stillfried is an archaeologically rich landscape, with evidence of human occupation spanning more than 30,000 years, from the Upper Palaeolithic through the Bronze Age to the Middle Ages. The site of Grub-Kranawetberg was discovered in 1993 and has since been excavated in several campaigns between 1993 and 2011, and again in 2021 ongoing. Since the excavations in 2022 GK is divided into two excavation areas. The area that was excavated between 1993 and 2011 and again in 2021 is referred to as Grub-Kranawetberg I and the area where excavation started in 2022 is called Grub-Kranawetberg II.

Grub-Kranawetberg stands out as a larger Gravettian base camp, featuring combustion features, possible dwelling structures, and indications of waste management strategies. Radiocarbon dates based on charcoal samples place Grub-Kranawetberg I between 25,640 and 24,620 uncal. BP, making it contemporaneous or partly contemporaneous with other key Central European Gravettian sites such as Willendorf II (Layer 8 and 9) in the Wachau valley, Dolní Věstonice II (Hearth close to triple burial; hearth D close to male burial; male burial) and Pavlov I (cultural layer) in southern Moravia, and Trenčianske Bohuslavice in western Slovakia. With slightly older (e.g. Krems-Wachtberg, Krems-Hundsteig, Willendorf II: layers below Layer 8 & 9, Langenlois) and younger (e.g. Lubná, Willendorf II: layers above Layer 8 & 9) Gravettian sites in the Central Europe, the central positions of Grub-Kranawetberg in the middle of those sites makes Grub-Kranawetberg a crucial link within the broader Gravettian network of Central Europe.

The lithic assemblages from GK I & II reveal the presence of six raw material types: chert, radiolarite, flint, obsidian, quartz, and quartzite. However, obsidian, quartz, and quartzite occur only in small numbers. The primary materials – chert, radiolarite, and flint – vary in distribution between archaeological horizons. Statistical analyses of artifact count, and raw material weights confirm significant differences between the major AHs at both sites. The older AHs, AH 4 and AH Luc, contain higher proportions of flint, while the younger AHs, AH 3 and AH Michi, show increased use of radiolarite. Chert appears consistently throughout all phases. Although, the corresponding AHs of both sites share a common tendency, the differences are significant.

The sourcing of raw materials suggests a change in procurement strategies over time. The older AHs relied more on distant sources – possibly reflecting long-distance movement – while the younger AHs drew more from middle-distance sources, indicating a shift in mobility patterns. This also reflects a directional change in raw material acquisition, from an earlier route starting at the Moravian Gate passing South Moravia to GK I & II to a later connection with the Carpathian Mountains.

In addition to raw material differences, the tool types also vary between the older and younger AHs. Gravette/Microgravette points are present only in the older AHs, while backed bladelets dominate the younger assemblages. Notably, the Gravette/Microgravette points and backed bladelets in AH 4 and AH Luc are made exclusively of flint, whereas in AH 3 and AH Michi, backed bladelets are made from a broader range of materials including chert and radiolarite.

Another important observation is the low number of cortical pieces across all AHs, suggesting that the initial decortification and potentially early reduction stages took place elsewhere, outside the excavated areas of both Grub-Kranawetberg I & II.

In conclusion, this thesis identifies and discusses differences in lithic raw material economy between AH 3 and AH 4 at Grub-Kranawetberg I and between AH Michi and AH Luc at Grub-Kranawetberg II. While certain similarities exist across the sites and horizons, these are more reflective of general tendencies rather than actual equivalence – statistical analyses consistently show significant differences in raw material use and tool production.

10. Bibliography

- Anghelinu, M., Händel, M., Niță, L., Cordoș, C., Veres, D., Hambach, U., Murătoareanu, G., Ciornei, A., Schmidt, C., Sava, T., Mănăilescu, C., Ilie, M., Demay, L., & Georgescu, V. (2021). From Gravettian to Epigravettian in the Eastern Carpathians: Insights from the Bistricioara-Lutărie III archaeological site. *Quaternary International*, 587–588, 210–229. <https://doi.org/10.1016/j.quaint.2020.06.044>
- Antl, W. (1997). KG Grub an der March, MG Angern an der March, VB Gänserndorf. *Fundberichte Aus Österreich*, 35 (1996), 391.
- Antl, W. (1998). KG Grub an der March, MG Angern an der March, VB Gänserndorf. *Fundberichte Aus Österreich*, 36 (1997), 725–726.
- Antl, W. (1999). KG Grub an der March, MG Angern an der March, VB Gänserndorf. *Fundberichte Aus Österreich*, 37 (1998), 675–676.
- Antl, W. (2001). KG Grub an der March, MG Angern an der March, VB Gänserndorf. *Fundberichte Aus Österreich*, 39 (1999-2000), 675–676.
- Antl, W. (2006). KG Grub an der March, MG Angern an der March, VB Gänserndorf. *Fundberichte Aus Österreich*, 44 (2004-2005), 449–450.
- Antl, W. (2007). *Stillfried- Zentrum der Urzeit* (2.). Museumsverein Stillfried-Grub.
- Antl, W. (2008). KG Grub an der March, MG Angern an der March, VB Gänserndorf. *Fundberichte Aus Österreich*, 46 (2007), 609.
- Antl, W. (2011). KG Grub an der March, MG Angern an der March, VB Gänserndorf. *Fundberichte Aus Österreich*, 49 (2010), 278–280.
- Antl, W. (2012). KG Grub an der March, MG Angern an der March, VB Gänserndorf. *Fundberichte Aus Österreich*, 50 (2011), 250–251.
- Antl, W. (2013). The inventory of archaeological horizon 4 and 3 and the loess section of Grub/Kranawetberg, a Gravettian camp site in Lower Austria. *E&G Quaternary Science Journal*, 62(2), 120–126. <https://doi.org/10.3285/eg.62.2.03>
- Antl, W., & Fladerer, F. (2002). KG Grub an der March, MG Angern an der March, VB Gänserndorf. *Fundberichte Aus Österreich*, 40 (2001), 549–550.
- Antl, W., & Fladerer, F. (2004a). KG Grub an der March, MG Angern an der March, VB Gänserndorf. *Fundberichte Aus Österreich*, 42 (2003), 587–588.
- Antl, W., & Fladerer, F. (2004b). Outlook to the East: The 25 ky BP Gravettian Grub/Kranawetberg Campsite (Lower Austria). In P. Šída (Ed.), *The Gravettian along the Danube, Proceedings of the Mikulov Conference, 20-21 November, 2002* (pp. 116–130). Academy of sciences of the Czech republic, Institute of archaeology.

- Antl-Weiser, W. (1994). KG Grub an der March, MG Angern an der March, VB Gänserndorf. *Fundberichte Aus Österreich*, 32 (1993), 634–644.
- Antl-Weiser, W. (1995a). Die Paläolithstation am Kranawetberg in Grub bei Stillfried, Niederösterreich (Vorbericht). *Fundberichte Aus Österreich*, 33 (1994), 25–30.
- Antl-Weiser, W. (1995b). *Spuren der Vergangenheit. Stillfried-Grub, Wie es war—Was es ist. Teil 1: Von den Anfängen bis 1848*. Museumsverein Stillfried.
- Antl-Weiser, W. (1995c). *Stillfried—Zentrum der Urzeit*. Museumsverein Stillfried.
- Antl-Weiser, W. (1996). KG Grub an der March, MG Angern an der March, VB Gänserndorf. *Fundberichte Aus Österreich*, 34 (1995), 595.
- Antl-Weiser, W. (1999). Paläolithischer Schmuck von der Gravettienfundstelle Grub/Kranawetberg bei Stillfried, Niederösterreich. *Ann. Naturhist. Mus. Wien*, 101 A, 23–41.
- Antl-Weiser, W. (2008). Grub/Kranawetberg and Ollersdorf/Heidenberg (Lower Austria) – two Gravettian camp Sites in Eastern Austria. *Venus08 - Art and Lifestyle, Symposium Vienna 10-14 November 2008, Wiss. Mitt. Niederösterreich. Landesmuseum* 19, 59–78.
- Antl-Weiser, W. (2013). Palaeolithic sites in the area of Stillfried/Lower Austria. In 55. *Jahrestagung in Wien. Hugo Obermaier-Gesellschaft für Erforschung des Eiszeitalters und der Steinzeit* (pp. 102–116). Hugo Obermaier-Gesellschaft für Erforschung des Eiszeitalters und der Steinzeit.
- Antl-Weiser, W. (2017). NHM Forschung: Grub-Kranawetberg—Ein Lagerplatz aus der Zeit der Venus von Willendorf. In Grömer K. und Kern A. (eds.). *Fundstücke. Kostbarkeiten der Jahrtausende. Ein Führer durch die Prähistorische Schausammlung. Naturhistorisches Museum Wien* (pp. 89–97).
- Antl-Weiser, W. (2019). Schmuck der Horizonte 3 und 4 von Grub/Kranawetberg bei Stillfried, Niederösterreich, im Vergleich zu den übrigen Paläolithfundstellen in Ostösterreich. In M. Baales & C. Pasda (Eds.), *‘All der holden Hügel ist keiner mir fremd ...’: Festschrift zum 65. Geburtstag von Claus-Joachim Kind* (Vol. 327, pp. 241–254). Verlag Dr. Rudolf Habelt GmbH.
- Antl-Weiser, W., & Bosch, M. D. (2015). The use of ivory at the Gravettian site Grub/Kranawetberg, Lower Austria. *Anthropologie*, LIII/1-2, 233–244.
- Antl-Weiser, W., Bosch, M. D., & Nigst, P. R. (2019). Bericht zur Grabung Ollersdorf-Heidenberg 2017. *Fundberichte Aus Österreich*, 56, D2370–D2402.
- Antl-Weiser, W., Bosch, M. D., & Nigst, P. R. (2021c). Bericht zur Prospektion (Survey/Oberflächenbegehung) Grub-Kranawetberg 2021. *Fundberichte Aus Österreich*.
- Antl-Weiser, W., Bosch, M. D., Pirson, S., & Nigst, P. R. (2021a). Bericht zur Ausgrabung

- Grub-Kranawetberg 2021. *Fundberichte Aus Österreich*.
- Antl-Weiser, W., Bosch, M. D., Pirson, S., & Nigst, P. R. (2021b). KG Grub an der March, MG Angern an der March Mnr. 06008.21.02 | Gst. Nr. 132 | Paläolithikum, Fundstelle. *Fundberichte Aus Österreich*, 60, 246.
- Antl-Weiser, W., Fladerer, F. A., Nigst, P. R., & Verpoorte, A. (2010). Grub/Kranawetberg (Lower Austria) – Insights into a Gravettian micro-region in Eastern Austria. In C. Neugebauer-Maresch & L. R. Owen (Eds.), *New aspects of the Central and Eastern European Upper palaeolithic – methods, chronology, technology and subsistence*. MPK 72, 2010 (pp. 231–244). Verlag der Österreichischen Akademie Wissenschaften.
- Antl-Weiser, W., Fladerer, F., Peticzka, R., Stadler, F. C., & Verginis, S. (1997). Ein Lagerplatz eiszeitlicher Jäger in Grub bei Stillfried. *Archäologie Österreichs*, 8(1), 4–20.
- Baales, M. (2002). *Der Spätpaläolithische Fundplatz Kettig: Untersuchungen zur Siedlungsarchäologie der Federmesser-Gruppen am Mittelrhein*. R. Habelt.
- Bamforth, D. B. (1986). Technological Efficiency and Tool Curation. *American Antiquity*, 51(1), 38–50. <https://doi.org/10.2307/280392>
- Binford, L. R. (1979). Organization and Formation Processes: Looking at Curated Technologies. *Journal of Anthropological Research*, 35(3), 255–273.
- Binford, L. R. (1980). Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity*, 45(1), 4–20. <https://doi.org/10.2307/279653>
- Binford, L. R. (1982). The archaeology of place. *Journal of Anthropological Archaeology*, 1(1), 5–31. [https://doi.org/10.1016/0278-4165\(82\)90006-X](https://doi.org/10.1016/0278-4165(82)90006-X)
- Biró, Katalin. T., & Regenye, J. (2003). Exploitation regions and workshop complexes in the Bakony mountains, Hungary. In T. Stöllner, G. Körlin, G. Steffens, & J. Cierny (Eds.), *Man and Mining—Mensch und Bergbau, Studies in honour of Gerd Weisgerber on occasion of his 65th birthday*. (pp. 55–63).
- Bosch, M. D. (2009). *Age-at-death profiles of mammoth molars in the mid-Upper Palaeolithic in the Middle Danube region*. [Master]. University of Lieden.
- Bosch, M. D., Nigst, P. R., Fladerer, F. A., & Antl-Weiser, W. (2012). Humans, bones and fire: Zooarchaeological, taphonomic, and spatial analyses of a Gravettian mammoth bone accumulation at Grub-Kranawetberg (Austria). *Quaternary International*, 252, 109–121. <https://doi.org/10.1016/j.quaint.2011.08.019>
- Bosch, M. D., Pirson, S., Verdianu, D., Kasemann, S., Viola, B. T., & Nigst, P. R. (in press). Bericht zur Ausgrabung Grub-Kranawetberg 2023. *Fundberichte Aus Österreich*.

- Bosch, M. D., Pirson, S., Viola, B. T., Verdianu, D., & Nigst, P. R. (2025a). Bericht zur Ausgrabung Grub-Kranawetberg 2022. *Fundberichte Aus Österreich*, 61, D2742–D2759.
- Bosch, M. D., Pirson, S., Viola, B. T., Verdianu, D., & Nigst, P. R. (2025b). KG Grub an der March, MG Angern an der March Mnr. 06008.22.02 | Gst. Nr. 130, 131/4 | Paläolithikum, Fund- stelle. *Fundberichte Aus Österreich*, 61, 236.
- Bosch, M. D., Viola, B. T., Verdianu, D., & Nigst, P. R. (2025c). Bericht zur Bohrprospektion Grub-Kranawetberg 2022. *Fundberichte Aus Österreich*, 61, D2718–D2741.
- Brandl, M. (2010). Classification of rocks within the chert group: Austrian practice. *Archeometria Muhely*, 3, 183–190.
- Brandl, M. (2014). Genesis, Provenance and Classification of Rocks within the Chert Group in Central Europe. *Archaeologia Austriaca*, 1, 33–58. <https://doi.org/10.1553/archaeologia97-98s33>
- Brandl, M. (2016). The multi layered chert sourcing approach (mla) analytical provenance studies of silicite raw materials. *Archeometria Muhely*, 13, 145–156.
- Brandl, M. (2023). Rohmaterialanalysen. In B. Horejs (Ed.), *Das Jungpaläolithikum von Krems-Wachtberg: Die Steinartefakte der Ausgrabungen 2005–2015* (pp. 41–62). Verlag der Österreichischen Akademie der Wissenschaften.
- Brandl, M., Hauzenberger, C., Martinez, M., Filzmoser, P., & Werra, D. (2016). The Application of the Multi-Layered Chert Sourcing Approach (MLA) for the Characterisation and Differentiation of ‘Chocolate Silicites’ from the Holy Cross Mountains, South-Central Poland. *Archaeologia Austriaca*, 1, 119–150. <https://doi.org/10.1553/archaeologia100s119>
- Brandl, M., Hauzenberger, C., Postl, W., Martinez, M. M., Filzmoser, P., & Trnka, G. (2014). Radiolarite studies at Krems-Wachtberg (Lower Austria): Northern Alpine versus Carpathian lithic resources. *Quaternary International*, 351, 146–162. <https://doi.org/10.1016/j.quaint.2013.01.031>
- Brandl, M., Martinez, M. M., Hauzenberger, C., Filzmoser, P., Nymoen, P., & Mehler, N. (2018). A multi-technique analytical approach to sourcing Scandinavian flint: Provenance of ballast flint from the shipwreck “Leirvigen 1”, Norway. *PLOS ONE*, 13(8), e0200647. <https://doi.org/10.1371/journal.pone.0200647>
- Brandl, M., Moreau, L., Schmitsberger, O., & Neugebauer-Maresch, C. (2015). The Southern Moravian Cherts at the Aurignacian Site of Stratzing-Galgenberg, Austria. *Anthropologie*, LIII/1-2, 181–202.
- Brandl, M., & Trnka, G. (2014). The eastern fringe: Lithic raw materials from the easternmost

- Alps in Austria. In D. Piotrowska, W. Piotrowski, K. Kaptur, & A. Jedynek (Eds.), *Górnictwo z epoki kamienia: Krzemionki – Polska – Europa: W 90. Rocznicę odkrycia kopalni w Krzemionkach / Stone Age Mining: Krzemionki – Poland – Europe. On the 90. Anniversary of Krzemionki Mine Discovery*. Muzeum Historyczno-Archeologiczne w Ostrowcu Świętokrzyskim – *Historical and Archaeological Museum in Ostrowiec Świętokrzyski* (pp. 335–359). Ostrowiec Świętokrzysk.
- Brandtner, F. (1951). Über die relative Chronologie des Jüngeren Pleistozäns Niederösterreichs. *Archaeologia Austriaca*, 5, 101–113.
- Brandtner, F. (1956). Lößstratigraphie und paläolithische Kulturabfolge in Niederösterreich und in den angrenzenden Gebieten. *Eiszeitalter Und Gegenwart*, 7, 127–175.
- Chang, W. (2018). *Gcookbook: Data for 'R Graphics Cookbook'. R package version 2.0* [Computer software]. <https://CRAN.R-project.org/package=gcookbook>
- Damblon, F., Haesaerts, P., & van der Plicht, J. (1996). New Datings and Considerations on the Chronology of Upper Palaeolithic Sites in the Great Eurasiatic Plain. *Prehistoire Européenne*, 8, 177–231.
- Davies, W., & Hedges, R. (2005). Dating the middle-to-upper Palaeolithic Transition: A new Chronometric Framework. In K. L'ubomíra, J. K. Kozłowski, & J. A. Svoboda (Eds.), *Pleistocene environments and archaeology of the Dzeravá skala Cave, Lesser Carpathians, Slovakia* (pp. 59–66). Polska Akademia Umiejętności.
- Debénath, A., & Dibble, H. L. (1994). *Handbook of Paleolithic Typology: Lower and Middle Paleolithic of Europe*. University of Pennsylvania Museum of Archaeology and Anthropology. <https://doi.org/10.2307/j.ctt14btgq9>
- Delage, C. (2003). *Siliceous rocks and prehistory: Bibliography on geo-archaeological approaches to chert sourcing and prehistoric exploitation*. Hedges [u.a.].
- Demars, P.-Y., & Laurent, P. (1992). *Types d'outils lithiques: Du paléolithique supérieur en Europe*. Presses du CNRS.
- Dibble, H. L. (1995). Biache Saint-Vaast, Level IIA: A Comparison of Analytical Approaches. In H. L. Dibble & O. Bar-Yosef (Eds.), *The Definition and Interpretation of Levallois Variability* (Vol. 23, pp. 93–116).
- Einwögerer, T. (2019). *Die jungpaläolithischen Stationen in der Ziegelei Kargl in Langenlois, Niederösterreich* (Vol. 88). VÖAW.
- Einwögerer, T., Friesinger, H., Händel, M., Neugebauer-Maresch, C., Simon, U., & Teschler-Nicola, M. (2006). Upper Palaeolithic infant burials. *Nature*, 444(7117), 285–285. <https://doi.org/10.1038/444285a>

- Einwögerer, T., Händel, M., Neugebauer-Maresch, C., Simon, U., Steier, P., Teschler-Nicola, M., & Wild, E. M. (2009). ^{14}C Dating of the Upper Paleolithic Site at Krems-Wachtberg, Austria. *Radiocarbon*, 51(2), 847–855. <https://doi.org/10.1017/S0033822200056150>
- Elekes, Z., Biró, K. T., Uzonyi, I., Rajta, I., & Kiss, Á. Z. (2000). Geochemical analysis of radiolarite samples from the Carpathian basin. *Nuclear Instruments and Methods in Physics Research B*, 170, 501–514.
- Faragó, N., Péter, R. K. P., Viktorik, O., Máté, L., & Mester, Z. (2022). Prehistoric Stone Raw Materials from the Bükk Mountains in Northeastern Hungary. *Archaeologia Polona*, 60, 187–229. <https://doi.org/10.23858/APa60.2022.3084>
- Féblot-Augustins, J. (Ed.). (1997). *La circulation des matières premières lithiques au Paléolithique* (Vol. 75). Université de Liège.
- Féblot-Augustins, J. (2008). EUROPE | Paleolithic Raw Material Provenance Studies. In *Encyclopedia of Archaeology* (pp. 1187–1198). Elsevier Inc.
- Féblot-Augustins, J. (2009). Revisiting European Upper Paleolithic Raw Material Transfers: The Demise of the Cultural Ecological Paradigm? In B. Adams & B. S. Blades (Eds.), *Lithic materials and paleolithic societies* (pp. 25–46). Wiley-Blackwell.
- Felgenhauer, F. (1951). Aggsbach: Ein Fundplatz des späten Paläolithikums in Niederösterreich. *Mitteilungen Der Prähistorischen Kommission Der Österreichischen Akademie Der Wissenschaften*, 5, 161–266.
- Felgenhauer, F. (1957). *Willendorf in der Wachau: Monographie der Fundstellen I - VII*.
- Felgenhauer, F. (Ed.). (1978). *Forschungen in Stillfried, Band 3, 1978* (Vol. 10). Österreichische Arbeitsgemeinschaft für Ur- und Frühgeschichte.
- Fink, J. (1956). Zur Korrelation der Terrassen und Löss in Österreich. *Eiszeitalter Und Gegenwart*, 7, 49–77.
- Fink, J. (1961). Die Gliederung des Jungpleistozäns in Oesterreich. *Mitteilungen Der Geologischen Gesellschaft in Wien*, 54, 1–25.
- Floss, H. (1994). *Rohmaterialversorgung im Paläolithikum des Mittelrheingebietes*. R. Habelt.
- Floss, H. (Ed.). (2012). *Steinartefakte vom Altpaläolithikum bis in die Neuzeit*. Kerns.
- Frank, C., & Rabeder, G. (1999). Eiszeitliche Klimageschichte des Waldviertels. In *Erdgeschichten des Waldviertels* (2nd ed.).
- Gauthier, G., Burke, A. L., & Leclerc, M. (2012). Assessing XRF for the geochemical characterization of radiolarian chert artifacts from northeastern North America. *Journal of Archaeological Science*, 39(7), 2436–2451. <https://doi.org/10.1016/j.jas.2012.02.019>
- Geneste, J.-M. (1988). Systèmes d’approvisionnement en matières premières au Paléolithique

- moyen et au Paléolithique supérieur en Aquitaine. In J. K. Kozłowski (Ed.), *La Mutation. Actes du Colloque International de Liège 1986, 4-7 Decembre: L'homme de Neanderthal* 8 (Vol. 35, pp. 61–70).
- Graf Wurmbrand, G., & Much, M. (1888). Diluvial-, Stein-, Bronze- und Eisenzeit. In *Die österreichisch-ungarische Monarchie in Word und Bild, 2. Abtheilung: Niederösterreich* (pp. 123–134). Kaiserlich-Königliche Hof- und Staatsdruckerei.
- Habu, J., & Fitzhugh, B. (2002). Introduction: Beyond Foraging and Collecting: Evolutionary Change in Hunter-Gatherer Settlement Systems. In B. Fitzhugh & J. Habu (Eds.), *Beyond Foraging and Collecting* (pp. 1–11). Springer US. https://doi.org/10.1007/978-1-4615-0543-3_1
- Haesaerts, P., Damblon, F., Bachner, M., & Trnka, G. (1996). Revised stratigraphy and chronology of the Willendorf II sequence, Lower Austria. *Archaeologia Austriaca*, 80, 25–42.
- Hahn, J. (1977). *Aurignacien: Das ältere Jungpaläolithikum in Mittel- und Osteuropa*. Böhlau Verlag.
- Hahn, J. (1988). *Die Geißenklösterle-Höhle im Aichtal bei Blaubeuren I: Fundhorizontbildung und Besiedlung im Mittelpaläolithikum und im Aurignacien* (Vol. 26).
- Hahn, J. (1991). *Erkennen und Bestimmen von Stein- und Knochenartefakten: Einführung in die Artefaktmorphologie* (Vol. 10). Verlag Archaeologica Venatoria : Institut für Urgeschichte der Universität Tübingen.
- Hahn, J. (1993). *Erkennen und Bestimmen von Stein- und Knochenartefakten: Einführung in die Artefaktmorphologie* (2. Aufl.). Verl. Archaeologica Venatoria [u.a.].
- Händel, M. (2017). The stratigraphy of the Gravettian sites at Krems. *Quartär – Internationales Jahrbuch Zur Erforschung Des Eiszeitalters Und Der Steinzeit*, 64, 129-155 Seiten. https://doi.org/10.7485/QU64_6
- Helbling, J. (1987). *Theorie der Wildbeutergesellschaft: Eine ethnozoologische Studie*. Campus Verl.
- Higgs, E. S., & Vita-Finzi, C. (1972). Prehistoric economies: A territorial approach. In E. S. Higgs (Ed.), *Papers in economic prehistory: Studies by members and associates of the British academy major research project in the early history of agriculture* (pp. 27–36). Cambridge University Press.
- Hughes, R. E., Högberg, A., & Olausson, D. (2012). The Chemical Composition of some Archaeologically Significant Flint from Denmark and Sweden. *Archaeometry*, 54(5), 779–795. <https://doi.org/10.1111/j.1475-4754.2011.00655.x>

- Hughes, R. E., Werra, D. H., & Sulgostowska, Z. (2018). On the sources and uses of obsidian during the Paleolithic and Mesolithic in Poland. *Quaternary International*, 468, 84–100. <https://doi.org/10.1016/j.quaint.2017.11.013>
- Inizan, M.-L., Reduron-Ballinger, M., Roche, H., & Tixier, J. (with Cercle de recherches et d'études préhistoriques). (1999). *Technology and terminology of knapped stone: Followed by a multilingual vocabulary Arabic, English, French, German, Greek, Italian, Portuguese, Spanish* (J. Féblot-Augustins, Trans.). CREP.
- Kaminská, L. (2016). Gravettian and Epigravettian lithics in Slovakia. *Quaternary International*, 406, 144–165. <https://doi.org/10.1016/j.quaint.2015.08.083>
- Kaminská, L., Kozłowski, J. K., & Svoboda, J. (Eds.). (2005). *Pleistocene environments and archaeology of the Dzeravá skala Cave, Lesser Carpathians, Slovakia*. Polska Akademia Umiejętności.
- Klaric, L., Guillermin, P., & Aubry, T. (2009). Des armatures variées et des modes de productions variables. Réflexions à partir de quelques exemples issus du Gravettien d'Europe occidentale (France, Portugal, Allemagne). *Gallia préhistoire*, 51(1), 113–154. <https://doi.org/10.3406/galip.2009.2476>
- Krammer, M. (2008). Naturräumliche Rahmenbedingungen. In *Krems-Hundsteig –Mammutjägerlager der Eiszeit* (Vol. 67, pp. 17–27).
- Kuhn, S. L. (1989). Hunter-gatherer foraging organisation and strategies of artefact replacement and discard. In D. S. Amick & R. P. Mauldin (Eds.), *Experiments in lithic technology* (Vol. 528, pp. 33–47). BAR.
- Luedtke, B. E. (1992). *An archaeologist's guide to chert and flint*. Institute of Archaeology, University of California.
- Mateiciucová, I., Trnka, G., & Götzinger, M. A. (2006). Zur Rohstoffverteilung und -verfügbarkeit in der westlichen Lengyel-Kultur. *Archäologie Österreichs*, 17/2, 82–89.
- McPherron, S. P., & Dibble, H. L. (2002). *Using computers in archaeology: A practical guide*. McGraw-Hill.
- Milne, S. B., Hamilton, A., & Fayek, M. (2009). Combining visual and geochemical analyses to source chert on Southern Baffin Island, Arctic Canada. *Geoarchaeology*, 24(4), 429–449. <https://doi.org/10.1002/gea.20273>
- Moník, M., Nerudová, Z., Gregar, F., Pluháček, T., Součková, J., & Hamrozi, P. (2025a). Chemical fingerprinting of European radiolarites and raw material economies from the Moravian Aurignacian. *Archaeological and Anthropological Sciences*, 17(1), 22. <https://doi.org/10.1007/s12520-024-02128-9>

- Moník, M., Nerudová, Z., Novák, M., Přichystal, A., Gregar, F., Hamrozi, P., & Pluháček, T. (2025b). Tracing the transfers of raw materials in the Gravettian of Moravia and Silesia. *Quaternary International*, 719, 109665. <https://doi.org/10.1016/j.quaint.2025.109665>
- Montet-White, A. (1991). Lithic acquisition, settlement pattern and territory in the epigravettian of central Europe: A case study. In *Raw material economies among prehistoric hunter-gatherers* (Vol. 19). University of Kansas.
- Montet-White, A., & Holen, S. R. (Eds.). (1991). *Raw material economies among prehistoric hunter-gatherers*. University of Kansas.
- Moreau, L. (2012). Le Gravettien ancien d'Europe centrale revisité: Mise au point et perspectives. *L'Anthropologie*, 116(5), 609–638. <https://doi.org/10.1016/j.anthro.2011.10.002>
- Moreau, L., Brandl, M., Filzmoser, P., Hauzenberger, C., Goemaere, É., Jadin, I., Collet, H., Hauzeur, A., & Schmitz, R. W. (2016a). Geochemical Sourcing of Flint Artifacts from Western Belgium and the German Rhineland: Testing Hypotheses on Gravettian Period Mobility and Raw Material Economy. *Geoarchaeology*, 31(3), 229–243. <https://doi.org/10.1002/gea.21564>
- Moreau, L., Brandl, M., & Nigst, P. R. (2016b). Did prehistoric foragers behave in an economically irrational manner? Raw material availability and technological organisation at the early Gravettian site of Willendorf II (Austria). *Quaternary International*, 406, 84–94. <https://doi.org/10.1016/j.quaint.2015.11.123>
- Moreau, L., Ciornei, A., Gjesfjeld, E., Filzmoser, P., Gibson, S. A., Day, J., Nigst, P. R., Noiret, P., Macleod, R. A., Niță, L., & Anghelinu, M. (2019). First Geochemical ‘Fingerprinting’ of Balkan and Prut Flint from Palaeolithic Romania: Potentials, Limitations and Future Directions. *Archaeometry*, 61(3), 521–538. <https://doi.org/10.1111/arcm.12433>
- Movius, H., David, N., Bricker, H., & Clay, B. (1968). *The Analysis of Certain Major Classes of Upper Palaeolithic Tools*. Peabody Museum of Archaeology and Ethnology, Harvard University.
- Müller, K., & Wickham, H. (2023). *_tibble: Simple Data Frames_*. R package version 3.2.1. <https://CRAN.R-project.org/package=tibble>
- Neuwirth, E. (2022). *RColorBrewer: ColorBrewer Palettes*. R package version 1.1-3 [Computer software]. <https://CRAN.R-project.org/package=RColorBrewer>
- Nigst, P. (2012). *The Early Upper Palaeolithic of the Middle Danube Region*. Leiden University Press.
- Nigst, P., & Antl-Weiser, W. (2011). Intrasite Spatial Organization of Grub/Kranawetberg: Methodology and Interpretations - Insights into the Spatial Organization of Gravettian

