Outside the box: Lithic raw material analysis as an indication of crossing cultural borderlines by the earliest Linear Pottery Culture?

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Abstract:

Southern Bavaria marks a marginal area of the earliest Linear Pottery Culture in Central Europe. It is adjacent to the Southern Alpine Foreland, which represents an area for potential interaction with other cultural entities. Neolithic research in this region has largely focused on pottery analysis as a basis for answering chrono-cultural questions, leaving lithic analysis as a proxy for spatial processes at a lower resolution. For comparisons with the preceding Mesolithic however, the study of lithic finds is essential as they are the common denominator between the two periods. To confront this gap in the empirical data, a lithic assemblage from an earliest LBK site in the Isar valley of southern Bavaria was studied with a special focus on raw material analysis and typo-technological aspects of the Knappable Siliceous Sedimentary Rocks (henceforth, KSSR). The objective was to generate high-resolution raw material data obtained by sorting and determination of sedimentary microfacies. Results show that the main raw material components originate from two different regions of Bavaria, the Ortenburg district and the Donau-Altmühl region. Additionally, they reveal bridges across the Alps and into Switzerland, which supports the idea that clear-cut archaeological borders were in fact more permeable and that long-distance importation occurred from non-LBK regions. This opens up a discussion about the agents and processes of long-distance raw material transport, relations between cultural entities as well as the mobility of the earliest LBK itself across its archaeological distribution. Set in a diachronic perspective, it is shown that Southern Bavaria can be viewed as a transitional zone during the earliest phase of the LBK, with mobility occurring for different motives.

Keywords: Early Neolithic; Bavaria; siliceous raw material study; earliest Linear Pottery Culture; long-distance importation of raw material; cultural borders; Southern Alpine raw material

1. Introduction and background: Regionality within the earliest LBK

The earliest Linear Pottery Culture (hereinafter, earliest LBK, from the German, *älteste Linearbandkeramik*, 5,400 - 5,200 cal. BCE) (LBK I after Quitta 1960) marks the initial phase of the LBK, the first Neolithic culture in large parts of Central Europe. As the LBK is one of the best researched cultural entities of the Central European Neolithic, the earliest phase is also well-researched in terms of house structures (Stäuble 2005) and typo-stylistic features of

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ceramic finds (Cladders 2001; Hillemeyer 2003), even though the low proportion of decorated pottery can be a limiting factor. Despite a quite uniform canon of ceramic styles and house structures, regional differences are apparent, where specific stylistic traits can show connections between regional groups. This suggests the existence of subordinate borders within the distribution area already in the earliest phase (Pechtl 2009), which continues into later phases of the LBK (Pechtl 2016). Also, depending on the spatial relation of the individual areas within the distribution, differences between more inland and marginal regions can be a factor in variability. Since bordering regions, by definition, have contact with other geographical areas with different archaeological entities, it is more probable that interaction and mixing of traits will occur there. This is especially the case for the earliest period of the LBK, where central places, that might constitute another aspect of regional and inter-site variability, had not yet been established. Additionally, marginal settlements are likely to be situated in more challenging environments (*e.g.*, Pechtl 2011), therefore probably prompting a degree of deviating subsistence activity.

Apart from the stylistic perspective on this topic, siliceous raw material varieties present in an assemblage indicate geographical references and can therefore reflect directions of mobility, potential contact and exchange, as well as regional borders (*e.g.*, Gehlen *et al.* 2022; Gronenborn 2007; Kind 1998). This makes raw material analysis an excellent tool for exploring this issue. However, lithic analysis and especially raw material analysis remain under-researched for this period. To tackle this gap in research, the objective of this study is to generate high-quality data for the variety of siliceous raw materials, and thus to throw light on the directions of procurement and networks within the earliest LBK. As border phenomena are at the heart of this issue, the marginal settlement area of Southern Bavaria was chosen as an illustration.

2. Regional setting: The earliest LBK in Southern Bavaria

The transition to the earliest LBK in Southern Bavaria takes place around 5,400 cal. BCE, with earliest dates for the Ries valley (Stäuble 1995: 234) and around 5,350 cal. BCE for the Middle Isar Valley (Hofmann 2011). According to ceramic studies and $\delta^{14}C$ dates, two phases can be distinguished here for Southern Bavaria (Pechtl 2009; Pechtl & Hofmann 2016). Several processes of temporal, spatial and social overlapping have been discussed for this period.

In temporal terms, the region south of the Danube seems to have been settled only in the later phase of the earliest LBK (Pechtl 2009); however, the assumed end of the earliest LBK around 5,300 cal. BCE must be reviewed in the light of more recent $\delta^{14}C$ dates (*e.g.*, Pechtl & Hofmann 2016; Stäuble 2005). Therefore, overlapping processes with the subsequent Flomborn phase are also probable (Pechtl 2009; Stäuble 2005), as shown for other sites (recently Nadler *et al.* 2023). Since the Isar confluence, with sites like Stephansposching (Pechtl 2019) is settled later in the older LBK (LBK II after Quitta 1960), the direction in which settlement took place remains unclear.

In spatial terms, Southern Bavaria is situated at the fringe of the earliest LBK distribution area. For the period around 5,400 to 5,300 cal. BCE, there is no archaeological evidence for the adjacent Iller-Lech Plateau and the Bavarian Alpine Foreland to the south. In particular, the Middle Isar Valley represents a rather marginal area of the earliest LBK distribution, being the southernmost cluster of settlements. Stylistic analysis of ceramics shows that Southern Bavaria is characterized by a dominance of specific traits, suggesting that a distinct regional group; these traits connect Southern Bavaria to Bohemia, the Neckar valley and Lower Franconia (Hofmann *et al.* 2013: 211; Pechtl 2009).

In terms of climatic conditions, higher precipitation rates and more unfavourable temperatures make Southern Bavaria a region at the borderline of agricultural feasibility (Pechtl

& Land 2019). This aspect can be illustrated quite well with later LBK settlements in the Lech valley, which represent colonization experiments on loess patches further south, with several periods of hiatus and abandonment of settlements (Pechtl 2011; 2020). The challenging conditions in Southern Bavaria may also be reflected in the higher proportions of wild animal bones present in the earliest LBK settlements of Southern Germany (Lüning 2000: 114).

2.1. State of research on earliest LBK lithic assemblages

Even though the state of research on earliest LBK lithic assemblages has been improved during the last decades (Fischer 2011; 2020; Gronenborn 1997; Mateiciucová 2008), some aspects still remain poorly defined. For Southern Bavaria, only a few assemblages have been studied so far (Figure 1; Table 1). For other excavated assemblages, lithic finds are unpublished. This is partly due to the fact that lithic assemblages from Bavaria tend to be quite small, which sets limits to statistical analysis (Pechtl 2017, 2019: 209, Figure 100; Wild *et al.* 2020), compared to assemblage sizes from Western Germany (Kind 1989: 218, table 125; Löhr *et al.* 1977: 161-165, 188-189; Zimmermann 1988: 629, 648, 662, table 593) and Baden-Wuerttemberg (Kind 2005); this renders them unattractive within the context of statistically-oriented lithic research, where the prime objective is to analyse larger numbers of finds (Drafehn *et al.* 2008; Zimmermann 1988). Reasons for small assemblages in Bavaria remain unclear. Even though assemblages tend to decrease with increasing distance from outcrops, this is not the exclusive factor (Pechtl 2019: 209-210); however, even for bigger excavations with several occupational phases like Schwanfeld, lithic numbers are comparatively low (Gronenborn 1997: 34). Preservation and erosion of features also adds to that, but is also not explanatory for these major differences (Pechtl 2019: 205-206). Additionally, the mixed nature of many assemblages hinders their analysis (Gronenborn 1997: 12; Pechtl 2009: 79; Reinecke 1983).

Previous techno-typological studies on lithic assemblages have shown traits similar to the Late Mesolithic in Southern Bavaria - namely, the production of small regular blades and symmetrical trapeze microliths (Fischer *et al.* 2009; Gehlen 2010: 118, 132; Gronenborn 1997; Tillmann 1993a; for Southwestern Germany, Kind 2010). Even though it has been claimed that technical traits like facetted butts were a tradition of the Southern German Late Mesolithic carried into the earliest LBK (Tillmann 1993a), this preparation method is not exclusive, but rather was executed side by side with dorsal reduction (for Late Mesolithic, Richter 2017: 125; for earliest LBK, Bauer 2023; Fischer 2011: 40-42). This closeness to Mesolithic lithic technology triggered a debate on the relationship between these cultural phenomena with hypotheses ranging from an autochthonous development of the Southern Bavarian LBK by Mesolithic groups (*e.g.*, Gehlen & Schön 2003; Kind 1998; Tillmann 1993a), to up until now, the coexistence of the earliest LBK with Final Mesolithic groups (Gehlen 2017; Gronenborn 1999; Kind 1997: 117, 121; Schier *et al.* 2020; Stäuble & Wolfram 2013).

For comparability reasons, the terms chert, flint, radiolarite and quartzite are used according to their respective use for specific materials in the literature in this section. In terms of raw material analysis, only macroscopic characterisation and sorting has so far been conducted. As a result, in the main only broad attributions to raw material varieties have been made based on general macroscopic features like colour, cortex and opacity (*e.g.*, Gronenborn 1997; de Grooth 2011; Löhr *et al.* 1977; Zimmermann 1988). In contrast, certain macroscopically more distinct raw materials were highlighted, especially the imported Szentgál radiolarite (see Mateiciucová 2008: 49-50; Přichystal 2013: 129-130) from the Bakony Mountains at Lake Balaton (Gronenborn 1997: 108-110; Mateiciucová 2008: 118-119; Tillmann 1993a), spanning enormous distances between Central Europe and Transdanubia. This generates major differences between scales of localisation. As regards Southern Bavaria,

the exogenous raw materials constitute only minor proportions of the assemblage, while the main components of raw material procurement are limited to assignments such as Jurassic KSSR (Knappable Siliceous Sedimentary Rocks), assigned in general to the Franconian Alb (for the site of Mintraching, see Gronenborn 1997: 25-26).

