Linking Neolithic lakeshore settlements through raw material of siliceous artefacts

Jehanne Affolter [1,2], Helena Wehren [1,2], Caroline Heitz [3], Regine Stapfer [1,4], Lea Emmenegger [1], Martin Hinz [1], Gisela Thierrin-Michael [5], Albert Hafner [1,6]

1. Institute of Archaeological Sciences, University of Bern, Hochschulstrasse 6, 3012 Bern, Switzerland. Email: Affolter: affolterjs@bluewin.ch; Wehren: wehren@gmx.ch; Stapfer: regine.stapfer@iaw.unibe.ch; Emmenegger: lea_emmenegger@outlook.com; Hinz: martin.hinz@iaw.unibe.ch; Hafner: albert.hafner@iaw.unibe.ch
2. Ar-Geo-Lab, Dîme 86, 2000 Neuchâtel, Switzerland.
3. Institute of Pre- and Protohistory, University of Kiel, Johanna-Mestorf-Straße 2-6, 24118 Kiel, Germany. Email: cheitz@sfb1266.uni-kiel.de
4. Archaeological Service of Canton Bern, Brünnenstrasse 66, 3018 Bern, Switzerland.
5. Department of Geosciences, University of Fribourg, Chem. du Musée 4, 1700 Fribourg, Switzerland. Email: gisela.thierrin-michael@unifr.ch
6. Oeschger Centre for Climate Change Research (OCCR), University of Bern, Hochschulstrasse 4, 3012 Bern, Switzerland.

Abstract:

This paper presents the results of the provenience analysis of siliceous artefacts from Neolithic lakeshore settlements studied in the scope of the SNSF-project MET ("Mobilities, entanglements and transformations in Neolithic societies on the Swiss Plateau (3900-3500 BCE) supported by the Swiss National Science Foundation (Project No 100011 156205). The aim of this paper is to compare the cultural entanglements as defined by the pottery studies with the regions of origins of the knappable siliceous sedimentary rocks (KSSR) raw materials. The analysed siliceous artefacts were found in cultural layers of wetland settlements in the Northern Alpine Foreland, most of which are dated dendrochronologically with extreme precision. The sources of the raw materials were determined by the identification of the sedimentary microfacies of the siliceous artefacts, which allows the accurate location of the exploited outcrops without destroying the artefacts. This enabled detailed insights into complex entanglements, ties and mobility patterns in the raw material procurement between settlement communities on the Swiss Plateau, southern Germany and eastern France. Furthermore, these results were compared visually with stylistic entanglements in the pottery of the 4th millennium BCE. As a first attempt in this direction, this paper shows the potential of studies on mobility patterns when different find categories are studied in combination regarding their raw materials but also their typology.

Keywords: Neolithic; flint; knappable siliceous sedimentary rocks; Raw material sourcing; Raw material exchange; Northern Alpine; Wetland archaeology; Mobility studies

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1. Introduction

Within the project "Mobilities, Entanglements, Transformations in Neolithic Wetland Sites on the Swiss Plateau (3900-3500 BCE)", short MET-project, different patterns of mobility of Neolithic settlement communities were studied by drawing on ceramics and stone tools (Hafner *et al.*, 2016). Since the beginning of the new millennium, mobility has become a focal point of research in social sciences and humanities (mobility turn) including archaeology (Cresswell 2006: 6-30; Salazar 2016; Sheller & Urry 2006). Cultural and social phenomena are seen "through the lens of movement" (Heitz & Stapfer 2017b: 23). Appropriating this perspective in archaeology, means to acknowledge that mobility not only underpins a large part of todays, but also past human practices in their material, social, political, cultural and economic worlds. Taking this perspective, past communities seem to be full of "multiple and extended connections", "topologies of social networks" and their "nodes" (Hannam *et al.* 2006: 12-13). In this paper we examine the spatial mobility patterns visible on siliceous artefacts based on the investigation of raw material provenance of the industry in knappable siliceous sedimentary rocks. In the following the term "siliceous knappable sedimentary rocks" or "KSSR" describes all sedimentary siliceous rocks originating from chemical, biochemical or diagenetic precipitation of SiO2 and consisting of its various mineral modifications (Affolter et al. 2022b; Přichystal 2010: 178-179). We do not make use of the terms flint, hornstone or chert for KSSR artefacts, as all these denominations have geological implications which are often wrong.