- Sites in Eastern Central Europe. In S. Gaudzinski-Windheuser, O. Jöris, M. Sensburg, M. Street, & E. Turner (Eds.), *Site-internal spatial organization of hunter-gatherer societies: Case studies from the European Palaeolithic and Mesolithic* (pp. 11–29). Verlag des RGZM.
- Nigst, P. R. (2003). *Fundverteilungen um Feuerstellen, die Ring and Sector Method und Grub/Kranawetberg: Eine Studie zur Analyse latenter Strukturen altsteinzeitlicher WildbeuterInnenlager* [Master, Universität Wien]. https://www.academia.edu/9313326/Fundverteilungen_um_Feuerstellen_die_Ring_and_Sector_Method_und_Grub_Kranawetberg_Eine_Studie_zur_Analyse_latenter_Strukturen_altsteinzeitlicher_WildbeuterInnenlager
- Nigst, P. R., & Antl-Weiser, W. (2012). Les structures d'occupation gravettiennes en Europe centrale: Le cas de Grub/Kranawetberg, Autriche. *L'Anthropologie*, 116(5), 639–664. <https://doi.org/10.1016/j.anthro.2012.09.001>
- Nigst, P. R., Antl-Weiser, W., & Bosch, M. D. (2024a). Exploring the Surrounding of a Gravettian Site. The Case Study Grub-Kranawetberg, Austria. *Archaeologia Austriaca, Band 108/2024*, 201–224. <https://doi.org/10.1553/archaeologia108s201>
- Nigst, P. R., Antl-Weiser, W., & Bosch, M. D. (2024b). Neue Feldforschungen am Kranawetberg – Oberflächenaufsammlungen um die Fundstelle Grub-Kranawetberg. *Archäologie Österreich*, 31–32, 27–30.
- Nigst, P. R., Haesaerts, P., Damblon, F., Frank-Fellner, C., Mallol, C., Viola, B., Götzinger, M., Niven, L., Trnka, G., & Hublin, J.-J. (2014). Early modern human settlement of Europe north of the Alps occurred 43,500 years ago in a cold steppe-type environment. *Proceedings of the National Academy of Sciences*, 111(40), Article 40. <https://doi.org/10.1073/pnas.1412201111>
- Nigst, P. R., Viola, T. B., Doneus, M., & Antl-Weiser, W. (2004). Digitale Dokumentation paläolithischer Grabungen. *Archäologie Österreich*, 15/1, 36–48.
- Oliva, M. (2009). Geography, Stratigraphy and Dating. In M. Oliva (Ed.), *Sídliště mamutiho lidu u milovic pod pálavou: Otázka struktur s mamutími kostmi: Vol. 27 = N.S. 19* (pp. 22–24). Moravské Zemské Muzeum.
- Olofsson, A., & Rodushkin, I. (2011). Provenancing Flint Artefacts with ICP–MS Using REE Signatures and Pb Isotopes as Discriminants: Preliminary Results of a Case Study from Northern Sweden. *Archaeometry*, 53(6), 1142–1170. <https://doi.org/10.1111/j.1475-4754.2011.00605.x>
- Ott, I. (1996). Die Artefakte der jungpaläolithischen Fundstelle von Rosenberg am Kamp,

- Niederösterreich. *Archaeologia Austriaca*, 80, 43–114.
- Otte, M., & Noiret, P. (2004). Évolution du gravettien au moyen Danube. In P. Šída (Ed.), *The Gravettian along the Danube, Proceedings of the Mikulov Conference, 20-21 November, 2002* (pp. 8–32). Academy of sciences of the Czech republic, Institute of archaeology.
- Pedersen, T. L. (2024). *Patchwork: The Composer of Plots. R package version 1.3.0* [Computer software]. <https://CRAN.R-project.org/package=patchwork>
- Pesesse, D. (2013). Le Gravettien existe-t-il? Le prisme du système technique lithique,. In M. Otte (Ed.), *Les Gravettiens* (pp. 67–104). Errance archéologie.
- Peticzka, R., & Terhorst, B. (2008). *Eurosoil 2008—Excursion 7A-pre-post-congress "Excursion Guide for the Loess Region of the Eastern Weinviertel, Stillfried (AUSTRIA)*. 1–16.
- Přichystal, A. (2013). *Lithic raw materials in prehistoric times of Eastern Central Europe* (1st ed). Masaryk University.
- R Core Team. (2024a). *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing. <https://www.R-project.org/>
- R Core Team. (2024b). *R: A Language and Environment for Statistical Computing* [Computer software]. R Foundation for Statistical Computing. <https://www.R-project.org/>
- Rácz, B., Szakmány, G., & Biró, K. T. (2016). Contribution to the cognizance of raw materials and raw material regions of the Transcarpathian Palaeolithic. *Acta Archaeologica Academiae Scientiarum Hungaricae*, 67(2), 209–229. <https://doi.org/10.1556/072.2016.67.2.1>
- Riegler, D., & Peticzka, R. (2004). Typuslokalität Stillfried an der March—Ausgangssituation. In R. Peticzka (Ed.), *Beiträge zur Quartärforschung und Landschaftsökologie: Gedenkschrift zum 60. Geburtstag von Spyridon Verginis* (pp. 41–45). Inst. für Geographie und Regionalforschung der Univ.
- Rögl, F., & Summesberger, H. (1978). Die geologische Lage von Stillfried a. D. March. *Forschungen in Stillfried*, 3, 76–86.
- Rottländer, R. C. A. (1975). The formation of patina on flint. *Archaeometry*, 17(1), 106–110.
- Schilt, F., Verpoorte, A., & Antl, W. (2017). Micromorphology of an Upper Paleolithic cultural layer at Grub-Kranawetberg, Austria. *Journal of Archaeological Science: Reports*, 14, 152–162. <https://doi.org/10.1016/j.jasrep.2017.05.041>
- Schmid, V. C., Bosch, M. D., Brandl, M., Götzinger, M., & Nigst, P. R. (2019). Neue Einblicke in das Gravettien von Willendorf II. Die Steinartefakte der Grabung 1993. *Archaeologia Austriaca, Band 103/2019*, 11–73. <https://doi.org/10.1553/archaeologia103s11>
- Schwartz, M., & file. vafPmle. (2024). *WriteXLS: Cross-Platform Perl Based R Function to*

- Create Excel 2003 (XLS) and Excel 2007 (XLSX) Files. R package version 6.7.0 [Computer software]. <https://CRAN.R-project.org/package=WriteXLS>
- Shackley, M. S. (2008). Archaeological Petrology and the Archaeometry of Lithic Materials. *Archaeometry*, 50(2), 194–215. <https://doi.org/10.1111/j.1475-4754.2008.00390.x>
- Šída, P. (2009a). Geography of the Gravettian in Bohemia. In P. Šída (Ed.), *The Gravettian of Bohemia* (Vol. 17, pp. 20–26). Academy of sciences of the Czech republic, Institute of archaeology.
- Šída, P. (2009b). *The Gravettian of Bohemia*. Academy of sciences of the Czech republic, Institute of archaeology.
- Sobkowiak-Tabaka, I., Werra, D. H., Hughes, R. E., & Siuda, R. (2016). Erratic Flint from Poland: Preliminary results of petrographic and geochemical analyses. *Archaeologia Polona*, 54, 67–82.
- Speer, C. A. (2014). LA-ICP-MS analysis of Clovis period projectile points from the Gault Site. *Journal of Archaeological Science*, 52, 1–11. <https://doi.org/10.1016/j.jas.2014.08.014>
- Svoboda, J. (2005). Pavlov I - Southeast. Location, Stratigraphy, Microstratigraphies, and Features. In J. Svoboda (Ed.), *Pavlov I Southeast: A window into the Gravettian lifestyles* (Vol. 14, pp. 25–52). Academy of sciences of the Czech republic, Institute of archaeology.
- Svoboda, J. (2008). The Předmostí Area: Spatial Structure, Stratigraphy and Chronology. In J. Velemínská & J. Brůžek (Eds.), *Early Modern Humans from Předmostí near Přerov, Czech Republic: A New Reading of Old Documentation* (pp. 131–138). Academia.
- Svoboda, J. (2016). *Dolní Věstonice II: Chronostratigraphy, paleoethnology, paleoanthropology*. Academy of Sciences of the Czech Republic, Institute of Archeology.
- Svoboda, J. A. (2010). *Dolní Věstonice - Pavlov: Ort: Südmähren, Zeit: 30000 Jahre v.Chr. = Unter-Wisternitz und Pollau* (1. Ausg). Regionalmuseum.
- Svoboda, J. A., & Klíma, B. (Eds.). (1996). *Paleolithic in the middle Danube region: Anniversary volume to Bohuslav Klíma*. Conference ‘Paleolithic in the Middle Danube area’, Brno. Archeologický Ústav ČR.
- Svoboda, J. (with Ložek, V., & Vlček, E.). (1996). *Hunters Between East and West: The Paleolithic of Moravia*. Springer.
- Svoboda, J., Novák, M., Sázelová, S., & Demek, J. (2016). Pavlov I: A large Gravettian site in space and time. *Quaternary International*, 406, 95–105. <https://doi.org/10.1016/j.quaint.2015.09.015>
- Svoboda, J., & Sedláčková, L. (with Mikulov conference). (2004). *The gravettian along the Danube: Proceedings of the Mikulov conference, 20.-21. November 2002*. Archeologický

ústav AV ČR.

- Thomas, R., Brandl, M., Einwögerer, T., & Simon, U. (2023). *Das Jungpaläolithikum von Krems-Wachtberg: Die Steinartefakte der Ausgrabungen 2005–2015*. Verlag der Österreichischen Akademie der Wissenschaften.
- Thorpe, O. W. (1978). *A study of obsidian in Prehistoric Central and Eastern Europe, and its trace elements characterization. An analytically-based study of archaeological obsidian in Central and Eastern Europe, an investigation of obsidian sources in this area, and the characterization of these obsidians using neutron activation analysis* [PhD]. University of Bradford.
- Tixier, J., Inizan, M.-L., Roche, H., & Dauvois, M. (with Cercle de recherches et d'études préhistoriques). (1980). *Préhistoire de la pierre taillée*. CREP diffusion Association pour la promotion et la diffusion des connaissances archéologiques.
- Turq, A. (2005). Réflexions méthodologiques sur les études de matières premières lithiques: 1—Des lithothèques au matériel archéologique. *Paléo (Les Eyzies de Tayac-Sireuil)*, 17, 111–131.
- Uthmeier, T. (2004). *Micoquien, Aurignacien und Gravettien in Bayern: Eine regionale Studie zum Übergang vom Mittel- zum Jungpaläolithikum*. R. Habelt.
- Valoch, K. (1986). Raw material used in the Moravian Middle and Upper Palaeolithic. In K. T. Bíró (Ed.), *International Conference on Prehistoric Flint Mining and Lithic Raw Material Identification in the Carpathian Basin* (pp. 263–268). Magyar Nemzeti Múzeum.
- van der Plicht, J. (1997). The Radiocarbon Dating. In J. Svoboda (Ed.), *Pavlov I: northwest the upper paleolithic burial and its settlement context* (pp. 427–436). Academy of sciences of the Czech republic, Institute of archaeology.
- Verpoorte, A. (2001). *Places of art, traces of fire. A contextual approach to anthropomorphic figurines in the Pavlovian (Central Europe)*. Leiden University. <https://hdl.handle.net/1887/13512>
- Verpoorte, A. (2009). Chronology of the Gravettian in Bohemia. In P. Sida (Ed.), *The Gravettian of Bohemia* (pp. 44–58). Academy of sciences of the Czech republic, Institute of archaeology.
- Verpoorte, A., & Einwögerer, T. (2002). Comment on Langenlois, Austria. *Archaeometry*, 44(Supplement Datalist 31), 31–32.
- Vita-Finzi, C., Higgs, E. S., Sturdy, D., Harriss, J., Legge, A. J., & Tippet, H. (1970). Prehistoric Economy in the Mount Carmel Area of Palestine: Site Catchment Analysis. *Proceedings of the Prehistoric Society*, 36, 1–37.

<https://doi.org/10.1017/S0079497X00013074>

- Vukosavljević, N., & Perhoč, Z. (2017). Lithic raw material procurement of the Late Epigravettian hunter-gatherers from Kopačina Cave (island of Brač, Dalmatia, Croatia). *Quaternary International*, 450, 164–185. <https://doi.org/10.1016/j.quaint.2016.09.017>
- Weiser, W. (1978). Die Paläolithischen Funde von Stillfried a. D. March 1879-1977. *Forschungen in Stillfried*, 3, 5–14.
- Weniger, G.-Chr. (1990). Germany at 18.000 BP. In O. Soffer & C. Gamble (Eds.), *The world at 18 000 BP: Vol. Vol.1 High latitudes* (pp. 171–192). Unwin Hyman.
- Wessely, G. (2006). *Geologie der österreichischen Bundesländer: Niederösterreich*. Geologische Bundesanstalt.
- Wickham, H. (2007). Reshaping Data with the {reshape} Package. *Journal of Statistical Software*, 21(12), 1–20.
- Wickham, H. (2011). The Split-Apply-Combine Strategy for Data Analysis. *Journal of Statistical Software*, 40(1), 1–29.
- Wickham, H. (2016). *ggplot2: Elegant Graphics for Data Analysis* [Computer software]. Springer-Verlag.
- Wickham, H., & Bryan, J. (2015). *Readxl: Read Excel Files. R package version 1.4.5* [Computer software]. <https://CRAN.R-project.org/package=readxl>
- Wickham, H., François, R., Henry, L., Müller, K., & Vaughan, D. (2023). *Dplyr: A Grammar of Data Manipulation. R package version 1.1.4* [Computer software]. <https://CRAN.R-project.org/package=dplyr>
- Wickham, H., & Vaughan, D. (2024). *Tidyr: Tidy Messy Data_. R package version 1.3.1*. <https://CRAN.R-project.org/package=tidyr>
- Wilczyński, J., Goslar, T., Wojtal, P., Oliva, M., Göhlich, U. B., Antl-Weiser, W., Šída, P., Verpoorte, A., & Lengyel, G. (2020a). New Radiocarbon Dates for the Late Gravettian in Eastern Central Europe. *Radiocarbon*, 62(1), 243–259. <https://doi.org/10.1017/RDC.2019.111>
- Wilczyński, J., Šída, P., Kufel-Diakowska, B., Mroczek, P., Pryor, A., Oberc, T., Sobieraj, D., & Lengyel, G. (2021). Population mobility and lithic tool diversity in the Late Gravettian – The case study of Lubná VI (Bohemian Massif). *Quaternary International*, 587–588, 103–126. <https://doi.org/10.1016/j.quaint.2020.08.046>
- Wilczyński, J., Žaár, O., Nemergut, A., Kufel-Diakowska, B., Hoyo, M. M., Mroczek, P., Páll-Gergely, B., Oberc, T., & Lengyel, G. (2020b). The Upper Palaeolithic at Trenčianske Bohuslavice, Western Carpathians, Slovakia. *Journal of Field Archaeology*, 45(4), 270–

292. <https://doi.org/10.1080/00934690.2020.1733334>

Wild, E. M., Neugebauer-Maresch, C., Einwögerer, T., Stadler, P., Steier, P., & Brock, F. (2008). ^{14}C Dating of the Upper Paleolithic Site at Krems-Hundssteig in Lower Austria. *Radiocarbon*, 50(1), 1–10.

11.1.1. Annex 1: Morphological Attributes

11.1.1. Annex 1: Morphological Attributes

artifactID	inventory	siteName	layer	AH	refitting	refitGroup	refitType	RMU	patina	calcareousSinter	jointPlane	thermalAlteration1	thermalAlteration2	dataclass	basaltTech
No	, cortex	, cortexPosition2	length	width	thickness	weight	fragmentation1	fragmentation2	fragmentation3	platformType	platformShape	platformWidth	platformThickness	dorsalReduction1	dorsalReduction2
F9-103	GKII	GK2	X	Michi	No	X	No	No	No	chip	n/a	0	3.95	6.73	1.6
F9-105	GKII	GK2	X	Michi	No	X	No	No	No	chip	n/a	0	4.31	6.04	1.3
F9-106	GKII	GK2	X	Michi	No	X	No	No	No	chip	n/a	0	5.84	5.78	0.64
F9-111	GKII	GK2	X	Michi	No	X	No	No	No	flake	flake/normal	0	13.67	13.98	2.19
F9-112	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	9.8	8.03	1.3
F9-113	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	6.88	6.73	1.21
F9-120	GKII	GK2	X	Michi	No	X	No	No	No	Yes	shelledSpallings	chip	n/a	0	8.9
F9-122	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	7.91	6.57	1.52
F9-131	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	5.16	7.48	0.84
F9-134	GKII	GK2	X	Michi	No	X	No	No	No	shatter	n/a	0	7.41	2.8	0.77
F9-143	GKII	GK2	X	Michi	No	X	No	No	No	curved	trapezoidal	No	No	0	0
F9-144	GKII	GK2	X	Michi	No	X	Yes	Yes	No	No	chip	flake/normal	0	7.69	9.57
F9-145	GKII	GK2	X	Michi	No	X	No	No	No	blade	blade	0	32.38	14.49	7.77
F9-154	GKII	GK2	X	Michi	No	X	No	No	No	chip	n/a	0	6.25	2.55	0.85
F9-155	GKII	GK2	X	Michi	No	X	No	No	Yes	No	shatter	n/a	0	15.59	10.63
F9-161	GKII	GK2	X	Chase	No	X	No	No	No	chip	flake/normal	0	4.63	6.34	1.13
F9-162	GKII	GK2	X	Michi	No	X	No	No	Yes	No	shatter	n/a	0	4.07	3.7
F9-163	GKII	GK2	X	Michi	No	X	No	No	No	curved	triangular	blade	0	14.53	6.13
F9-165	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	8.45	7.89	1.65
F9-166	GKII	GK2	X	Michi	No	X	n/a	Yes	No	chip	n/a	0	4.31	6.11	1.42
F9-167	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	8.07	4.12	0.59
F9-169	GKII	GK2	X	Michi	No	X	No	No	No	chip	n/a	0	7.61	7.28	1.14
F9-170	GKII	GK2	X	Michi	No	X	No	No	No	curved	triangular	blade	0	14.53	6.13
F9-171	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	8.45	7.89	1.65
F9-172	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	8.45	7.89	1.65
F9-173	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	8.45	7.89	1.65
F9-174	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	8.45	7.89	1.65
F9-175	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	8.45	7.89	1.65
F9-176	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	8.45	7.89	1.65
F9-177	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	8.45	7.89	1.65
F9-178	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	8.45	7.89	1.65
F9-179	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	8.45	7.89	1.65
F9-180	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	8.45	7.89	1.65
F9-181	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0	8.45	7.89	1.65
F9-182	GKII	GK2	X	Michi	No	X	No	No	No	chip	flake/normal	0			

F9-75	GKII	GK2	X	Michi	No	, , X	No	No	No	flake	flake/norml	0	, 6.11	12.33	1.48	0.1	Yes	length	distal	, , 0	0	, , , , 0	irregular	hinged	2				
F9-76	GKII	GK2	X	Michi	No	, , irregular	No	No	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
F9-77	GKII	GK2	X	Michi	No	, , X	No	No	No	chip	flake/norml	0	, 8.31	5.41	1.7	0.1	Yes	length	proximal	linearRidge	linearRidge	2.54	0.01	Yes	hingedScars+abraded				
F9-78	No	No	Yes	0	, 2	unipolar	sameDirection	, , Yes	damage/use	, , 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
F9-79	GKII	GK2	X	Michi	No	, , X	No	No	No	Yes	craquelation	shatter	n/a	0	7.26	4.81	0.96	0.1	Yes	length	distal	0	0	0	No	, , , , 0			
F9-80	GKII	GK2	X	Michi	No	, , X	No	Yes	No	chip	flake/norml	0	, 5.81	4.73	1	0.1	Yes	length	proximal	plain	irregular	0.99	0.21	Yes	abraded	Yes	No	No	
F9-81	GKII	GK2	X	Michi	No	, , X	No	No	No	chip	n/a	0	4.31	14.82	1.61	0.1	Yes	length+width	medial	0	0	0	0	indetermined	indetermined				
F9-82	GKII	GK2	X	Michi	No	, , X	No	Yes	No	chip	flake/norml	0	, 9.63	10.4	2.43	0.1	Yes	length+width	medial	0	0	0	0	2	indetermined				
F9-91	GKII	GK2	X	Michi	No	, , X	No	No	No	bladelet	blade	0	, 8.71	4.25	1.68	0.1	Yes	length	proximal	linearRidge	linearRidge	3.29	0.15	Yes	abraded	No	No		
No	No	0	, 3	unipolar	sameDirection	no	Yes	rectilinear	triangular	Yes	damage/use	No	, , 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
F9-96	GKII	GK2	X	Michi	No	, , X	No	No	No	n/a	shatter	n/a	0	10.77	4.44	1.34	0.1	Yes	length	distal	0	0	0	0	0	0	0		
F9-97	GKII	GK2	X	Michi	No	, , X	No	Yes	No	flake	flake/norml	0	, 10.93	9.74	3.53	0.4	No	, all	plain	triangular	5.47	1.85	Yes	hingedScars+abraded	Yes	No			
edgeRetouch	No	0	0	0	0	0	0	0	0	irregular	Yes	damage/use	Yes	1	dorsal	dextrorotational-medial	fine/edgeless	convex	5.71	0.17	, , , , 0	0	0	0	0	0			
F9-98	GKII	GK2	X	Michi	No	, , X	No	No	No	Yes	shelledSpallings	thermalShatter	n/a	0	6.15	4.1	1.3	0.1	Yes	length	distal	0	0	0	0	0	0		
G10-107	GKII	GK2	X	Michi	No	, , X	No	No	No	chip	n/a	0	2	5.21	0.5	0.1	Yes	length	distal	0	0	0	0	convex	hinged	0	n/a	n/a	, , No
G10-108	GKII	GK2	X	Michi	No	, , X	No	Yes	No	chip	flake/norml	0	, 7.07	16.15	3.95	0.4	Yes	length+width	medial	0	0	0	0	2	indetermined				
indetermined	, , Yes	damage/use	, , 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
G10-109	GKII	GK2	X	Michi	No	, , X	No	No	No	chip	n/a	0	6.74	4.2	0.85	0.1	Yes	length	proximal	linearRidge	linearRidge	1.95	0.14	Yes	abraded	No	No	No	
No	0	, 5	unipolar	sameDirection	, , No	, , 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
G10-11	GKII	GK2	X	above Chase	No	, , X	No	No	No	bladelet	n/a	0	4.71	1.68	0.67	0.1	n/a	n/a	0	0	0	0	0	indetermined	indetermined	n/a			
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
G10-110	GKII	GK2	X	Michi	No	, , X	No	No	No	chip	n/a	0	5.95	5.37	0.89	0.1	Yes	length+width	medial	0	0	0	0						

[illegible]

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[illegible]

11.2. Annex 2: Raw material attributes

artifactID,	inventory,	siteName,	RMU,	RMS,	patina,	cortex,	remarks
F9-103,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-105,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-106,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-111,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-112,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-113,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-120,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-122,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-131,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-134,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-143,	GKII,	GK2,	1,	n/a,	No,	66-99%,	
F9-144,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-145,	GKII,	GK2,	1.1.7,	n/a,	No,	0%,	
F9-146,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-154,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-155,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-161,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-162,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-163,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-165,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-166,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-167,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-169,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-170,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-171,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-172,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-174,	GKII,	GK2,	1.1.7,	n/a,	No,	0%,	
F9-175,	GKII,	GK2,	2,	ErraticFlint,	Yes,	0%,	
F9-179,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-180,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-181,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-186,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-21,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-211,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-212,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-213,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-214,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-24,	GKII,	GK2,	1.1,	n/a,	No,	33-66%,	
F9-248,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-249,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-258,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-259,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-260,	GKII,	GK2,	1.1,	n/a,	Yes,	0%,	
F9-261,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-262,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-263,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-27,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-28,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-29,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-291,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-295,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-30,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-31,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-323,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-324,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-325,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-326,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-327,	GKII,	GK2,	1,	n/a,	Yes,	0%,	
F9-33,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-331,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-34,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-35,	GKII,	GK2,	2,	ErraticFlint,	Yes,	0%,	
F9-356,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-357,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-358,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-359,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-36,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-360,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-361,	GKII,	GK2,	2,	ErraticFlint,	Yes,	0%,	
F9-363,	GKII,	GK2,	1.1,	n/a,	Yes,	0%,	
F9-364,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-365,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-366,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-37,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-38,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-39,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-399,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-407,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-411,	GKII,	GK2,	2,	ErraticFlint,	Yes,	0%,	
F9-417,	GKII,	GK2,	4,	n/a,	No,	n/a,	?
F9-419,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-423,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-424,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-434,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-436,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-437,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-438,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
F9-449,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-45,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-46,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-47,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-472,	GKII,	GK2,	1,	n/a,	No,	1-33%,	
F9-473,	GKII,	GK2,	1.1,	n/a,	No,	0%,	burnt
F9-474,	GKII,	GK2,	1,	n/a,	No,	0%,	
F9-475,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-483,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-484,	GKII,	GK2,	2,	ErraticFlint,	No,	0%,	
F9-49,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
F9-491,	GKII,	GK2,	2,	ErraticFlint,	Yes,	0%,	
F9-492,	GKII,	GK2,	2,	ErraticFlint,	Yes,	0%,	

F9-50, GKII, GK2, n/a, n/a, No, 0%,
F9-507, GKII, GK2, 1, n/a, No, 0%,
F9-514, GKII, GK2, 1.1, n/a, No, 0%,
F9-515, GKII, GK2, 1.1, n/a, No, 0%,
F9-523, GKII, GK2, 1.1, n/a, No, 0%,
F9-524, GKII, GK2, 1.1, n/a, No, 0%,
F9-525, GKII, GK2, n/a, n/a, No, 0%,
F9-529, GKII, GK2, 1.1, n/a, No, 0%,
F9-54, GKII, GK2, 1.1, n/a, No, 0%,
F9-542, GKII, GK2, 2, ErraticFlint, Yes, 0%,
F9-55, GKII, GK2, 1.1, n/a, No, 0%,
F9-556, GKII, GK2, 2, ErraticFlint, Yes, 0%,
F9-557, GKII, GK2, 2, ErraticFlint, Yes, 0%,
F9-561, GKII, GK2, 2, ErraticFlint, Yes, 0%,
F9-562, GKII, GK2, 1, n/a, Yes, 0%,
F9-565, GKII, GK2, 4, n/a, No, 0%,
F9-566, GKII, GK2, 2, ErraticFlint, Yes, 0%,
F9-568, GKII, GK2, 2, ErraticFlint, Yes, 0%,
F9-569, GKII, GK2, 2, ErraticFlint, Yes, 0%,
F9-574, GKII, GK2, n/a, n/a, 0%, burnt
F9-577, GKII, GK2, 2, ErraticFlint, Yes, 0%,
F9-578, GKII, GK2, 1, n/a, No, 0%,
F9-586, GKII, GK2, 2, ErraticFlint, Yes, 1-33%,
F9-589, GKII, GK2, 2, ErraticFlint, Yes, 0%,
F9-609, GKII, GK2, 1, n/a, No, 0%,
F9-61, GKII, GK2, 1.1, n/a, No, 0%,
F9-63, GKII, GK2, n/a, n/a, No, 0%,
F9-630, GKII, GK2, n/a, n/a, Yes, 0%,
F9-631, GKII, GK2, 2, ErraticFlint, Yes, 0%,
F9-632, GKII, GK2, 2, ErraticFlint, Yes, 0%,
F9-640, GKII, GK2, 2, ErraticFlint, Yes, 0%,
F9-649, GKII, GK2, 2, ErraticFlint, Yes, 0%,
F9-681, GKII, GK2, 2, ErraticFlint, Yes, 0%,
F9-73, GKII, GK2, 1, n/a, No, 33-66%,
F9-75, GKII, GK2, 1.1, n/a, No, 0%,
F9-77, GKII, GK2, 1.1, n/a, No, 0%,
F9-79, GKII, GK2, n/a, n/a, No, 0%,
F9-80, GKII, GK2, 1.1, n/a, No, 0%,
F9-81, GKII, GK2, 1.1.7, n/a, No, 0%,
F9-82, GKII, GK2, 1, n/a, No, 0%,
F9-91, GKII, GK2, n/a, n/a, No, 0%,
F9-96, GKII, GK2, 1.1, n/a, No, 0%,
F9-97, GKII, GK2, 1.1, n/a, No, 0%,
F9-98, GKII, GK2, n/a, n/a, No, 0%,
G10-107, GKII, GK2, 1.1, n/a, No, 0%,
G10-108, GKII, GK2, 1.1, n/a, No, 0%,
G10-109, GKII, GK2, n/a, n/a, No, 0%,
G10-11, GKII, GK2, n/a, n/a, No, 0%,
G10-110, GKII, GK2, n/a, n/a, No, 0%,
G10-111, GKII, GK2, 1, n/a, No, 0%,
G10-116, GKII, GK2, n/a, n/a, No, 0%,
G10-117, GKII, GK2, 1.1, n/a, No, 0%,
G10-118, GKII, GK2, n/a, n/a, No, 0%, burnt

G10-119, GKII, GK2, n/a, n/a, No, 0%, burnt
G10-120, GKII, GK2, 1.1, n/a, No, 0%,
G10-121, GKII, GK2, 1, n/a, No, 0%,
G10-122, GKII, GK2, n/a, n/a, No, 0%,
G10-123, GKII, GK2, 1.1, n/a, No, 0%,
G10-124, GKII, GK2, 1.1, n/a, No, 0%,
G10-125, GKII, GK2, n/a, n/a, No, 0%,
G10-126, GKII, GK2, 1.1, n/a, No, 0%,
G10-128, GKII, GK2, 1.1, n/a, No, 0%,
G10-130, GKII, GK2, 1.1, n/a, Yes, 0%,
G10-160, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-212, GKII, GK2, 1, n/a, No, 0%,
G10-213, GKII, GK2, 1.1, n/a, No, 0%,
G10-214, GKII, GK2, 1.1, n/a, No, 0%,
G10-215, GKII, GK2, 1.1, n/a, No, 0%,
G10-216, GKII, GK2, n/a, n/a, No, 0%,
G10-217, GKII, GK2, 1.1, n/a, No, 0%,
G10-218, GKII, GK2, 1.1, n/a, No, 0%,
G10-219, GKII, GK2, 1.1, n/a, No, 0%,
G10-220, GKII, GK2, 1, n/a, No, 0%,
G10-236, GKII, GK2, n/a, n/a, No, 0%,
G10-237, GKII, GK2, 1.1, n/a, No, 0%,
G10-240, GKII, GK2, 1.1, n/a, No, 0%,
G10-241, GKII, GK2, 1.1, n/a, No, 0%,
G10-258, GKII, GK2, 1.1, n/a, No, 0%,
G10-260, GKII, GK2, 1.1, n/a, No, 0%,
G10-262, GKII, GK2, 1.1, n/a, No, 0%,
G10-263, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-266, GKII, GK2, 1.1, n/a, No, 0%,
G10-267, GKII, GK2, n/a, n/a, No, 0%,
G10-268, GKII, GK2, 1.1, n/a, No, 0%,
G10-276, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-285, GKII, GK2, 1.1, n/a, No, 0%,
G10-297, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-298, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-299, GKII, GK2, n/a, n/a, No, 0%,
G10-300, GKII, GK2, n/a, n/a, No, 0%,
G10-301, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-302, GKII, GK2, 1.1, n/a, No, 0%,
G10-303, GKII, GK2, 1.1, n/a, No, 0%,
G10-304, GKII, GK2, 1, n/a, No, 0%,
G10-305, GKII, GK2, n/a, n/a, n/a, 0%, burnt
G10-306, GKII, GK2, 1.1, n/a, No, 0%,
G10-307, GKII, GK2, 1.1, n/a, No, 0%,
G10-308, GKII, GK2, 1.1, n/a, No, 0%,
G10-309, GKII, GK2, n/a, n/a, No, 0%,
G10-31, GKII, GK2, n/a, n/a, No, 0%,
G10-310, GKII, GK2, 1.1, n/a, No, 0%,
G10-311, GKII, GK2, n/a, n/a, No, 0%,
G10-312, GKII, GK2, 1.1, n/a, No, 0%, burnt
G10-313, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-314, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-315, GKII, GK2, 1.1, n/a, No, 0%,