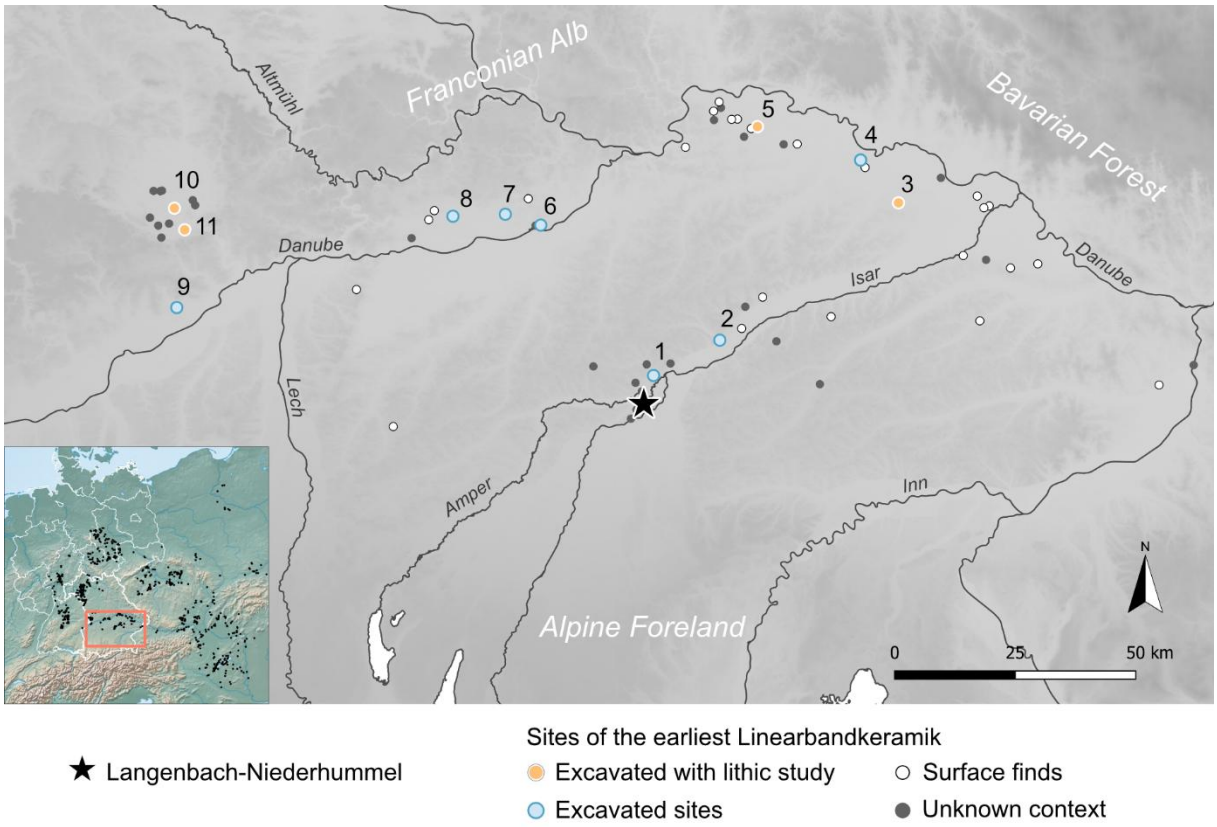

Figure 1. Earliest LBK sites of Southern Bavaria. 1 Wang-Zieglberg, 2 Altdorf, 3 Meindling, 4 Aiterhofen, 5 Mintraching, 6 Vohburg-Oberdünzing, 7 Kösching-Gradhof, 8 Gaimersheim, 9 Weilheim, 10 Enkingen, 11 Kleinsorheim. For Meindling, only two pits with exclusively earliest LBK material were recovered (Moddermann 1992, 26), the lithic study is only concerning Early and Middle LBK pits (de Grooth 1992). (basic geodata: 2012 Natural Earth. Technical data: database made available by A.-L. Fischer in 2019; graphics: L. Bauer).
Figure 1. Sites du Rubané le plus ancien (*Älteste Bandkeramik*) découverts dans le sud de la Bavière. 1 Wang-Zieglberg, 2 Altdorf, 3 Meindling, 4 Aiterhofen, 5 Mintraching, 6 Vohburg-Oberdünzing, 7 Kösching-Gradhof, 8 Gaimersheim, 9 Weilheim, 10 Enkingen, 11 Kleinsorheim. À Meindling, seules deux fosses contenant exclusivement du matériel du Rubané le plus ancien ont été retrouvées (Moddermann 1992, 26), l'étude lithique ne concerne que les fosses rubané ancien et moyen (de Grooth 1992). (Fonds de carte: 2012 Natural Earth. Données techniques: base de données fournie par A.-L. Fischer en 2019; CAD L. Bauer).

Table 1. Earliest LBK sites in Southern Bavaria with numbers of published lithic finds (missing numbers are not published).
Tableau 1. Sites du Rubané le plus ancien (*Älteste Bandkeramik*) découverts dans le sud de la Bavière et décomptes publiés (en nombre) des artefacts lithiques (les informations non disponibles ne sont pas présentées).

No. (Fig. 1)	Site	Lithic Count	References
star	Langenbach-Niederhummel	296	Bauer 2023
5	Mintraching	202	Gronenborn 1997
10	Kleinsorheim	6	Gronenborn 1997
11	Enkingen	84	Gronenborn 1997

2.2 Studies on lithic raw materials in Southern Bavaria

Primary and sub-primary deposits for Bavaria are very much limited to the Jurassic deposits of the Franconian Alb, but also small residual deposits in the so-called Ortenburg district (Figure 2). Research on outcrops mostly focused on the mining sites of Abensberg-Arnhofen (Roth 2008) and to a lesser extent on Flintsbach-Hardt (Weißmüller 1991) and in general on the southern part of the Franconian Alb, whereas the middle and northern part is only studied based on individual outcrops (*e.g.*, Scharl 2016). Studies with a distinct focus on raw material varieties, as was done for Southern Bavaria with the distinction of Franconian and Ortenburg materials (Schötz 1988), as well as for western Franconia (Scharl 2010), needed to rely on macroscopic sorting of surface assemblages. Hence, the state of research is patchy and characterization of raw material varieties leaves room for improvement. To the south, only secondary sources are available from the river banks, originating from the Alps. Thus, the area to the south of the Danube is particularly lacking in high-quality raw material.

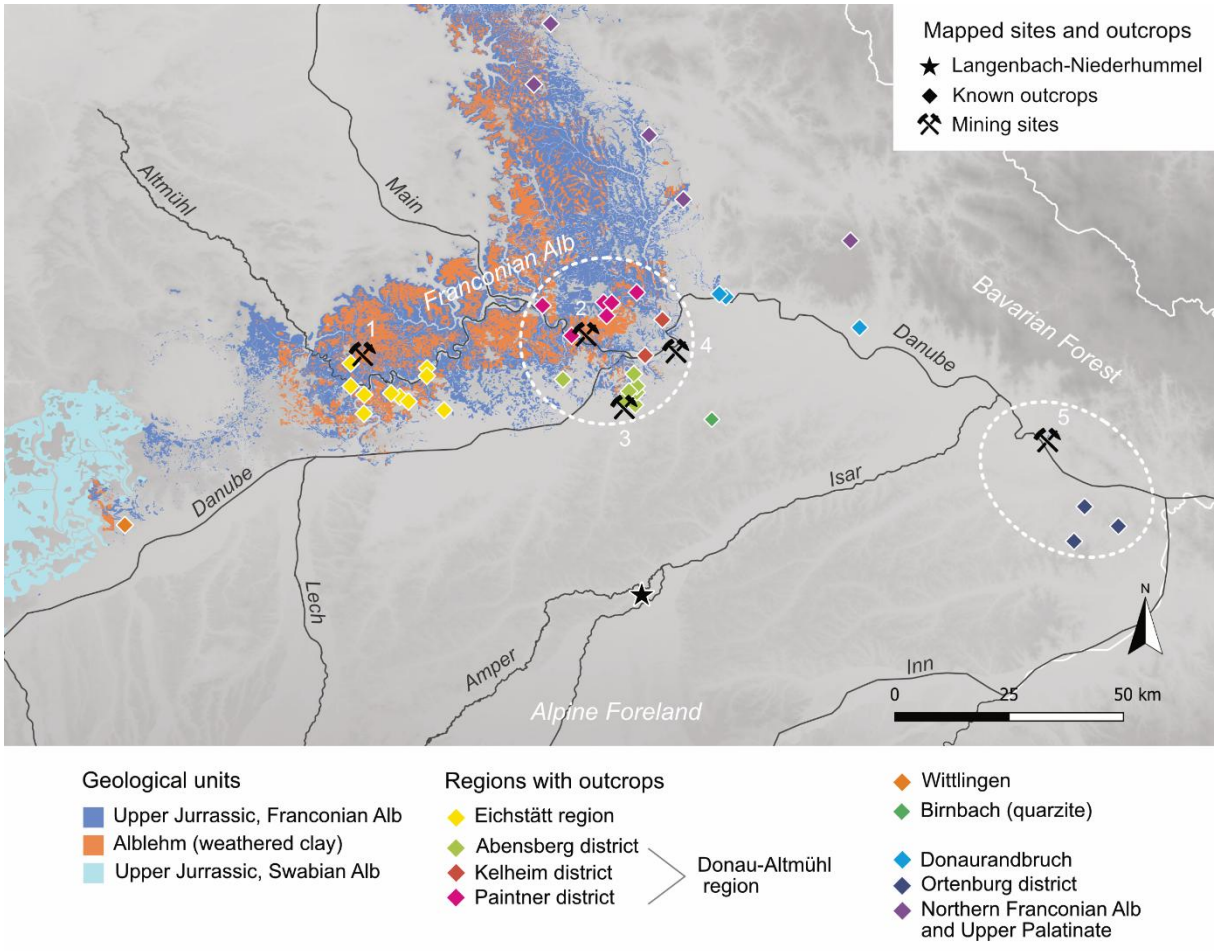

Figure 2. Raw material sources in Southern Bavaria. Star: Langenbach-Niederhummel (case study). Mining sites: 1 Schernfelder Forst, 2 Baiersdorf, 3 Abensberg-Arnhofen, 4 Lengfeld, 5 Flintsbach-Hardt (Basic geodata: 2012 Natural Earth. Geological data: Bayerisches Landesamt für Umwelt, geological map 1:500.000; points of outcrops and groupings of outcrops: Binsteiner 2005: 148-149; Böhner 2012: 80).
Figure 2. Sources de matières premières lithiques en Bavière du Sud. Étoile: Langenbach-Niederhummel (site étudié). Sites miniers: 1 Schernfelder Forst, 2 Baiersdorf, 3 Abensberg-Arnhofen, 4 Lengfeld, 5 Flintsbach-Hardt (Fond de carte: 2012 Natural Earth. Données géologiques: Office bavarois de l'environnement, cartes géologiques 1:500.000; points des gîtes et leur regroupement: Binsteiner 2005: 148-149; Böhner 2012: 80).