Thereby we contrast the location of the outcrops with the settlements where the respective tools were found and hypothesize that the observable pattern of entanglements reveals past actors' relationships on a very general level. The statistical approach on the KSSR artefacts is still in progress, so preliminary data set is presented here. However, the results of provenience analysis of KSSR will be compared qualitatively to the mobility patterns as understood by analysing pottery (see Heitz 2017; 2018; Heitz & Stapfer 2017a; 2017b; 2021; Stapfer 2017; 2019a: 221-242; 2019b). For selected settlements we will take a look at the stylistic entanglements of the pottery. As we will show, in each settlement in addition to the typical local style also encompasses vessels whose styles are reminiscent of those of neighbouring regions. Beyond that we will examine if the pottery- and KSSR-based mobility patterns are spatially congruent or not. Our results refute the longstanding premise of the culture-historical approach that each archaeological culture - usually defined by pottery - has a clear spatial boundary and is culturally homogeneous (Figure 1).

2. Description of the Data Set

The corpus studied derives from wetland sites dating between 4000-3500 BCE containing pottery and KSSR industries (see supplementary file 1). While we compiled quantitative data for most of the sites (see supplementary file 2), for some only semi-quantitative information was available due to the lack of details in previous publications. We consider semi-quantitative data to be data that are not precisely reported, for example when a study only indicates that there is "very little", "little", or "a lot of" a material in a site, or if only a small portion of the material could be studied. Analyses are considered quantitative when the majority of the industry at the site in question could be determined. Hence, our results were divided in two levels of detail. In the case of large KSSR assemblages, we selected the artefacts for more detailed analyses by macroscopic sampling and counting. The macroscopic sampling was done by the naked eye and gave an arbitrary assignment to raw material sources. Accordingly, it is prone to errors. Strongly patinated or burnt pieces were ignored, as the chance for successful determination is very small. In general, the aim was to sample all the different occurring raw material varieties in proportion as well as sampling all

materials with exotic appearance. All artefacts derive from assemblages belonging to stratified cultural layers of settlements. In total we will discuss in detail the results of provenience analyses of 11 sites (Figure 2). Some of these sites have several well-dated and clearly separated layers, which we consider to be separate settlements or settlement phases. Of those, we have considered 24 in total (Table 1 and supplementary file 1).