G10-32, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-325, GKII, GK2, 1, n/a, No, 0%,
G10-34, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-367, GKII, GK2, 1, n/a, No, 0%,
G10-37, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-376, GKII, GK2, 1, n/a, No, 0%,
G10-377, GKII, GK2, 1.1, n/a, No, 0%,
G10-378, GKII, GK2, 1.1, n/a, No, 0%,
G10-380, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-381, GKII, GK2, 1, n/a, No, 0%,
G10-382, GKII, GK2, 1.1, n/a, No, 0%,
G10-383, GKII, GK2, 1, n/a, No, 0%,
G10-384, GKII, GK2, 1.1, n/a, No, 0%,
G10-385, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-386, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-388, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-389, GKII, GK2, 1.1, n/a, No, 0%,
G10-4, GKII, GK2, 1, n/a, No, 0%,
G10-40, GKII, GK2, 1.1, n/a, No, 0%,
G10-43, GKII, GK2, 1.1, n/a, No, 0%,
G10-44, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-447, GKII, GK2, n/a, n/a, n/a, No, 0%, burnt
G10-448, GKII, GK2, 1, n/a, No, 0%,
G10-45, GKII, GK2, 1.1, n/a, No, 0%,
G10-450, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-455, GKII, GK2, n/a, n/a, n/a, No, 0%, burnt
G10-458, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-46, GKII, GK2, 1.1, n/a, No, 0%,
G10-462, GKII, GK2, 1.1, n/a, No, 0%,
G10-465, GKII, GK2, 1.1, n/a, No, 0%,
G10-474, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-475, GKII, GK2, 1.1, n/a, No, 0%,
G10-489, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-49, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-490, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-491, GKII, GK2, 1.1, n/a, No, 0%,
G10-492, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-493, GKII, GK2, 1, n/a, No, 0%,
G10-494, GKII, GK2, 1.1, n/a, Yes, 0%,
G10-495, GKII, GK2, 1, n/a, No, 0%,
G10-496, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-497, GKII, GK2, 1.1, n/a, No, 0%,
G10-498, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-4a, GKII, GK2, n/a, n/a, Yes, 0%,
G10-5, GKII, GK2, 1, n/a, Yes, n/a,
G10-50, GKII, GK2, 1.1, n/a, No, 0%,
G10-500, GKII, GK2, 1.1, n/a, No, 0%,
G10-52, GKII, GK2, n/a, n/a, No, 0%,
G10-539, GKII, GK2, 1.1, n/a, No, 0%,
G10-540, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-541, GKII, GK2, 1, n/a, No, 0%,
G10-542, GKII, GK2, n/a, n/a, n/a, 0%, burnt
G10-543, GKII, GK2, 1.1, n/a, No, 0%, burnt

G10-544, GKII, GK2, 1, n/a, No, 0%,
G10-545, GKII, GK2, 1.1, n/a, No, 0%,
G10-546, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-547, GKII, GK2, 1.1, n/a, No, 0%,
G10-548, GKII, GK2, 1.1, n/a, No, 0%,
G10-549, GKII, GK2, 1.1, n/a, No, 0%,
G10-55, GKII, GK2, 2, ErraticFlint, Yes, 0%, burnt
G10-550, GKII, GK2, 1.1, n/a, No, 0%,
G10-551, GKII, GK2, 1.1, n/a, No, 0%,
G10-552, GKII, GK2, n/a, n/a, n/a, n/a, burnt
G10-553, GKII, GK2, 1, n/a, No, 0%,
G10-554, GKII, GK2, 1.1, n/a, No, 0%, burnt
G10-555, GKII, GK2, 1.1, n/a, No, 0%,
G10-556, GKII, GK2, 1, n/a, No, 0%,
G10-557, GKII, GK2, 1, n/a, No, 0%,
G10-558, GKII, GK2, 1.1, n/a, No, 0%,
G10-571, GKII, GK2, 1, n/a, No, 0%,
G10-590, GKII, GK2, 1, n/a, No, 0%,
G10-591, GKII, GK2, 2, ErraticFlint, Yes, 0%,
G10-592, GKII, GK2, 1.1, n/a, No, 0%,
G10-593, GKII, GK2, 1.1, n/a, No, 0%,
G10-594, GKII, GK2, 1.1, n/a, No, 0%,
G10-60, GKII, GK2, 3, n/a, No, 0%, ?
G10-600, GKII, GK2, 1.1, n/a, No, 0%,
G10-605, GKII, GK2, 1.1, n/a, No, 0%,
G10-61, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-616, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-619, GKII, GK2, 2, ErraticFlint, Yes, 0%, burnt
G10-62, GKII, GK2, 1, n/a, No, 0%,
G10-620, GKII, GK2, 1, n/a, No, 0%,
G10-622, GKII, GK2, 1.1, n/a, No, 0%,
G10-623, GKII, GK2, 1, n/a, No, 0%,
G10-63, GKII, GK2, 1.1, n/a, Yes, 0%,
G10-636, GKII, GK2, 1.1, n/a, n/a, 0%,
G10-637, GKII, GK2, 1, n/a, No, 0%,
G10-639, GKII, GK2, 1.1, n/a, No, 0%,
G10-64, GKII, GK2, 1, n/a, No, 0%,
G10-640, GKII, GK2, n/a, n/a, n/a, No, 0%,
G10-641, GKII, GK2, 1, n/a, No, 0%,
G10-643, GKII, GK2, 1.1, n/a, No, 0%,
G10-644, GKII, GK2, 1.1, n/a, No, 0%,
G10-646, GKII, GK2, n/a, n/a, No, 0%,
G10-65, GKII, GK2, 1, n/a, No, 0%,
G10-653, GKII, GK2, n/a, n/a, No, 0%,
G10-654, GKII, GK2, n/a, n/a, No, 0%,
G10-655, GKII, GK2, n/a, n/a, No, 0%,
G10-657, GKII, GK2, 1.1, n/a, No, 0%,
G10-66, GKII, GK2, 1.1, n/a, No, 0%,
G10-662, GKII, GK2, 1.1, n/a, No, 0%,
G10-663, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-67, GKII, GK2, n/a, n/a, No, 0%, burnt
G10-672, GKII, GK2, 1.1, n/a, No, 0%,
G10-68, GKII, GK2, 1.1, n/a, No, 0%,

G10-69, GKII, GK2, n/a, n/a, n/a, n/a, n/a,
G10-697, GKII, GK2, 1, n/a, No, 0%,
G10-698, GKII, GK2, 1, n/a, No, 0%,
G10-699, GKII, GK2, 1, n/a, No, 0%,
G10-7, GKII, GK2, 1, n/a, No, 0%,
G10-700, GKII, GK2, n/a, n/a, No, 0%,
G10-701, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-702, GKII, GK2, 1, n/a, No, 0%,
G10-703, GKII, GK2, 1.1, n/a, No, 0%,
G10-704, GKII, GK2, 1.1, n/a, No, 0%,
G10-705, GKII, GK2, 1.1, n/a, No, 0%,
G10-706, GKII, GK2, 1, n/a, No, 0%,
G10-707, GKII, GK2, 1.1, n/a, No, 0%,
G10-708, GKII, GK2, 1, n/a, No, 0%,
G10-709, GKII, GK2, 1.1, n/a, Yes, 0%,
G10-710, GKII, GK2, 1.1, n/a, No, 0%,
G10-711, GKII, GK2, n/a, n/a, No, 0%,
G10-717, GKII, GK2, 2, ErraticFlint, Yes, 0%,
G10-718, GKII, GK2, 1.1, n/a, No, 0%,
G10-731, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-733, GKII, GK2, 1, n/a, No, 0%,
G10-734, GKII, GK2, n/a, n/a, No, 0%,
G10-735, GKII, GK2, n/a, n/a, No, 0%,
G10-736, GKII, GK2, 1, n/a, No, 0%,
G10-737, GKII, GK2, 1.1, n/a, No, 0%,
G10-739, GKII, GK2, 1.1, n/a, No, 0%,
G10-743, GKII, GK2, 1.1, n/a, No, 0%,
G10-745, GKII, GK2, 1, n/a, No, 0%,
G10-746, GKII, GK2, 1, n/a, No, 0%,
G10-749, GKII, GK2, 1.1, n/a, No, 0%,
G10-755, GKII, GK2, 1.1, n/a, Yes, 0%,
G10-756, GKII, GK2, n/a, n/a, No, 0%,
G10-757, GKII, GK2, n/a, n/a, No, 0%,
G10-759, GKII, GK2, 1.1, n/a, No, 0%,
G10-760, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-770, GKII, GK2, 1.1, n/a, Yes, 0%,
G10-771, GKII, GK2, 1.1, n/a, No, 0%,
G10-772, GKII, GK2, n/a, n/a, No, 0%,
G10-776, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-777, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-783, GKII, GK2, 1.1, n/a, No, 0%,
G10-784, GKII, GK2, 1.1, n/a, No, 0%,
G10-789, GKII, GK2, n/a, n/a, n/a, 0%, burnt
G10-791, GKII, GK2, 1.1, n/a, Yes, 0%,
G10-793, GKII, GK2, 1.1, n/a, No, 0%,
G10-794, GKII, GK2, n/a, n/a, No, 0%,
G10-8, GKII, GK2, 1.1, n/a, No, 0%,
G10-806, GKII, GK2, 1.1, n/a, No, 0%,
G10-810, GKII, GK2, n/a, n/a, No, 0%,
G10-812, GKII, GK2, n/a, n/a, No, 0%, burnt
G10-815, GKII, GK2, 1.1, n/a, No, 0%,
G10-817, GKII, GK2, 1.1, n/a, No, 0%,
G10-818, GKII, GK2, n/a, n/a, No, 0%,

G10-820, GKII, GK2, 1.1, n/a, No, 0%,
G10-823, GKII, GK2, 1.1, n/a, No, 0%,
G10-826, GKII, GK2, 1.1, n/a, No, 0%,
G10-834, GKII, GK2, n/a, n/a, No, 0%,
G10-835, GKII, GK2, n/a, n/a, No, 0%,
G10-836, GKII, GK2, 1.1, n/a, No, 0%,
G10-837, GKII, GK2, 1.1, n/a, No, 0%,
G10-838, GKII, GK2, 1.1, n/a, No, 0%,
G10-839, GKII, GK2, n/a, n/a, No, 0%,
G10-840, GKII, GK2, 1.1, n/a, No, 0%,
G10-841, GKII, GK2, 1, n/a, No, 0%,
G10-842, GKII, GK2, 1.1, n/a, No, 0%,
G10-843, GKII, GK2, 1.1, n/a, No, 0%,
G10-855, GKII, GK2, 1.1, n/a, No, 0%,
G10-862, GKII, GK2, 1, n/a, No, 0%,
G10-866, GKII, GK2, 1.1.7, n/a, No, 0%,
G10-867, GKII, GK2, n/a, n/a, No, 0%,
G10-868, GKII, GK2, 2, ErraticFlint, Yes, 0%, burnt
G10-869, GKII, GK2, 1.1, n/a, No, 0%,
G10-872, GKII, GK2, 1.1, n/a, No, 0%,
G10-881, GKII, GK2, 1.1, n/a, No, 0%,
G10-893, GKII, GK2, 2, ErraticFlint, Yes, 0%,
GK02-2028, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-2029, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-2030, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-2031, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-2034, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-2035, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-2036, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-2037, GK-Antl, GK1, n/a, n/a, n/a, 0%,
GK02-2038, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-2914, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-2915, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-2926, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-2964, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3352, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3353, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3354, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3355, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3356, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3357, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3358, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3359, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3360, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3361, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-3362, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3363, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3364, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3365, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3366, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-3367, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3368, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3369, GK-Antl, GK1, 1.1, n/a, No, 0%,

GK02-3370, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3371, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-3372, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-3373, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3374, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3375, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3398, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3427, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3429, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3430, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-3431, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-3436, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3438, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3443, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3444, GK-Antl, GK1, 1.1.7, n/a, No, 0%,
GK02-3973, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3974, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3975, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3976, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-3977, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3979, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3980, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-3981, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3982, GK-Antl, GK1, 1, n/a, No, 1-33%,
GK02-3983, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-3985, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-3986, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-3987, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3988, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-3989, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-3990, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-3991, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-3994, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-4025, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4037, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4038, GK-Antl, GK1, n/a, n/a, n/a, 0%,
GK02-4039, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4040, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4041, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4042, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4043, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4044, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-4046, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4047, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4048, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4049, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4060, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4068, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4678, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4679, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4680, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4681, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4682, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4683, GK-Antl, GK1, 1.1, n/a, No, 0%,

GK02-4684, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4685, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4686, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4688, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4689, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4690, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4707, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4713, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4722, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4725, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4739, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4740, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4742, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-4743, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4744, GK-Antl, GK1, n/a, n/a, n/a, 0%,
GK02-4745, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4746, GK-Antl, GK1, 2, ErraticFlint, Yes, 33-66%,
GK02-4747, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4748, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4749, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4750, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4752, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4753, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4754, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4755, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4756, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-4757, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4758, GK-Antl, GK1, 1.1, n/a, No, 1-33%,
GK02-4759, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4760, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4761, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4763, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4775, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4778, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4779, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4780, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4781, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4782, GK-Antl, GK1, 1.1, n/a, No, 66-99%,
GK02-4786, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4793, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4795, GK-Antl, GK1, n/a, n/a, n/a, 0%,
GK02-4800, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4801, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4802, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4804, GK-Antl, GK1, 4, n/a, No, 0%,
GK02-4844, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4850, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4856, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4902, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-4910, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4958, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-4959, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-4961, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,

GK02-5410, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5411, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5413, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5414, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5416, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-5417, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5418, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5419, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5420, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5421, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5422, GK-Antl, GK1, n/a, n/a, n/a, 0%,
GK02-5423, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5424, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5425, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5426, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5427, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5428, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-5429, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5430, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5431, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5438, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5460, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5461, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5462, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5463, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5464, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5465, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5466, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5467, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5468, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5469, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5470, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-5471, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5472, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5474, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5475, GK-Antl, GK1, 2, ErraticFlint, Yes, 66-99%,
GK02-5486, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-55, GK-Antl, GK1, 1.1, n/a, Yes, 0%,
GK02-5805, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5806, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5807, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5808, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5809, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5810, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-5811, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5812, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5813, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5815, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5816, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5817, GK-Antl, GK1, 1, n/a, No, 1-33%,
GK02-5818, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5819, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5820, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,

GK02-5821, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5822, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5823, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-5824, GK-Antl, GK1, 4, n/a, No, 0%,
GK02-5826, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5842, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5863, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5864, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5865, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-5867, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-5868, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-6406, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-6407, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6408, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6410, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6411, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6412, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6413, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6414, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6415, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6416, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-6417, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6418, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6419, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6443, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK02-6444, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-6445, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-6446, GK-Antl, GK1, 1, n/a, n/a, 33-66%, river cortex
GK02-6447, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-6449, GK-Antl, GK1, 1, n/a, No, 100%, burnt
GK02-6450, GK-Antl, GK1, 1, n/a, No, 66-99%, river cortex
GK02-6452, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-6453, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-6454, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-6455, GK-Antl, GK1, 1, n/a, Yes, 1-33%, river cortex
GK02-6456, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-6457, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-66, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-67, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6759, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-6760, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6761, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6762, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6763, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6764, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6765, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-6766, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-6768, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-6769, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-6770, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-6771, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-6772, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-6773, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,

GK02-6774, GK-Antl, GK1, 1, n/a, Yes, 0%,
GK02-6775, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-6776, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-6777, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-6778, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-6779, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-6780, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-6781, GK-Antl, GK1, 3, n/a, Yes, 0%, burnt
GK02-6782, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-6783, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-6784, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-6785, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-6786, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-6787, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-6789, GK-Antl, GK1, 1, n/a, n/a, 1-33%,
GK02-7142, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7300, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-7301, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-7302, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7303, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7304, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7305, GK-Antl, GK1, 1, n/a, No, 66-99%,
GK02-7306, GK-Antl, GK1, 1.1, Bakony?, No, 0%,
GK02-7307, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-7308, GK-Antl, GK1, 1.1, n/a, Yes, 0%,
GK02-7315, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7316, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7317, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7318, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7335, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7336, GK-Antl, GK1, 1, n/a, No, 33-66%,
GK02-7337, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-7338, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7339, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7340, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7341, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7342, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7343, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7344, GK-Antl, GK1, 2, ErraticFlint, Yes, 1-33%,
GK02-7345, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7346, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7347, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7348, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7349, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7350, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7351, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7352, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7353, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7354, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7355, GK-Antl, GK1, 1, n/a, No, 100%,
GK02-7356, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7357, GK-Antl, GK1, 1, n/a, No, 33-66%, river cortex
GK02-7358, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt

GK02-7359, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7360, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7361, GK-Antl, GK1, 2, ErraticFlint, Yes, 33-66%,
GK02-757, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-7577, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7578, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK02-7579, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-758, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7580, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7581, GK-Antl, GK1, 1, ErraticFlint, Yes, 0%,
GK02-7586, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK02-7587, GK-Antl, GK1, 1, n/a, No, 33-66%,
GK02-7588, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7589, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-759, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7590, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-7592, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7594, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK02-7595, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7596, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7597, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7599, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-760, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7600, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7601, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7603, GK-Antl, GK1, 2, ErraticFlint, Yes, n/a,
GK02-7605, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-7606, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-7608, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-761, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-762, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-763, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-764, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-765, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-768, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8142, GK-Antl, GK1, 1, n/a, No, 66-99%,
GK02-8168, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8319, GK-Antl, GK1, 1, n/a, No, 33-66%,
GK02-8320, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8321, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8322, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8323, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8324, GK-Antl, GK1, 1, n/a, Yes, 0%,
GK02-8325, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-8326, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8327, GK-Antl, GK1, 1, n/a, No, 66-99%,
GK02-8328, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8329, GK-Antl, GK1, 1.1, n/a, No, 33-66%,
GK02-8330, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8331, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8332, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8333, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK02-8334, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,

GK02-8335, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8336, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8337, GK-Antl, GK1, 1, n/a, Yes, 1-33%,
GK02-8338, GK-Antl, GK1, 2, ErraticFlint, Yes, 1-33%,
GK02-8339, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8340, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8341, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8342, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8343, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8344, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK02-8345, GK-Antl, GK1, 1, n/a, Yes, 0%,
GK02-8346, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8347, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8348, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8349, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8377, GK-Antl, GK1, 1, n/a, No, 1-33%, moraine-cortex?
GK02-8378, GK-Antl, GK1, 2, ErraticFlint, Yes, 66-99%,
GK02-8379, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8380, GK-Antl, GK1, 1, n/a, No, 0%, burnt
GK02-8381, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8382, GK-Antl, GK1, n/a, n/a, No, 0%, burnt
GK02-8495, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8496, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8497, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8498, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8499, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8500, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8501, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8502, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8503, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8504, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8505, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8506, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8507, GK-Antl, GK1, 1, n/a, No, 1-33%,
GK02-8508, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8510, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK02-8511, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK02-8512, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK02-8513, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-8515, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8516, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK02-8517, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8518, GK-Antl, GK1, 2, ErraticFlint, Yes, 1-33%,
GK02-8542, GK-Antl, GK1, 1, n/a, No, 33-66%,
GK02-8543, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8544, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8545, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8546, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8613, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8616, GK-Antl, GK1, 1, n/a, No, 33-66%,
GK02-8618, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK02-8621, GK-Antl, GK1, n/a, n/a, No, 0%, burnt
GK02-8622, GK-Antl, GK1, 1, n/a, No, 0%,

GK02-8624, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8626, GK-Antl, GK1, 2, ErraticFlint, Yes, 33-66%, neo-cortex
GK02-8630, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8633, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8637, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8641, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8662, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8663, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8694, GK-Antl, GK1, 4, n/a, No, 0%,
GK02-8695, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8696, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-8697, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8698, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-8699, GK-Antl, GK1, 1, n/a, Yes, 0%,
GK02-8700, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8701, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8702, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8703, GK-Antl, GK1, 1, n/a, No, 0%, burnt
GK02-8703a, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8705, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8706, GK-Antl, GK1, n/a, n/a, Yes, 0%,
GK02-8707, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK02-8708, GK-Antl, GK1, 1, n/a, n/a, 0%,
GK02-8723, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8724, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8725, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8726, GK-Antl, GK1, 2, ErraticFlint, Yes, n/a,
GK02-8727, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8728, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8729, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8731, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8859, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8860, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8861, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8862, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8863, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8864, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8865, GK-Antl, GK1, 1, n/a, No, 33-66%,
GK02-8866, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8867, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8868, GK-Antl, GK1, 2, ErraticFlint, Yes, 1-33%,
GK02-8869, GK-Antl, GK1, n/a, n/a, n/a, 0%, burnt
GK02-8871, GK-Antl, GK1, 1, n/a, No, 33-66%,
GK02-8878, GK-Antl, GK1, 1, n/a, No, n/a,
GK02-8879, GK-Antl, GK1, 1, n/a, No, 1-33%,
GK02-8880, GK-Antl, GK1, 4, n/a, No, 0%,
GK02-8881, GK-Antl, GK1, 1, n/a, No, 0%,
GK02-8882, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK02-8882a, GK-Antl, GK1, n/a, n/a, No, 0%,
GK02-8883, GK-Antl, GK1, n/a, n/a, No, 33-66%,
GK02-8884, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK02-8918, GK-Antl, GK1, n/a, n/a, n/a, 0%, burnt
GK02-8921, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt

GK02-8923, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK02-8924, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK02-8925, GK-Antl, GK1, 2, ErraticFlint, Yes, 33-66%,
GK02-8971, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK05-79, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK05-88, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-1003, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-1005, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-1272, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-1273, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-1274, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-1275, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-1276, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-1277, GK-Antl, GK1, 4, n/a, No, 0%,
GK07-1278, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-1279, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-1280, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-1281, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-1282, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-2, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-2115, GK-Antl, GK1, 1.1, Bakony?, No, 0%,
GK07-2116, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-2117, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-2118, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-2119, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-2120, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-2121, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-2122, GK-Antl, GK1, 2, ErraticFlint, Yes, 66-99%,
GK07-2123, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-2124, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-2125, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-2126, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-2127, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-2128, GK-Antl, GK1, 1.1, n/a, No, n/a,
GK07-2129, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-2130, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-2131, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-2494, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-2495, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-2496, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-2497, GK-Antl, GK1, 4, n/a, No, 0%,
GK07-2498, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-2499, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-2500, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-2501, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-2502, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-2503, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-2534, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-2735, GK-Antl, GK1, n/a, n/a, No, 0%, burnt
GK07-2736, GK-Antl, GK1, 4, n/a, No, 0%,
GK07-2737, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-2738, GK-Antl, GK1, 1.1, n/a, No, 0%, GK07-1003
GK07-2739, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,

GK07-2740, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-2741, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-2742, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-2743, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-2744, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-3, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-3196, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-3198, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-3199, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-3200, GK-Antl, GK1, 1, n/a, No, 100%,
GK07-3201, GK-Antl, GK1, n/a, n/a, No, 0%,
GK07-3202, GK-Antl, GK1, n/a, n/a, No, 0%,
GK07-3203, GK-Antl, GK1, n/a, n/a, No, 0%,
GK07-3204, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-323, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-325, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3483, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-3484, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-3662, GK-Antl, GK1, n/a, n/a, No, 0%,
GK07-3663, GK-Antl, GK1, n/a, n/a, No, 0%,
GK07-3664, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-3665, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3666, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3677, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3678, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3679, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3680, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3681, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3682, GK-Antl, GK1, 1, n/a, No, 100%, neocortex
GK07-3691, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-3692, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3693, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-3694, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3695, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3696, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%, burnt
GK07-3697, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3808, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-3809, GK-Antl, GK1, 1.1, n/a, No, 0%, burnt
GK07-3810, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-3811, GK-Antl, GK1, 1, n/a, No, 0%,
GK07-3812, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3820, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3821, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3822, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-3823, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3824, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3825, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3826, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3827, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3828, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3830, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,
GK07-3831, GK-Antl, GK1, 1.1, n/a, No, 0%,
GK07-3832, GK-Antl, GK1, 2, ErraticFlint, Yes, 0%,

1	n/a	No	1-33%	GK1	GK-Antl	GK09-2610	2	ErraticFlint	Yes	0%	la	DB	GK09-4355
1	n/a	No	0%	GK1	GK-Antl	GK09-3078	2	ErraticFlint	Yes	0%	la	DB	GK09-4356; burnt
1	n/a	No	0%	GK1	GK-Antl	GK09-3079	2	ErraticFlint	Yes	0%	la	DB	GK09-4357
1	n/a	No	0%	GK1	GK-Antl	GK09-3080	2	ErraticFlint	Yes	0%	la	DB	GK09-4358
1	n/a	No	0%	GK1	GK-Antl	GK09-3081	2	ErraticFlint	Yes	0%	la	DB	GK09-4359
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3082	2	ErraticFlint	Yes	0%	la	DB	GK09-4360
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3083	2	ErraticFlint	Yes	0%	la	DB	GK09-4361
3	n/a	Yes	0%	GK1	GK-Antl	GK09-3084	2	ErraticFlint	Yes	0%	la	DB	GK09-4362
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3085	2	ErraticFlint	Yes	0%	la	DB	GK09-4363
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3086	2	ErraticFlint	Yes	0%	la	DB	GK09-4364
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3087	2	ErraticFlint	Yes	0%	la	DB	GK09-4365
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3088	2	ErraticFlint	Yes	0%	la	DB	GK09-4366
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3089	2	ErraticFlint	Yes	0%	la	DB	GK09-4367
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3090	2	ErraticFlint	Yes	0%	la	DB	GK09-4368
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3091	2	ErraticFlint	Yes	0%	la	DB	GK09-4369
1	n/a	No	0%	GK1	GK-Antl	GK09-3092	2	ErraticFlint	Yes	0%	la	DB	GK09-4370
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3093	2	ErraticFlint	Yes	0%	la	DB	GK09-4371
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3094	2	ErraticFlint	Yes	0%	la	DB	GK09-4372
1	n/a	No	0%	GK1	GK-Antl	GK09-3095	2	ErraticFlint	Yes	0%	la	DB	GK09-4373
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3096	2	ErraticFlint	Yes	0%	la	DB	GK09-4374
1	n/a	No	33-66%	burnt	GK1	GK09-3097	1	n/a	No	0%	la	DB	GK09-4375
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3098	2	ErraticFlint	Yes	0%	la	DB	GK09-4376
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3099	2	ErraticFlint	Yes	0%	la	DB	GK09-4377
2	ErraticFlint	Yes	33-66%	GK1	GK-Antl	GK09-3100	2	ErraticFlint	Yes	0%	la	DB	GK09-4378
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3101	2	ErraticFlint	Yes	0%	la	DB	GK09-4379
2	ErraticFlint	Yes	1-33%	GK1	GK-Antl	GK09-3102	2	ErraticFlint	Yes	0%	la	DB	GK09-4380
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3103	2	ErraticFlint	Yes	0%	la	DB	GK09-4381
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3104	2	ErraticFlint	Yes	0%	la	DB	GK09-4382
2	ErraticFlint	Yes	66-99%	GK1	GK-Antl	GK09-3105	2	ErraticFlint	Yes	0%	la	DB	GK09-4383
1	n/a	No	0%	GK1	GK-Antl	GK09-3106	2	ErraticFlint	Yes	0%	la	DB	GK09-4384
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3107	2	ErraticFlint	Yes	0%	la	DB	GK09-4385
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3108	2	ErraticFlint	Yes	0%	la	DB	GK09-4403
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3109	2	ErraticFlint	Yes	0%	la	DB	GK09-4404
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3110	2	ErraticFlint	Yes	0%	la	DB	GK09-4893
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3111	2	ErraticFlint	Yes	0%	la	DB	GK09-4894
2	ErraticFlint	Yes	0%	GK1	GK-Antl	GK09-3112	2	ErraticFlint	Yes	0%	la	DB	GK09-4895
1	n/a	No	0%	GK1	GK-Antl	GK09-3113	2	ErraticFlint	Yes	0%	la	DB	GK09-4896
2	ErraticFlint</												

GK21-114, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-116, GK21, GK1, 2.1, ErraticFlint, Yes, 0%, erratic flint?
 GK21-117, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-124, GK21, GK1, 2.1, ErraticFlint, Yes, 0%, three-axial spicules; non
 alpine?
 GK21-125, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-127, GK21, GK1, 1.1.3, Danube/oldDanubeGrav, No, 0%,
 GK21-137, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-138, GK21, GK1, 2.1, ErraticFlint, Yes, 0%, erratic flint?
 GK21-139, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-140, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-15, GK21, GK1, 1.1.2, northAlpine?, No, 1-33%,
 GK21-150, GK21, GK1, 1.2.1, SouthMoravia?, No, 0%,
 GK21-152, GK21, GK1, 1, northAlpine, No, 0%,
 GK21-156, GK21, GK1, 1.1.4, Bakony?, No, 0%,
 GK21-159, GK21, GK1, 1.1.6, northAlpine, Yes, 0%,
 GK21-16, GK21, GK1, 1.1.3, northAlpine, No, 1-33%, Danube or old danube
 gravel; river cortex?
 GK21-161, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-162, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-164, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-165, GK21, GK1, 1.2.4, OldDanubeGravel, No, 0%,
 GK21-167, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-169, GK21, GK1, 1.1.3, northAlpine, No, 0%,
 GK21-172, GK21, GK1, 1.2.1, SouthMoravia?, No, 1-33%,
 GK21-173, GK21, GK1, 1, n/a, No, 0%,
 GK21-174, GK21, GK1, 1, n/a, No, 0%,
 GK21-176, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-177, GK21, GK1, 1, SouthMoravia?, No, 0%,
 GK21-178, GK21, GK1, 1.2.1, n/a, No, 0%,
 GK21-179, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-194, GK21, GK1, 1.2.2, SouthMoravia, No, 0%,
 GK21-195, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-199, GK21, GK1, 1.2.5, SouthMoravia, No, 1-33%, maybe Stranska Skala
 GK21-2, GK21, GK1, 1.2.1, SouthMoravia?, No, 1-33%, river cortex
 GK21-202, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-205, GK21, GK1, 1, n/a, No, 0%,
 GK21-210, GK21, GK1, 1.2.1, SouthMoravia, No, 1-33%,
 GK21-212, GK21, GK1, 1.1.4, n/a, No, n/a, sub-cortex
 GK21-213, GK21, GK1, 1.1.4, n/a, No, n/a,
 GK21-214, GK21, GK1, 2.1, ErraticFlint, Yes, 1-33%, neocortex
 GK21-222, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-223, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-224, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-227, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-228, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-23, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-230, GK21, GK1, 1, n/a, Yes, 0%,
 GK21-231, GK21, GK1, 1.2.1, SouthMoravia?, No, 1-33%, cortex+neocortex
 GK21-233, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-239, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-24, GK21, GK1, 1.1, northAlpine, No, 0%,
 GK21-240, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,

GK21-241, GK21, GK1, 1.2.2, SouthMoravia, No, 0%,
 GK21-242, GK21, GK1, n/a, n/a, n/a, 0%, burnt
 GK21-242a, GK21, GK1, n/a, n/a, n/a, 0%, burnt
 GK21-247, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-248, GK21, GK1, 2, ErraticFlint, Yes, 1-33%, moraine cortex
 GK21-249, GK21, GK1, 1.2.1, SouthMoravia?, Yes, 33-66%, river cortex
 GK21-250, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-258, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-259, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-267, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-269, GK21, GK1, 2, ErraticFlint, Yes, 1-33%, neo-cortex?
 GK21-27, GK21, GK1, 1, n/a, No, 0%,
 GK21-270, GK21, GK1, 2.1, ErraticFlint, Yes, 0%, ?
 GK21-271, GK21, GK1, 1.2.1, SouthMoravia?, Yes, 0%,
 GK21-272, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-274, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-275, GK21, GK1, 1.1.6, northAlpine?, No, 0%,
 GK21-276, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-277, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-278, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-279, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-282, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-284, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-286, GK21, GK1, 2, ErraticFlint, Yes, 66-99%, moraine cortex
 GK21-289, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-292, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-295, GK21, GK1, 2, ErraticFlint, Yes, 0%, Crag.
 GK21-298, GK21, GK1, 1.2.1, SouthMoravia?, No, 66-99%, neocortex
 GK21-3, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-30, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-303, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-307, GK21, GK1, 1.1, n/a, Yes, 0%,
 GK21-311, GK21, GK1, n/a, n/a, No, 0%, burnt
 GK21-314, GK21, GK1, 1, SouthMoravia?, No, 0%, vgl. DAS_4_20x_1
 GK21-314a, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-316, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-317, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-319, GK21, GK1, 1.2.1, SouthMoravia?, No, 66-99%, river cortex
 GK21-320, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-321, GK21, GK1, 1, northAlpine, No, 0%,
 GK21-322, GK21, GK1, 1, northAlpine, No, 0%,
 GK21-327, GK21, GK1, 1.1.3, northAlpine, No, 0%,
 GK21-330, GK21, GK1, 1.1.2, northAlpine, No, 0%,
 GK21-340, GK21, GK1, 1.1.1, Danube, No, 0%,
 GK21-341, GK21, GK1, 1.1.3, OldDanubeGravel, No, 0%,
 GK21-342, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-343, GK21, GK1, 1.1.6, northAlpine, No, 0%,
 GK21-344, GK21, GK1, 1.1, northAlpine, No, 0%,
 GK21-347, GK21, GK1, 1.1.1, n/a, No, 0%,
 GK21-348, GK21, GK1, 1.1.1, Danube, No, 0%,
 GK21-349, GK21, GK1, 1.1.2, northAlpine?, No, 0%,
 GK21-350, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-351, GK21, GK1, 1.2.2, SouthMoravia, No, 0%, craq.