3. Case study: Langenbach-Niederhummel

For this study, the assemblage from the earliest LBK site of Langenbach-Niederhummel was selected for analysis. This is in line with several aspects mentioned above. The site is situated in the Middle Isar valley in the district of Freising, Upper Bavaria, and marks one of the southernmost points of the earliest LBK distribution (Figure 1). First discovered in the 1980s, excavations took place in 1991 (Engelhardt 1991; Engelhardt *et al.* 1991) and 2008 (Hofmann 2009; 2011). It is one of the few excavated sites with an unmixed assemblage of the earliest LBK; assemblages from other sites in the vicinity, like Wang-Ziegelberg (Figure 1), are unsuitable for study due to their mixed nature (Gronenborn 1997: 12). Ceramic finds suggest that the settlement falls in a later phase of the earliest LBK (Pechtl 2009; Pechtl & Hofmann 2016; Strien 2018), with $\delta^{14}C$ dates around 5,350 cal. BCE for the settlement (Hofmann 2011). Both excavations focused on a small area on a hillside and opened 300 m² (1991) and 730 m² (2008); excavations yielded pits and several ditches, but no clear house structures. Since the 2008 excavation yielded only a small number of lithics (n=22), these were not included in the study. This low number may have taphonomic (erosion), but also functional causes, as the number of ceramic finds is more in line with find numbers of 1991 (Bauer 2023: 26, table 2).

The 1991 excavation comprised six test areas, yielding 12 features, among them six elongated pits or ditches and an oven feature. The lithic assemblage comprises 296 lithic artefacts, mainly from two pits. Distribution of lithics within the settlement cannot be further analysed due to the small excavation area and missing clear house structures. For Bavaria however, the assemblage is quite big relative to the excavated area. However, as the assemblage is still quite small, this allowed for a qualitative study method of the raw material varieties.

In a preliminary report, Tillmann (1993a) discussed the varieties of raw materials in the assemblage on a macroscopic level. He assumed the main component to have originated from the Southern Franconian Alb. Also, he put special emphasis on pieces he classified as Szentgál radiolarite, in 465 km distance from the site, which constituted 4% (n=12) of the assemblage (Tillmann 1993a: 160). The main objective of this study therefore was to verify this data in order to improve the resolution of exploited outcrops and to clarify raw material variability at the site.

The high number of unmodified flakes stresses the importance of local production at the site of Langenbach-Niederhummel (Table 2). This is also testified by equal shares of blank fragments and a high number of pieces with cortical surfaces. The small number of cores may be due to the small excavation area. They can be classified as rest cores at the end of blade production (Figure 3.11). The number of modified blanks shows the importance of blades for tool production, as is evident for the earliest LBK in general and also Late and Final Mesolithic assemblages (Gronenborn 1997: 63-64; Richter 2017: 188, 227). Alterations by heating is only detected for a small number of pieces (n=17; 6.1% of assemblage), mostly due to them being discarded in the oven feature (n=9, 52.9% of burned pieces). The high proportion of facetted butts, especially on blades (55.6 %) underlines the importance of this mode of preparation in the assemblage, as is also attested in other earliest LBK assemblages (Gronenborn 1997: 174-175, table 4). In contrast, smooth butts with dorsal preparation are seen as alternative concept; however, facetted butts and dorsal reduction are not mutually exclusive, but differ in terms of the quantity present in the assemblage (Fischer 2011: 42). For Langenbach-Niederhummel, dorsal reduction is also present on lithics with facetted butts, which underlines this observation (Bauer 2023: 68, table 23).

The spectrum of tools matches those of other earliest LBK assemblages. Of the tools present (27.4% of the assemblages), blades were primarily retouched, followed by flakes (see, Table 3). A few trapezoid microliths (Figure 3.1-2), small borers (Figure 3.4-5) and pieces with sickle gloss (Figure 3.6) are present, but the majority of tools are truncations (Figure 3.7), end-

scrapers (Figure 3.9) and lateral retouches. Only two splintered pieces are documented; a few cores and debris pieces were used as percussors. Typologically, the microliths are symmetrical trapezes, as is common for the earliest LBK. One piece shows a partial oblique retouch on one edge (Figure 3.3); it may be interpreted as a semi-finished truncation or micro-point, which would not be as common. One medial blade fragment shows double truncation, one with alternating retouch (Figure 3.8); this might be classified as an elongated trapeze, even though it is quite big (Taute 1971: 42). The small borers exhibit finely retouched points. They are typical for the earliest LBK (Gronenborn 1997: 23, 90-91) and can be associated with continuing traditions from the Late Mesolithic (Mateiciucová 2003). Truncations are found primarily on blades, therefore representing a morphologically more uniform group compared to end-scrapers, which are frequently found on larger flakes. Also, lateral retouches are more common on flakes than blades.

From a functional perspective, most of the present tools (borers, endscrapers, truncations and lateral retouches) can be associated with craft activities (*e.g.*, Mischka 2012), while subsistence-oriented tools - projectiles and sickle glosses - are underrepresented within the excavated settlement area.

Table 2. Langenbach-Niederhummel. Proportion of blanks with regard to their modification.
Tableau 2. Langenbach-Niederhummel. Proportion des supports en fonction de leur modification.

Blank type	**Modification**	**Count**	***%***
Flake	unmodified	142	*49.8*
	modified	31	*10.9*
Blade	unmodified	43	*15.1*
	modified	37	*13*
Core	unmodified	2	*0.7*
	modified	3	*1.1*
Debris	unmodified	21	*7.4*
	modified	6	*2.1*
TOTAL		**285**	***100***

Table 3. Langenbach-Niederhummel. Proportion of tools in the assemblage in relation to blank type.
Tableau 3. Langenbach-Niederhummel. Proportion des outils dans l'assemblage en fonction du type de supports.

Tool type	**Flake**	**Blade**	**Debris**	**Core**	**Count**	***%***
Trapeze microliths	-	2	-	-	2	*2.6*
Micro points	-	1	-	-	1	*1.3*
Borers	1	1	-	-	2	*2.6*
Sickle blades	-	3	-	-	3	*3.9*
Truncations	4	12	-	-	16	*20.8*
Endscrapers	3	7	2	-	12	*15.6*
Lateral retouches	22	11	2	-	35	*45.5*
Splintered pieces	2	-	-	-	2	*2.6*
Hammer stones	-	-	2	3	5	*6.5*
TOTAL	**32**	**37**	**6**	**3**	**78**	***100***
%	***41.6***	***46.6***	***7.8***	***3.9***	***27.4***	

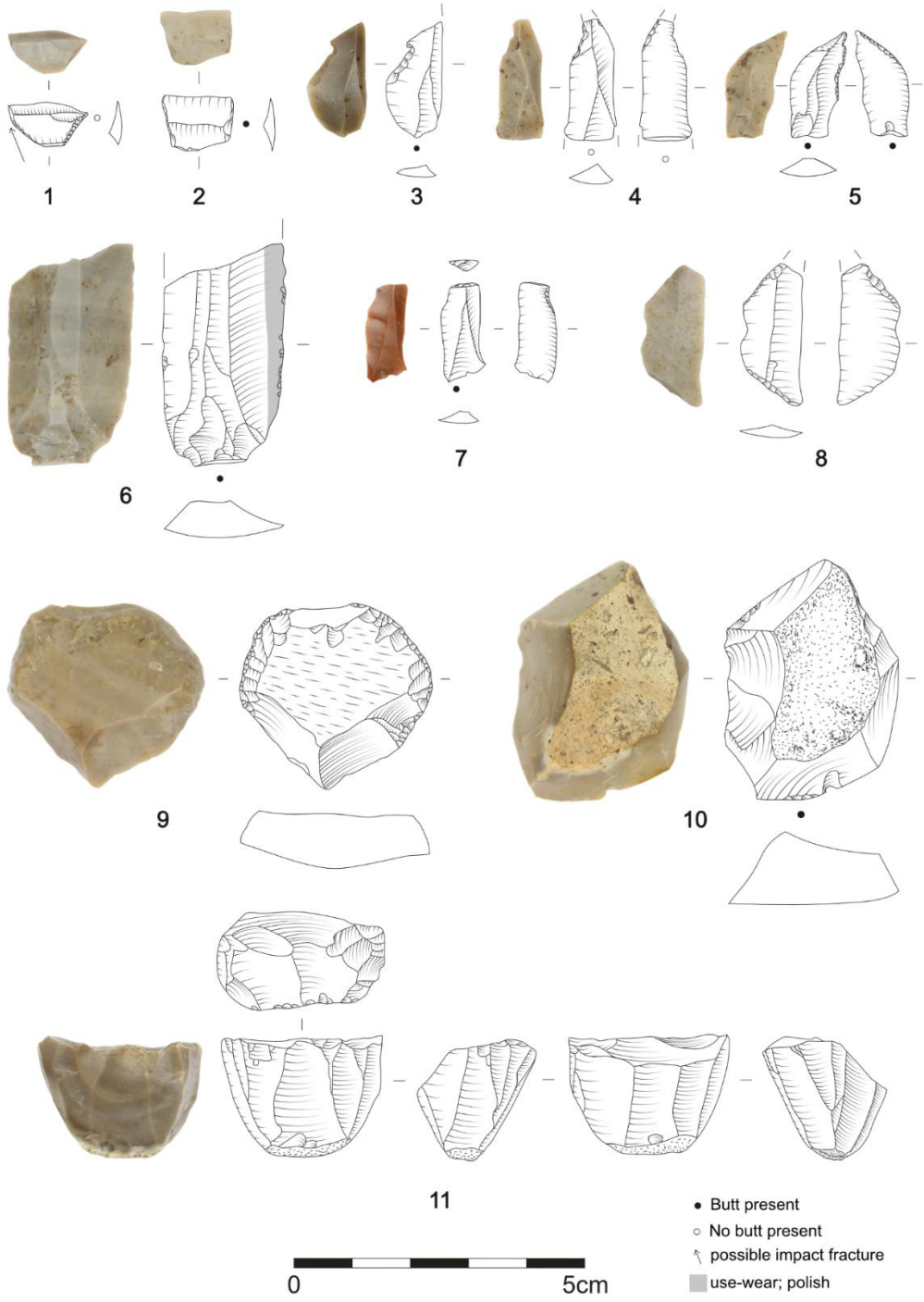

Figure 3. Langenbach-Niederhummel. Overview of lithic tools and cores recovered from the site during the excavation of 1991. 1-2 microliths (trapezes); 3 semi-finished products; 4-5 borers; 6 blade fragment with use-wear polish (sickle gloss) on lateral edge; 7 small blade with truncation and marginal lateral retouch; 8 bilateral diagonal truncations on blade; 9 end-scraper on debris; 10 decortification flake with small amount of use retouch; 11 small rest core with blade negatives (drawings: L. Bauer).