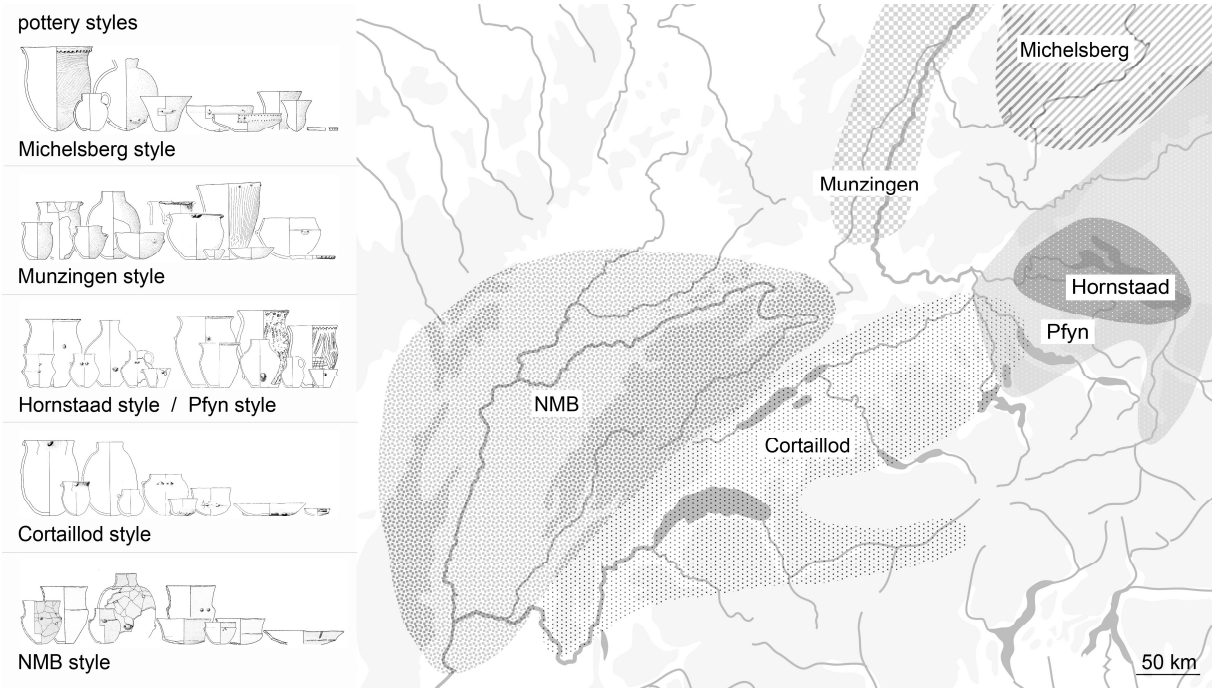

Figure 1. Rough overview of archaeological cultures - typo-chronological stylistic units of pottery - in the investigated region between 3900-3500 BCE.

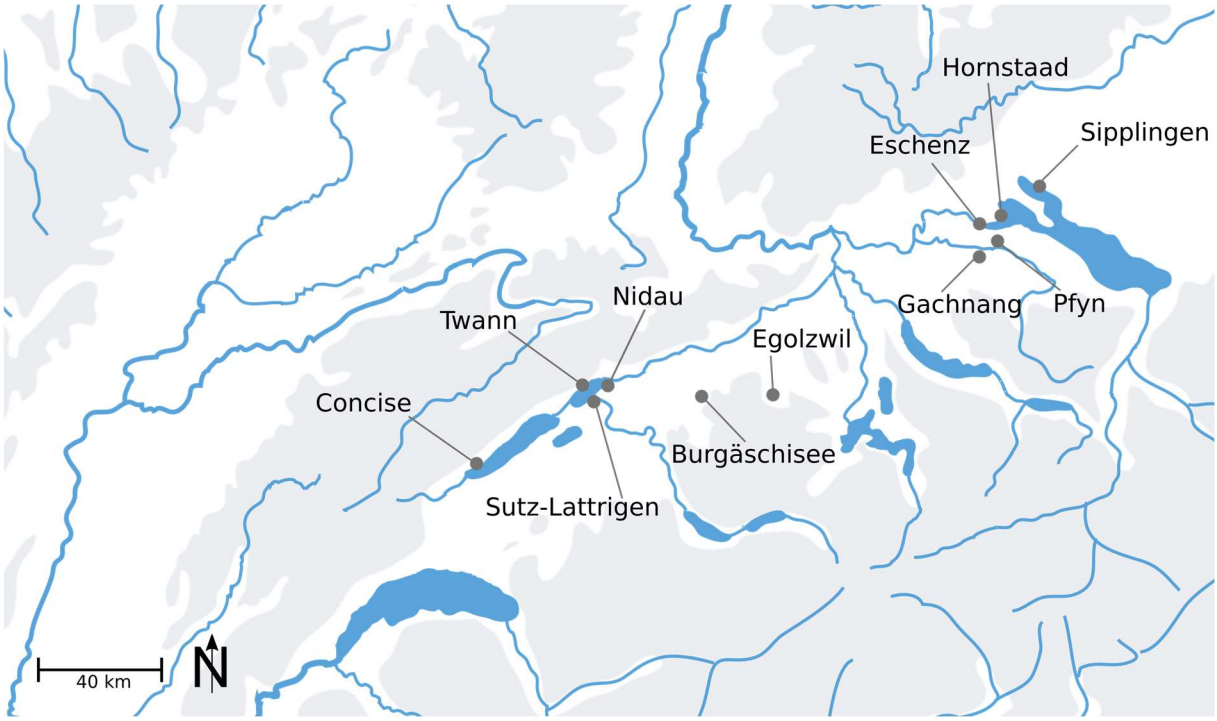

Figure 2. Location of the 11 wetland sites encompassing in total 24 settlement phases studied in detail in Three-Lakes-Region, in Central Switzerland and in the Region of Lake Constance (see supplementary files 1-3).