GK21-364, GK21, GK1, 1.1.4, n/a, No, 0%,
 GK21-365, GK21, GK1, 1.1.1, Danube, No, 0%,
 GK21-369, GK21, GK1, 1.1.1, Danube, No, 0%,
 GK21-37, GK21, GK1, 1.2.1, n/a, Yes, 66-99%, river cortex
 GK21-371, GK21, GK1, 1.1.2, northAlpine?, No, 0%,
 GK21-381, GK21, GK1, 1.1.3, OldDanubeGravel, No, 0%,
 GK21-384, GK21, GK1, 1.1.3, OldDanubeGravel, No, 0%,
 GK21-388, GK21, GK1, 1.1, northAlpine, No, 0%,
 GK21-393, GK21, GK1, 1.1, SouthMoravia, No, 66-99%, River
 GK21-394, GK21, GK1, 1.1.1, Danube, No, 0%, vgl. RD 11_20x_3 and RD 3_20x_1
 GK21-395, GK21, GK1, 1.1.3, OldDanubeGravel, No, 0%,
 GK21-397, GK21, GK1, 1, n/a, No, 0%,
 GK21-398, GK21, GK1, 2.1, ErraticFlint, Yes, 1-33%, Moraine cortex
 GK21-399, GK21, GK1, n/a, n/a, n/a, 0%, burnt
 GK21-4, GK21, GK1, 2, n/a, Yes, 0%,
 GK21-402, GK21, GK1, 1, ErraticFlint, No, 0%,
 GK21-404, GK21, GK1, 1.2.4, Danube/oldDanubeGrav, No, 0%, vgl.Divers_1_20x_1
 GK21-414, GK21, GK1, 1.1.2, northAlpine?, No, 0%,
 GK21-416, GK21, GK1, n/a, n/a, No, 0%, burnt
 GK21-418, GK21, GK1, 1.1, n/a, No, 0%, burnt
 GK21-419, GK21, GK1, 1.1.1, Carpathian?, No, 0%,
 GK21-43, GK21, GK1, 2.1, ErraticFlint, Yes, 33-66%, moraine cortex
 GK21-431, GK21, GK1, 1.1, n/a, No, 0%,
 GK21-433, GK21, GK1, 1.1.2, northAlpine?, No, 0%,
 GK21-434, GK21, GK1, 1, n/a, No, 0%,
 GK21-436, GK21, GK1, 1.1.1, Carpathian?, No, 0%,
 GK21-438, GK21, GK1, 1.1.1, Carpathian?, No, 0%,
 GK21-439, GK21, GK1, 1.1, n/a, No, 0%,
 GK21-440, GK21, GK1, 1.1.6, northAlpine?, No, 0%,
 GK21-5, GK21, GK1, 1, SouthMoravia?, No, 0%,
 GK21-50, GK21, GK1, 1, northAlpine, No, 0%,
 GK21-53, GK21, GK1, 1.1.6, northAlpine, No, 0%,
 GK21-54, GK21, GK1, 1.1.4, n/a, No, 0%,
 GK21-57, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-61, GK21, GK1, 1, n/a, Yes, 0%, ev. vgl. FST_EmaelFlint_6_20x_1; maybe Danube?
 GK21-62, GK21, GK1, 1.1.3, OldDanubeGravel, No, 0%,
 GK21-66, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-69, GK21, GK1, 1.1, n/a, Yes, 0%,
 GK21-7, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-70, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-77, GK21, GK1, 1, SouthMoravia, n/a, 66-99%, residual cortex
 GK21-8, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-84, GK21, GK1, 1.1.3, OldDanubeGravel, No, 0%,
 GK21-85, GK21, GK1, 1, n/a, No, 0%,
 GK21-87, GK21, GK1, 2, ErraticFlint, Yes, 0%,
 GK21-9, GK21, GK1, 1.1.2, northAlpine?, No, 0%, Danube or old danube gravel?
 GK21-92, GK21, GK1, 2.1, ErraticFlint, Yes, 0%,
 GK21-96, GK21, GK1, 1, Danube/oldDanubeGrav, No, 1-33%, river cortex
 GK21-98, GK21, GK1, 1.1.6, northAlpine, No, 1-33%,
 H11-1, GKII, GK2, 1.1, n/a, No, 0%,
 H11-102, GKII, GK2, 1.1, n/a, No, 0%,
 H11-103, GKII, GK2, 1.1.1, Carpathian?, No, 0%,
 H11-111, GKII, GK2, 1.1.1, Carpathian?, No, 0%,
 H11-122, GKII, GK2, 1.1.2, n/a, No, 0%,
 H11-123, GKII, GK2, 4, n/a, No, 0%,
 H11-124, GKII, GK2, 1.1, n/a, No, 0%,
 H11-131, GKII, GK2, 1.1.1, Carpathian?, No, 0%,
 H11-137, GKII, GK2, 1.1, n/a, No, 0%,
 H11-142, GKII, GK2, 1.1, n/a, No, 0%,
 H11-145, GKII, GK2, 1.1, n/a, No, 0%,
 H11-185, GKII, GK2, 1.1.7, n/a, No, 0%, not north of the alps
 H11-189, GKII, GK2, 1.1.1, n/a, No, 0%,
 H11-190, GKII, GK2, n/a, n/a, No, 0%,
 H11-193, GKII, GK2, 1, n/a, No, 0%, burnt
 H11-198, GKII, GK2, 1.1.2, northAlpine?, No, 0%,
 H11-204, GKII, GK2, 1.1.2, northAlpine?, No, 0%,
 H11-215, GKII, GK2, 1.1, n/a, No, 0%, burnt
 H11-216, GKII, GK2, 1.1.7, n/a, No, 0%, not north of the alps
 H11-217, GKII, GK2, 1.1.2, northAlpine?, No, 0%,
 H11-218, GKII, GK2, 1.1, n/a, No, 0%,
 H11-219, GKII, GK2, 1.1, n/a, No, 0%,
 H11-230, GKII, GK2, 1.1, n/a, No, 0%,
 H11-231, GKII, GK2, 1.1.2, northAlpine?, No, 0%,
 H11-236, GKII, GK2, 1.1, n/a, Yes, 0%,
 H11-237, GKII, GK2, 1.1.1, Carpathian?, No, 0%,
 H11-238, GKII, GK2, 1.1.2, northAlpine?, No, 0%,
 H11-239, GKII, GK2, 1.1, n/a, No, 0%,
 H11-242, GKII, GK2, 1.1.1, Carpathian?, No, 0%,
 H11-243, GKII, GK2, 1.1.2, northAlpine?, No, 0%,
 H11-244, GKII, GK2, 1.1.1, Carpathian?, No, 0%,
 H11-248, GKII, GK2, 1.1, n/a, No, 0%,
 H11-254, GKII, GK2, 1.1, n/a, Yes, 0%,
 H11-255, GKII, GK2, 1, n/a, No, 0%,
 H11-26, GKII, GK2, 1.1.7, n/a, No, 0%,
 H11-263, GKII, GK2, 1.1, n/a, No, 0%,
 H11-267, GKII, GK2, 1, n/a, No, 0%,
 H11-269, GKII, GK2, 1, n/a, No, 0%,
 H11-272, GKII, GK2, 1.1, n/a, No, 0%,
 H11-275, GKII, GK2, 1.1, n/a, No, 0%,
 H11-276, GKII, GK2, n/a, n/a, No, 0%, burnt
 H11-279, GKII, GK2, 1.1, n/a, No, 0%,
 H11-283, GKII, GK2, 1.1, n/a, No, 0%,
 H11-284, GKII, GK2, 1, n/a, No, 0%,
 H11-285, GKII, GK2, 1.1, n/a, No, 0%,
 H11-286, GKII, GK2, 1.1, n/a, No, 0%,
 H11-35, GKII, GK2, 1.1, n/a, No, 0%,
 H11-42, GKII, GK2, 1.1, n/a, No, 0%,
 H11-49, GKII, GK2, 1.1, n/a, No, 0%,
 H11-53, GKII, GK2, 1.1, n/a, No, 0%,
 H11-57, GKII, GK2, 1.1, n/a, No, 0%,
 H11-65, GKII, GK2, 1.1, n/a, No, 0%,
 H11-72, GKII, GK2, 1.1.2, northAlpine?, No, 0%,
 H11-73, GKII, GK2, 1.1, n/a, No, 0%,
 H11-74, GKII, GK2, 1.1.1, Carpathian?, No, 0%,
 H11-76, GKII, GK2, 1.1, n/a, No, 0%, burnt

H11-77,	GKII,	GK2,	1.1.1,	Carpathian?,	No,	0%,	H9-230,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H11-78,	GKII,	GK2,	1.1.1,	n/a,	No,	0%,	H9-243,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H11-83,	GKII,	GK2,	2,	ErraticFlint,	Yes,	0%,	H9-248,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H11-84,	GKII,	GK2,	1.1.1,	Carpathian?,	No,	0%,	H9-25,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H11-85,	GKII,	GK2,	1.1.1,	Carpathian?,	No,	0%,	H9-255,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
H11-96,	GKII,	GK2,	1.1.1,	Carpathian?,	No,	0%,	H9-256,	GKII,	GK2,	n/a,	n/a,	No,	66-99%,	
H9-103,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-258,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
H9-107,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-259,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-120,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-26,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-125,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-260,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
H9-137,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-261,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
H9-138,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-264,	GKII,	GK2,	1,	n/a,	No,	0%,	
H9-139,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-267,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-140,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-268,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-147,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-270,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
H9-148,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-271,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-156,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-272,	GKII,	GK2,	1,	n/a,	No,	0%,	
H9-157,	GKII,	GK2,	1,	n/a,	Yes,	0%,	H9-273,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-158,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-276,	GKII,	GK2,	1,	n/a,	No,	0%,	
H9-159,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-277,	GKII,	GK2,	1,	n/a,	Yes,	0%,	
H9-160,	GKII,	GK2,	n/a,	n/a,	No,	0%,	H9-278,	GKII,	GK2,	1,	n/a,	No,	0%,	
H9-161,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-279,	GKII,	GK2,	1,	n/a,	No,	0%,	
H9-162,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-281,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-163,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-282,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-164,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-287,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-165,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-288,	GKII,	GK2,	n/a,	n/a,	n/a,	0%,	
H9-166,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-290,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-167,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-297,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
H9-168,	GKII,	GK2,	n/a,	n/a,	No,	33-66%,	H9-298,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-169,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-30,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-170,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-302,	GKII,	GK2,	n/a,	n/a,	Yes,	n/a,	
H9-171,	GKII,	GK2,	n/a,	n/a,	No,	0%,	H9-308,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-172,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-310,	GKII,	GK2,	1,	n/a,	No,	0%,	
H9-173,	GKII,	GK2,	n/a,	n/a,	No,	0%,	H9-311,	GKII,	GK2,	1.1,	n/a,	Yes,	0%,	
H9-174,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-312,	GKII,	GK2,	1,	n/a,	No,	0%,	
H9-175,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-313,	GKII,	GK2,	4,	n/a,	No,	0%,	
H9-176,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-314,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
H9-177,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-319,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-198,	GKII,	GK2,	n/a,	n/a,	No,	0%,	H9-320,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-199,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-33,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-200,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-332,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-201,	GKII,	GK2,	n/a,	n/a,	No,	0%,	H9-333,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-202,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-334,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-203,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-339,	GKII,	GK2,	4,	n/a,	No,	n/a,	?
H9-204,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-340,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-205,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-341,	GKII,	GK2,	1,	n/a,	No,	0%,	
H9-206,	GKII,	GK2,	1,	n/a,	No,	0%,	H9-342,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-207,	GKII,	GK2,	n/a,	n/a,	No,	0%,	H9-343,	GKII,	GK2,	1,	n/a,	No,	0%,	
H9-217,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-348,	GKII,	GK2,	n/a,	n/a,	n/a,	0%,	
H9-218,	GKII,	GK2,	1.1,	n/a,	No,	0%,	H9-35,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-220,	GKII,	GK2,	1.1,	n/a,	No,	100%,	H9-352,	GKII,	GK2,	n/a,	n/a,	No,	0%,	
H9-221,	GKII,	GK2,	n/a,	n/a,	No,	0%,	H9-353,	GKII,	GK2,	1.1,	n/a,	No,	0%,	
H9-229,	GKII,	GK2,	1.1,	n/a,	Yes,	0%,	H9-356,	GKII,	GK2,	1,	n/a,	No,	0%,	
burnt														

burnt

H9-36, GKII, GK2, n/a, n/a, n/a, No, 0%,
 H9-37, GKII, GK2, n/a, n/a, n/a, No, 0%,
 H9-381, GKII, GK2, 1.1, n/a, No, 0%,
 H9-382, GKII, GK2, n/a, n/a, n/a, n/a, 0%, burnt
 H9-383, GKII, GK2, 1.1, n/a, No, 0%,
 H9-385, GKII, GK2, 1.1.7, n/a, No, 0%,
 H9-386, GKII, GK2, 1.1.1, Carpathian?, No, 0%,
 H9-388, GKII, GK2, 1.1, n/a, No, 0%,
 H9-400, GKII, GK2, 1.1, n/a, No, 0%,
 H9-402, GKII, GK2, 1.1, n/a, No, 0%,
 H9-403, GKII, GK2, 1.1, n/a, No, 0%,
 H9-409, GKII, GK2, 1.1, n/a, Yes, 0%,
 H9-41, GKII, GK2, 1.1, n/a, No, 0%,
 H9-410, GKII, GK2, 1.1, n/a, No, 0%,
 H9-411, GKII, GK2, 1.1.7, n/a, No, 0%,
 H9-412, GKII, GK2, 1.1, n/a, No, 0%,
 H9-413, GKII, GK2, 1.1, n/a, No, 0%,
 H9-414, GKII, GK2, 1.1, n/a, No, 0%, burnt?
 H9-415, GKII, GK2, 4, n/a, No, 0%,
 H9-416, GKII, GK2, 1, n/a, No, 0%,
 H9-417, GKII, GK2, 1, n/a, No, 0%,
 H9-418, GKII, GK2, 1.1, n/a, No, 0%,
 H9-421, GKII, GK2, 1.1, n/a, No, 0%,
 H9-422, GKII, GK2, 1.1, n/a, No, 0%,
 H9-424, GKII, GK2, 1.1.7, n/a, No, 0%,
 H9-425, GKII, GK2, 1.1, n/a, No, 0%,
 H9-426, GKII, GK2, 1.1, n/a, No, 0%, burnt
 H9-43, GKII, GK2, n/a, n/a, No, 0%,
 H9-433, GKII, GK2, 1.1.7, n/a, No, 0%,
 H9-44, GKII, GK2, 1.1, n/a, No, 0%,
 H9-45, GKII, GK2, n/a, n/a, No, 0%,
 H9-467, GKII, GK2, 2, ErraticFlint, Yes, 0%,
 H9-468, GKII, GK2, 1.1, n/a, No, 0%,
 H9-469, GKII, GK2, n/a, n/a, No, 0%,
 H9-47, GKII, GK2, 1.1, n/a, No, 0%,
 H9-470, GKII, GK2, 1.1, n/a, No, 0%,
 H9-471, GKII, GK2, 1, n/a, No, 0%,
 H9-472, GKII, GK2, 1, n/a, No, 0%,
 H9-473, GKII, GK2, 1.1, n/a, No, 0%,
 H9-474, GKII, GK2, 1.1, n/a, No, 0%,
 H9-475, GKII, GK2, 1.1, n/a, No, 0%,
 H9-476, GKII, GK2, 1, n/a, No, 0%, burnt?
 H9-477, GKII, GK2, 1, n/a, No, 0%,
 H9-49, GKII, GK2, n/a, n/a, No, 0%,
 H9-500, GKII, GK2, 1.1, n/a, n/a, 0%,
 H9-505, GKII, GK2, 2, ErraticFlint, Yes, 0%,
 H9-506, GKII, GK2, 1.1, n/a, No, 0%,
 H9-507, GKII, GK2, 1.1, n/a, No, 0%,
 H9-508, GKII, GK2, 1.1, n/a, Yes, 0%,
 H9-509, GKII, GK2, n/a, n/a, No, 0%,
 H9-51, GKII, GK2, 1.1, n/a, No, 0%,
 H9-510, GKII, GK2, 2, ErraticFlint, Yes, 0%,
 H9-511, GKII, GK2, 2, ErraticFlint, Yes, 0%,

H9-512, GKII, GK2, 2, ErraticFlint, Yes, 0%,
 H9-518, GKII, GK2, 1, n/a, No, 0%,
 H9-52, GKII, GK2, n/a, n/a, No, 0%,
 H9-521, GKII, GK2, n/a, n/a, n/a, 0%, burnt?
 H9-525, GKII, GK2, 2, ErraticFlint, Yes, 0%,
 H9-529, GKII, GK2, 1, n/a, No, 0%,
 H9-529a, GKII, GK2, n/a, n/a, No, 0%,
 H9-53, GKII, GK2, 1.1, n/a, No, 0%,
 H9-531, GKII, GK2, n/a, n/a, n/a, 0%, burnt
 H9-533, GKII, GK2, 1, n/a, No, 0%,
 H9-537, GKII, GK2, n/a, n/a, No, 0%,
 H9-538, GKII, GK2, 1.1, n/a, No, 0%,
 H9-543, GKII, GK2, n/a, n/a, n/a, 1-33%,
 H9-544, GKII, GK2, 2, ErraticFlint, Yes, 33-66%,
 H9-545, GKII, GK2, 1.1, n/a, No, 0%,
 H9-546, GKII, GK2, 1.1, n/a, No, 0%,
 H9-547, GKII, GK2, 2, ErraticFlint, Yes, 0%,
 H9-548, GKII, GK2, 1, n/a, No, 0%,
 H9-549, GKII, GK2, 1.1, n/a, No, 0%,
 H9-566, GKII, GK2, 2, ErraticFlint, Yes, 0%,
 H9-567, GKII, GK2, n/a, n/a, No, 0%,
 H9-568, GKII, GK2, 2, ErraticFlint, Yes, 0%,
 H9-569, GKII, GK2, 1, n/a, No, 0%,
 H9-570, GKII, GK2, n/a, n/a, No, 0%,
 H9-571, GKII, GK2, 2, ErraticFlint, Yes, 0%,
 H9-572, GKII, GK2, 1.1.7, n/a, No, 0%,
 H9-573, GKII, GK2, 1.1, n/a, No, 0%, burnt
 H9-574, GKII, GK2, n/a, n/a, n/a, 0%, burnt
 H9-575, GKII, GK2, n/a, n/a, No, 0%,
 H9-576, GKII, GK2, 1, n/a, No, 0%,
 H9-600, GKII, GK2, 2, ErraticFlint, Yes, 0%,
 H9-601, GKII, GK2, 1, n/a, No, 0%,
 H9-602, GKII, GK2, 2, ErraticFlint, Yes, 0%,
 H9-603, GKII, GK2, 2, ErraticFlint, Yes, 66-99%,
 H9-604, GKII, GK2, 2, ErraticFlint, Yes, 0%,
 H9-615, GKII, GK2, 2, ErraticFlint, Yes, n/a,
 H9-627, GKII, GK2, 2, ErraticFlint, Yes, 0%,
 H9-63, GKII, GK2, n/a, n/a, No, 0%,
 H9-632, GKII, GK2, n/a, n/a, No, 0%,
 H9-633, GKII, GK2, 1.1, n/a, No, 0%,
 H9-634, GKII, GK2, n/a, n/a, No, 0%,
 H9-635, GKII, GK2, 1.1, n/a, n/a, 0%,
 H9-64, GKII, GK2, n/a, n/a, No, 0%,
 H9-69, GKII, GK2, n/a, n/a, No, 0%,
 H9-70, GKII, GK2, 1.1, n/a, No, 0%,
 H9-71, GKII, GK2, 1, n/a, No, 0%,
 H9-75, GKII, GK2, 1.1.7, n/a, No, 0%,
 H9-76, GKII, GK2, 1.1, n/a, No, 0%,
 H9-77, GKII, GK2, n/a, n/a, No, 0%,
 H9-79, GKII, GK2, 1.1, n/a, No, 0%,
 H9-80, GKII, GK2, 1.1, n/a, No, 0%,
 H9-83, GKII, GK2, n/a, n/a, No, 0%,
 H9-85, GKII, GK2, 1.1, n/a, No, 0%,

H9-87, GKII, GK2, 1.1, n/a, No, 0%,
H9-88, GKII, GK2, 1.1, n/a, No, 0%,
H9-95, GKII, GK2, 1.1, n/a, No, 0%,
H9-97, GKII, GK2, 1.1, n/a, No, 0%,
I10-100, GKII, GK2, n/a, n/a, No, 0%,
I10-101, GKII, GK2, n/a, n/a, No, 0%,
I10-102, GKII, GK2, n/a, n/a, No, 0%,
I10-103, GKII, GK2, n/a, n/a, No, 0%,
I10-104, GKII, GK2, 1.1, n/a, No, 0%,
I10-111, GKII, GK2, 1.1.7, n/a, No, 0%,
I10-112, GKII, GK2, 1, n/a, No, 0%,
I10-113, GKII, GK2, 1.1, n/a, No, 0%,
I10-114, GKII, GK2, 1.1, n/a, No, 0%,
I10-115, GKII, GK2, 1, n/a, No, 0%,
I10-116, GKII, GK2, 1.1.7, n/a, No, 0%,
I10-127, GKII, GK2, 1.1, n/a, No, 0%,
I10-128, GKII, GK2, 1.1, n/a, No, 100%,
I10-130, GKII, GK2, n/a, n/a, No, 0%,
I10-131, GKII, GK2, n/a, n/a, No, 1-33%,
I10-132, GKII, GK2, n/a, n/a, No, 0%,
I10-135, GKII, GK2, 1.1, n/a, No, 0%,
I10-137, GKII, GK2, n/a, n/a, No, 0%,
I10-139, GKII, GK2, 1, n/a, No, 0%,
I10-140, GKII, GK2, 1, n/a, No, 0%,
I10-141, GKII, GK2, n/a, n/a, No, 0%,
I10-142, GKII, GK2, 1.1, n/a, No, 0%,
I10-143, GKII, GK2, 1.1, n/a, No, 0%,
I10-144, GKII, GK2, 1.1, n/a, No, 0%,
I10-145, GKII, GK2, 1, n/a, No, 0%,
I10-146, GKII, GK2, 1.1, n/a, No, 0%,
I10-147, GKII, GK2, 4, n/a, No, 0%,
I10-149, GKII, GK2, 1.1, n/a, No, 0%,
I10-150, GKII, GK2, n/a, n/a, No, 0%,
I10-151, GKII, GK2, 1.1, n/a, No, 0%,
I10-152, GKII, GK2, 1.1, n/a, Yes, 0%,
I10-153, GKII, GK2, n/a, n/a, Yes, 0%,
I10-154, GKII, GK2, 1.1, n/a, No, 0%,
I10-155, GKII, GK2, 1, n/a, No, 0%,
I10-159, GKII, GK2, 1, n/a, No, 0%,
I10-166, GKII, GK2, 1, n/a, No, 0%,
I10-167, GKII, GK2, 1.1, n/a, No, 0%,
I10-19, GKII, GK2, 1, n/a, No, 0%,
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I10-205, GKII, GK2, 1.1, n/a, No, 0%,
I10-206, GKII, GK2, 1, n/a, No, 0%,
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I10-225, GKII, GK2, 1.1, n/a, No, 0%,
I10-226, GKII, GK2, 1, n/a, No, 0%,
I10-23, GKII, GK2, n/a, n/a, No, 0%,
I10-24, GKII, GK2, 1.1, n/a, No, 0%,
I10-25, GKII, GK2, 1.1, n/a, No, 0%,
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I10-290, GKII, GK2, 1, n/a, No, 0%,
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I10-293, GKII, GK2, 1.1, n/a, No, 0%,
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burnt

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I10-476, GKII, GK2, 1.1, n/a, No, 0%,
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I10-76, GKII, GK2, n/a, n/a, No, 0%,
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I10-81, GKII, GK2, 1.1, n/a, No, 0%,
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I10-90, GKII, GK2, 1.1, n/a, No, 0%,
I10-96, GKII, GK2, n/a, n/a, No, 0%,
I10-97, GKII, GK2, 1.1, n/a, No, 0%,
I10-98, GKII, GK2, n/a, n/a, No, 0%,

11.3. Annex 3: R-script

```
#master thesis Grub-Kranawetberg I and II
#load necessary libraries####
install.packages("ggplot2")
library(ggplot2)
install.packages("WriteXLS")
library(WriteXLS)
install.packages("patchwork")
library(patchwork)
install.packages("readxl")
library(readxl)
install.packages("dplyr")
library(dplyr)
install.packages("RColorBrewer")
library(RColorBrewer)
install.packages("reshape2")
library(reshape2)
install.packages("gcookbook")
library(gcookbook)
install.packages("plyr")
library(plyr)
install.packages("tidyr")
library(tidyr)

# Pfad zur .xlsx-Datei
daten <- read_excel("/Users/samuelkasemann/Dropbox/Lithics-Samuel/MA_Daten zum Arbeiten/Korrekturen/Dateien zum Arbeiten/R/Master_Li-
thics_rawMaterial.xlsx", sheet = Master_Lithics_rawMaterial)

#set working directory
setwd("~/Dropbox/Lithics-Samuel/MA_Daten zum Arbeiten/Korrekturen/Dateien zum Arbeiten/R/")
#myimport are all data from MA-thesis (all inventory) (Stand 12.03.25)
#import data
myimport <- read_xlsx("Master_Lithics_rawMaterial.xlsx")

#look at structure of data
str(myimport)

#convert chraracter (chr) to factor etc.
myimport <- mutate_if(myimport, is.character, as.factor)
myimport <- mutate_if(myimport, is.logical, as.factor)

#look at structure of data
str(myimport)

#Anzahl in AHs in all inventories. GKI(Antl/21), GKII
inventory <- table(myimport$Lithic_all_inventory)
View(inventory)
write.csv(inventory, "Inventory.csv")

#mydata is only GKAntl (n=1192)
#select only parcels with finds
mydata <- myimport %>%
  filter(lithic_all_inventory == "GK-Antl")
write.csv(mydata, "mydataGKAntl.csv")
View(mydata)
write.csv(mydata, "GKAntl/mydataGKAntl.csv")

#Make frequency table and graph
xt1 <- xtabs(~AH, data = mydata)
View(xt1)
write.csv(xt1, "GKAntl/AH_GKAntl.csv")
#Der Befehl write.csv() in R wird verwendet,
#um Daten aus einem Dataframe oder einer Tabelle in eine CSV-Datei (Comma Separated Values) zu schreiben.
#Dabei wird die Struktur der Daten in einem durch Kommas getrennten Format gespeichert,
#das leicht in anderen Programmen (z.B. Excel) geöffnet und weiterverarbeitet werden kann.

#Tabelle mit NA-Anzahl
xt2 <- table(mydata$AH, useNA = "ifany") #ifany zeigt NA Werte an sofern sie vorhanden sind
View(xt2)
write.csv(xt2, "AH_GKAntl.csv")

p <- ggplot(mydata, aes(AH)) + geom_bar(stat = "count") + coord_flip() + theme_bw()
p

p1 <- ggplot(mydata, aes(AH)) +
  geom_bar(aes(y = (..count..)/sum(..count..))) +
  scale_y_continuous(labels=scales::percent) +
  ylab("relative frequencies") + coord_flip() + theme_bw()

p + p1
####
#AH allg.###
TableAH <- table(myimport$AH, useNA = "ifany")
View(TableAH)
write.csv(TableAH, "TableAH_allg.csv")

#ggplot test####
#absolute H\Sufigkeit der Lithics/AH in GKAntl####
p2 <- ggplot(mydata, aes(x = AH, fill = AH)) +
  geom_bar(stat = "count") + # stat = "count" z\hlt automatisch die H\Sufigkeit der Kategorien
  scale_fill_manual(values = c("darkgoldenrod1", "darkgoldenrod2", "darkorange2", "chocolate4", "chocolate2", "grey")) + # Manuelle Far-
  bauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Absolute Frequency",
        x = "AH",
        y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom", #Legende unterhalb des Plots
        plot.title = element_text(hjust = 0.5)) + # Titel mittig ausrichten)
  geom_text(
    aes(label = ..count..), # Zeigt die H\Sufigkeit unter den Balken an
    stat = "count", # Wichtig, um die H\Sufigkeit zu berechnen
    position = position_dodge(width = 0.9), # Gleiche Position wie die Balken, um den Text darunter zu setzen
    vjust = -0.5) # Setzt den Text etwas unterhalb der Balken
p2
ggsave("GKAntl/Plots/p2_AH_GKAntl.pdf", plot = p2, width = 8, height = 6)

#relative H\Sufigkeit
p3 <- ggplot(mydata, aes(x = AH, y = Relative_H\Sufigkeit, fill = AH)) +
```

```

geom_bar(aes(y = (..count..)/sum(..count..))) +
scale_fill_manual(values = c("darkgoldenrod1", "darkgoldenrod2", "darkorange2", "chocolate4", "chocolate2", "grey")) + # Manuelle Far-
bauswahl
theme_minimal() + # Einfache Darstellung
labs(title = "Relative Frequency",
      x = "AH",
      y = "Percent") +
scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
theme(legend.title = element_blank(),
      legend.position = "bottom",
      legend.text.position = "bottom", # Legende unterhalb des Plots
      plot.title = element_text(hjust = 0.5)) # Titel mittig ausrichten)

p3
p2+p3
plot_abs_rel <- p2+p3
plot_abs_rel

combined_plot <- p2 + p3 + plot_layout(guides = "collect")
combined_plot

#Test f r Deskriptive Statistik der Bem vungen aufgeteilt in AHs (GKI)####

descriptive_stats <- mydata %>%
  group_by(AH) %>%
  summarise(
    Mean_Length = mean(length),
    SD_Length = sd(length),
    Median_Length = median(length),
    Min_Length = min(length),
    Max_Length = max(length),

    Mean_Width = mean(width),
    SD_Width = sd(width),
    Median_Width = median(width),
    Min_Width = min(width),
    Max_Width = max(width),

    Mean_Thickness = mean(thickness),
    SD_Thickness = sd(thickness),
    Median_Thickness = median(thickness),
    Min_Thickness = min(thickness),
    Max_Thickness = max(thickness),

    Mean_Weight = mean(weight),
    SD_Weight = sd(weight),
    Median_Weight = median(weight),
    Min_Weight = min(weight),
    Max_Weight = max(weight)
  )
descriptive_stats
View(descriptive_stats)

# Descriptive statistics for length
GKI_length_stats <- mydata %>%
  group_by(AH) %>%
  summarise(
    mean_length = mean(length),
    sd_length = sd(length),
    median_length = median(length),
    min_length = min(length),
    max_length = max(length)
  )

# Descriptive statistics for width
GKI_width_stats <- mydata %>%
  group_by(AH) %>%
  summarise(
    mean_width = mean(width),
    sd_width = sd(width),
    median_width = median(width),
    min_width = min(width),
    max_width = max(width)
  )

# Descriptive statistics for thickness
GKI_thickness_stats <- mydata %>%
  group_by(AH) %>%
  summarise(
    mean_thickness = mean(thickness),
    sd_thickness = sd(thickness),
    median_thickness = median(thickness),
    min_thickness = min(thickness),
    max_thickness = max(thickness)
  )

# Descriptive statistics for weight
GKI_weight_stats <- mydata %>%
  group_by(AH) %>%
  summarise(
    mean_weight = mean(weight),
    sd_weight = sd(weight),
    median_weight = median(weight),
    min_weight = min(weight),
    max_weight = max(weight)
  )

View(GKI_length_stats)
View(GKI_width_stats)
View(GKI_thickness_stats)
View(GKI_weight_stats)

#Boxplot####
# Erstelle Boxplot f r die Spalte 'length' aus der Tabelle 'mydata'
ggplot(mydata, aes(x = "", y = length)) + # "" bedeutet keine Gruppierung auf der x-Achse
  geom_boxplot(fill = "lightblue", color = "black") + # Boxplot mit Farbe
  labs(title = "Boxplot of Length", y = "Length", x = "") + # Titel und Beschriftung der y-Achse
  theme_minimal() # Einfache Darstellung

# Entferne die Zeilen mit NA in der Spalte AH
mydata_clean <- mydata[!is.na(mydata$AH), ]