Figure 3. Langenbach-Niederhummel. Outils et nucléus découverts lors de la fouille de 1991. 1-2 microlithes (trapèzes); 3 produits semi-finis; 4-5 perçoirs; 6 fragment de lame avec lustre envahissant sur un bord latéral (faucille); 7 troncature distale sur petite lame et retouches latérales marginales; 8 lame bitronquée (troncatures obliques); 9 grattoir sur débris; 10 éclat de décorticage portant quelques retouches d'utilisation; 11 petit nucléus résiduel avec négatifs de lames (dessins: L. Bauer).

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4. Methods of raw material analysis

In the following, the term KSSR "Knappable Siliceous Sedimentary Rocks" (equivalent for the European term silicites *sensu* Přichystal 2013) is used as an umbrella term for all sedimentary siliceous rocks; the artefacts manufactured from them are designed as 'silices' (Affolter *et al.* 2021; Brandl 2013). Prior to analysis, the assemblage was studied in a double-sorting approach. In a first step, the silices were sorted on the basis of macroscopic criteria. This approach results in bigger groups of pieces formed on the basis of corresponding general features. As colour is a strong visual factor, there is a risk of grouping similarly coloured pieces that are not of the same variety of raw material. Additionally, patination and alterations by heating have influence on colouration. To tackle this problem, each group was then further studied by analysing the pieces under a microscope (Dino-Lite Digital Microsope Edge series, AM4000 series, magnification 50-298x). Through this, false allocations and groupings could be corrected due to traits such as residual texture (after silicification) and matrix, orientations and visible microfossils and intraclasts. Part of the assemblage could not be further sorted due to lacking diagnostic features.

The resulting raw material units were then analysed using the sedimentary microfacies method (see recently Affolter *et al.* 2021). This assigns silicites to the most appropriate geological reference samples based on their petrographic traits. This does not equal a clear assignment to specific outcrops; at best, it is equivalent to an approximation of the exploited locality. Therefore, the localities of the reference samples must not be viewed as exact geographic determinations, but as reliable narrowed-down locations. The quality of this attribution is dependent on factors such as the extent of the reference collection (with no collection being complete). In current practice, it is common to give the name of the nearest outcrop from the studied archaeological site, where one can find the same KSSR with the same sedimentary silicified microfacies.

5. Results of raw material analysis

Through the double-sorting, it became clear that the grouping procedure was quite precise, with only some pieces requiring re-sorting. Also, low proportions of patination and alterations by heat effects this in a positive way. This turned out to be an excellent preparation for the following analysis, keeping costs within the budget. Of 197 sorted pieces of the assemblage (n=296), 193 could be analysed and attributed to localities and possible outcrops (Table 4). The remaining silicites could not be sorted further due to lack of diagnostic features (n=65), size (n=20) or alterations by heating (n=18). Sorted raw material units, probably originating from individual cores or working pieces (*Werkstücke*, after Weißmüller 1995), could subsequently be grouped into the determined raw material varieties.

The detected raw material varieties can be organized into several regional groups (Figure 4). It could be affirmed that the main KSSR sources are situated in Northern Bavaria. However, compared to the later phases of the LBK and the dominant view of research, there are two main components lying in different directions: the Ortenburg district and the Donau-Altmühl region, which was of great significance later as a source of the aforementioned tabular KSSR of Abensberg-Arnhofen (Roth 2008). The Ortenburg district comprises several small residual Upper Jurassic deposits along the Danube between the Isar and Inn confluences, with the mining site of Flintsbach-Hardt. The Donau-Altmühl region describes the area around the Altmühl confluence into the Danube at the southern fringe of the Franconian Alb, with a number of known outcrops and three mining sites. In contrast several minor components indicate links to other regions, including the Ulm area, the Swiss canton of Schaffhausen (the so-called *Randenregion*), the Trentino area in Northern Italy and the Balaton area in Hungary.

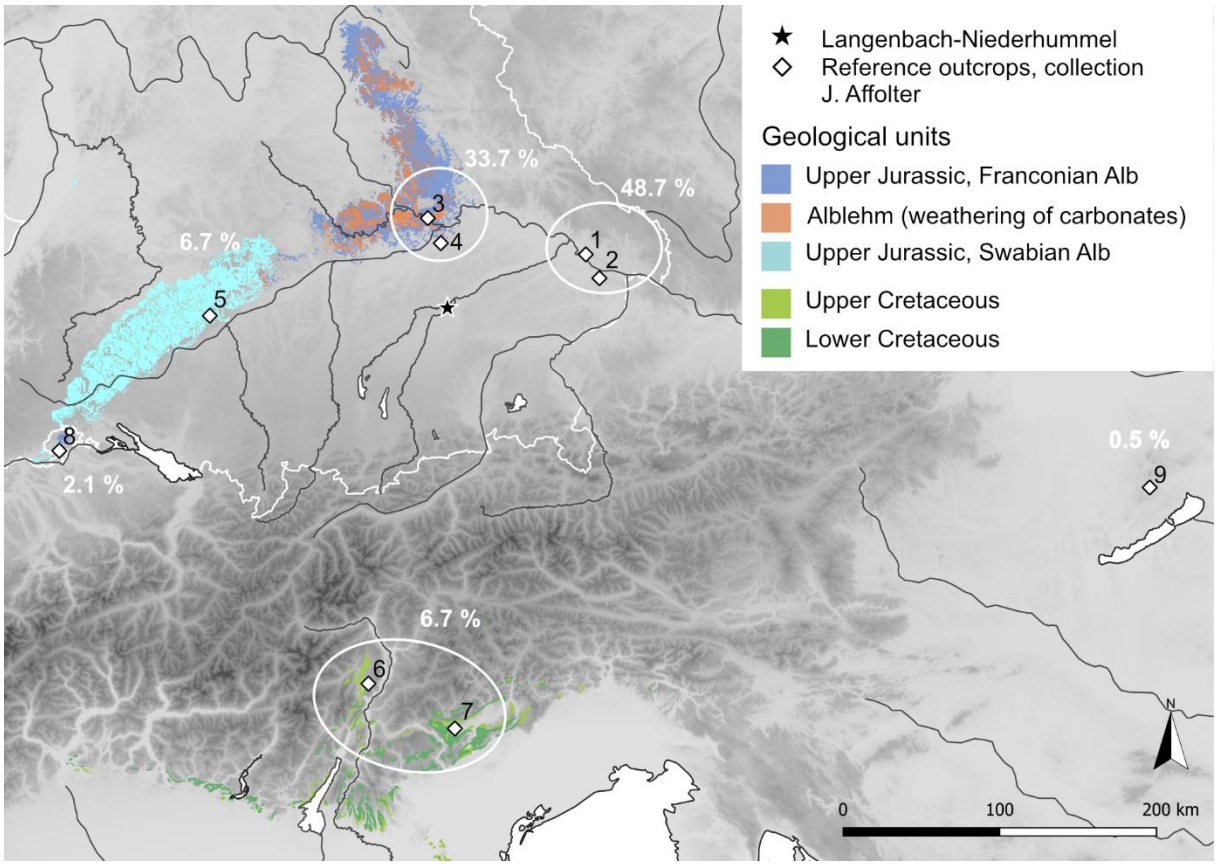


Figure 4. Regional groups of detected siliceous raw materials in the assemblage. For numbers of reference outcrops see Table 4. Percentages are proportions of regional groups of all analysed silicites (Basic geodata: 2004 - 2021, CGIAR - Consortium for Spatial Information; OpenStreetMap; geological data: Bayerisches Landesamt für Umwelt, geological map 1:500.000; coordinates for outcrops: J. Affolter; graphics: L. Bauer).
Figure 4. Groupes régionaux des matières premières siliceuses identifiées dans l'assemblage étudié. Les numéros de référence des gisements sont présentés dans le tableau 4. Les pourcentages représentent la part des groupes régionaux identifiés pour l'ensemble des silicites analysées. (Fond de carte: 2004 - 2021, CGIAR - Consortium for Spatial Information; OpenStreetMap; données géologiques: Office bavarois de l'environnement, cartes géologiques 1:500.000; coordonnées pour les gisements: J. Affolter; CAD: L. Bauer).

5.1. Main KSSR sources

The highest proportion of raw material can be linked to sources located in the area of Regensburg and further southwards, generally called the Ortenburg district (Figure 4). The outcrops are situated in very small residual Upper Jurassic deposits between the Isar and Inn confluence into the Danube. Those KSSR materials were relocated during the Eocene, resulting in impregnation with iron oxides and discoloration. There are five outcrops known or mentioned in the literature. One of them, Flintsbach-Hardt, is the only excavated site. Here, Neolithic mining is proven (Binsteiner 2005: 76-79; Weißmüller 1991; 1994; 1996), with open-pit mining suggested for the Neolithic (Weißmüller 1991: 25-26). Even though the quality varies significantly, the yield is profitable (Gayck 2000: 247). Other known outcrops are situated further to the south and in some cases, they have yielded prehistoric artefacts (Binsteiner 2005: 75, table 30). In the assemblage, the highest proportion can be associated with reference samples from Flintsbach-Hardt (Figure 5.A). Technological analysis could show on-site production for this raw material with minor to no decortication or preparation at the outcrop. This is remarkable as the distance involved is about 100 km as the crow flies and, as mentioned, the raw material quality can be quite heterogeneous. Smaller groups can be associated with the reference outcrop at Söldenau or Maierhof (Figure 5.B) and to the district (Figure 5.C) in general. The high proportion of this raw material group stresses the importance of the Isar valley

as a pathway to the Northeast, as has already been suggested by stylistic similarities to ceramics from Bohemia (Pechtl 2009). Whereas these raw materials seem to be of regional significance, as attested later for the Southern Bavarian Middle Neolithic (Grillo 1997), nationwide they play only a minor role regarding long-distance transport and exchange (for Lower Franconia, see Scharl 2010: 37).