Table 1. Stratigraphy and dating of the 24 settlements/layers studied in detail (Supplementary file 1)

Region	Site	Settlement/Layer	Datation BC	Short name / Layer
Three-Lakes Region	Concise/Sous Colachoz	Ensemble 6	3533 - 3516	Co E6
		Ensemble 5	3570 - 3516	Co E5
		Ensemble 4	3645 - 3635	Co E4
		Ensemble3	3666 - 3655	Co E3
		Ensemble 2	3713 - 3675	Co E2
		Ensemble 1	3868 - 3793	Co E1
	Twann/ Bahnhof	OS	3596 - 3532	TW OS
		MS	3702 - 3607	TW MS
		US	3838 -3768	TW US
	Nidau/ Agglolac		3875 - 3750	Ni
	Sutz-Lattrigen Hauptstation	innen	3607/3582 3566	SH i
		Hafen OS	3638 - 3631	SH OS
		Hafen US	3827 - 3820	SH US
Central Switzerland	Seeberg/Burgäschi	Süd	around 3750	Bu S
		Südwest	3752 - 3746	Bu SW
		Nord	around 3700 - 3600	Bu N
	Egolzwil 4		around 3860	Eg
Region of Lake Constance	Gachnang/ Niederwil		around 3714 - 3626	Ga
	Pfyn/ Breitenloo		3708 - 3702	Pf
	Eschenz/ Insel Werd		3900 - 3850	Es
	Sipplingen/ Osthafen	Si AB (mixed layer)	3919 - 3817	Si AB
		Si B	3857- 3817	Si B
		Si A	3919 - 3904	Si A
	Hornstaad/ Hörnle	I A	3918 - 3902	HH IA

The sites all date back to the period between 3950 and 3500 BCE, but thanks to dendrochronology, it is possible to detail their occupation in time slices whose dating frames were defined by changes in pottery producing practices (Heitz 2018: 149-178; Stapfer 2019b). Stylistic practices of pottery production were shared over a larger area by different settlement communities and often handed on for several generations. The pottery styles and production practices thus reflect a common cultural heritage (*habitus*) and social relations between the settlement communities. Our research has shown that the interpretation of typo-chronological entities such as Cortaillod and Pfyn as cultures, as used throughout the history of research, is problematic. These terms serve here only as a unit of investigation of the coarsest level of similarity in stylistic practices, but are - as empirical research showed - not tenable in the sense of cultural, homogeneous units any longer (Heitz 2017; 2018: 226-253; Stapfer 2019a: 221-255; 2019b). Within the pottery found at the individual sites, vessels that differ from the mainly produced typically local pottery style of the settlements may indicate spatial mobility of potters and pottery vessels. Vessels of non-local raw material and atypical style were made elsewhere and then brought to the respective settlement where they were found. Other vessels were produced locally but in a non-local style or they show combinations of different pottery-

making practices, what indicates a collaboration of potters who had learned to make pottery in different regions and cultural (habitus) groups (Heitz 2017; Heitz & Stapfer 2017a; 2021). These stylistic entanglements point to different direction of spatial mobility and social ties. The networks of the settlements' communities that is inferred from pottery can thus be compared with the regions of origin of the siliceous artefacts found in the same or different equally dated settlements.

Furthermore, the comparison of the KSSR assemblages of the studied settlements allows to recognize similarities and differences in the raw material supply of contemporarily existing settlements as well as potential changes over time.