```

```

# Umkehren der Reihenfolge der AH-Gruppen
mydata_clean$AH <- factor(mydata_clean$AH, levels = rev(levels(factor(mydata_clean$AH))))

# Erstelle Boxplot f r 'length' und gruppiere nach 'AH'
Boxplot_length_GK_Ant1 <- ggplot(mydata_clean, aes(x = AH, y = length, fill = AH)) +
  geom_boxplot(color = "black") +
  labs(title = "Boxplot of Length by Archaeological Horizon (AH)", y = "Length", x = "AH") +
  scale_fill_manual(values = c("darkgoldenrod1", "darkorange2", "chocolate4", "grey")) + # Benutzerdefinierte Farben f r die Boxen
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) # Rotiert die Achsentitel f r eine bessere Lesbarkeit

Boxplot_length_GK_Ant1

# Erstelle Boxplot f r 'thickness' und gruppiere nach 'AH'
Boxplot_thickness_GK_Ant1 <- ggplot(mydata_clean, aes(x = AH, y = thickness, fill = AH)) +
  geom_boxplot(color = "black") +
  labs(title = "Boxplot of Thickness by Archaeological Horizon (AH)", y = "Thickness", x = "AH") +
  scale_fill_manual(values = c("darkgoldenrod1", "darkorange2", "chocolate4", "grey")) + # Benutzerdefinierte Farben f r die Boxen
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) # Rotiert die Achsentitel f r eine bessere Lesbarkeit

Boxplot_thickness_GK_Ant1

# Erstelle Boxplot f r 'width' und gruppiere nach 'AH'
Boxplot_width_GK_Ant1 <- ggplot(mydata_clean, aes(x = AH, y = width, fill = AH)) +
  geom_boxplot(color = "black") +
  labs(title = "Boxplot of Width by Archaeological Horizon (AH)", y = "Width", x = "AH") +
  scale_fill_manual(values = c("darkgoldenrod1", "darkorange2", "chocolate4", "orange")) + # Benutzerdefinierte Farben f r die Boxen
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) # Rotiert die Achsentitel f r eine bessere Lesbarkeit

Boxplot_width_GK_Ant1

# Erstelle Boxplot f r 'weight' und gruppiere nach 'AH'
Boxplot_weight_GK_Ant1 <- ggplot(mydata_clean, aes(x = AH, y = log(weight), fill = AH)) +
  geom_boxplot(color = "black") +
  labs(title = "Boxplot of Weight by Archaeological Horizon (AH)", y = "log(weight)", x = "AH") +
  scale_fill_manual(values = c("darkgoldenrod1", "darkorange2", "chocolate4", "orange")) + # Benutzerdefinierte Farben f r die Boxen
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) # Rotiert die Achsentitel f r eine bessere Lesbarkeit

Boxplot_weight_GK_Ant1

#####
#####

# Zeige die einzigartigen Werte in der Spalte rawMaterial_all_RMU an
unique_values_rawMaterial_all_RMU_GK_Ant1 <- unique(mydata$rawMaterial_all_RMU)
print(unique_values_rawMaterial_all_RMU_GK_Ant1)

# Z hle die Anzahl der einzigartigen Werte in der Spalte rawMaterial_all_RMU
num_unique_values_rawMaterial_all_RMU_GK_Ant1 <- length(unique(mydata$rawMaterial_all_RMU))
print(num_unique_values_rawMaterial_all_RMU_GK_Ant1)

#Boxplot f r RMU/AH f r GKAnt1####
#Erstelle Boxplot f r 'rawMaterial_all_RMU' und gruppiere nach 'AH'
RMU_GK_Ant1 <- ggplot(mydata, aes(x = AH, fill = rawMaterial_all_RMU)) +
  geom_bar(stat = "count") + # Z hlt die H ufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("bisque4", "orangered3", "brown4", "gainsboro", "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki")) +
  # Benutzerdefinierte Farben f r die Balken
  theme_minimal() + # Einfaches Design
  labs(title = "Lithic Raw Materials by Archaeological Horizon (AH) in GK I (1993-2011)",
       x = "Archaeological Horizon (AH)",
       y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "right",
        legend.text.position = "bottom") # Legende unterhalb des Plots

RMU_GK_Ant1
ggsave("GKAnt1/Plots/RMU_GK_Ant1.pdf", plot = RMU_GK_Ant1, width = 8, height = 6)

#Tabelle weight > 0.1####

mydata_weight_filtered <- mydata_clean[mydata_clean$weight > 0.1, ]
View(mydata_weight_filtered)

Boxplot_weight_GK_Ant1_filtered <- ggplot(mydata_weight_filtered, aes(x = AH, y = weight, fill = AH)) +
  geom_boxplot(color = "black") +
  labs(title = "Weight by Archaeological Horizon (AH)", y = "weight", x = "AH") +
  scale_fill_manual(values = c("darkgoldenrod1", "darkorange2", "chocolate4", "grey")) + # Benutzerdefinierte Farben f r die Boxen
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) #+ # Rotiert die Achsentitel f r eine bessere Lesbarkeit
  #geom_jitter(width = 0.2)

#Boxplot_weight_GK_Ant1_filtered

Boxplot_weight_GK_Ant1_filtered_log <- ggplot(mydata_weight_filtered, aes(x = AH, y = log(weight), fill = AH)) +
  geom_boxplot(color = "black") +
  labs(title = "Weight by Archaeological Horizon (AH)", y = "log(weight)", x = "AH") +
  scale_fill_manual(values = c("darkgoldenrod1", "darkorange2", "chocolate4", "grey")) + # Benutzerdefinierte Farben f r die Boxen
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) #+ # Rotiert die Achsentitel f r eine bessere Lesbarkeit
  #geom_jitter(width = 0.2)

Boxplot_weight_GK_Ant1_filtered_log

Boxplot_weight_GK_Ant1_filtered + Boxplot_weight_GK_Ant1_filtered_log

#####
#Deskriptive Statistik GK1
#####

descriptive_stats_GK_Ant1
# Descriptive statistics for length
GK_Ant1_length_stats <- mydata %>%
  group_by(AH) %>%
  summarise(
    mean_length = mean(length),
    sd_length = sd(length),
    median_length = median(length),
    min_length = min(length),
    max_length = max(length)
  )

```

```

# Descriptive statistics for width
GK_Antl_width_stats <- mydata %>%
  group_by(AH) %>%
  summarise(
    mean_width = mean(width),
    sd_width = sd(width),
    median_width = median(width),
    min_width = min(width),
    max_width = max(width)
  )

# Descriptive statistics for thickness
GK_Antl_thickness_stats <- mydata %>%
  group_by(AH) %>%
  summarise(
    mean_thickness = mean(thickness),
    sd_thickness = sd(thickness),
    median_thickness = median(thickness),
    min_thickness = min(thickness),
    max_thickness = max(thickness)
  )

# Descriptive statistics for weight
GK_Antl_weight_stats <- mydata %>%
  group_by(AH) %>%
  summarise(
    mean_weight = mean(weight),
    sd_weight = sd(weight),
    median_weight = median(weight),
    min_weight = min(weight),
    max_weight = max(weight)
  )

##getting 0.0 out of the data
mydata_platform_filtered <- mydata[mydata$platformWidth > 0.00, ]
View(mydata_platform_filtered)

# Descriptive statistics for platform_width
GK_Antl_platform_width_stats <- mydata_platform_filtered %>%
  group_by(AH) %>%
  summarise(
    mean_platform_width = mean(platformWidth),
    sd_platform_width = sd(platformWidth),
    median_platform_width = median(platformWidth),
    min_platform_width = min(platformWidth),
    max_platform_width = max(platformWidth)
  )

View(GK_Antl_platform_width_stats)

# Descriptive statistics for platform_thickness
GK_Antl_platform_thickness_stats <- mydata_platform_filtered %>%
  group_by(AH) %>%
  summarise(
    mean_platform_thickness = mean(platformThickness),
    sd_platform_thickness = sd(platformThickness),
    median_platform_thickness = median(platformThickness),
    min_platform_thickness = min(platformThickness),
    max_platform_thickness = max(platformThickness)
  )

View(GK_Antl_platform_thickness_stats)
####
###      #      #####      #
### ##   # #   #           # #
### ##   #####   #   #####
### ##   #   #   #   #
#####GKAntl
#GKAntl/Plots/
#mydata2 is a new table with only the lithics/finds with AH 3 and AH 4 (without AH 2 and NA)
mydata2 <- mydata[mydata$AH %in% c("AH3", "AH4"), ]
View(mydata2)
mydata2$AH <- factor(mydata2$AH, levels = c("AH3", "AH4"))

###Descriptive Statistics###
#AHS
##absolute HV$ufigkeit GK_Antl####
p001 <- ggplot(mydata2, aes(x = AH, fill = AH)) +
  geom_bar(stat = "count") + # stat = "count" z$hl automatisch die HV$ufigkeit der Kategorien
  scale_fill_manual(values = c("darkorange2", "chocolate4")) + # Manuelle Farbauswahl, "darkgoldenrod1", "grey"
  theme_minimal() + # Einfache Darstellung
  labs(#title = "Finds by Archaeological Horizon (AH) in GK I",
    x = "",
    y = "Count") +
  theme(plot.title = element_text(hjust = 0.5)) + # Zentriert den Titel
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") # Legende unterhalb des Plots

p001
# Speichern des Plots als PNG
ggsave("GKAntl/Plots/p001_absfreqAH.pdf", plot = p001, width = 8, height = 6)

#Tabelle
xtab_001 <- addmargins(xtabs(~ mydata2$AH), margin = 1)
xtab_001
write.csv(xtab_001, "xtab_001_absfreqAH.csv")
View(xtab_001)

##relative HV$ufigkeit####
p002 <- ggplot(mydata2, aes(x = AH, y = Relative HV$ufigkeit, fill = AH)) +
  geom_bar(aes(y = (..count..)/sum(..count..))) +
  scale_fill_manual(values = c("darkorange2", "chocolate4")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(#title = "Finds by Archaeological Horizon (AH) in GK I",
    x = "",
    y = "Percent") +
  theme(plot.title = element_text(hjust = 0.5)) + # Zentriert den Titel
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent

```

```

    theme(legend.title = element_blank(),
          legend.position = "bottom",
          legend.text.position = "bottom") # Legende unterhalb des Plots

p002
# Speichern des Plots als PNG
#ggsave("p002_relfreqAH.png", plot = p002, width = 8, height = 6, dpi = 300, bg = "white")
ggsave("GKAnt1/Plots/p002_relfreqAH.pdf", plot = p002, width = 8, height = 6)
P1 <- p001+p002 + plot_annotation(title = "Finds by Archaeological Horizon (AH) in GK I", #gemeinsamer Titel
                                theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift

    plot_layout(guides = "collect") +
    theme(legend.title = element_blank(),
          legend.position = "bottom",
          legend.text.position = "bottom")
P1 # Absolute und Relative Frequency of the finds within the AHs
#Speichern des Plots als PNG
#ggsave("P1_absrelfreqAH.png", plot = P1, width = 8, height = 6, dpi = 300, bg = "white")
ggsave("GKAnt1/Plots/P1_absrelfreqAH.pdf", plot = P1, width = 8, height = 6)
#####
#####
#basistechnology #####
xtab_021 <- mydata2 %>%
  group_by(AH, basistechnology) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HVSufigkeit pro AH-Gruppe

View(xtab_021)
write.csv(xtab_021, "xtab_021.csv")

#absfreq###
p022 <- ggplot(mydata2, aes(x = AH, fill = basistechnology)) +
  geom_bar(stat = "count") + # ZV$ht die HVSufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("darkred", "plum4", "darkgreen", "grey")) + # "black", "royalblue2", "skyblue1", "orange1", "lightgoldenrod1") + #, "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3", "blue")) + # Benutzerdefinierte Farben fVr die Balken
  theme_minimal() + # Einfaches Design
  labs(#title = "Basis Technologies by Archaeological Horizon (AH) in GK I (1993-2011)",
       x = "",
       y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p022
ggsave("GKAnt1/Plots/p022_basistechnology.pdf", plot = p022, width = 8, height = 6)

#relfreq###
p023 <- ggplot(xtab_021, aes(x = AH, y = percent, fill = basistechnology)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("darkred", "plum4", "darkgreen", "grey")) + # "black", "royalblue2", "skyblue1", "orange1", "lightgoldenrod1") + #, "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3", "blue")) + # Benutzerdefinierte Farben fVr die Balken
  theme_minimal() + # Einfache Darstellung
  labs(#title = "Basis Technologies by Archaeological Horizon (AH) in GK I (1993-2011)",
       x = "",
       y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p023
# Speichern des Plots als PNG
ggsave("p023_basistechnology.pdf", plot = p023, width = 8, height = 6)

P9 <- p022+p023 + plot_annotation(title = "Basis Technologies by Archaeological Horizon (AH) in GK I", #gemeinsamer Titel
                                theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift

    plot_layout(guides = "collect") + # Gemeinsame Legende
    theme(legend.position = "bottom")

P9
ggsave("GKAnt1/Plots/P9_basistechnology.pdf", plot = P9, width = 8, height = 6)

#dataclass #####
xtab_020 <- mydata2 %>%
  group_by(AH, dataclass) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HVSufigkeit pro AH-Gruppe

View(xtab_020)
write.csv(xtab_020, "xtab_020.csv")

mydata2$ataclass <- factor(mydata2$ataclass, levels = c("flake","chip", "blade", "bladelet", "burinSpall", "potlid", "core", "coreShatter", "crestedBlade", "shatter", "thermalShatter"))

#absfreq###
p020 <- ggplot(mydata2, aes(x = AH, fill = dataclass)) +
  geom_bar(stat = "count") + # ZV$ht die HVSufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("darkgreen", "darkolivegreen2", "darkred", "lightpink2", "plum4", "black", "royalblue2", "skyblue1", "brown", "orange1", "lightgoldenrod1")) + #, "gray", "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3", "blue")) + # Benutzerdefinierte Farben fVr die Balken
  theme_minimal() + # Einfaches Design
  labs(#title = "Dataclass by Archaeological Horizon (AH) in GK I (1993-2011)",
       x = "",
       y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p020
ggsave("GKAnt1/Plots/p020_dataclass.pdf", plot = p020, width = 8, height = 6)

#relfreq###
p021 <- ggplot(xtab_020, aes(x = AH, y = percent, fill = dataclass)) +

```

```

    geom_bar(stat = "identity", position = "fill") +
    scale_fill_manual(values = c("darkgreen", "darkolivegreen2", "darkred", "lightpink2", "plum4", "black", "royalblue2", "skyblue1", "brown",
"orange1", "lightgoldenrod1")) + #, "gray", "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3",
"blue")) + # Benutzerdefinierte Farben für die Balken
    theme_minimal() + # Einfache Darstellung
    labs(title = "Dataclass by Archaeological Horizon (AH) in GK I (1993-2011)", # Hier kannst du deinen Titel einführen, z.B. "Thermal
Alteration GK I"
        x = "",
        y = "Percent") +
    scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
    theme(legend.title = element_blank(),
          legend.position = "bottom",
          legend.text.position = "bottom") + # Legende unterhalb des Plots
    theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p021
# Speichern des Plots als PDF
ggsave("p021_Dataclass.pdf", plot = p021, width = 8, height = 6)

P21 <- p020+p021 + plot_annotation(title = "Dataclass by Archaeological Horizon (AH) in GK I", #gemeinsamer Titel
                                theme = theme(plot.title = element_text(hjust = 0.5))) #+ Zentrieren der Überschrift
    plot_layout(guides = "collect") + # Gemeinsame Legende
    theme(legend.position = "bottom")

P21
ggsave("GKAnt1/Plots/P21_Dataclass.pdf", plot = P21, width = 8, height = 6)

#thermalAlteration #####
mydata2$thermalAlteration1 <- factor(mydata2$thermalAlteration1, levels = c("Yes", "No", "NA"))

#absfreq###
p003 <- ggplot(mydata2, aes(x = AH, fill = thermalAlteration1)) +
    geom_bar(stat = "count", position = "dodge") + #Erstellt ein gruppiertes Balkendiagramm, bei dem die Balken nebeneinander (nicht
übereinander) angezeigt werden.
    #geom_bar(stat = "count") + # stat = "count" zshlt automatisch die Hsufigkeit der Kategorien
    scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
    theme_minimal() + # Einfache Darstellung
    labs(title = "Thermal Alterations by Archaeological Horizon (AH) in GK I (1993-2011)", #Thermal Alteration GK I
        x = "",
        y = "Count") +
    theme(legend.title = element_blank(),
          legend.position = "bottom",
          legend.text.position = "bottom") + # Legende unterhalb des Plots
    theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p003
# Speichern des Plots als PNG
#ggsave("p003_ThermalAlteration.png", plot = p003, width = 8, height = 6, dpi = 300, bg = "white")
ggsave("GKAnt1/Plots/p003_ThermalAlteration.pdf", plot = p003, width = 8, height = 6)
#Tabelle
xtab_003 <- table(mydata2$thermalAlteration1, mydata2$AH, useNA = "ifany")
xtab_003
write.csv(xtab_003, "xtab_003_absfreqThAl.csv")

#relfreq###
# Berechne die Hsufigkeiten und die relative Hsufigkeit für jede AH-Gruppe
xtab_014 <- mydata2 %>%
    group_by(AH, thermalAlteration1) %>%
    tally() %>%
    group_by(AH) %>%
    mutate(percent = n / sum(n)) # Berechnung der relativen Hsufigkeit pro AH-Gruppe
View(xtab_014)
write.csv(xtab_014, "GKAnt1/Tables/xtab_014.csv")

# Erstelle den Plot mit den berechneten Prozentwerten
p004 <- ggplot(xtab_014, aes(x = AH, y = percent, fill = thermalAlteration1)) +
    geom_bar(stat = "identity", position = "fill") +
    scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
    theme_minimal() + # Einfache Darstellung
    labs(title = "Thermal Alterations by Archaeological Horizon (AH) in GK I (1993-2011)", # Hier kannst du deinen Titel einführen, z.B.
"Thermal Alteration GK I"
        x = "",
        y = "Percent") +
    scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
    theme(legend.title = element_blank(),
          legend.position = "bottom",
          legend.text.position = "bottom") + # Legende unterhalb des Plots
    theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p004
# Speichern des Plots als PNG
#ggsave("p004_ThermalAlteration.png", plot = p004, width = 8, height = 6, dpi = 300, bg = "white")
ggsave("GKAnt1/Plots/p004_ThermalAlteration.pdf", plot = p004, width = 8, height = 6)

P2 <- p003+p004 + plot_annotation(title = "Thermal Alterations by Archaeological Horizon (AH) in GK I", #gemeinsamer Titel
                                theme = theme(plot.title = element_text(hjust = 0.5))) #+ Zentrieren der Überschrift
    plot_layout(guides = "collect") +
    theme(legend.title = element_blank(),
          legend.position = "bottom",
          legend.text.position = "bottom")

P2
# Speichern des Plots als PNG
#ggsave("P2_ThermalAlteration.png", plot = P2, width = 8, height = 6, dpi = 300, bg = "white")
ggsave("GKAnt1/Plots/P2_ThermalAlteration.pdf", plot = P2, width = 8, height = 6)

#fragmentation #####
mydata2$fragmentation1 <- factor(mydata2$fragmentation1, levels = c("Yes", "No", "NA"))

#absfreq###
p005 <- ggplot(mydata2, aes(x = AH, fill = fragmentation1)) +
    geom_bar(stat = "count", position = "dodge") + #Erstellt ein gruppiertes Balkendiagramm, bei dem die Balken nebeneinander (nicht
übereinander) angezeigt werden.
    #geom_bar(stat = "count") + # stat = "count" zshlt automatisch die Hsufigkeit der Kategorien
    scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
    theme_minimal() + # Einfache Darstellung
    labs(title = "Fragmentation by Archaeological Horizon (AH) in GK I (1993-2011)",
        x = "",
        y = "Count") +
    theme(legend.title = element_blank(),
          legend.position = "bottom",
          legend.text.position = "bottom") + # Legende unterhalb des Plots

```

```

  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p005
ggsave("GKAnt1/Plots/p005_fragmentation1.pdf", plot = p005, width = 8, height = 6)

#Tabelle
xtab_005 <- table(mydata2$fragmentation1, mydata2$AH, useNA = "ifany")
xtab_005
write.csv(xtab_005, "GKAnt1/Table/xtab_005_absfreqFrag.csv")

#relfreq###
xtab_015 <- mydata2 %>%
  group_by(AH, fragmentation1) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen H\u00f6ufigkeit pro AH-Gruppe
View(xtab_015)
write.csv(xtab_015, "GKAnt1/Tables/xtab_015.csv")

# Erstelle den Plot mit den berechneten Prozentwerten
p006 <- ggplot(xtab_015, aes(x = AH, y = percent, fill = fragmentation1)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Fragmentation by Archaeological Horizon (AH) in GK I (1993-2011)", # Hier kannst du deinen Titel einf\u00fcgen, z.B. "Thermal
  Alteration GK I"
    x = "",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel
  # F\u00fcgt die Prozentwerte als Text unter den Balken hinzu
  # geom_text(
  #   aes(label = scales::percent(percent, accuracy = 0.1)), # Prozentwerte f\u00fcr jede Gruppe
  #   position = position_fill(vjust = 0.5), # Text in der Mitte des gestapelten Balkens
  #   size = 3) # Gr\u00f6\u00dfe des Textes

p006
ggsave("GKAnt1/Plots/p006_fragmentation1.pdf", plot = p006, width = 8, height = 6)

P3 <- p005+p006 + plot_annotation(title = "Fragmentation by Archaeological Horizon (AH) in GK I", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der \u00dcberschrift
  plot_layout(guides = "collect") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom")

P3
ggsave("GKAnt1/Plots/P3_fragmentation1.pdf", plot = P3, width = 8, height = 6)

#Cortex #####
#umformen auf
mydata_Cortex <- mydata2 %>%
  mutate(
    mydata_Cortex = case_when(
      #lithic_all_cortex == "0%" ~ "0%", # 0% bleibt wie es ist
      lithic_all_cortex %in% c("1-33%", "33-66%", "66-99%", "100%") ~ "Yes", # 1-33% und 33-66% zusammenfassen
      lithic_all_cortex %in% c("0%") ~ "No", # 66-99% und 100% zusammenfassen
      TRUE ~ lithic_all_cortex # Falls es andere Kategorien gibt, unver\u00e4ndert lassen
    )
  )

##### Ahs sortieren
mydata_Cortex$AH <- factor(mydata_Cortex$AH, levels = c("AH3","AH4"))
mydata_Cortex$mydata_Cortex <- factor(mydata_Cortex$mydata_Cortex, levels = c("Yes","No", "NA"))
###
# Berechne die H\u00f6ufigkeiten und die relative H\u00f6ufigkeit f\u00fcr jede AH-Gruppe
xtab_016 <- mydata_Cortex %>%
  group_by(AH, mydata_Cortex) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen H\u00f6ufigkeit pro AH-Gruppe
View(xtab_016)
write.csv(xtab_016, "GKAnt1/Tables/xtab_016.csv")

##absfreq###
p007 <- ggplot(mydata_Cortex, aes(x = AH, fill = mydata_Cortex)) +
  geom_bar(stat = "count", position = "dodge") + #Erstellt ein gruppiertes Balkendiagramm, bei dem die Balken nebeneinander (nicht
  \u00fcberlappend) angezeigt werden.
  #geom_bar(stat = "count") + # stat = "count" z\u00fchlt automatisch die H\u00f6ufigkeit der Kategorien
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Cortical pieces by Archaeological Horizon (AH) in GK I (1993-2011)",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p007
# Speichern des Plots als PNG
#ggsave("p007_CorticalPiecesGKI.png", plot = p007, width = 8, height = 6, dpi = 300, bg = "white")
ggsave("GKAnt1/Plots/p007_CorticalPiecesGKI.pdf", plot = p007, width = 8, height = 6)

##Tabelle
xtab_cortex <- addmargins(xtabs(~ mydata_Cortex$AH + mydata_Cortex$mydata_Cortex), margin = 1)
xtab_cortex
write.csv(xtab_cortex, "GKAnt1/Tables/xtab_cortex.csv")

#relfreq###
p008 <- ggplot(xtab_016, aes(x = AH, y = percent, fill = mydata_Cortex)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) +
  theme_minimal() +
  labs(
    title = "Cortical pieces by Archaeological Horizon (AH) in GK I (1993-2011)",
    x = "",

```

```

    y = "Percent"
  ) +
  scale_y_continuous(labels = scales::percent) +
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16),          # Achsenbeschriftungen (Zahlen)
    axis.title = element_text(size = 16),         # Achsentitel (hier nur y)
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
    strip.text = element_text(size = 12)          # falls du Facets verwendest
  )

p008
#ggsave("p008_CorticalPiecesGKI.png", plot = p008, width = 8, height = 6, dpi = 300, bg = "white")
ggsave("GKAntl/Plots/p008_CorticalPiecesGKI.pdf", plot = p008, width = 8, height = 6)

##Tabelle?
xtab_cortex_r <- addmargins(prop.table(xtab_cortex, margin = 2) * 100)
xtab_cortex_r
write.csv(xtab_cortex_r, "GKAntl/Tables/xtab_cortex_r.csv")

P4 <- p007+p008 + plot_annotation(title = "Cortical Pieces by Archaeological Horizon (AH) in GK I", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom")

P4
#ggsave("P4_CorticalPiecesGKI.png", plot = P4, width = 8, height = 6, dpi = 300, bg = "white")
ggsave("GKAntl/Plots/P4_CorticalPiecesGKI.pdf", plot = P4, width = 8, height = 6)

#edgeDamage #####
mydata2$edgeDamage1 <- factor(mydata2$edgeDamage1, levels = c("Yes", "No", "NA"))

#absfreq ###
p013 <- ggplot(mydata2, aes(x = AH, fill = edgeDamage1)) +
  geom_bar(stat = "count", position = "dodge") + #Erstellt ein gruppiertes Balkendiagramm, bei dem die Balken nebeneinander (nicht
  übereinander) angezeigt werden.
  #geom_bar(stat = "count") + # stat = "count" z\shlt automatisch die H\zufügkeit der Kategorien
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Frequency of edge damage by Archaeological Horizon (AH) in GK I (1993-2011)",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p013
#Tabelle
#xtab_0 <- table(mydata2$fragmentation1, mydata2$AH, useNA = "ifany")
#xtab_005
#write.csv(xtab_005, "xtab_absfreqFrag.csv")

# Speichern des Plots als PNG
#ggsave("p013_edgeDamageGKI.png", plot = p013, width = 8, height = 6, dpi = 300, bg = "white")
ggsave("GKAntl/Plots/p013_edgeDamageGKI.pdf", plot = p013, width = 8, height = 6)

#relfreq###
xtab_017 <- mydata2 %>%
  group_by(AH, edgeDamage1) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen H\zufügkeit pro AH-Gruppe
View(xtab_017)
write.csv(xtab_017, "GKAntl/Tables/xtab_017.csv")

# Erstelle den Plot mit den berechneten Prozentwerten
p014 <- ggplot(xtab_017, aes(x = AH, y = percent, fill = edgeDamage1)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Frequency of edge damage by Archaeological Horizon (AH) in GK I (1993-2011)", # Hier kannst du deinen Titel einf\ugen,
  z.B. "Thermal Alteration GK I"
    x = "",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p014
# Speichern des Plots als PNG
#ggsave("p014_edgeDamageGKI.png", plot = p014, width = 8, height = 6, dpi = 300, bg = "white")
ggsave("GKAntl/Plots/p014_edgeDamageGKI.pdf", plot = p014, width = 8, height = 6)

P6 <- p013+p014 + plot_annotation(title = "Frequency of edge damage by Archaeological Horizon (AH) in GK I", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom")

P6
# Speichern des Plots als PNG
#ggsave("P6_edgeDamageGKI.png", plot = P6, width = 8, height = 6, dpi = 300, bg = "white")
ggsave("GKAntl/Plots/P6_edgeDamageGKI.pdf", plot = P6, width = 8, height = 6)

#modification #####
xtab_018 <- mydata2 %>%
  group_by(AH, modification) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen H\zufügkeit pro AH-Gruppe