Table 4. Proportions of KSSR varieties in the analysed assemblage. Pieces that were not analysed are not included (Codes and coordinates according to Affolter 2002 and J. Affolter reference collection database). A dash indicates the outcrops that extend at a regional scale and no specific coordinates can be given.
Tableau 4. Proportions des différentes matières dans l'assemblage analysé. Les pièces n'ayant pas fait l'objet d'une analyse ne sont pas reprises dans le tableau (Codes et coordonnées géographiques d'après Affolter 2002 et base de données de la collection de référence de J. Affolter). Un tiret indique les affleurements qui s'étendent à l'échelle régionale et dont les coordonnées précises ne peuvent donc être indiquées.

No. (Fig. 4)	**Reference outcrop**	**Country**	**Code J. Affolter**	**Long./Lat. (WGS 84)**	**n**	***%***
1	Flintsbach-Hardt	Germany	256	801892.665 5403908.171	81	*42*
2	Söldenau-Maierhof	Germany	2343	810582.437 5388751.405	3	*1.6*
-	Ortenburg district	Germany	-	-	10	*5.2*
3	Baiersdorf	Germany	184	700938.609 5427059.447	57	*29.5*
4	Abensberg-Arnhofen	Germany	153	709262.186 5411112.326	7	*3.6*
-	Donau-Altmühl region	Germany	-	-	1	*0.5*
5	Borgerhau	Germany	299	561619.347 5364774.554	13	*6.7*
6	Vervò	Italy	1215	662982.488 5129879.427	5	*2.6*
7	Monte Avena	Italy	260	718202.534 5101200.350	4	*2.1*
8	Neunkirch Neuweghalde 1	Switzerland	448	465507.750 5278583.426	4	*2.1*
-	Baltic (glacial till)	Germany	11	-	4	*2.1*
-	Northern alpine; Schrattenkalk?	Germany	2306	-	2	*1*
-	Northern Alpine radiolarite	Germany	9	-	1	*0.5*
9	Szentgál	Hungary	687	1162234.368 5255124.520	1	*0.5*
TOTAL					**193**	***100***

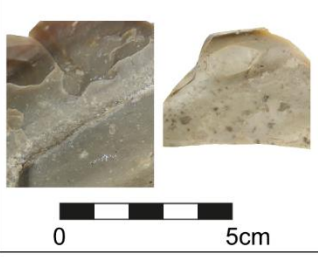
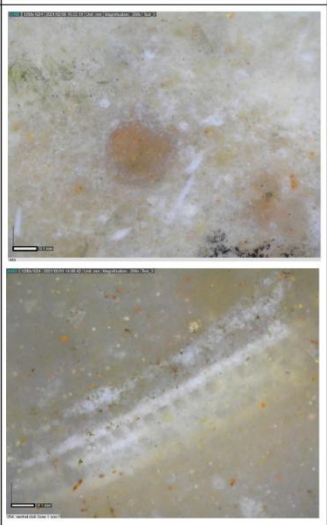
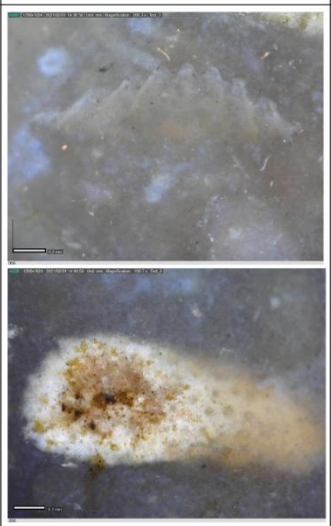
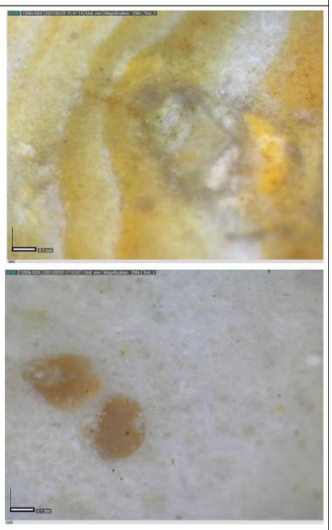
	A	B	C
Common name	Jurassic chert	Jurassic chert	Jurassic chert
Photo			
Texture	Wackestone	Wackestone	Wackestone
Matrix & lustre	semi-translucent, partly felt-like	(semi-) translucent	semi-translucent, felt-like
Components	Foraminifera, sponge needles, reddish intraclasts, micritic intraclasts	sponge fragments, micritic intraclasts, bivalves	sponge needles, some micritic intraclasts
Structures	orientation; lamination	slight orientation	slight orientation
Interpretation	marine platform	marin, back-reef	marin, reef environment
Microphotos			
Geological age	Brown Jurassic; relocated during Eocene	Upper Jurassic, joL (mittlere Weißjuramergel)	Upper Jurassic
Reference sample	JA 256 Flintsbach-Hardt (residual)	JA 2343 Söldenau or Maierhof (residual)	Ortenburg area (residual)

Figure 5. Main raw material components of the Ortenburg district. A Flintsbach-Hardt, B Söldenau or Maierhof, C Ortenburg district in general (photos: L. Bauer).
Figure 5. Principales caractéristiques des matières premières du district d'Ortenburg. A Flintsbach-Hardt, B Söldenau or Maierhof, C Ortenburg district au sens large (photos: L. Bauer)

The second main component is related to the Donau-Altmühl region, mostly to reference samples from the mining site of Baiersdorf (Figure 6.A). The pieces are predominantly related to nodular volumes, based on the morphology of cortex flakes and the minor proportion of lithics with horizontal laminations. While tabular volumes are well-characterized and studied for Baiersdorf (Gayck 2000: 250-254) and also the mining site of Abensberg-Arnhofen (Binsteiner 1990; Binsteiner & Engelhardt 1987: 10; Eisele & Rind 2000; Gayck 2000: 264-272; Roth 2008), nodular forms are only occasionally mentioned or described (*e.g.*, Bertola & Schäfer 2011: 528-529; 2013). This raw material was also reduced on site. Only a small proportion can be classified as tabular volumes from Baiersdorf or Abensberg-Arnhofen

(Figure 6.B). The very characteristic finely-banded tabular volumes from Abensberg-Arnhofen that are common of later periods, and especially the Middle Neolithic (Roth 2008) are absent in the assemblage.

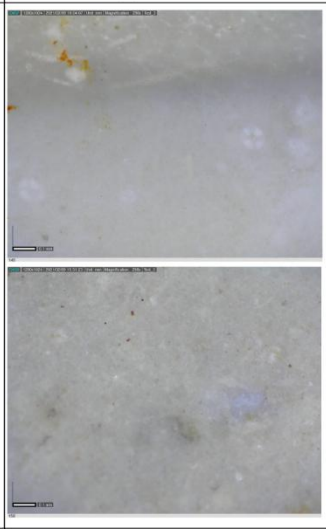
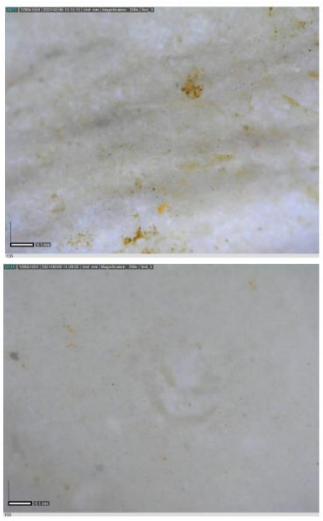
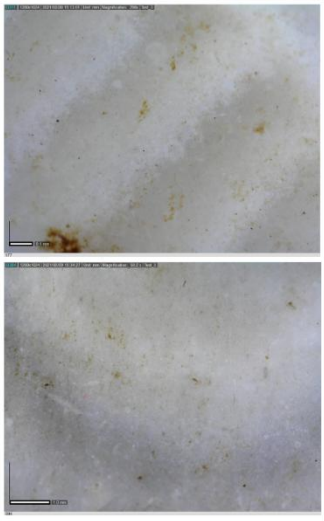
	A	B	C
Common name	Jurassic chert	Jurassic chert	Jurassic chert
Photo			
Texture	Mudstone	Mudstone	Mudstone
Matrix & lustre	semi-translucent - opaque	semi-translucent	semi-translucent
Components	intraclasts, algae filaments, foraminifera, sponge needles, bivalves	algae filaments, sponge needles, stromatoliths	algae filaments, sponge needles, stromatoliths
Structures	stromatolithic	stromatolithic	stromatolithic
Interpretation	marine, upper infratidal area	marine, upper infratidal area	marine, upper infratidal area
Microphotos			
Geological age	joHB (Hangende Bankkalke) joZ (Zementmergel)	joHB (Hangende Bankkalke) joZ (Zementmergel)	joZ (Zementmergel) joLB (Liegende Bankkalke)
Reference sample	JA 184 Baiersdorf, nodular (residual)	184 Baiersdorf, tabular (residual)	JA 153 Abensberg-Arnhofen (residual)

Figure 6. Main raw material components of the Donau-Altmühl region. A Baiersdorf, nodular varieties, B tabular varieties of Baiersdorf, C tabular varieties of Abensberg-Arnhofen (photos: L. Bauer).
Figure 6. Principales caractéristiques des matières premières de la région du la région du Danube-Altmühl. A variétés noduleuses de Baiersdorf, B variétés tabulaires de Baiersdorf, C variétés tabulaires de Abensberg-Arnhofen (photos: L. Bauer).