```

```

View(xtab_018)
write.csv(xtab_018, "GKAntl/Tables/xtab_018.csv")

mydata2$modification <- factor(mydata2$modification, levels = c("Yes","No", "NA"))

#absfreq ###
p015 <- ggplot(mydata2, aes(x = AH, fill = modification)) +
  geom_bar(stat = "count", position = "dodge") + #Erstellt ein gruppiertes Balkendiagramm, bei dem die Balken nebeneinander (nicht
  übereinander) angezeigt werden.
  #geom_bar(stat = "count") + # stat = "count" z\shlt automatisch die H\ufigkeit der Kategorien
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Modified Pieces by Archaeological Horizon (AH) in GK I (1993-2011)",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p015
ggsave("GKAntl/Plots/p015_modification.pdf", plot = p015, width = 8, height = 6)
#relfreq###
p016 <- ggplot(xtab_018, aes(x = AH, y = percent, fill = modification)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Modified Pieces by Archaeological Horizon (AH) in GK I (1993-2011)",
    x = "",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p016
ggsave("GKAntl/Plots/p016_modification.pdf", plot = p016, width = 8, height = 6)

P7 <- p015+p016 + plot_annotation(title = "Modified Pieces by Archaeological Horizon (AH) in GK I", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) #+ Zentrieren der Überschrift
  plot_layout(guides = "collect") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom")

P7
ggsave("GKAntl/Plots/P7_ModifiedPiecesGKI.pdf", plot = P7, width = 8, height = 6)

#toolTyp #####
mydata2$toolType <- factor(mydata2$toolType, levels = c("backedbladelet", "backedPiece", "edgeRetouch", "endscraper", "gravette-point",
  "microgravette-point", "burin-on-truncation", "n/a"))

xtab_019 <- mydata2 %>%
  group_by(AH, toolType) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen H\ufigkeit pro AH-Gruppe

View(xtab_019)
write.csv(xtab_019, "GKAntl/Tables/xtab_019.csv")

# Entferne die Zeilen mit NA in der Spalte AH
mydata_p017_clean <- mydata2[!is.na(mydata2$toolType), ]
#absfreq###
p017 <- ggplot(mydata_p017_clean, aes(x = AH, fill = toolType)) +
  geom_bar(stat = "count") + # Z\shlt die H\ufigkeit der verschiedenen Werte in 'rawMaterial_all RMU'
  scale_fill_manual(values = c("bisque4", "orangered3", "gainsboro", "firebrick", "cadetblue", "blue", "brown", "grey")) + #, "gray30",
  "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3", "blue")) + # Benutzerdefinierte Farben f\ur
  die Balken
  theme_minimal() + # Einfaches Design
  labs(title = "Tools by Archaeological Horizon (AH) in GK I (1993-2011)",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p017
ggsave("GKAntl/Plots/p017_ToolTypes.pdf", plot = p017, width = 8, height = 6)
#relfreq###
xtab_019_2 <- xtab_019[-c(4, 13), ]

p018 <- ggplot(xtab_019_2, aes(x = AH, y = percent, fill = toolType)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("bisque4", "orangered3", "gainsboro", "firebrick", "cadetblue", "blue", "brown", "grey")) + #, "gray30",
  "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3", "blue")) + # Benutzerdefinierte Farben f\ur
  die Balken
  theme_minimal() + # Einfache Darstellung
  labs(title = "Tools by Archaeological Horizon (AH) in GK I (1993-2011)", # Hier kannst du deinen Titel einf\ugen, z.B. "Thermal
  Alteration GK I"
    x = "",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p018
ggsave("GKAntl/Plots/p018_ToolTypes.pdf", plot = p018, width = 8, height = 6)

P8 <- p017+p018 + plot_annotation(title = "Tools by Archaeological Horizon (AH) in GK I", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) #+ Zentrieren der Überschrift
  plot_layout(guides = "collect") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom")

```

P8

```

ggsave("GKAntl/Plots/P8_ToolTypes.pdf", plot = P8, width = 8, height = 6)

#patination####
xtab_031 <- mydata2 %>%
  group_by(AH, rawMaterial_all_patina) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HV$ufigkeit pro AH-Gruppe
View(xtab_031)
write.csv(xtab_031, "GKAntl/Tables/xtab_031_Patina_GKAntl.csv")

mydata2$rawMaterial_all_patina <- factor(mydata2$rawMaterial_all_patina, levels = c("Yes", "No", "NA"))

#absfreq####
p041 <- ggplot(mydata2, aes(x = AH, fill = rawMaterial_all_patina)) +
  geom_bar(stat = "count", position = "dodge") + #Erstellt ein gruppiertes Balkendiagramm, bei dem die Balken nebeneinander (nicht
  #bereinander) angezeigt werden.
  #geom_bar(stat = "count") + # stat = "count" z$ht automatisch die HV$ufigkeit der Kategorien
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Patinated Pieces by Archaeological Horizon (AH) in GK I (1993-2011)",
        x = "",
        y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p041
ggsave("GKAntl/Plots/p041_patination.pdf", plot = p041, width = 8, height = 6)
#relfreq####
p042 <- ggplot(xtab_031, aes(x = AH, y = percent, fill = rawMaterial_all_patina)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Patinated Pieces by Archaeological Horizon (AH) in GK I (1993-2011)",
        x = "",
        y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16), # Achsenbeschriftungen (Zahlen)
    axis.title = element_text(size = 16), # Achsentitel (hier nur y)
    plot.title = element_text(hjust = 0.9, size = 16, face = "bold"), # Titel
    strip.text = element_text(size = 12) # falls du Facets verwendest
  )

p042
ggsave("GKAntl/Plots/p042_patination.pdf", plot = p042, width = 8, height = 6)

P22 <- p041+p042 + plot_annotation(title = "Patinated Pieces by Archaeological Horizon (AH) in GK I", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom")

P22
ggsave("GKAntl/Plots/P22_PatinaGKI.pdf", plot = P22, width = 8, height = 6)

#RMU####
RMUAntl1 <- mydata2 %>%
  mutate(
    RMU = case_when(
      rawMaterial_all_RMU %in% c("1.1", "1.1.1", "1.1.2", "1.1.3", "1.1.4", "1.1.6", "1.1.7") ~ "1.1", # zu 1.1 zusammenfassen
      rawMaterial_all_RMU %in% c("1.2.1", "1.2.2", "1.2.4", "1.2.5") ~ "1", # zu 1 zusammenfassen
      rawMaterial_all_RMU %in% c("2", "2.1") ~ "2", # 2 und 2.1 zu 2 zusammenfassen
      TRUE ~ rawMaterial_all_RMU # Falls es andere Kategorien gibt, unver$ndert lassen
    )
  )
View(RMUAntl1)
RMUAntl2 <- ggplot(RMUAntl1, aes(x = AH, fill = RMU)) +
  geom_bar(stat = "count") +
  scale_fill_manual(values = c("bisque4", "orangered3", "gainsboro", "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki")) +
  theme_minimal() +
  labs(title = "Lithic Raw Materials by Archaeological Horizon (AH) in GK I (1993-2011)",
        x = "",
        y = "Count") +
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom",
    plot.title = element_text(hjust = 0.5) # optional: zentrierter Titel
  ) +
  guides(fill = guide_legend(nrow = 1)) # Legende in einer Zeile

RMUAntl2

ggsave("GKAntl/Plots/RMUAntl.pdf", plot = RMUAntl, width = 8, height = 6)
#Tabele
xtab_GKAntl <- RMUAntl1 %>%
  group_by(AH, RMU) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HV$ufigkeit pro AH-Gruppe
View(xtab_GKAntl)
write.csv(xtab_GKAntl, "GKAntl/Tables/xtab_RMU_GKAntl.csv")

# Erstelle den Plot mit den berechneten Prozentwerten
p068 <- ggplot(xtab_GKAntl, aes(x = AH, y = percent, fill = RMU)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(
    values = c("1" = "bisque4", "1.1" = "orangered3", "2" = "gainsboro",
              "3" = "gray30", "4" = "lightgoldenrod1", "5" = "papayawhip", "n/a" = "darkkhaki"),
    labels = c("1" = "Chert", "1.1" = "Radiolarite", "2" = "Flint",
              "3" = "Obsidian", "4" = "Quartzite", "5" = "Quartz", "n/a" = "n/a")
  ) +
  theme_minimal() +
  labs(
    title = "Lithic Raw Materials by Archaeological Horizon (AH)\nin GK I (1992-2011)",

```

```

    x = "",
    y = "Percent"
  ) +
  scale_y_continuous(labels = scales::percent) +
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16),          # Achsenbeschriftungen (Zahlen)
    axis.title = element_text(size = 16),         # Achsenteil (hier nur y)
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
    strip.text = element_text(size = 12)         # falls du Facets verwendest
  ) +
  guides(fill = guide_legend(nrow = 1))

p068

ggsave("GKAnt1/Plots/p068_relfreqRMU_GKAnt1.pdf", plot = p068, width = 8, height = 6)

P37 <- RMUAnt1+p068 + plot_annotation(title = "Lithic Raw Material by Archaeological Horizon (AH) in GK I (1993-2011)", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P37
ggsave("GKII/Plots/P37_RMU_GKAnt1.pdf", plot = P37, width = 8, height = 6)

#####
#####
#####
##GK21
#####
#####
#####
#mydataGK21 is only lithics from GK21###
mydataGK21 <- myimport %>%
  filter(lithic_all inventory == "GK21")
write.csv(mydataGK21, "mydataGK21.csv")
View(mydataGK21)

#####
#visualization with all AHs###
#absfreq
#table
xtab_009 <- addmargins(xtabs(~ mydataGK21$AH), margin = 1)
xtab_009
View(xtab_009)
write.csv(xtab_009, "xtab_009.csv")

#plot
p009 <- ggplot(mydataGK21, aes(x = AH, fill = AH)) +
  geom_bar(stat = "count") + # stat = "count" z$htl automatisch die H$ufigkeit der Kategorien
  scale_fill_manual(values = c("darkgoldenrod3", "darkgoldenrod1", "darkorange2", "chocolate4", "darkorange3")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Absolute Frequency of finds in GKI (2021)",
    x = "AH",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) + # Zentriert den Titel

p009
ggsave("p009_absfreqAHGK21.pdf", plot = p009, width = 8, height = 6)

#relfreq
#table
xtab_022 <- mydataGK21 %>%
  group_by(AH, mydata) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen H$ufigkeit pro AH-Gruppe
View(xtab_022)
write.csv(xtab_022, "xtab_022.csv")

#plot
p010 <- ggplot(mydataGK21, aes(x = AH, y = Relative_H$ufigkeit, fill = AH)) +
  geom_bar(aes(y = (..count../sum(..count..))) +
  scale_fill_manual(values = c("darkgoldenrod3", "darkgoldenrod1", "darkorange2", "chocolate4", "darkorange3")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Relative Frequency of finds in GKI (2021)",
    x = "AH",
    y = "Percent") +
  theme(plot.title = element_text(hjust = 0.5)) + # Zentriert den Titel
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) + # Zentriert den Titel

p010
ggsave("p010_relfreqAHGK21.pdf", plot = p010, width = 8, height = 6)

P10 <- p009+ p010 + plot_annotation(title = "Frequency of finds in GKI (2021)", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom")

P10
ggsave("P10_freqAHGK21.pdf", plot = P10, width = 8, height = 6)
#####
#making table with only AH3 and AH4###
mydataGK21_2 <- mydataGK21[mydataGK21$AH %in% c("AH3", "AH4"), ]
View(mydataGK21_2)

###Descriptive Statistics###

#AHs###

```

```
##absolute HV$ufigkeit GK21
p011 <- ggplot(mydataGK21_2, aes(x = AH, fill = AH)) +
  geom_bar(stat = "count") + # stat = "count" z$hl automatisch die HV$ufigkeit der Kategorien
  scale_fill_manual(values = c("darkorange2", "chocolate4")) + # Manuelle Farbauswahl, "darkgoldenrod1", "grey"
  theme_minimal() + # Einfache Darstellung
  labs(title = "Absolute Frequency",
       x = "AH",
       y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") # Legende unterhalb des Plots

p011
#Tabelle
#xtab_011 <- addmargins(xtabs(~ mydataGK21_2$AH), margin = 1)
#xtab_011
#write.csv(xtab_011, "xtab_011.csv")

##relative HV$ufigkeit
p012 <- ggplot(mydataGK21_2, aes(x = AH, y = Relative_HV$ufigkeit, fill = AH)) +
  geom_bar(aes(y = (..count..)/sum(..count..)) +
  scale_fill_manual(values = c("darkorange2", "chocolate4")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Relative Frequency",
       x = "AH",
       y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") # Legende unterhalb des Plots

p012
P11 <- p011 + p012 +plot_annotation(title = "Frequency of finds in AH 3 and AH 4 in GKI (2021)",
                                   theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom")

P11
ggsave("P11_freqFinds_GK21.pdf", plot = P11, width = 8, height = 6)
#absolute HV$ufigkeiten
xtab_011 <- table(mydataGK21_2$AH)
xtab_011
write.csv(xtab_011, "xtab_011.csv")

#relative HV$ufigkeiten
xtab_012 <- (xtab_011 / sum(xtab_011))*100
xtab_012
write.csv(xtab_012, "xtab_012.csv")

#kummulative HV$ufigkeiten
#cum_freq_country <- cumsum(rel_freq_country)
#cum_freq_country

#fertige HV$ufigkeitstabelle
xtab_013 <- cbind(xtab_011, xtab_012)#, cum_freq_country)
xtab_013
#Spaltennamen $ndern
colnames(xtab_013) <- c("Absolut Freq.", "Relative Freq.") # erstes "x" ist Name der ersten Spalte, zweites "y" ist Name der zweiten
Spalte,...
View(xtab_013)
write.csv(xtab_013, "xtab_013.csv")

P5 <- p011+p012 + plot_annotation(title = "Absolute and Relative Frequency", #gemeinsamer Titel
                                theme = theme(plot.title = element_text(hjust = 0.5))) # Zentrieren der Überschrift
P5 # Absolute und Relative Frequency of the finds within the AHs

#####
###
View(mydataGK21_RMU)
#cleaning data RMU###
mydataGK21_RMU <- mydataGK21_2 %>%
  mutate(
    RMU = case when(
      rawMaterial_all_RMU %in% c("1.1", "1.1.1", "1.1.2", "1.1.3", "1.1.4", "1.1.6", "1.1.7") ~ "1.1", # zu 1.1 zusammenfassen
      rawMaterial_all_RMU %in% c("1.2.1", "1.2.2", "1.2.4", "1.2.5") ~ "1", # zu 1 zusammenfassen
      rawMaterial_all_RMU %in% c("2", "2.1") ~ "2", # 2 und 2.1 zu 2 zusammenfassen
      TRUE ~ rawMaterial_all_RMU # Falls es andere Kategorien gibt, unver$ndert lassen
    )
  )

#absfreq###
# Erstelle Boxplot f$or 'rawMaterial_all_RMU' und gruppiere nach 'AH'
RMU21 <- ggplot(mydataGK21_RMU, aes(x = AH, fill = RMU)) +
  geom_bar(stat = "count") + # Z$hl die HV$ufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("bisque4", "orangered3", "gainsboro", "grey")) + #, "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki",
"grey", "grey1", "gray40", "brown1", "brown3", "blue")) + # Benutzerdefinierte Farben f$or die Balken
  theme_minimal() + # Einfaches Design
  labs(title = "Lithic Raw Materials by Archaeological Horizon (AH) in GK I (2021)",
       x = "", # "Archaeological Horizon (AH)",
       y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") # Legende unterhalb des Plots

RMU21
ggsave("RMU21.pdf", plot = RMU21, width = 8, height = 6)
#Tabele
RMU21_tab <- addmargins(table(mydataGK21_RMU$AH, mydataGK21_RMU$mydataGK21_RMU), margin = 1)
#RMU21_tab2 <- dcast(as.data.frame(RMU21_tab), Var1 ~ Var2, value.var = "Freq", fill = 0)
write.csv(RMU21_tab, "RMU21_tab.csv")
View(RMU21_tab)

# Erstelle den Plot mit den berechneten Prozentwerten
p067 <- ggplot(xtab_047, aes(x = AH, y = percent, fill = RMU)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("bisque4", "orangered3", "brown4", "gainsboro", "gray30", "lightgoldenrod1", "darkkhaki")) + # Benutzerde-
finierte Farben f$or die Balken
  theme_minimal() + # Einfache Darstellung
  labs(title = "Lithic Raw Materials by Archaeological Horizon (AH) in GK II", # Hier kannst du deinen Titel einf$ogen
```

```

x = "", # "Archaeological Horizons (AH)",
y = "Percent") +
scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
theme(legend.title = element_blank(),
      legend.position = "bottom",
      legend.text.position = "bottom") + # Legende unterhalb des Plots
theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p067
ggsave("GKII/Plots/p067_elfreqRMU_GKII.pdf", plot = p067, width = 8, height = 6)

P36 <- RMUGKII+p067 + plot_annotation(title = "Lithic Raw Material by Archaeological Horizon (AH) in GK II", #gemeinsamer Titel
                                     theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
plot_layout(guides = "collect") + # Gemeinsame Legende
theme(legend.position = "bottom")

P36
ggsave("GKII/Plots/P36_RMUGKII.pdf", plot = P36, width = 8, height = 6)
#xtab_cortex <- addmargins(xtabs(~ mydata_Cortex$AH + mydata_Cortex$mydata_Cortex), margin = 1)
#elfreq####
xtab_022 <- mydataGK21_RMUG %>%
  group_by(AH, RMUG) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HVSufigkeit pro AH-Gruppe
View(xtab_022)
write.csv(xtab_022, "xtab_022_RMUG21.csv")

# Erstelle den Plot mit den berechneten Prozentwerten
p024 <- ggplot(xtab_022, aes(x = AH, y = percent, fill = RMUG)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(
    values = c("1" = "bisque4",
              "1.1" = "orangered3",
              "2" = "gainsboro",
              "n/a" = "grey"),
    labels = c("1" = "Chert",
              "1.1" = "Radiolarite",
              "2" = "Flint",
              "n/a" = "n/a")
  ) +
  theme_minimal() +
  labs(title = "Lithic Raw Materials by Archaeological Horizon (AH)\nin GK I (2021)",
       x = "",
       y = "Percent") +
  scale_y_continuous(labels = scales::percent) +
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16), # Achsenbeschriftungen (Zahlen)
    axis.title = element_text(size = 16), # Achsentitel (hier nur y)
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
    strip.text = element_text(size = 12) # falls du Facets verwendest
  ) +
  guides(fill = guide_legend(nrow = 1)) # Legende in 1 Zeile

p024

ggsave("GK21/Plots/p024_elfreqRMUG_GK21.pdf", plot = p024, width = 8, height = 6)

P12 <- RMUG21+p024 + plot_annotation(title = "Lithic Raw Material by Archaeological Horizon (AH) in GK I (2021)", #gemeinsamer Titel
                                     theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
plot_layout(guides = "collect") + # Gemeinsame Legende
theme(legend.position = "bottom")

P12
ggsave("P12_RMUG_GK21.pdf", plot = P12, width = 8, height = 6)

#basistechnology####
mydataGK21_RMUG$basistechnology <- factor(mydataGK21_RMUG$basistechnology, levels = c("flake/normal", "burin", "blade", "bladelet", "resharpening", "NA"))
xtab_023 <- mydataGK21_RMUG %>%
  group_by(AH, basistechnology) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HVSufigkeit pro AH-Gruppe
View(xtab_023)
write.csv(xtab_023, "xtab_023_GK21_basistech.csv")

#absfreq####
p025 <- ggplot(mydataGK21_RMUG, aes(x = AH, fill = basistechnology)) +
  geom_bar(stat = "count") + # ZVshlt die HVSufigkeit der verschiedenen Werte in 'rawMaterial_all_RMUG'
  scale_fill_manual(values = c("darkgreen", "skyblue1", "darkred", "lightpink2", "grey", "black")) + # "darkgreen", "darkolivegreen2", "darkred", "plum4", "black", "royalblue2", "skyblue1", "orange1", "lightgoldenrod1" "black", "royalblue2", "skyblue1", "orange1", "lightgoldenrod1")) + #, "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3", "blue")) + #
  Benutzerdefinierte Farben fVr die Balken
  theme_minimal() + # Einfaches Design
  labs(title = "Basic Technologies by Archaeological Horizon (AH) in GK I (2021)",
       x = "",
       y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p025
ggsave("p025_basistech.pdf", plot = p025, width = 8, height = 6)

#elfreq####
p033 <- ggplot(xtab_023, aes(x = AH, y = percent, fill = basistechnology)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("darkgreen", "skyblue1", "darkred", "lightpink2", "grey", "black")) + # "darkgreen", "darkolivegreen2", "darkred", "plum4", "black", "royalblue2", "skyblue1", "orange1", "lightgoldenrod1" "black", "royalblue2", "skyblue1", "orange1", "lightgoldenrod1")) + #, "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3", "blue")) + #
  Benutzerdefinierte Farben fVr die Balken
  theme_minimal() + # Einfache Darstellung
  labs(title = "Basic Technology by Archaeological Horizon (AH) in GK I (2021)", # Hier kannst du deinen Titel einfVgen

```

```

    x = "", #"Archaeological Horizons (AH)",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
        legend.position = "none",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p033
ggsave("p033_basicTech_GK21.pdf", plot = p033, width = 8, height = 6)

P13 <- p025+p033 + plot_annotation(title = "Basic Technology by Archaeological Horizon (AH) in GK I (2021)", #gemeinsamer Titel
                                   theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P13
ggsave("P13_basicTech_GK21.pdf", plot = P13, width = 8, height = 6)

#dataclass####
mydataGK21_RMU$dataclass <- factor(mydataGK21_RMU$dataclass, levels = c("flake", "chip", "blade", "bladelet", "burinSpall", "burinbladelet",
"core", "coreTablet", "shatter", "thermalShatter", "NA"))
xtab_024 <- mydataGK21_RMU %>%
  group_by(AH, dataclass) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen Hvufigkeit pro AH-Gruppe
View(xtab_024)
write.csv(xtab_024, "xtab_024_GK21_dataclass.csv")

# scale_fill_manual(values = c("darkgreen", "darkolivegreen2", "darkred", "lightpink2", "plum4", "black", "royalblue2", "skyblue1",
"orange1", "lightgoldenrod1")) + #, "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3",
"blue")) + # Benutzerdefinierte Farben für die Balken
#absfreq####
p026 <- ggplot(mydataGK21_RMU, aes(x = AH, fill = dataclass)) +
  geom_bar(stat = "count") + # Zählt die Hvufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("darkgreen", "darkolivegreen2", "darkred", "lightpink2", "plum4", "black", "royalblue2", "skyblue1",
"orange1", "lightgoldenrod1", "grey")) + #, "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1",
"brown3", "blue")) + # Benutzerdefinierte Farben für die Balken
  theme_minimal() + # Einfaches Design
  labs(title = "Dataclass by Archaeological Horizon (AH) in GKI (2021)",
        x = "",
        y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p026
ggsave("p026_dataclass.pdf", plot = p026, width = 8, height = 6)

#relfreq####
p034 <- ggplot(xtab_024, aes(x = AH, y = percent, fill = dataclass)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("darkgreen", "darkolivegreen2", "darkred", "lightpink2", "plum4", "black", "royalblue2", "skyblue1", "or-
ange1", "lightgoldenrod1", "grey")) + #, "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1",
"brown3", "blue")) + # Benutzerdefinierte Farben für die Balken
  theme_minimal() + # Einfache Darstellung
  labs(title = "Dataclass by Archaeological Horizon (AH) in GK I (2021)", # Hier kannst du deinen Titel einführen
        x = "", #"Archaeological Horizons (AH)",
        y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
        legend.position = "none",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p034
ggsave("p034_dataclass_GK21.pdf", plot = p034, width = 8, height = 6)

P14 <- p026+p034 + plot_annotation(title = "Dataclass by Archaeological Horizon (AH) in GK I (2021)", #gemeinsamer Titel
                                   theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P14
ggsave("P14_Dataclass_GK21.pdf", plot = P14, width = 8, height = 6)

#thermalAlteration####
mydataGK21_RMU$thermalAlteration1 <- factor(mydataGK21_RMU$thermalAlteration1, levels = c("Yes", "No", "NA"))
xtab_025 <- mydataGK21_RMU %>%
  group_by(AH, thermalAlteration1) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen Hvufigkeit pro AH-Gruppe
View(xtab_025)
write.csv(xtab_025, "xtab_025_GK21_thA1.csv")
#absfreq####
p027 <- ggplot(mydataGK21_RMU, aes(x = AH, fill = thermalAlteration1)) +
  geom_bar(stat = "count") + # Zählt die Hvufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Thermal Alterations by Archaeological Horizon (AH) in GKI (2021)",
        x = "",
        y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p027
ggsave("p027_thA1.pdf", plot = p027, width = 8, height = 6)

#relfreq####
p035 <- ggplot(xtab_025, aes(x = AH, y = percent, fill = thermalAlteration1)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Thermal Alterations by Archaeological Horizon (AH) in GKI (2021)",
        x = "", #"Archaeological Horizons (AH)",
        y = "Percent") +

```

```

scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
theme(legend.title = element_blank(),
      legend.position = "bottom",
      legend.text.position = "bottom") + # Legende unterhalb des Plots
theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p035
ggsave("p035_thA1_GK21.pdf", plot = p035, width = 8, height = 6)

P15 <- p027+p035 + plot_annotation(title = "Thermal Alterations by Archaeological Horizon (AH) in GK I (2021)", #gemeinsamer Titel
                                   theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P15
ggsave("P15_thA1_GK21.pdf", plot = P15, width = 8, height = 6)

#fragmentation####
mydataGK21_RMU$fragmentation1 <- factor(mydataGK21_RMU$fragmentation1, levels = c("Yes", "No", "NA"))
xtab_026 <- mydataGK21_RMU %>%
  group_by(AH, fragmentation1) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HVSufigkeit pro AH-Gruppe
View(xtab_026)
write.csv(xtab_026, "xtab_026_GK21_frag.csv")
#absfreq####
p028 <- ggplot(mydataGK21_RMU, aes(x = AH, fill = fragmentation1)) +
  geom_bar(stat = "count") + # ZVshlt die HVSufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfaches Design
  labs(title = "Fragmentation by Archaeological Horizon (AH) in GKI (2021)",
        x = "",
        y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p028
ggsave("p028_frag.pdf", plot = p028, width = 8, height = 6)

#relfreq####
p036 <- ggplot(xtab_026, aes(x = AH, y = percent, fill = fragmentation1)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Fragmentation by Archaeological Horizon (AH) in GKI (2021)",
        x = "", # "Archaeological Horizons (AH)",
        y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p036
ggsave("p036_frag_GK21.pdf", plot = p036, width = 8, height = 6)

P16 <- p028+p036 + plot_annotation(title = "Fragmentation by Archaeological Horizon (AH) in GK I (2021)", #gemeinsamer Titel
                                   theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P16
ggsave("P16_frag_GK21.pdf", plot = P16, width = 8, height = 6)

#cortex####
mydataGK21_Cortex <- mydataGK21_RMU %>%
  mutate(
    Cortex = case_when(
      #lithic_all_cortex == "0%" ~ "0%", # 0% bleibt wie es ist
      lithic_all_cortex %in% c("1-33%", "33-66%", "66-99%", "100%") ~ "Yes", # 1-33% und 33-66% zusammenfassen
      lithic_all_cortex %in% c("0%") ~ "No", # 66-99% und 100% zusammenfassen
      TRUE ~ lithic_all_cortex # Falls es andere Kategorien gibt, unverändert lassen
    )
  )
mydataGK21_Cortex$Cortex <- factor(mydataGK21_Cortex$Cortex, levels = c("Yes", "No", "NA"))
xtab_027 <- mydataGK21_Cortex %>%
  group_by(AH, Cortex) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HVSufigkeit pro AH-Gruppe
View(xtab_027)
write.csv(xtab_027, "xtab_027_GK21_cortex.csv")
#absfreq####
p029 <- ggplot(mydataGK21_Cortex, aes(x = AH, fill = Cortex)) +
  geom_bar(stat = "count") + # ZVshlt die HVSufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfaches Design
  labs(title = "Presence of Cortex by Archaeological Horizon (AH) in GKI (2021)",
        x = "",
        y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p029
ggsave("p029_cortex.pdf", plot = p029, width = 8, height = 6)

#relfreq####
p037 <- ggplot(xtab_027, aes(x = AH, y = percent, fill = Cortex)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Cortical pieces by Archaeological Horizon (AH) in GKI (2021)",
        x = "", # "Archaeological Horizons (AH)",
        y = "Percent") +

```

```

scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
theme(
  legend.title = element_blank(),
  legend.position = "bottom",
  legend.text = element_text(size = 16),
  legend.text.position = "bottom",
  axis.text = element_text(size = 16), # Achsenbeschriftungen (Zahlen)
  axis.title = element_text(size = 16), # Achsentitel (hier nur y)
  plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
  strip.text = element_text(size = 12) # falls du Facets verwendest
)

p037
ggsave("GK21/Plots/p037_cortex_GK21.pdf", plot = p037, width = 8, height = 6)

P17 <- p029+p037 + plot_annotation(title = "Presence of Cortex by Archaeological Horizon (AH) in GK I (2021)", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P17
ggsave("P17_cortex_GK21.pdf", plot = P17, width = 8, height = 6)

#edgeDamage####
mydataGK21_RMU$edgeDamage1 <- factor(mydataGK21_RMU$edgeDamage1, levels = c("Yes", "No", "NA"))
xtab_028 <- mydataGK21_RMU %>%
  group_by(AH, edgeDamage1) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HvSufigkeit pro AH-Gruppe
View(xtab_028)
write.csv(xtab_028, "xtab_028_GK21_edgeD.csv")
#absfreq####
p030 <- ggplot(mydataGK21_RMU, aes(x = AH, fill = edgeDamage1)) +
  geom_bar(stat = "count") + # Zvshlt die HvSufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfaches Design
  labs(title = "Edge Damage on Lithics by Archaeological Horizon (AH) in GKI (2021)",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p030
ggsave("p030_edgeD.pdf", plot = p030, width = 8, height = 6)

#relfreq####
p038 <- ggplot(xtab_028, aes(x = AH, y = percent, fill = edgeDamage1)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Edge Damage on Lithics by Archaeological Horizon (AH) in GKI (2021)",
    x = "", # "Archaeological Horizons (AH)",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p038
ggsave("p038_edgeD_GK21.pdf", plot = p038, width = 8, height = 6)

P18 <- p030+p038 + plot_annotation(title = "Presence of Cortex by Archaeological Horizon (AH) in GK I (2021)", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P18
ggsave("P18_edgeD_GK21.pdf", plot = P18, width = 8, height = 6)

#modification####
mydataGK21_RMU$modification <- factor(mydataGK21_RMU$modification, levels = c("Yes", "No", "NA"))
xtab_029 <- mydataGK21_RMU %>%
  group_by(AH, modification) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HvSufigkeit pro AH-Gruppe
View(xtab_029)
write.csv(xtab_029, "xtab_029_GK21_mod.csv")
#absfreq####
p031 <- ggplot(mydataGK21_RMU, aes(x = AH, fill = modification)) +
  geom_bar(stat = "count") + # Zvshlt die HvSufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfaches Design
  labs(title = "Modification on Lithics by Archaeological Horizon (AH) in GKI (2021)",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p031
ggsave("p031_mod.pdf", plot = p031, width = 8, height = 6)

#relfreq####
p039 <- ggplot(xtab_029, aes(x = AH, y = percent, fill = modification)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Modification on Lithics by Archaeological Horizon (AH) in GKI (2021)",
    x = "", # "Archaeological Horizons (AH)",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
    legend.position = "bottom",