Weight distribution of silices from these main sources suggests a good availability of the raw materials. This likely indicates that Langenbach-Niederhummel was not situated in an established settlement network, where exchange was possible, and that people probably carried out self-procurement of some sort. For this, larger distances needed to be overcome. This fits

with the observation that the regions in the Upper Isar to the Isar confluence were settled only in a later phase of the LBK (Pechtl 2009: 98). Generally, an emphasis on nodular raw materials becomes evident. Regarding tabular materials throughout other periods, they are already present to a significant extent in Late Mesolithic Bavarian assemblages (for Germering-Nebel, Richter 2011), as in later Neolithic phases (Grillo 1997; Roth 2008). Hence, this marks a distinction with regard to preceding and subsequent phases.

5.2. Minor KSSR sources

For the minor components, the picture reflects several connections beyond the distribution of earliest LBK sites in Southern Bavaria, specifically to the Southern Alps and Switzerland.

One group corresponds to reference samples from the region of Ulm, close by Borgerhau within the Swabian Alb (Figure 7.A). Flat oval nodules up to 8 cm in thickness, and nodules up to 15 cm in length, can be found in these deposits (Fisher *et al.* 2013; Weisgerber *et al.* 1981: 450). The studied assemblage includes the remains of a larger core of this variety of raw material (130g). Regarding the lower raw material quality of the piece and the distance to the presumed outcrop, the presence of this core, which was rejected only after some testing, is not surprising, because the material from Borgerhau is better silicified on its external part and the core often is lesser silicified (centrifuge silicification). For the Late Mesolithic, the region of Ulm and the corresponding raw materials are seen as occupying an interface between the Western and Eastern parts of Southern Germany (Richter 2017: 158). As there are no other earliest LBK sites where this raw material is documented, Langenbach-Niederhummel can only selectively attest to the continuity of this contact zone. However, further evidence for this is needed.

Moving our attention towards the southwest, one small group of silices matches references from the area of Schaffhausen, near Neunkirch (Figure 7.B). This region is very rich in KSSR materials. They are of Jurassic origin, but were relocated during the Eocene and embedded in bean ore loam, which results in yellowish discoloration (*e.g.*, Affolter & Altorfer 2018: 163-164). Usually, these nodules only have a thin neocortex (Affolter & Altorfer 2018: 159). Even though Neolithic mining activities have so far not been identified, the ready availability suggests with low effort pit mining could have been carried out (Affolter & Altorfer 2018: 158). For the Late and Final Mesolithic as well as for other earliest LBK sites, there is no evidence for this material yet.

Most of the reddish and yellowish pieces correspond to reference samples from the east Italian Alps. The region of Trentino includes several outcrops and deposits along the Adige Valley (*e.g.*, Barbieri *et al.* 2013). The varieties present in the assemblage fit samples of the Upper Cretaceous limestones of the Piave valley in the foothills of the Dolomite Alps and the Non valley (Bertola 2011; Della Casa 2005: 222-223). The former group corresponds to reference samples from Monte Avena (Figure 8.A), attributed to Upper Cretaceous sediments, the so-called *Scaglia rossa* (Bertola 2011: 468-469). This variety is quite distinct due to the presence of many clearly visible foraminifera (*Globotruncanidae*). The latter group matches samples of the Middle to Lower Cretaceous sediments of the *Scaglia variegata* from Vervò (Bertola 2011: 468), with high numbers if radiolarians (Figure 8.B). As the artefacts of both groups are mainly unmodified blanks and knapping debris, apart from one retouched bladelet of the Monte Avena type (Figure 3.7), this raw material does not just reflect the importation of finished products. Only one piece in the assemblage could be assigned to the Szentgál outcrop in the Balaton area (Figure 8.C). It is clearly distinct from other reddish to yellow pieces due to dark mineral inclusions, calcitic intraclasts and the absence of foraminifera. These results qualify the emphasis on Szentgál radiolarite in favour of other raw material varieties. They also draw attention to the fact that the assumption of the presence of Szentgál radiolarite in earliest

LBK assemblages can also lead to false determinations for other sites. Furthermore, identification of this single outcrop is mostly based on colour, which has been proven to not be a distinct criterion (Szilasi 2017).

The remaining raw material components comprise only a single piece of Northern Alpine origin (Figure 9.A), with no specific outcrop type identified, as well as regionally indistinct groups such as Alpine quartzites of the *Schrattenkalk* formation (Figure 9.B). Whereas these materials, probably deriving from secondary deposits, form a main component of Late Mesolithic assemblages (Gehlen 2010: 34, table 2A; 35, table 2B; Richter 2011: 27; 2017: 118-119), they are only attested by individual pieces for the earliest LBK (for radiolarite pieces, see Fischer 2011: 21; Gronenborn 1997: 97). A small silices group of KSSR from glacial deposits (Figure 9.C) may originate from tills of the Thuringian region (*e.g.*, Weber 2012). This raw material is also mentioned and characterized macroscopically in minor amounts for other earliest LBK assemblages in Bavaria (for Mintraching, see Gronenborn 1997: 26). In contrast, this KSSR material is more prominent in settlements in the northern part of Bavaria (for Schwanfeld, Gronenborn 1997: 34-35), indicating a geographic distinction between the supply of Jurassic silicites in the south and Baltic silicites in the North, as is already attested for Early Mesolithic assemblages of Franconia (Spies 2020).

6. Southern alpine raw material in Southern Bavaria - diachronic overview

The evidence of southern Alpine KSSR, represented by the groups of northern Italian KSSR materials in Langenbach-Niederhummel proves continuity of the connection to the South already attested since the Early Mesolithic. At the Early Mesolithic site of Ullafelsen (Tyrol, Austria), large quantities of southern Alpine material, but also from the Donau-Altmühl region, mirror this north-south connection (Bertola & Schäfer 2011). For the Late Mesolithic in Southern Bavaria, the assemblage of Germering-Nebel includes 1.7% of southern Alpine material, possibly from the Non valley (Richter 2011: 34); also, the Late Mesolithic assemblage of Leeder includes raw material from Monte Baldo (n=1; 0.2 %), while further pieces correspond to raw material from Arzo (0.6 %) (Richter 2017: 118, table 94). The sites of Forggensee may also include some southern Alpine materials, but these only account for about 0.1 % of the assemblage (Gehlen 2010: 32). Additionally, typological similarities between Southern Bavarian microliths and Castelnoviano types in northern Italy suggest a connection (Richter *et al.* 2020). In north-eastern Italy itself, *Scaglia rossa* and *Scaglia variegata* are the main KSSR materials on Castelnoviano and Sauveterrian sites (Fontana *et al.* 2020), but also on Early Neolithic sites (Santaniello *et al.* 2016). In later phases, the presence of southern Alpine material indicates the connection of the Bavarian Neolithic to the Alps, due to the increasing importance of metal. At the Tyrolean site of Kiechlberg bei Thaur, raw material from the Monti Lessini region as well as from the Donau-Altmühl region and Ortenburg district is attested (Töchterle *et al.* 2011: 36, Figure 8). Further mentions of southern Alpine raw materials include finds from a Late Neolithic pit house in Chieming-"Markstatt" (Möslein & Pechtl 2020: 245-246) dating to the 3rd millennium BCE from a female burial in a Münchshöfen context in Dingolfing (Eibl 2016), and a single piece from the LBK settlement of Stephansposching (Pechtl & Rößner 2022). Finally, southern Alpine raw material is attested from the Cham culture site of Jesenwang (Wild & Pechtl in prep.). For the Altheim culture, contact with the Upper Italian *Vasi a bocca quadrata* culture is also evidenced by the daggers made from so-called Monti Lessini flint (Metzner-Nebelsick *et al.* 2017; Mottes 2006; Tillmann 1993b; 2002). Another picture is visible for Northern Switzerland, where at the site of L'abri Unterkobel transalpine connections are detectable for the Early Mesolithic, but not for the Late Mesolithic and the Neolithic (Affolter 2022: 109).

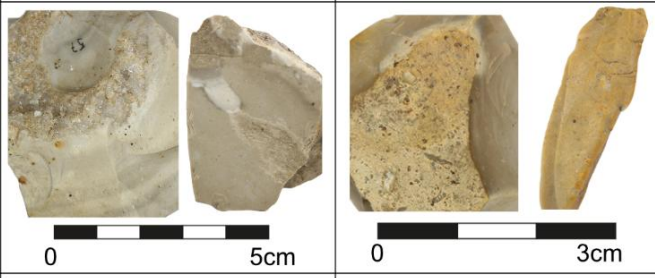
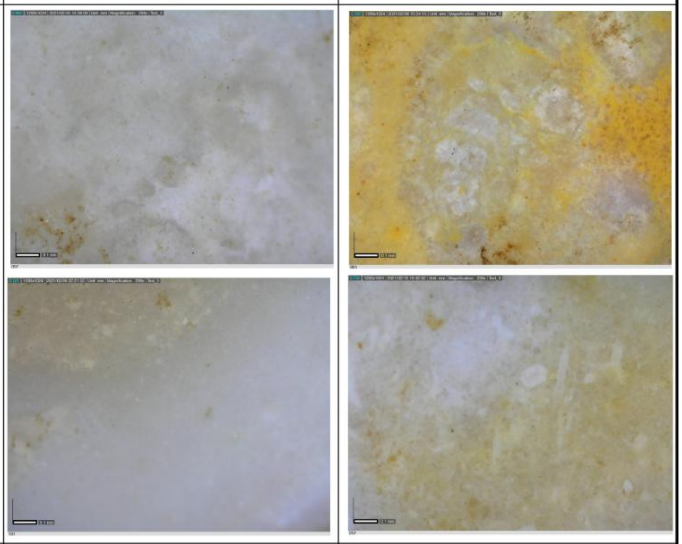
	A	B
Common name	Jurassic chert	Bean ore chert
Photo		
Texture	Mudstone - Wackestone	Wackestone
Matrix & lustre	opaque	opaque
Components	crystallized shell fragments, druses	shell fragments, sea urchin spines, sponge fragments
Structures	slight orientation	-
Interpretation	marine, open shelf	lower beach
Microphotos		
Geological age	Upper Jurassic	Upper Jurassic, relocated during Eocene
Reference sample	JA 299 Asch-Borgerhau (residual)	JA 448 Neunkirch (residual)

Figure 7. Raw material varieties. A Borgerhau, region of Ulm, B Neunkirch-Neuweghalde, canton of Schaffhausen, Switzerland (photos: L. Bauer).
Figure 7. Principales caractéristiques de matières premières mineures. A Borgerhau, région d'Ulm, B Neunkirch-Neuweghalde, canton de Schaffhausen, Suisse (photos: L. Bauer).