```

```

    legend.text.position = "bottom") + # Legende unterhalb des Plots
    theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p039
ggsave("p039_mod_GK21.pdf", plot = p039, width = 8, height = 6)

P19 <- p031+p039 + plot_annotation(title = "Modification on Lithics by Archaeological Horizon (AH) in GK I (2021)", #gemeinsamer Titel
    theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
    plot_layout(guides = "collect") + # Gemeinsame Legende
    theme(legend.position = "bottom")

P19
ggsave("P19_mod_GK21.pdf", plot = P19, width = 8, height = 6)

#toolType####
xtab_030 <- mydataGK21_RMU %>%
  filter(!is.na(AH) & !is.na(toolType)) %>% # Entfernt Zeilen mit NA in AH oder toolType
  group_by(AH, toolType) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HVSufigkeit pro AH-Gruppe
View(xtab_030)
write.csv(xtab_030, "xtab_030_GK21_toolType.csv")

#absfreq###
p032 <- ggplot(mydataGK21_RMU %>%
  filter(!is.na(AH) & !is.na(toolType)), # Entfernt Zeilen mit NA in AH oder toolType
  aes(x = AH, fill = toolType)) +
  geom_bar(stat = "count") + # Zählt die HVSufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("bisque4", "orangered4", "gainsboro")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfaches Design
  labs(title = "Tool Types by Archaeological Horizon (AH) in GKI (2021)",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p032
ggsave("p032_toolType.pdf", plot = p032, width = 8, height = 6)

#relfreq###
p040 <- ggplot(xtab_030, aes(x = AH, y = percent, fill = toolType)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("bisque4", "orangered4", "gainsboro")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Tool Types by Archaeological Horizon (AH) in GKI (2021)",
    x = "", # "Archaeological Horizons (AH)",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p040
ggsave("p040_toolType_GK21.pdf", plot = p040, width = 8, height = 6)

P20 <- p032+p040 + plot_annotation(title = "Tool Types by Archaeological Horizon (AH) in GK I (2021)", #gemeinsamer Titel
    theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
    plot_layout(guides = "collect") + # Gemeinsame Legende
    theme(legend.position = "bottom")

P20
ggsave("P20_toolType_GK21.pdf", plot = P20, width = 8, height = 6)

####
#patination####
mydataGK21_RMU$rawMaterial_all_patina <- factor(mydataGK21_RMU$rawMaterial_all_patina, levels = c("Yes", "No", "NA"))

xtab_032 <- mydataGK21_RMU %>%
  group_by(AH, rawMaterial_all_patina) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HVSufigkeit pro AH-Gruppe
View(xtab_032)
write.csv(xtab_032, "GK21/Tables/xtab_032_Patina_GK21.csv")

#absfreq ###
p043 <- ggplot(mydataGK21_RMU, aes(x = AH, fill = rawMaterial_all_patina)) +
  geom_bar(stat = "count", position = "dodge") + #Erstellt ein gruppiertes Balkendiagramm, bei dem die Balken nebeneinander (nicht
  übereinander) angezeigt werden.
  #geom_bar(stat = "count") + # stat = "count" z\ählt automatisch die HVSufigkeit der Kategorien
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Patinated Pieces by Archaeological Horizon (AH) in GK I (2021)",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p043
ggsave("GK21/Plots/p043_patination.pdf", plot = p043, width = 8, height = 6)

#relfreq###
p044 <- ggplot(xtab_032, aes(x = AH, y = percent, fill = rawMaterial_all_patina)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Patinated Pieces by Archaeological Horizon (AH) in GK I (2021)",
    x = "",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",

```

```

axis.text = element_text(size = 16),      # Achsenbeschriftungen (Zahlen)
axis.title = element_text(size = 16),     # Achsentitel (hier nur y)
plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
strip.text = element_text(size = 12)      # falls du Facets verwendest
)

p044
ggsave("GK21/Plots/p044_patination.pdf", plot = p044, width = 8, height = 6)

P23 <- p043+p044 + plot_annotation(title = "Patinated Pieces by Archaeological Horizon (AH) in GK I (2021)", #gemeinsamer Titel
                                   theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom")

P23
ggsave("GK21/Plots/P23_PatinaGKI.pdf", plot = P23, width = 8, height = 6)

#####
#####
#####
##GKII
#####
#####
#####
#####
#mydataGKII is data only with GKII assamblage###
mydataGKII <- myimport %>%
  filter(lithic_all_inventory == "GKII")
write.csv(mydataGKII, "GKII/Tables/mydataGKII.csv")
View(mydataGKII)
#Reihenfolge
mydataGKII$AH <- factor(mydataGKII$AH, levels = c("above Chase", "Chase", "Michi", "Luc", "Morgan", "Kristof", "Chris", "kroto")) # "Jorge",
"Frido", "Mario",

#visualization with all AHs###
#absfreq###
#table###
xtab_033 <- addmargins(xtabs(~ mydataGKII$AH), margin = 1)
xtab_033
View(xtab_033)
write.csv(xtab_033, "GKII/Tables/xtab_033_absfreqAH.csv")

#plot###
p045 <- ggplot(mydataGKII, aes(x = AH, fill = AH)) +
  geom_bar(stat = "count") + # stat = "count" zshlt automatisch die Hsufigkeit der Kategorien
  scale_fill_manual(values = c("darkgoldenrod", "darkgoldenrod1", "darkorange2", "chocolate4", "chocolate", "chocolatel", "chocolate3",
"grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Absolute Frequency of finds in GKII",
        x = "AH",
        y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom", # Legende unterhalb des Plots
        axis.text.x = element_text(angle = 45, hjust = 1)) + # Drehung der x-Achsen-Beschriftung um 45 Grad
  theme(plot.title = element_text(hjust = 0.5)) + # Zentriert den Titel

p045
ggsave("GKII/Plots/p045_absfreqAllAHGKII.pdf", plot = p045, width = 8, height = 6)

#relfreq###
#table
xtab_034 <- mydataGKII %>%
  group_by(AH) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen Hsufigkeit pro AH-Gruppe
View(xtab_034)
write.csv(xtab_034, "GKII/Tables/xtab_034relfreqAllAHGKII.csv")

#plot
p046 <- ggplot(mydataGKII, aes(x = AH, y = Relative_Hsufigkeit, fill = AH)) +
  geom_bar(aes(y = (.count.)/sum(.count.))) +
  scale_fill_manual(values = c("darkgoldenrod", "darkgoldenrod1", "darkorange2", "chocolate4", "chocolate", "chocolatel", "chocolate3",
"grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Relative Frequency of finds in GKII",
        x = "AH",
        y = "Percent") +
  theme(plot.title = element_text(hjust = 0.5)) + # Zentriert den Titel
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom", # Legende unterhalb des Plots
        axis.text.x = element_text(angle = 45, hjust = 1)) + # Drehung der x-Achsen-Beschriftung um 45 Grad
  theme(plot.title = element_text(hjust = 0.5)) + # Zentriert den Titel

p046
ggsave("GKII/Plots/p046_relfreqAllAHGKII.pdf", plot = p046, width = 8, height = 6)

P24 <- p045+ p046 + plot_annotation(title = "Frequency of finds in GKII", #gemeinsamer Titel
                                   theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom")

P24
ggsave("GKII/Plots/P24_freqAllAHGKII.pdf", plot = P24, width = 8, height = 6)

#RMU###
#making table with only Michi and luc###
mydataGKII_2 <- mydataGKII[mydataGKII$AH %in% c("Michi", "Luc"), ]
View(mydataGKII_2)

###Descriptive Statistics###

#AHs###
##absolute Hsufigkeit GKII###
p047 <- ggplot(mydataGKII_2, aes(x = AH, fill = AH)) +
  geom_bar(stat = "count") + # stat = "count" zshlt automatisch die Hsufigkeit der Kategorien

```

```

scale_fill_manual(values = c("darkorange2", "chocolate4")) + # Manuelle Farbauswahl, "darkgoldenrod1", "grey"
theme_minimal() + # Einfache Darstellung
labs(#title = "Absolute Frequency",
     x = "AH",
     y = "Count") +
theme(legend.title = element_blank(),
      legend.position = "bottom",
      legend.text.position = "bottom") + # Legende unterhalb des Plots
theme(plot.title = element_text(hjust = 0.5)) + # Zentriert den Titel

p047
ggsave("GKII/Plots/p047_absfreqAHGKII.pdf", plot = p047, width = 8, height = 6)

##relative HV$ufigkeit####
p048 <- ggplot(mydataGKII_2, aes(x = AH, y = Relative_HV$ufigkeit, fill = AH)) +
  geom_bar(aes(y = (..count..)/sum(..count..))) +
  scale_fill_manual(values = c("darkorange2", "chocolate4")) + # Manuelle Farbauswahl, "darkgoldenrod1", "grey"
  theme_minimal() + # Einfache Darstellung
  labs(#title = "Relative Frequency",
       x = "AH",
       y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) + # Zentriert den Titel

p048
ggsave("GKII/Plots/p048_relfreqAHGKII.pdf", plot = p048, width = 8, height = 6)

P25 <- p047 + p048 + plot_annotation(title = "Frequency of finds in AH Chase, Michi and Luc in GKII",
                                     theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom")

P25
ggsave("GKII/Plots/P25_freqFinds_GKII.pdf", plot = P25, width = 8, height = 6)

#tables####
#absolute HV$ufigkeiten
xtab_035 <- table(mydataGKII_2$AH)
xtab_035
write.csv(xtab_035, "GKII/Tables/xtab_035.csv")

#relative HV$ufigkeiten
xtab_036 <- (xtab_035 / sum(xtab_035))*100
xtab_036
write.csv(xtab_036, "GKII/Tables/xtab_036.csv")

#kumulative HV$ufigkeiten
#cum_freq_country <- cumsum(rel_freq_country)
#cum_freq_country

#fertige HV$ufigkeitstabelle
xtab_037 <- cbind(xtab_035, xtab_036)#, cum_freq_country)
xtab_037
#Spaltennamen v$ndern
colnames(xtab_037) <- c("Absolut Freq.", "Relative Freq.") # erstes "x" ist Name der ersten Spalte, zweites "y" ist Name der zweiten
Spalte,...
View(xtab_037)
write.csv(xtab_037, "GKII/Tables/xtab_037_abs_rel_freq.csv")

#P <- p047+p048 + plot_annotation(title = "Absolute and Relative Frequency", #gemeinsamer Titel
#                               theme = theme(plot.title = element_text(hjust = 0.5))) # Zentrieren der Überschrift
#P # Absolute und Relative Frequency of the finds within the AHs

#####
View(mydataGKII_2_RMU)
#cleaning data RMU####
mydataGKII_2_RMU <- mydataGKII_2 %>%
  mutate(
    RMU = case_when(
      rawMaterial_all_RMU %in% c("1.1", "1.1.1", "1.1.2", "1.1.7") ~ "1.1", # zu 1.1 zusammenfassen
      TRUE ~ rawMaterial_all_RMU # Falls es andere Kategorien gibt, unver$ndert lassen
    )
  )
#absfreq####
# Erstelle Boxplot f$ur 'rawMaterial_all_RMU' und gruppiere nach 'AH'
RMUGKII <- ggplot(mydataGKII_2_RMU, aes(x = AH, fill = RMU)) +
  geom_bar(stat = "count") + # Z$hlt die HV$ufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("bisque4", "orangered3", "brown4", "gainsboro", "gray30", "lightgoldenrod1", "darkkhaki")) + # Benutzerde-
finierte Farben f$ur die Balken
  theme_minimal() + # Einfaches Design
  labs(#title = "Lithic Raw Materials by Archaeological Horizon (AH) in GK II",
       x = "", # "Archaeological Horizon (AH)",
       y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) + # Zentriert den Titel

RMUGKII
ggsave("GKII/Plots/RMUGKII_absfreq.pdf", plot = RMUGKII, width = 8, height = 6)

#Tabele
RMUGKII_tab <- addmargins(table(mydataGKII_2_RMU$AH, mydataGKII_2_RMU$RMU), margin = 1)
#RMU21_tab2 <- dcast(as.data.frame(RMU21_tab), Var1 ~ Var2, value.var = "Freq", fill = 0)
write.csv(RMUGKII_tab, "GKII/Tables/RMUGKII_tab.csv")
View(RMUGKII_tab)
#xtab_cortex <- addmargins(xtabs(~ mydata_Cortex$AH + mydata_Cortex$mydata_Cortex), margin = 1)
#relfreq####
xtab_047 <- mydataGKII_2_RMU %>%
  group_by(AH, RMU) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HV$ufigkeit pro AH-Gruppe
View(xtab_047)
write.csv(xtab_047, "GKII/Tables/xtab_047_RMUGKII.csv")

```

```

# Erstelle den Plot mit den berechneten Prozentwerten
p067 <- ggplot(xtab_047, aes(x = AH, y = percent, fill = RMU)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(
    values = c("1" = "bisque4", "1.1" = "orangered3", "2" = "gainsboro",
              "3" = "gray30", "4" = "lightgoldenrod1", "n/a" = "darkkhaki"),
    labels = c("1" = "Chert", "1.1" = "Radiolarite", "2" = "Flint",
              "3" = "Obsidian", "4" = "Quartzite", "n/a" = "n/a")
  ) + theme_minimal() +
  labs(
    title = "Lithic Raw Materials by Archaeological Horizon (AH)\nin GK II",
    x = "",
    y = "Percent"
  ) +
  scale_y_continuous(labels = scales::percent) +
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16),
    axis.title = element_text(size = 16),
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"),
    strip.text = element_text(size = 12)
  ) +
  guides(fill = guide_legend(nrow = 1)) # Symbole in einer Zeile

p067

ggsave("GKII/Plots/p067_relfreqRMU_GKII.pdf", plot = p067, width = 8, height = 6)

P36 <- RMUGKII+p067 + plot_annotation(title = "Lithic Raw Material by Archaeological Horizon (AH) in GK II", #gemeinsamer Titel
                                     theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P36
ggsave("GKII/Plots/P36_RMU_GKGKII.pdf", plot = P36, width = 8, height = 6)

#basistechnology####
mydataGKII_2_RMU$basistechnology <- factor(mydataGKII_2_RMU$basistechnology, levels = c("flake/normal", "burin", "blade", "resharpening",
"NA"))
xtab_038 <- mydataGKII_2_RMU %>%
  group_by(AH, basistechnology) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen H\u00f4ufigkeit pro AH-Gruppe
View(xtab_038)
write.csv(xtab_038, "GKII/Tables/xtab_038_GKII_basitech.csv")

#absfreq####
p049 <- ggplot(mydataGKII_2_RMU, aes(x = AH, fill = basistechnology)) +
  geom_bar(stat = "count") + # Z\u00fchlt die H\u00f4ufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("darkgreen", "skyblue1", "darkred", "grey", "black")) + # "darkgreen", "darkolivegreen2", "darkred",
"plum4", "black", "royalblue2", "skyblue1", "orangel", "lightgoldenrod1" "black", "royalblue2", "skyblue1", "orangel", "lightgoldenrod1"))
+ #, "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3", "blue")) + # Benutzerdefinierte
Farben f\u00fcr die Balken
  theme_minimal() + # Einfaches Design
  labs(title = "Basic Technologies by Archaeological Horizon (AH) in GKII",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p049
ggsave("GKII/Plots/p049_basitech.pdf", plot = p049, width = 8, height = 6)

#relfreq####
p050 <- ggplot(xtab_038, aes(x = AH, y = percent, fill = basistechnology)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("darkgreen", "skyblue1", "darkred", "grey", "black")) + # "darkgreen", "darkolivegreen2", "darkred",
"plum4", "black", "royalblue2", "skyblue1", "orangel", "lightgoldenrod1" "black", "royalblue2", "skyblue1", "orangel", "lightgoldenrod1"))
+ #, "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3", "blue")) + # Benutzerdefinierte
Farben f\u00fcr die Balken
  theme_minimal() + # Einfache Darstellung
  labs(title = "Basic Technology by Archaeological Horizon (AH) in GK II", # Hier kannst du deinen Titel einf\u00fcgen
    x = "", # "Archaeological Horizons (AH)",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p050
ggsave("GKII/Plots/p050_basTech_GKII.pdf", plot = p050, width = 8, height = 6)

P27 <- p049+p050 + plot_annotation(title = "Basic Technology by Archaeological Horizon (AH) in GK II", #gemeinsamer Titel
                                   theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P27
ggsave("GKII/Plots/P27_basTech_GKII.pdf", plot = P27, width = 8, height = 6)

#dataclass####
mydataGKII_2_RMU$dataclass <- factor(mydataGKII_2_RMU$dataclass, levels = c("flake", "chip", "blade", "bladelet", "burinSpall",
"burinbladelet", "core", "coreTablet", "shatter", "thermalShatter", "NA"))
xtab_039 <- mydataGKII_2_RMU %>%
  group_by(AH, dataclass) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen H\u00f4ufigkeit pro AH-Gruppe
View(xtab_039)
write.csv(xtab_039, "GKII/Tables/xtab_039_GKII_dataclass.csv")

# scale_fill_manual(values = c("darkgreen", "darkolivegreen2", "darkred", "lightpink2", "plum4", "black", "royalblue2", "skyblue1",
"orangel", "lightgoldenrod1")) + #, "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3",
"blue")) + # Benutzerdefinierte Farben f\u00fcr die Balken

```

```

#absfreq###
p051 <- ggplot(mydataGKII_2_RMU, aes(x = AH, fill = dataclass)) +
  geom_bar(stat = "count") + # ZV$ht die HVSufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("darkgreen", "darkolivegreen2", "darkred", "lightpink2", "plum4", "skyblue1", "orange1", "lightgoldenrod1",
"grey")) + #, "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3", "blue")) + # Benut-
zerdefinierte Farben fVr die Balken
  theme_minimal() + # Einfaches Design
  labs(title = "Dataclass by Archaeological Horizon (AH) in GKII",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p051
ggsave("GKII/Plots/p051_dataclass.pdf", plot = p051, width = 8, height = 6)

#relfreq###
p052 <- ggplot(xtab_039, aes(x = AH, y = percent, fill = dataclass)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("darkgreen", "darkolivegreen2", "darkred", "lightpink2", "plum4", "skyblue1", "orange1", "lightgoldenrod1",
"grey")) + #, "gray30", "lightgoldenrod1", "papayawhip", "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3", "blue")) + # Be-
nutzerdefinierte Farben fVr die Balken
  theme_minimal() + # Einfache Darstellung
  labs(title = "Dataclass by Archaeological Horizon (AH) in GK II", # Hier kannst du deinen Titel einfVgen
    x = "", # "Archaeological Horizons (AH)",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p052
ggsave("GKII/Plots/p052_dataclass_GKII.pdf", plot = p052, width = 8, height = 6)

P28 <- p051+p052 + plot_annotation(title = "Dataclass by Archaeological Horizon (AH) in GK II", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Vberschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P28
ggsave("GKII/Plots/P28_Dataclass_GKII.pdf", plot = P28, width = 8, height = 6)

#thermalAlteration###
mydataGKII_2_RMU$thermalAlteration1 <- factor(mydataGKII_2_RMU$thermalAlteration1, levels = c("Yes", "No", "NA"))
xtab_040 <- mydataGKII_2_RMU %>%
  group_by(AH, thermalAlteration1) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HVSufigkeit pro AH-Gruppe
View(xtab_040)
write.csv(xtab_040, "GKII/Tables/xtab_040_GKII_thAl.csv")
#absfreq###
p053 <- ggplot(mydataGKII_2_RMU, aes(x = AH, fill = thermalAlteration1)) +
  geom_bar(stat = "count") + # ZV$ht die HVSufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfaches Design
  labs(title = "Thermal Alterations by Archaeological Horizon (AH) in GKII",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p053
ggsave("GKII/Plots/p053_absfreqthAl.pdf", plot = p053, width = 8, height = 6)

#relfreq###
p054 <- ggplot(xtab_040, aes(x = AH, y = percent, fill = thermalAlteration1)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Thermal Alterations by Archaeological Horizon (AH) in GKII",
    x = "", # "Archaeological Horizons (AH)",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p054
ggsave("GKII/Plots/p054_relfreq_thAl_GKII.pdf", plot = p054, width = 8, height = 6)

P29 <- p053+p054 + plot_annotation(title = "Thermal Alterations by Archaeological Horizon (AH) in GK II", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Vberschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P29
ggsave("GKII/Plots/P29_thAl_GKII.pdf", plot = P29, width = 8, height = 6)

#fragmentation###
mydataGKII_2_RMU$fragmentation1 <- factor(mydataGKII_2_RMU$fragmentation1, levels = c("Yes", "No", "NA"))
xtab_041 <- mydataGKII_2_RMU %>%
  group_by(AH, fragmentation1) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HVSufigkeit pro AH-Gruppe
View(xtab_041)
write.csv(xtab_041, "GKII/Tables/xtab_041_GKII_frag.csv")
#absfreq###
p055 <- ggplot(mydataGKII_2_RMU, aes(x = AH, fill = fragmentation1)) +
  geom_bar(stat = "count") + # ZV$ht die HVSufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfaches Design
  labs(title = "Fragmentation by Archaeological Horizon (AH) in GKII",

```

```

    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p055
ggsave("GKII/Plots/p055_absfreq_frag.pdf", plot = p055, width = 8, height = 6)

#relfreq###
p056 <- ggplot(xtab_041, aes(x = AH, y = percent, fill = fragmentation1)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(#title = "Fragmentation by Archaeological Horizon (AH) in GKII",
       x = "", # "Archaeological Horizons (AH)",
       y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p056
ggsave("GKII/Plots/p056_relfreq_frag_GKII.pdf", plot = p056, width = 8, height = 6)

P30 <- p055+p056 + plot_annotation(title = "Fragmentation by Archaeological Horizon (AH) in GK II", #gemeinsamer Titel
                                  theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P30
ggsave("GKII/Plots/P30_frag_GKII.pdf", plot = P30, width = 8, height = 6)

#cortex###
mydataGKII_Cortex <- mydataGKII_2_RMU %>%
  mutate(
    Cortex = case_when(
      #lithic_all_cortex == "0%" ~ "0%", # 0% bleibt wie es ist
      lithic_all_cortex %in% c("1-33%", "33-66%", "66-99%", "100%") ~ "Yes", # 1-33% und 33-66% zusammenfassen
      lithic_all_cortex %in% c("0%") ~ "No", # 66-99% und 100% zusammenfassen
      TRUE ~ lithic_all_cortex # Falls es andere Kategorien gibt, unverändert lassen
    )
  )
mydataGKII_Cortex$Cortex <- factor(mydataGKII_Cortex$Cortex, levels = c("Yes", "No", "NA"))
xtab_042 <- mydataGKII_Cortex %>%
  group_by(AH, Cortex) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HÄufigkeit pro AH-Gruppe
View(xtab_042)
write.csv(xtab_042, "GKII/Tables/xtab_042_GKII_cortex.csv")
#absfreq###
p057 <- ggplot(mydataGKII_Cortex, aes(x = AH, fill = Cortex)) +
  geom_bar(stat = "count") + # Zählt die HÄufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfaches Design
  labs(#title = "Presence of Cortex by Archaeological Horizon (AH) in GKII",
       x = "",
       y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p057
ggsave("GKII/Plots/p057_absfreq_cortex.pdf", plot = p057, width = 8, height = 6)

#relfreq###
p058 <- ggplot(xtab_042, aes(x = AH, y = percent, fill = Cortex)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(#title = "Cortical pieces by Archaeological Horizon (AH) in GKII",
       x = "", # "Archaeological Horizons (AH)",
       y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16), # Achsenbeschriftungen (Zahlen)
    axis.title = element_text(size = 16), # Achsentitel (hier nur y)
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
    strip.text = element_text(size = 12) # falls du Facets verwendest
  )

p058
ggsave("GKII/Plots/p058_relfreq_cortex_GKII.pdf", plot = p058, width = 8, height = 6)

P31 <- p057+p058 + plot_annotation(title = "Presence of Cortex by Archaeological Horizon (AH) in GK II", #gemeinsamer Titel
                                  theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P31
ggsave("GKII/Plots/P31_cortex_GKII.pdf", plot = P31, width = 8, height = 6)

#edgeDamage###
mydataGKII_2_RMU$edgeDamage1 <- factor(mydataGKII_2_RMU$edgeDamage1, levels = c("Yes", "No", "NA"))
xtab_043 <- mydataGKII_2_RMU %>%
  group_by(AH, edgeDamage1) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HÄufigkeit pro AH-Gruppe
View(xtab_043)
write.csv(xtab_043, "GKII/Tables/xtab_043_GKII_edgeD.csv")

```

```

#absfreq###
p059 <- ggplot(mydataGKII_2_RMU, aes(x = AH, fill = edgeDamage1)) +
  geom_bar(stat = "count") + # ZV$ht die HV$ufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfaches Design
  labs(title = "Edge Damage on Lithics by Archaeological Horizon (AH) in GKII",
       x = "",
       y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p059
ggsave("GKII/Plots/p059_absfreq_edgeD.pdf", plot = p059, width = 8, height = 6)

#relfreq###
p060 <- ggplot(xtab_043, aes(x = AH, y = percent, fill = edgeDamage1)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Edge Damage on Lithics by Archaeological Horizon (AH) in GKII",
       x = "", # "Archaeological Horizons (AH)",
       y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p060
ggsave("GKII/Plots/p060_relfreq_edgeD_GK21.pdf", plot = p060, width = 8, height = 6)

P32 <- p059+p060 + plot_annotation(title = "Presence of Edge Damage by Archaeological Horizon (AH) in GK II", #gemeinsamer Titel
                                   theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P32
ggsave("GKII/Plots/P32_edgeD_GKII.pdf", plot = P32, width = 8, height = 6)

#modification###
#merging No and N/A
mydataGKII_2_RMU_mod <- mydataGKII_2_RMU
mydataGKII_2_RMU_mod$modification[is.na(mydataGKII_2_RMU$modification)] <- "No"

mydataGKII_2_RMU_mod$modification <- factor(mydataGKII_2_RMU_mod$modification, levels = c("Yes", "No", "NA"))
xtab_044 <- mydataGKII_2_RMU_mod %>%
  # filter(!is.na(AH) & !is.na(modification)) %>% # Entfernt Zeilen mit NA in AH oder toolType
  group_by(AH, modification) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HV$ufigkeit pro AH-Gruppe
View(xtab_044)
write.csv(xtab_044, "GKII/Tables/xtab_044_GKII_mod.csv")
#absfreq###
p061 <- ggplot(mydataGKII_2_RMU_mod %>%
               filter(!is.na(AH) & !is.na(modification)), # Entfernt Zeilen mit NA in AH oder toolType
               aes(x = AH, fill = modification)) +
  geom_bar(stat = "count", na.rm = TRUE) + # Entfernt NA-Werte
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfaches Design
  labs(title = "Modification on Lithics by Archaeological Horizon (AH) in GKII",
       x = "",
       y = "Count") +
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p061
ggsave("GKII/Plots/p061_absfreq_mod_GKII.pdf", plot = p061, width = 8, height = 6)

#relfreq###
p062 <- ggplot(xtab_044, aes(x = AH, y = percent, fill = modification)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Modification on Lithics by Archaeological Horizon (AH) in GKII",
       x = "", # "Archaeological Horizons (AH)",
       y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
        legend.position = "bottom",
        legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p062
ggsave("GKII/Plots/p062_relfreq_mod_GKII.pdf", plot = p062, width = 8, height = 6)

P33 <- p061+p062 + plot_annotation(title = "Modification on Lithics by Archaeological Horizon (AH) in GK I (2021)", #gemeinsamer Titel
                                   theme = theme(plot.title = element_text(hjust = 0.5))) + # Zentrieren der Überschrift
  plot_layout(guides = "collect") + # Gemeinsame Legende
  theme(legend.position = "bottom")

P33
ggsave("GKII/Plots/P33_mod_GKII.pdf", plot = P33, width = 8, height = 6)

#toolType###
mydataGKII_2_RMU$toolType <- factor(mydataGKII_2_RMU$toolType, levels = c("backedbladelet", "backedPiece", "edgeRetouch", "microgravette-
point", "saw", "saw+backed", "Borer+edgeRetouch", "n/a"))

xtab_045 <- mydataGKII_2_RMU %>%
  filter(!is.na(AH) & !is.na(toolType)) %>% # Entfernt Zeilen mit NA in AH oder toolType
  group_by(AH, toolType) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen HV$ufigkeit pro AH-Gruppe

```

```

View(xtab_045)
write.csv(xtab_045, "GKII/Tables/xtab_045_GKII_toolType.csv")

#absfreq###
p063 <- ggplot(mydataGKII_2_RMU %>%
  filter(!is.na(AH) & !is.na(toolType)), # Entfernt Zeilen mit NA in AH oder toolType
  aes(x = AH, fill = toolType)) +
  geom_bar(stat = "count") + # Zählt die Häufigkeit der verschiedenen Werte in 'rawMaterial_all_RMU'
  scale_fill_manual(values = c("bisque4", "orangered3", "gainsboro", "firebrick", "cadetblue", "blue", "brown", "grey")) + #, "papayawhip",
  "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3", "blue")) + # Benutzerdefinierte Farben für die Balken
  theme_minimal() + # Einfaches Design
  labs(title = "Tool Types by Archaeological Horizon (AH) in GKII",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p063
ggsave("GKII/Plots/p063_absfreq_toolType.pdf", plot = p063, width = 8, height = 6)

#relfreq###
p064 <- ggplot(xtab_045, aes(x = AH, y = percent, fill = toolType)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("bisque4", "orangered3", "gainsboro", "firebrick", "cadetblue", "blue", "brown", "grey")) + #, "papayawhip",
  "darkkhaki", "grey", "grey1", "gray40", "brown1", "brown3", "blue")) + # Benutzerdefinierte Farben für die Balken
  theme_minimal() + # Einfache Darstellung
  labs(title = "Tool Types by Archaeological Horizon (AH) in GKII",
    x = "", # "Archaeological Horizons (AH)",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(legend.title = element_blank(),
    legend.position = "none",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p064
ggsave("GKII/Plots/p064_toolType_GKII.pdf", plot = p064, width = 8, height = 6)

P34 <- p063+p064 + plot_annotation(title = "Tool Types by Archaeological Horizon (AH) in GK II", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) #+ # Zentrieren der Überschrift
# plot_layout(guides = "collect") + # Gemeinsame Legende
# theme(legend.position = "bottom")

P34
ggsave("GKII/Plots/P34_toolType_GKII.pdf", plot = P34, width = 8, height = 6)

####
#patination####
mydataGKII_2_RMU$rawMaterial_all_patina <- factor(mydataGKII_2_RMU$rawMaterial_all_patina, levels = c("Yes", "No", "NA"))

xtab_046 <- mydataGKII_2_RMU %>%
  group_by(AH, rawMaterial_all_patina) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen Häufigkeit pro AH-Gruppe
View(xtab_046)
write.csv(xtab_046, "GKII/Tables/xtab_046_Patina_GKII.csv")

#absfreq ###
p065 <- ggplot(mydataGKII_2_RMU, aes(x = AH, fill = rawMaterial_all_patina)) +
  geom_bar(stat = "count", position = "dodge") + #Erstellt ein gruppiertes Balkendiagramm, bei dem die Balken nebeneinander (nicht
  übereinander) angezeigt werden.
  #geom_bar(stat = "count") + # stat = "count" zählt automatisch die Häufigkeit der Kategorien
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Patinated Pieces by Archaeological Horizon (AH) in GK II",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p065
ggsave("GKII/Plots/p065_absfreq_patination_GKII.pdf", plot = p065, width = 8, height = 6)

#relfreq###
p066 <- ggplot(xtab_046, aes(x = AH, y = percent, fill = rawMaterial_all_patina)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("firebrick", "cadetblue", "grey")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Patinated Pieces by Archaeological Horizon (AH) in GK II",
    x = "",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16), # Achsenbeschriftungen (Zahlen)
    axis.title = element_text(size = 16), # Achsentitel (hier nur y)
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
    strip.text = element_text(size = 12) # falls du Facets verwendest
  )
p066
ggsave("GKII/Plots/p066_relfreq_patination.pdf", plot = p066, width = 8, height = 6)

P35 <- p065+p066 + plot_annotation(title = "Patinated Pieces by Archaeological Horizon (AH) in GK II", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) #+ Zentrieren der Überschrift
  plot_layout(guides = "collect") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom")

P35
ggsave("GKII/Plots/P35_PatinaGKII.pdf", plot = P35, width = 8, height = 6)

#####

```

```

#Distance
#####GKII####
mydataGKII_Dist <- mydataGKII_2_RMU %>% # local 1km, regional <20km, intermediate 20-60km, exogenous >60km
mutate(
  Distance = case_when(
    #lithic_all_cortex == "0%" ~ "0%", # 0% bleibt wie es ist
    RMU %in% c("1") ~ "local",
    RMU %in% c("1.1", "1.1.7") ~ "regional",
    RMU %in% c("4", "5") ~ "intermediate",
    RMU %in% c("2", "3") ~ "exogenous",
    TRUE ~ RMU # Falls es andere Kategorien gibt, unverändert lassen
  )
)
#distance####
mydataGKII_Dist$Distance <- factor(mydataGKII_Dist$Distance, levels = c("local", "regional", "intermediate", "exogenous", "n/a"))

xtab_048 <- mydataGKII_Dist %>%
  group_by(AH, Distance) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen H ufigkeit pro AH-Gruppe
View(xtab_048)
write.csv(xtab_048, "GKII/Tables/xtab_048_Distance_GKII.csv")

#absfreq ###
p068 <- ggplot(mydataGKII_Dist, aes(x = AH, fill = Distance)) +
  geom_bar(stat = "count", position = "dodge") + #Erstellt ein gruppiertes Balkendiagramm, bei dem die Balken nebeneinander (nicht
  #bereinander) angezeigt werden.
  #geom_bar(stat = "count") + # stat = "count" z hlt automatisch die H ufigkeit der Kategorien
  scale_fill_manual(values = c("orange3", "salmon1", "goldenrod2", "brown2", "goldenrod4")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Raw material distances by Archaeological Horizon (AH) in GK II",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p068
ggsave("GKII/Plots/p068_absfreq_distance_GKII.pdf", plot = p068, width = 8, height = 6)
#relfreq###
p069 <- ggplot(xtab_048, aes(x = AH, y = percent, fill = Distance)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("orange3", "salmon1", "goldenrod2", "brown2", "goldenrod4")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Raw material distances by Archaeological Horizon (AH) in GK II",
    x = "",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16), # Achsenbeschriftungen (Zahlen)
    axis.title = element_text(size = 16), # Achsentitel (hier nur y)
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
    strip.text = element_text(size = 12) # falls du Facets verwendest
  )

p069
ggsave("GKII/Plots/p069_relfreq_distance.pdf", plot = p069, width = 8, height = 6)

P37 <- p068+p069 + plot_annotation(title = "Raw material distances by Archaeological Horizon (AH) in GK II", #gemeinsamer Titel
  theme = theme(plot.title = element_text(hjust = 0.5))) #+ Zentrieren der  berschrift
plot_layout(guides = "collect") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom")
P37
ggsave("GKII/Plots/P37_DistanceGKII.pdf", plot = P37, width = 8, height = 6)

#####GKAntI####
mydataGKAntI_Dist <- mydata2 %>% # local 1km, regional <20km, intermediate 20-60km, exogenous >60km
mutate(
  Distance = case_when(
    #lithic_all_cortex == "0%" ~ "0%", # 0% bleibt wie es ist
    rawMaterial_all_RMU %in% c("1") ~ "local",
    rawMaterial_all_RMU %in% c("1.1", "1.1.7") ~ "regional",
    rawMaterial_all_RMU %in% c("4", "5") ~ "intermediate",
    rawMaterial_all_RMU %in% c("2", "3") ~ "exogenous",
    TRUE ~ rawMaterial_all_RMU # Falls es andere Kategorien gibt, unver ndert lassen
  )
)
#distance####
mydataGKAntI_Dist$Distance <- factor(mydataGKAntI_Dist$Distance, levels = c("local", "regional", "intermediate", "exogenous", "n/a"))

xtab_049 <- mydataGKAntI_Dist %>%
  group_by(AH, Distance) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen H ufigkeit pro AH-Gruppe
View(xtab_049)
write.csv(xtab_049, "GKAntI/Tables/xtab_049_Distance_GKAntI.csv")

#absfreq ###
p070 <- ggplot(mydataGKAntI_Dist, aes(x = AH, fill = Distance)) +
  geom_bar(stat = "count", position = "dodge") + #Erstellt ein gruppiertes Balkendiagramm, bei dem die Balken nebeneinander (nicht
  #bereinander) angezeigt werden.
  #geom_bar(stat = "count") + # stat = "count" z hlt automatisch die H ufigkeit der Kategorien
  scale_fill_manual(values = c("orange3", "salmon1", "goldenrod2", "brown2", "goldenrod4")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Raw material distances by Archaeological Horizon (AH) in GK I (1993-2011)",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",

```

```

        legend.text.position = "bottom") + # Legende unterhalb des Plots
        theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p070
ggsave("GKII/Plots/p070_absfreq_distance_GKAntl.pdf", plot = p070, width = 8, height = 6)
#relfreq####
p071 <- ggplot(xtab_049, aes(x = AH, y = percent, fill = Distance)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("orange3", "salmon1", "goldenrod2", "brown2", "goldenrod4")) +
  theme_minimal() +
  labs(
    title = "Raw material distances by Archaeological Horizon (AH)\nin GK I (1993,Äi2011)",
    x = "",
    y = "Percent"
  ) +
  scale_y_continuous(labels = scales::percent) +
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16),
    axis.title = element_text(size = 16),
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"),
    strip.text = element_text(size = 12)
  )

p071

ggsave("GKAntl/Plots/p071_relfreq_distance_GKAntl.pdf", plot = p071, width = 8, height = 6)

#P37 <- p068+p069 + plot_annotation(title = "Raw material distances by Archaeological Horizon (AH) in GK II", #gemeinsamer Titel
#                                     theme = theme(plot.title = element_text(hjust = 0.5))) #+ # Zentrieren der Überschrift
# plot_layout(guides = "collect") +
# theme(legend.title = element_blank(),
#       legend.position = "bottom",
#       legend.text.position = "bottom")
#P37
#ggsave("GKII/Plots/P37_DistanceGKII.pdf", plot = P37, width = 8, height = 6)

#####GK21####
mydataGK21_Dist <- mydataGK21_RMU %>% # local 1km, regional <20km, intermediate 20-60km, exogenous >60km
  mutate(
    Distance = case_when(
      #lithic all cortex == "0%" ~ "0%", # 0% bleibt wie es ist
      RMU %in% c("1") ~ "local",
      RMU %in% c("1.1", "1.1.7") ~ "regional",
      RMU %in% c("4", "5") ~ "intermediate",
      RMU %in% c("2", "3") ~ "exogenous",
      TRUE ~ RMU # Falls es andere Kategorien gibt, unverändert lassen
    )
  )
#distance####
mydataGK21_Dist$Distance <- factor(mydataGK21_Dist$Distance, levels = c("local", "regional", "intermediate", "exogenous", "n/a"))

xtab_050 <- mydataGK21_Dist %>%
  group_by(AH, Distance) %>%
  tally() %>%
  group_by(AH) %>%
  mutate(percent = n / sum(n)) # Berechnung der relativen Hñufigkeit pro AH-Gruppe
View(xtab_050)
write.csv(xtab_050, "GK21/Tables/xtab_050_Distance_GK21.csv")

#absfreq ####
p072 <- ggplot(mydataGK21_Dist, aes(x = AH, fill = Distance)) +
  geom_bar(stat = "count", position = "dodge") + #Erstellt ein gruppiertes Balkendiagramm, bei dem die Balken nebeneinander (nicht
  übereinander) angezeigt werden.
  #geom_bar(stat = "count") + # stat = "count" zñhlt automatisch die Hñufigkeit der Kategorien
  scale_fill_manual(values = c("orange3", "salmon1", "brown2", "goldenrod4")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Raw material distances by Archaeological Horizon (AH) in GK I (2021)",
    x = "",
    y = "Count") +
  theme(legend.title = element_blank(),
    legend.position = "bottom",
    legend.text.position = "bottom") + # Legende unterhalb des Plots
  theme(plot.title = element_text(hjust = 0.5)) #+ # Zentriert den Titel

p072
ggsave("GK21/Plots/p072_absfreq_distance_GK21.pdf", plot = p072, width = 8, height = 6)
#relfreq####
p073 <- ggplot(xtab_050, aes(x = AH, y = percent, fill = Distance)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("orange3", "salmon1", "brown2", "goldenrod4")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Raw material distances by Archaeological Horizon (AH)\nin GK I (1993-2011)",
    x = "",
    y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16), # Achsenbeschriftungen (Zahlen)
    axis.title = element_text(size = 16), # Achsentitel (hier nur y)
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
    strip.text = element_text(size = 12) # falls du Facets verwendest
  )

p073
ggsave("GK21/Plots/p073_relfreq_distance_GK21.pdf", plot = p073, width = 8, height = 6)

#P37 <- p068+p069 + plot_annotation(title = "Raw material distances by Archaeological Horizon (AH) in GK II", #gemeinsamer Titel
#                                     theme = theme(plot.title = element_text(hjust = 0.5))) #+ # Zentrieren der Überschrift
# plot_layout(guides = "collect") +
# theme(legend.title = element_blank(),
#       legend.position = "bottom",

```

```

# legend.text.position = "bottom")
#P37
#ggsave("GKII/Plots/P37_DistanceGKII.pdf", plot = P37, width = 8, height = 6)

#distance with weight#####
#GKII####
library(dplyr)

xtab_weight_dist <- mydataGKII_Dist %>%
  group_by(AH, Distance) %>%
  summarise(total_weight = sum(weight, na.rm = TRUE), .groups = "drop") %>%
  group_by(AH) %>%
  mutate(percent = total_weight / sum(total_weight)) %>%
  ungroup()

# Ergebnis anzeigen
View(xtab_weight_dist)
print(xtab_weight_dist)
#relfreq/boxplot####
p074 <- ggplot(xtab_weight_dist, aes(x = AH, y = percent, fill = Distance)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("orange3", "salmon1", "goldenrod2", "brown2", "goldenrod4")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Total Weight of Raw material distances by\nArchaeological Horizon (AH) in GK II",
        x = "",
        y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16), # Achsenbeschriftungen (Zahlen)
    axis.title = element_text(size = 16), # Achsentitel (hier nur y)
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
    strip.text = element_text(size = 12) # falls du Facets verwendest
  )

p074
ggsave("GKII/Plots/p074_relfreq_distanceWeight_GKII.pdf", plot = p074, width = 8, height = 6)

#GKAntl####
xtab_weight_distGKAntl <- mydataGKAntl_Dist %>%
  group_by(AH, Distance) %>%
  summarise(total_weight = sum(weight, na.rm = TRUE), .groups = "drop") %>%
  group_by(AH) %>%
  mutate(percent = total_weight / sum(total_weight)) %>%
  ungroup()

# Ergebnis anzeigen
View(xtab_weight_distGKAntl)
print(xtab_weight_distGKAntl)
#relfreq/boxplot####
p075 <- ggplot(xtab_weight_distGKAntl, aes(x = AH, y = percent, fill = Distance)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("orange3", "salmon1", "goldenrod2", "brown2", "goldenrod4")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Total Weight of Raw material distances by\nArchaeological Horizon (AH) in GK I (1993-2011)",
        x = "",
        y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16), # Achsenbeschriftungen (Zahlen)
    axis.title = element_text(size = 16), # Achsentitel (hier nur y)
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
    strip.text = element_text(size = 12) # falls du Facets verwendest
  )

p075
ggsave("GKAntl/Plots/p075_relfreq_distanceWeight_GKAntl.pdf", plot = p075, width = 8, height = 6)

#GK21####
xtab_weight_distGK21 <- mydataGK21_Dist %>%
  group_by(AH, Distance) %>%
  summarise(total_weight = sum(weight, na.rm = TRUE), .groups = "drop") %>%
  group_by(AH) %>%
  mutate(percent = total_weight / sum(total_weight)) %>%
  ungroup()

# Ergebnis anzeigen
View(xtab_weight_distGK21)
print(xtab_weight_distGK21)
#relfreq/boxplot####
p076 <- ggplot(xtab_weight_distGK21, aes(x = AH, y = percent, fill = Distance)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(values = c("orange3", "salmon1", "brown2", "goldenrod4")) + # Manuelle Farbauswahl
  theme_minimal() + # Einfache Darstellung
  labs(title = "Total Weight of Raw material distances by\nArchaeological Horizon (AH) in GK I (1993-2011)",
        x = "",
        y = "Percent") +
  scale_y_continuous(labels = scales::percent) + # Skaliert die y-Achse in Prozent
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16), # Achsenbeschriftungen (Zahlen)
    axis.title = element_text(size = 16), # Achsentitel (hier nur y)
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
    strip.text = element_text(size = 12) # falls du Facets verwendest
  )

p076
ggsave("GK21/Plots/p076_relfreq_distanceWeight_GK21.pdf", plot = p076, width = 8, height = 6)

```

```
####
#Patina/RMU####
#GKAntl
mydataGKAntl_RMU <- mydata2 %>%
  mutate(
    RMU = case_when(
      rawMaterial_all_RMU %in% c("1.1", "1.1.1", "1.1.2", "1.1.3", "1.1.4", "1.1.6", "1.1.7") ~ "1.1", # zu 1.1 zusammenfassen
      rawMaterial_all_RMU %in% c("1.2.1", "1.2.2", "1.2.4", "1.2.5") ~ "1", # zu 1 zusammenfassen
      rawMaterial_all_RMU %in% c("2", "2.1") ~ "2", # 2 und 2.1 zu 2 zusammenfassen
      TRUE ~ rawMaterial_all_RMU # Falls es andere Kategorien gibt, unverändert lassen
    )
  )
View(mydataGKAntl_RMU)

xtpat_RMU_GKAntl <- table(mydataGKAntl_RMU$lithic_all_patina, mydataGKAntl_RMU$RMU)
print(xtpat_RMU_GKAntl)

#GK21
xtpat_RMU_GK21 <- table(mydataGK21_RMU$lithic_all_patina, mydataGK21_RMU$RMU)
print(xtpat_RMU_GK21)
#GKII
xtpat_RMU_GKII <- table(mydataGKII_2_RMU2$lithic_all_patina, mydataGKII_2_RMU2$RMU)
print(xtpat_RMU_GKII)

#GewichtRMU####
#GKAntl (mydataGKAntl_RMU) ####
# 1. Nur die relevanten Spalten auswählen:
data_subset_GKAntl <- mydataGKAntl_RMU %>%
  dplyr::select(AH, RMU, weight)

# 2. Gruppieren und Gewicht zusammenfassen:
RMU_AH_weight_summary_GKAntl <- data_subset_GKAntl %>%
  dplyr::group_by(.data$AH, .data$RMU) %>%
  dplyr::summarise(total_weight = sum(weight, na.rm = TRUE), .groups = "drop") %>%
  dplyr::arrange(.data$AH, .data$RMU)

# 3. Ergebnis anzeigen:
print(RMU_AH_weight_summary_GKAntl)
View(RMU_AH_weight_summary_GKAntl)
write.csv(RMU_AH_weight_summary_GKAntl, "WeightRMU_GKAntl.csv")
RMU_AH_weight_summary_GKAntl
####
mydataGKAntl_RMU
xtab_weight_RMUGKAntl <- mydataGKAntl_RMU %>%
  dplyr::group_by(.data$AH, .data$RMU) %>%
  dplyr::summarise(total_weight = sum(weight, na.rm = TRUE), .groups = "drop") %>%
  dplyr::group_by(.data$AH) %>%
  dplyr::mutate(percent = total_weight / sum(total_weight)) %>%
  dplyr::ungroup()

xtab_weight_RMUGKAntl

p079 <- ggplot(xtab_weight_RMUGKAntl, aes(x = AH, y = percent, fill = RMU)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(
    values = c("1" = "bisque4", "1.1" = "orangered3", "2" = "gainsboro",
              "3" = "gray30", "4" = "lightgoldenrod1", "5" = "papayawhip", "n/a" = "darkkhaki"),
    labels = c("1" = "Chert", "1.1" = "Radiolarite", "2" = "Flint",
              "3" = "Obsidian", "4" = "Quartzite", "5" = "Quartz", "n/a" = "n/a")
  ) + theme_minimal() +
  labs(title = "Total Weight of Raw Material Groups by\nArchaeological Horizon (AH) in GK I (1993-2011)",
       x = "",
       y = "Percent") +
  scale_y_continuous(labels = scales::percent) +
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16), # Achsenbeschriftungen (Zahlen)
    axis.title = element_text(size = 16), # Achsentitel (hier nur y)
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
    strip.text = element_text(size = 12) # falls du Facets verwendest
  ) +
  guides(fill = guide_legend(nrow = 1)) # Legende in einer Zeile

p079
ggsave("GKAntl/Plots/p079_relfreq_RMUWeight_GKAntl.pdf", plot = p079, width = 8, height = 6)

#GK21 (mydataGK21_RMU)####
# 1. Nur die relevanten Spalten auswählen:
data_subset_GK21 <- mydataGK21_RMU %>%
  dplyr::select(AH, RMU, weight)

# 2. Gruppieren und Gewicht zusammenfassen:
RMU_AH_weight_summary_GK21 <- data_subset_GK21 %>%
  dplyr::group_by(.data$AH, .data$RMU) %>%
  dplyr::summarise(total_weight = sum(weight, na.rm = TRUE), .groups = "drop") %>%
  dplyr::arrange(.data$AH, .data$RMU)

# 3. Ergebnis anzeigen:
print(RMU_AH_weight_summary_GK21)
View(RMU_AH_weight_summary_GK21)
write.csv(RMU_AH_weight_summary_GK21, "WeightRMU_GK21.csv")

####
View(mydataGK21_RMU)
xtab_weight_RMUGK21 <- mydataGK21_RMU %>%
  dplyr::group_by(.data$AH, .data$RMU) %>%
  dplyr::summarise(total_weight = sum(weight, na.rm = TRUE), .groups = "drop") %>%
  dplyr::group_by(.data$AH) %>%
  dplyr::mutate(percent = total_weight / sum(total_weight)) %>%
  dplyr::ungroup()

xtab_weight_RMUGK21
####
p078 <- ggplot(xtab_weight_RMUGK21, aes(x = AH, y = percent, fill = RMU)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(
    values = c("1" = "bisque4", "1.1" = "orangered3", "2" = "gainsboro",
              "3" = "gray30", "4" = "lightgoldenrod1", "n/a" = "darkkhaki"),
```

```

    labels = c("1" = "Chert", "1.1" = "Radiolarite", "2" = "Flint",
              "3" = "Obsidian", "4" = "Quartzite", "n/a" = "n/a")
  ) + theme_minimal() +
  labs(title = "Total Weight of Raw Material Groups by\nArchaeological Horizon (AH) in GK I (2021)",
        x = "",
        y = "Percent") +
  scale_y_continuous(labels = scales::percent) +
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16),      # Achsenbeschriftungen (Zahlen)
    axis.title = element_text(size = 16),     # Achsentitel (hier nur y)
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
    strip.text = element_text(size = 12)      # falls du Facets verwendest
  ) +
  guides(fill = guide_legend(nrow = 1)) # Legende in einer Zeile

p078
ggsave("GK21/Plots/p078_relfreq_RMUWeight_GK21.pdf", plot = p078, width = 8, height = 6)

#GKII (mydataGKII_2_RMU)####
#RMUGKII_weight_tab <- addmargins(table( mydataGKII_2_RMU$RMU, mydataGKII_2_RMU$weight), margin = 1)
View(RMUGKII_weight_tab)
View(mydataGKII_2_RMU2)
str(mydataGKII_2_RMU2)
head(mydataGKII_2_RMU2)
mydataGKII_2_RMU3 <- mutate_if(mydataGKII_2_RMU2, is.character, as.factor)
mydataGKII_2_RMU3 <- mutate_if(mydataGKII_2_RMU2, is.logical, as.factor)
View(mydataGKII_2_RMU3)
str(mydataGKII_2_RMU3)
library(dplyr)

# Zusammenrechnen des Gewichts pro AH und RMU
library(dplyr)

# Sicherstellen, dass die Daten wirklich vorhanden sind:
# Anzeigen der Spaltennamen
colnames(mydataGKII_2_RMU2)

# 1. Nur die wichtigen Spalten ausw$hlen:
data_subset <- mydataGKII_2_RMU2 %>%
  dplyr::select(AH, RMU, weight)

# 2. Gruppieren und Gewicht zusammenfassen:
RMU_AH_weight_summary <- data_subset %>%
  dplyr::group_by(.data$AH, .data$RMU) %>%
  dplyr::summarise(total_weight = sum(weight, na.rm = TRUE), .groups = "drop") %>%
  dplyr::arrange(.data$AH, .data$RMU)

# 3. Ergebnis anschauen:
print(RMU_AH_weight_summary)
View(RMU_AH_weight_summary)
write.csv(RMU_AH_weight_summary, "WeightRMU_GKII.csv")
####

colnames(mydataGKII_2_RMU3)[grepl("AH", colnames(mydataGKII_2_RMU3))]
class(mydataGKII_2_RMU3)
library(dplyr)

xtab_weight_RMU <- mydataGKII_2_RMU3 %>%
  dplyr::group_by(.data$AH, .data$RMU) %>%
  dplyr::summarise(total_weight = sum(weight, na.rm = TRUE), .groups = "drop") %>%
  dplyr::group_by(.data$AH) %>%
  dplyr::mutate(percent = total_weight / sum(total_weight)) %>%
  dplyr::ungroup()

xtab_weight_RMU

p077 <- ggplot(xtab_weight_RMU, aes(x = AH, y = percent, fill = RMU)) +
  geom_bar(stat = "identity", position = "fill") +
  scale_fill_manual(
    values = c("1" = "bisque4", "1.1" = "orangered3", "2" = "gainsboro",
              "3" = "gray30", "4" = "lightgoldenrod1", "n/a" = "darkkhaki"),
    labels = c("1" = "Chert", "1.1" = "Radiolarite", "2" = "Flint",
              "3" = "Obsidian", "4" = "Quartzite", "n/a" = "n/a")
  ) + theme_minimal() +
  labs(title = "Total Weight of Raw Material Groups by\nArchaeological Horizon (AH) in GK II",
        x = "",
        y = "Percent") +
  scale_y_continuous(labels = scales::percent) +
  theme(
    legend.title = element_blank(),
    legend.position = "bottom",
    legend.text = element_text(size = 16),
    legend.text.position = "bottom",
    axis.text = element_text(size = 16),      # Achsenbeschriftungen (Zahlen)
    axis.title = element_text(size = 16),     # Achsentitel (hier nur y)
    plot.title = element_text(hjust = 0.5, size = 16, face = "bold"), # Titel
    strip.text = element_text(size = 12)      # falls du Facets verwendest
  ) +
  guides(fill = guide_legend(nrow = 1)) # Legende in einer Zeile

p077
ggsave("GKII/Plots/p077_relfreq_RMUWeight_GKII.pdf", plot = p077, width = 8, height = 6)

# Entferne NA-Werte und seltene Gruppen####
data_clean_GKII <- subset(RMU_AH_weight_summary, !is.na(RMU) & !(RMU %in% c("3", "4", "5"))) #entfernt n/a und "3", "4" und "5"
data_clean_GKII
RMU_AH_weight_summary_GKII_clean <- data_clean_GKII %>%
  filter(RMU != "n/a")
RMU_AH_weight_summary_GKII_clean
#GKI (data_clean_GKI)####
# 1. Nur die relevanten Spalten aus der bereinigten Tabelle ausw$hlen:
data_subset_GKI <- data_clean_GKI %>%
  dplyr::select(AH, RMU, weight)

# 2. Gruppieren und Gewicht pro RMU und AH aufsummieren:
RMU_AH_weight_summary_GKI <- data_subset_GKI %>%
  dplyr::group_by(.data$AH, .data$RMU) %>%

```

```

dplyr::summarise(total_weight = sum(weight, na.rm = TRUE), .groups = "drop") %>%
dplyr::arrange(.data$AH, .data$RMU)

# 3. Ergebnis anzeigen und exportieren:
print(RMU_AH_weight_summary_GKI)
View(RMU_AH_weight_summary_GKI)
write.csv(RMU_AH_weight_summary_GKI, "WeightRMU_GKI.csv")

# Optional: Objekt anzeigen
RMU_AH_weight_summary_GKI

# Entferne Zeilen, bei denen RMU gleich "n/a" ist
RMU_AH_weight_summary_GKI_clean <- RMU_AH_weight_summary_GKI %>%
  filter(RMU != "n/a")
RMU_AH_weight_summary_GKI_clean
#####
#####komplexe Statistik####
write.csv(mydataGKII_2_RM2, "mydataGKII_2_RM2.csv")
#GKAntl and GK21 -> mydataGKI
mydataGKI <- myimport %>%
  filter(lithic_all_siteName == "GK1")
write.csv(mydataGKI, "mydataGKI.csv")
View(mydataGKI)
mydataGKI_2 <- mydataGKI[mydataGKI$AH %in% c("AH3", "AH4"), ]
mydataGKI_2$AH <- factor(mydataGKI_2$AH, levels = c("AH3", "AH4"))

View(mydataGKI_2)

write.csv(mydataGKI_2, "mydataGKI_2.csv")

#GKI####
#AH/RMU####
mydataGKI_2_RM2 <- mydataGKI_2 %>%
  mutate(
    RMU = case_when(
      rawMaterial_all_RM2 %in% c("1.1", "1.1.1", "1.1.2", "1.1.3", "1.1.4", "1.1.6", "1.1.7") ~ "1.1", # zu 1.1 zusammenfassen
      rawMaterial_all_RM2 %in% c("1.2.1", "1.2.2", "1.2.4", "1.2.5") ~ "1", # zu 1 zusammenfassen
      rawMaterial_all_RM2 %in% c("2", "2.1") ~ "2", # 2 und 2.1 zu 2 zusammenfassen
      TRUE ~ rawMaterial_all_RM2 # Falls es andere Kategorien gibt, unverändert lassen
    )
  )

View(mydataGKI_2_RM2)
# Entferne NA-Werte und seltene Gruppen####
data_clean_GKI <- subset(mydataGKI_2_RM2, !is.na(RMU) & !(RMU %in% c("3", "4", "5"))) #entfernt n/a und "3", "4" und "5"

View(data_clean_GKI)
# Erstelle die Kontingenztafel####
tabelle_GKI <- table(data_clean_GKI$AH, data_clean_GKI$RMU)
View(tabelle_GKI)
tabelle_GKI_clean <- tabelle_GKI[, colnames(tabelle_GKI) != "n/a"]
tabelle_GKI_clean
View(tabelle_GKI_clean)
#chisq.test####
chisq.test(tabelle_GKI_clean, simulate.p.value = T, B=10000)

#GKII
#AH/RMU####
mydataGKII_2_RM2 <- mydataGKII_2 %>%
  mutate(
    RMU = case_when(
      rawMaterial_all_RM2 %in% c("1.1", "1.1.1", "1.1.2", "1.1.7") ~ "1.1", # zu 1.1 zusammenfassen
      TRUE ~ rawMaterial_all_RM2 # Falls es andere Kategorien gibt, unverändert lassen
    )
  )

# Entferne NA-Werte und seltene Gruppen####
data_clean_GKII <- subset(mydataGKII_2_RM2, !is.na(RMU) & !(RMU %in% c("3", "4", "5"))) #entfernt n/a und "3", "4" und "5"
#data_clean_GKII <- subset(mydataGKII_2_RM2, !is.na(RMU) & !(RMU %in% c("3", "4", "5")))

View(data_clean_GKII)
# Erstelle die Kontingenztafel####
tabelle_GKII <- table(data_clean_GKII$AH, data_clean_GKII$RMU)
View(tabelle_GKII)
tabelle_GKII_clean <- tabelle_GKII[-c(1, 2, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32), ]
tabelle_GKII_clean <- tabelle_GKII_clean[, colnames(tabelle_GKII_clean) != "n/a"]

View(tabelle_GKII_clean)
xt.lithicsRMU_AH_GKII <- xtabs(~ AH + RMU, data = data_clean_GKII, drop.unused.levels = T)
xt.lithicsRMU_AH_GKII
xt.lithicsRMU_AH_GKII <- xt.lithicsRMU_AH_GKII[, colnames(xt.lithicsRMU_AH_GKII) != "n/a"]
#chisq.test####
chisq.test(xt.lithicsRMU_AH_GKII)
chisq.test(xt.lithicsRMU_AH_GKII, simulate.p.value = T, B=10000)

View(xt.lithicsRMU_AH_GKII)

# Chi-Quadrat-Test durchföhren####
chi2_test_GKII <- chisq.test(tabelle_GKII_clean, simulate.p.value = T, B=10000)

# Ergebnisse ausgeben
print(chi2_test_GKII)

#myimport+RMU Spalte
#AH3/AHMichi####
mydataAH3Michi <- myimport %>%
  filter(AH %in% c("AH3", "Michi"))
write.csv(mydataAH3Michi, "mydataAH3Michi.csv")
View(mydataAH3Michi)

mydataAH3Michi_RM2 <- mydataAH3Michi %>%
  mutate(
    RMU = case_when(
      rawMaterial_all_RM2 %in% c("1.1", "1.1.1", "1.1.2", "1.1.3", "1.1.4", "1.1.6", "1.1.7") ~ "1.1", # zu 1.1 zusammenfassen
      rawMaterial_all_RM2 %in% c("1.2.1", "1.2.2", "1.2.4", "1.2.5") ~ "1", # zu 1 zusammenfassen
      rawMaterial_all_RM2 %in% c("2", "2.1") ~ "2", # 2 und 2.1 zu 2 zusammenfassen
      TRUE ~ rawMaterial_all_RM2 # Falls es andere Kategorien gibt, unverändert lassen
    )
  )

View(mydataAH3Michi_RM2)
# Entferne NA-Werte und seltene Gruppen####
data_clean_AH3Michi <- subset(mydataAH3Michi_RM2, !is.na(RMU) & !(RMU %in% c("3", "4", "5"))) #entfernt n/a und "3", "4" und "5"

```

```

View(data_clean_AH3Michi)
#AH4/AHLuc####
mydataAH4Luc <- myimport %>%
  filter(AH %in% c("AH4", "Luc"))
write.csv(mydataAH4Luc, "mydataAH4Luc.csv")
View(mydataAH4Luc)

mydataAH4Luc_RMU <- mydataAH4Luc %>%
  mutate(
    RMU = case when(
      rawMaterial_all_RMU %in% c("1.1", "1.1.1", "1.1.2", "1.1.3", "1.1.4", "1.1.6", "1.1.7") ~ "1.1", # zu 1.1 zusammenfassen
      rawMaterial_all_RMU %in% c("1.2.1", "1.2.2", "1.2.4", "1.2.5") ~ "1", # zu 1 zusammenfassen
      rawMaterial_all_RMU %in% c("2", "2.1") ~ "2", # 2 und 2.1 zu 2 zusammenfassen
      TRUE ~ rawMaterial_all_RMU # Falls es andere Kategorien gibt, unverändert lassen
    )
  )
View(mydataAH4Luc_RMU)
# Entferne NA-Werte und seltene Gruppen####
data_clean_AH4Luc <- subset(mydataAH4Luc_RMU, !is.na(RMU) & !(RMU %in% c("3", "4", "5"))) # entfernt n/a und "3", "4" und "5"
View(data_clean_AH4Luc)
#Tabellen####
#AH3/AHMichi####
tabelle_AH3Michi <- table(data_clean_AH3Michi$AH, data_clean_AH3Michi$RMU)
View(tabelle_AH3Michi)
tabelle_AH3Michi_clean <- tabelle_AH3Michi[, colnames(tabelle_AH3Michi) != "n/a"]
tabelle_AH3Michi_clean
View(tabelle_AH3Michi_clean)
#AH4/AHLuc####
tabelle_AH4Luc <- table(data_clean_AH4Luc$AH, data_clean_AH4Luc$RMU)
View(tabelle_AH4Luc)
tabelle_AH4Luc_clean <- tabelle_AH4Luc[, colnames(tabelle_AH4Luc) != "n/a"]
tabelle_AH4Luc_clean
View(tabelle_AH4Luc_clean)
#chisq.test####
#AH3/Michi####
chisq.test(tabelle_AH3Michi_clean, simulate.p.value = T, B=10000)

#AH/Luc####
chisq.test(tabelle_AH4Luc_clean, simulate.p.value = T, B=10000)

```