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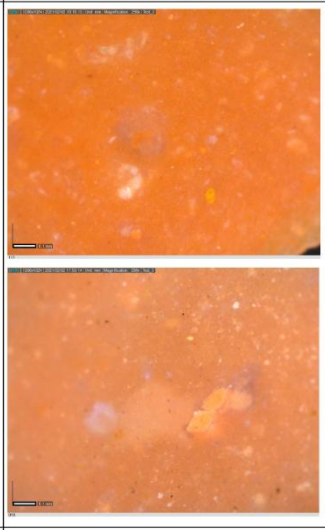
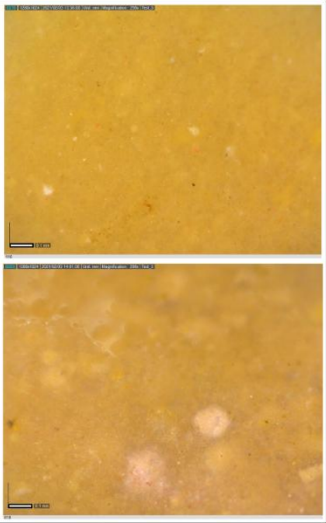
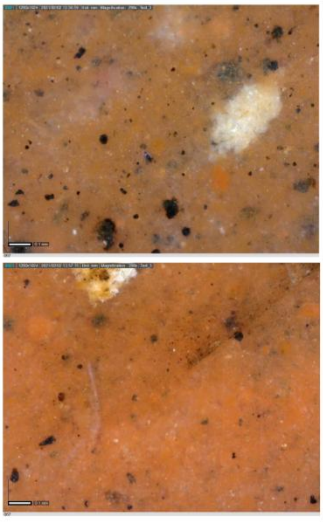
	A	B	C
Common name	Flint	Flint	Radiolarite
Photo			
Texture	Wackestone	Wackestone	Mudstone to Wackestone
Matrix & lustre	opaque	semi-translucent	semi-translucent
Components	radiolarians, foraminifera	radiolarians, foraminifera	radiolarians, black mineral intraclasts (Mn), white calcitic intraclasts
Structures	slight lamination	slight lamination	slight orientation
Interpretation	marine, deep pelagic	marine, upper intratidal area	marine, pelagic
Microphotos			
Geological age	Upper Cretaceous; Middle to Upper Turonian, *Scaglia rossa*	Upper Cretaceous; Upper Cenomanian, *Scaglia variegata*	Upper Jurassic
Reference sample	JA 260 Monte Avena (residual)	JA 1215 Vervò (primary or residual)	JA 687 Szentgál (primary)

Figure 8. Southern Alpine and Hungarian raw material varieties. A Monte Avena, Piave Valley (Alpine Feltrine), Upper Italy, B Vervò, Non valley, Upper Italy, C Szentgál, Bakony mountains, Hungary (photos: L. Bauer).
Figure 8. Variétés de matières premières des Alpes du Sud et de Hongrie. A Monte Avena, vallée du Piave (Feltrine alpin), Haute Italie, B Vervò, val di Non, Haute Italie, C Szentgál, montagnes Bakony, Hongrie (photos: L. Bauer).

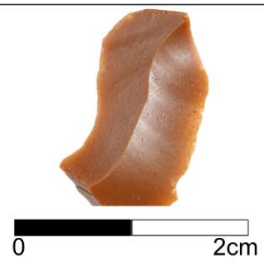
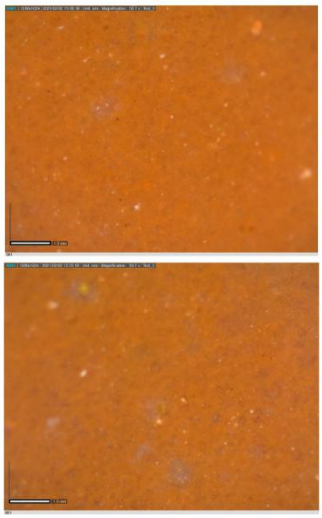
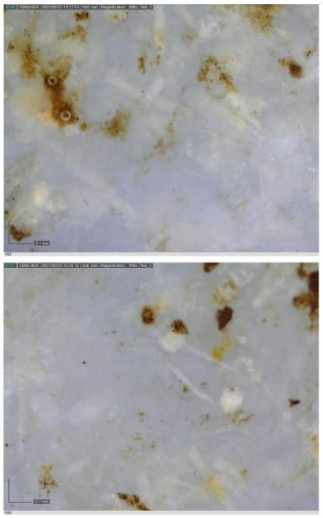
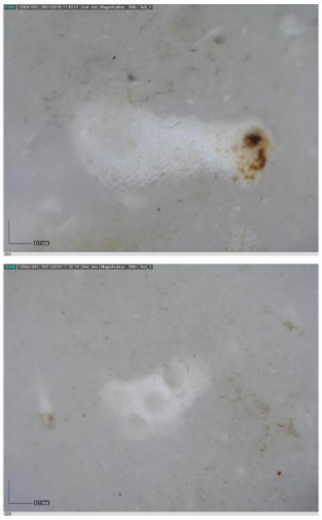
	A	B	C
Common name	Radiolarite	Quartzite	Flint
Photo			
Texture	Mudstone - Wackestone	Wackestone	Mudstone
Matrix & lustre	semi-translucent	translucent	(semi-) translucent
Components	radiolarians	altionares, sea urchin spines, sponge fragments	bivalve fragments, bryozoa, sea urchin spines
Structures	-	stromatolithic	-
Interpretation	marine, deep pelagic area	marine, upper infratidal area	marine, neritic zone
Microphotos			
Geological age	Brown Jurassic/Lower Cretaceous	Upper Jurassic	Upper Cretaceous
Reference sample	JA 9 Northern Alpine radiolarite (n.d.)	JA 2306 Schrattenkalk (n.d.)	JA 11 Baltic flint (n.d.)

Figure 9. Northern Alpine and Baltic KSSR varieties. A Northern Alpine radiolarite, Southern Germany, B quartzite of Schrattenkalk formation, Northern Alps, C KSSR from glacial deposits (photos: L. Bauer).
Figure 9. Variétés de matières premières des Alpes du Nord et des dépôts baltiques. A Radiolarite du Nord des Alpes, Allemagne méridionale, B quartzite de la formation de Schrattenkalk, Alpes du Nord, C silex baltique (photos: L. Bauer).

7. Implications of data results

As illustrated above, cross-alpine connections, evidenced by the KSSR materials, are a diachronic phenomenon, marking Southern Bavaria out as a transitional zone. From the results of this study, this can also be attested for the first time for the earliest LBK. In contrast to the presence of Szentgál radiolarite, KSSR materials from Northern Italy and Switzerland are located outside of earliest LBK distribution. It puts the emphasis on Szentgál radiolarite as primary long-distance raw material in perspective, in favor of other long-distance imports.

Although these imports contribute only a minor part to the assemblage and therefore does not present intensive processes of exchange, it opens up the discussion about the processes and agents behind this.

Traditionally, the distribution area of the earliest LBK with attested settlement structures is taken to represent the area of land use, as the earliest LBK is seen as sedentary once settled (Furholt 2017; Hofmann 2020). Therefore, links to other cultural regions via the presence of KSSR material evidence have been interpreted as evidence for contact with other cultural entities (*e.g.*, Kind 1998). In the case of Southern Bavaria and the attested raw materials from Langenbach-Niederhummel, it is often suggested that the Alpine foreland was used by Final Mesolithic groups (Gehlen 2010, 2017; Kind 1997; Richter 2017: 162, 225), who are characterized by their high mobility. In this model, mobility is one-sided. Following this, raw material evidence from the Southern Alps might represent embedded procurement by Final Mesolithic hunter-gatherers from the Alpine Foreland. For Northern Italy, agents of contact could also be Mesolithic groups, as Neolithization in the Adige valley starts around 5,000 cal. BCE (Santaniello *et al.* 2016) or Initial Neolithic groups in the Northeastern part (Perrin 2005).

An alternative line of thought is to also embed mobility within the earliest LBK subsistence (Figure 10). In this case, individuals or groups from the earliest LBK itself would have been mobile as a response to specific needs. Of course, mobility on the part of several entities, including Final Mesolithic groups, may have combined within this model. For Southern Bavaria, the higher quantities of wild animal bones suggest that the earliest LBK groups in this marginal region were forced to practice more hunting than in other areas. This is in line with the notion of generally more unfavorable conditions in Southern Bavaria. As a result, a greater dependence on hunting within the subsistence system would have led to greater mobility, at least of individuals. Additionally, the southern areas without attested settlements may have served as grazing areas. Therefore, these areas beyond the settled region provide options for subsistence activities other than agriculture. Within a subsistence system not entirely based on agriculture, areas with no archaeological evidence of settlements may also belong to the territory that was exploited. For the moment, this cannot be verified by earliest LBK sites and assemblages, so we have to depend on examples from other areas and later phases to reveal a more complex picture of subsistence activities, and therefore mobility patterns, of the LBK (Hofmann 2020). Isotopic data show that grazing of cattle took place in other areas than the settlements (Knipper 2011), and that LBK individuals originated from non-loess areas (Bentley *et al.* 2002). Examples of LBK sites from the low mountain ranges also support this more complex picture (Drummer 2016; Mischka *et al.* 2015).

To test these models, we face several problems. For now, there are only a handful of dated sites for so-called Final Mesolithic complexes (Richter 2017: 162), none of which are in Southern Bavaria. Thus, Final Mesolithic presence in Southern Bavaria and the Alpine Foreland cannot be verified. Moreover, Mesolithic sites in Bavaria tend to be surface assemblages, a fact that further complicates the evidence. Due to the lack of excavated, dated and published stratigraphies also for the Late Mesolithic in Bavaria, we have to refer to the typology established for the Jägerhaushöhle in Baden-Wuerttemberg by Taute (1971), leaving the Beuronian complex at a supraregional level, with a low regional resolution as a result.

In attempting to confirm evidence of earliest LBK hunter-gatherer groups and their sites, definitory problems arise. Until now, we lack clear distinctive features to distinguish potential Final Mesolithic from potential earliest LBK hunting camps. In fact, since the Final Mesolithic is defined by overlapping lithic criteria and late radiocarbon dates, the distinction between earliest LBK microliths and those of assumed Final Mesolithic groups is probably not possible at this point. When hunting camps of earliest LBK people are not seen as a viable option, the absence of ceramics at a site is probably considered as evidence for Mesolithic activity (Kind 1992; Gehlen 2017, 39). However, it is plausible for earliest LBK hunting camps not to yield

ceramics, given that they existed in small quantities and are quite fragile when not deposited within features. This is especially true for surface finds in intensively managed areas. The fact that raw material varieties are also quite similar between the Late Mesolithic and earliest LBK in Southern Bavaria may also be problematic in attempts to distinguish between these groups. Even though secondary KSSR materials from riverbeds were more or less solely used during the Mesolithic, this again poses the problem of comparing sites from different regions which may impact the raw material variety significantly. In regions very far from sources of Jurassic KSSR, as for example the later LBK site of Langenreichen-"Am Burgholz", quartzites are mainly used (Pechtl 2008: 36). This does not imply that Mesolithic and LBK subsistence was the same; rather, it highlights the risk of false conclusions made on the basis of single factors such as raw materials, trapeze microliths or the absence of ceramic finds.

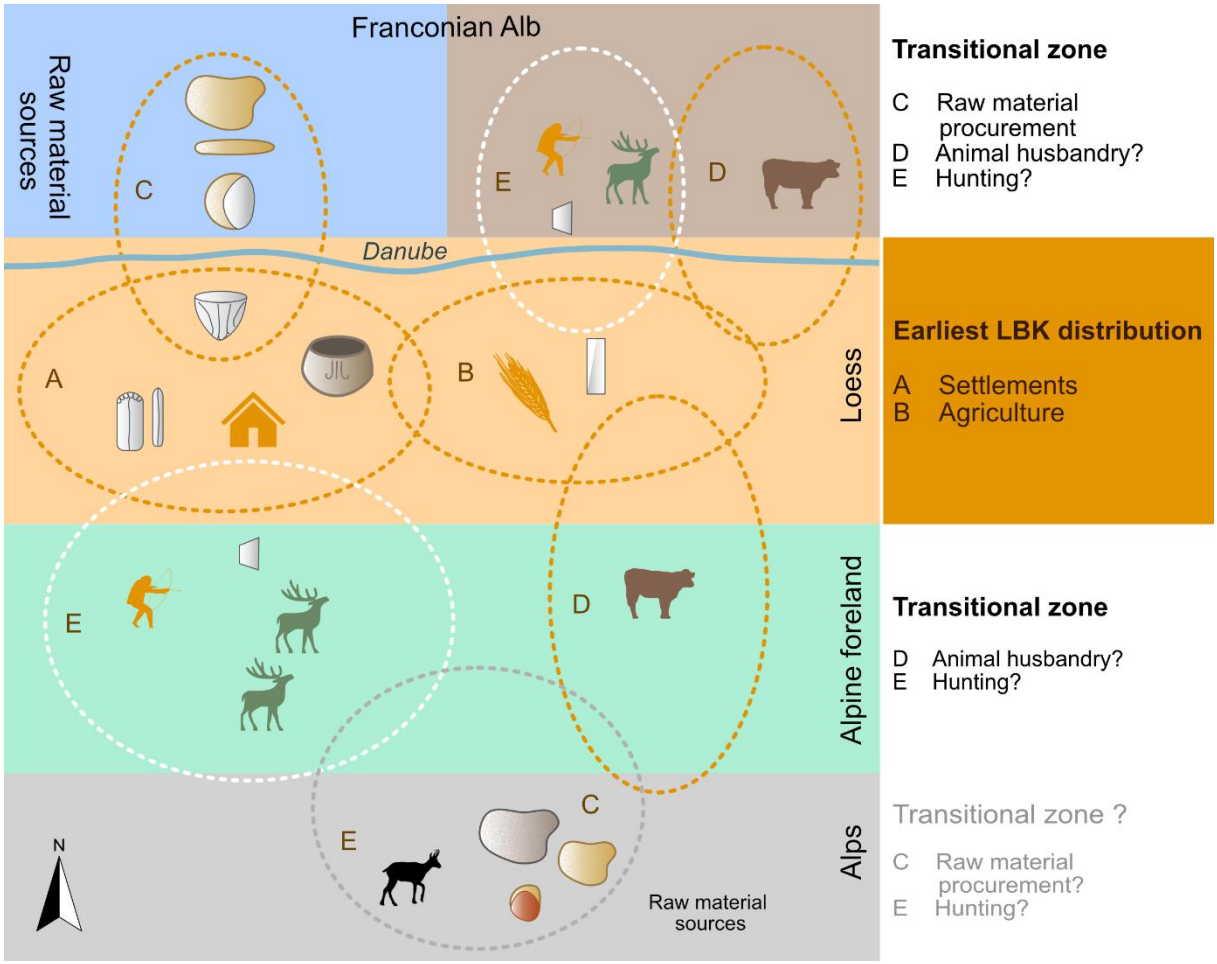


Figure 10. Schematic representation of possible scenarios of mobility and land use for Southern Bavaria. Orange circles as classical used areas and activities; white circles indicate complementary zones and activities; grey circle: areas and zones that are still undefined (graphic: L. Bauer).

Figure 10. Représentation schématique des scénarios possibles de mobilité et d'utilisation des sols pour le sud de la Bavière. Les cercles orange représentent les zones et activités utilisées de manière classique ; les cercles blancs indiquent les zones et activités complémentaires ; les cercles gris représentent les zones et zones qui ne sont pas encore définies (PAO-DAO: L. Bauer).

8. Conclusion

In examining the regional networks of the earliest LBK, raw material analysis makes a major contribution that complements insights provided by ceramic studies and it illustrates the geographical directions of raw material supply and exchange. In the case of Langenbach-Niederhummel, raw material analysis underlines that crossing of supposed cultural borders

beyond settled regions did take place and that areas outside of the archaeologically tangible distribution area hold meaning in functional or social terms or both. For the moment, it is not possible to put this data into a regional context. Further research on earliest LBK lithic assemblages is needed in order to grasp the quality and character of border-crossing processes as implied by the KSSR materials, but also to gain further insights regarding basic networks and exchange patterns within the earliest LBK of southern Germany. Although the agents of these processes cannot be examined yet, some mobility of the earliest LBK itself is likely for Southern Bavaria. Future lithic analysis of other LBK sites and the publication of hitherto unpublished Mesolithic inventories, we will hopefully allow both cultural entities to be more precisely defined, allowing us to distinguish more clearly between the two. As the cross-alpine connection between Southern Bavaria and Northern Italy can be seen as a diachronic phenomenon with different motives, Southern Bavaria should be viewed as a transitional zone, highlighting its permeable quality with several processes of exchange and mobility taking place over time, even in the context of sedentary farming societies. This will further broaden our picture of this Early Neolithic entity from a static sedentary society to a more differentiated complex.

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Data accessibility statement

The author confirms that the data supporting the findings of this study are available within the paper or were compiled from dissertations, theses and other published works, which are duly cited.

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Hors des sentiers battus. L'analyse des matières premières lithiques : Un indicateur du franchissement des frontières culturelles par les premières populations rubanées ?

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Résumé :

Le sud de la Bavière (Allemagne) constitue une zone en marge de l'aire d'extension des toutes premières populations agro-pastorales rubanées (*Älteste Bandkeramik*) en Europe centrale. Située sur les marges méridionales de cet espace néolithique, la zone d'étude est donc adossée à l'avant-pays alpin méridional, pont vers l'Italie notamment, qui représentent des zones non-colonisées par les premières populations néolithiques danubiennes. Cette aire géographique se révèle alors une zone d'interaction potentielle avec d'autres entités culturelles. La recherche néolithique dans cette région s'est largement concentrée sur l'analyse de la poterie, employée pour déterminer le cadre chrono-culturel général à l'instar de la majorité des recherches sur le Néolithique. L'analyse des industries lithiques comme indicateur de processus spatiaux est donc restée à une résolution plus faible. Toutefois, elles représentent un dénominateur commun avec le Mésolithique précédent et apparaissent donc essentielles pour établir des comparaisons et mieux cerner les processus de néolithisation dans ces régions en marge. Cela est particulièrement vrai pour ces régions à proximité de territoires montagneux, plus propices aux modes de vie prédateurs. Afin de mieux comprendre les scénarios historiques et les interactions entre groupes dans cette région, un assemblage lithique provenant d'un des premiers sites rubanés de la vallée de l'Isar, dans le sud de la Bavière (Langenbach-Niederhummel) a été étudié en mettant l'accent sur l'analyse des matières premières et les aspects typo-technologiques de la production des industries en roches siliceuses. Les matières premières ont été caractérisées suivant un double tri. L'assemblage étudié a d'abord été trié sur la base de critères macroscopiques pour former des grandes classes de matériaux. Puis chacun des groupes a fait l'objet d'une analyse microscopique (Dino-Lite Digital Microsope Edge series, AM4000 series, grossissement 50-298x). Cette analyse a permis de corriger les erreurs d'attribution et de regroupement par une meilleure caractérisation de la matrice, notamment grâce aux microfossiles visibles et aux intraclastes. L'objectif était de générer des données à haute résolution sur les matières premières afin de mieux comprendre les modalités d'approvisionnement. Les résultats montrent que les principales variétés des matières premières proviennent de deux régions distinctes de Bavière, (i) le district de l'Ortenburg et (ii) la région du Danube-Altmühl. En outre, ils révèlent l'existence de ponts à travers les Alpes et en Suisse à travers des importations à longues distances, ce qui suggère que les frontières culturelles archéologiques étaient sans doute assez perméables. Cela ouvre une discussion sur les agents et les processus de transport de matières premières sur de longues distances, sur les relations entre les entités culturelles ainsi que sur la mobilité des premières populations agro-pastorales rubanées. Dans une perspective diachronique, la Bavière méridionale peut être considérée comme une zone de transition au cours de cette première phase d'expansion du Rubané où la mobilité résultait de différents facteurs.

Mots-clés : Néolithique ancien ; Bavière ; étude des matières premières siliceuses ; Rubané le plus ancien ; importation de matières premières sur de longues distances ; frontières culturelles ; silex des Alpes méridionales