3. Methods: Microfacies Determination

There are several methods for determining the geological provenance of KSSR (see for example, Brandl 2016; Fernandes 2012: 122-127; Luedke 1979; Pereira *et al.* 2017: 15-29; Přichystal 2010: 178-179; Séronie-Vivien 1987). The microfacies method used here is totally non-destructive, since the water wetted surfaces of the artefacts are studied under a stereomicroscope concerning their geological properties, and inexpensive in comparison with the other methods (Affolter 2002: 18-41; Altorfer & Affolter 2011: 31-53). The determination of the geological provenance is based on reconstituting the biotope in which each siliceous material was formed, according to the elements contained in the KSSR (Affolter et al. 2022b, Fisher *et al.* 2013; Wehren *et al.* 2022). Because water lowers the refraction of light on the surface a view into the uppermost millimetres into the material of the flint is obtained. This allows the determination of the sedimentary features and the fossil content. Fossils and other components indicate the age and the deposit environment (so called sedimentary microfacies) of the KSSR material. Hence, the geological attribution of the mother rock can be determined which allows to infer to possible outcrops in an area of known geology. The determination of the microfacies reduces the area to be surveyed and thus also the field work to the minimum (Affolter *et al.* 2022b). To assure the determination, the artefacts need to be compared to samples of a reference collection. For the MET-project, the latter was done by comparison with the extensive reference collection of one of the authors (J. Affolter). For the region studied, the main limit to the effectiveness of the method lies in the possible presence of patination or thermal alteration that is too strong (*i.e.*, Affolter 2002: 19; 2016a); the pieces bearing remains of cortex generally make it possible to specify whether the material was sought directly in its primary deposit, or whether it was taken from a secondary deposit - Eocene, molasses, moraines, alluvium - each of these alterations leaving particular stigmas on the cortex.

4. The Geology of the Swiss Molasse Basin

On the Swiss territory, there is a polarity of the KSSR resources (Figure 3; Affolter 1989; 1995: 122-123). The Swiss molasse Plateau is situated between the Alps chain to the East and the Jura mountains ranges to the West (*e.g.*, Labhart 2004: 14-53). In the Jura mountains, KSSR varieties from the Muschelkalk and Malm stages to the North, from the lower Cretaceous to the Centre and the South, and from the Upper Cretaceous to the South-West can be found (Affolter 2002: fig. 68, 138-139). In the Alps, a lot of KSSR are present, which are mostly broken and of poor quality due to fracturing during the alpine uplift (Affolter 1995: 123). The Swiss molassic Plateau as foreland of the Alps contains rarely siliceous material of good quality, because it contains only alpine reworked flint pebbles in the relicts of the glacial moraines (*e.g.*, Affolter 2015: 29, 74). The polarity of the raw material resources helps us to get a better understanding of the raw material practices.

Figure 3. Main KSSR outcrops on the Northern Alpine Foreland and the nearby regions. Black triangles: outcrops of good KSSR (Trias, Dogger-Malm, Cretaceous, Oligocenous); red triangles: outcrops of alpine siliceous materials, often tectonic deformation by the alpine orogeny, partly reworked in the molasse and the moraines of the Northern Alpine Foreland.

5. Entanglements based on the KSSR

The MET-Project focuses on five timeframes (before 3950 BCE, 3950-3851 BCE, 3850-3751 BCE, 3750-3651 BCE and 3650-3500 BCE), according to which we present the KSSR study. The statistical exploitation of the data is still ongoing, so we present here only simple statistics (amounts and percentages). The settlements denoted by abbreviations in the pictures can be found in Table 1 and Supplementary file 1, whereas the link of numbers and sites is given in Supplementary file 3.

There are only a few sites that can be dated before 3950 BCE (Figure 4 and Supplementary file 3). Most of the siliceous artefacts of Gamprin Lutzengüetle and Schellenberg Borscht, which are situated in the Upper Rhine valley, are supplied with raw materials from the South and South-East. On the other side of the Jura mountains, the site Camp de Chassey, layers 10 and 9, indicates major supplies coming from the east and South-East too (Thevenot 2005: 189-193). Even if only semi-quantitative data is available of these sites, it can be noted that all sites present a small range of raw materials only.

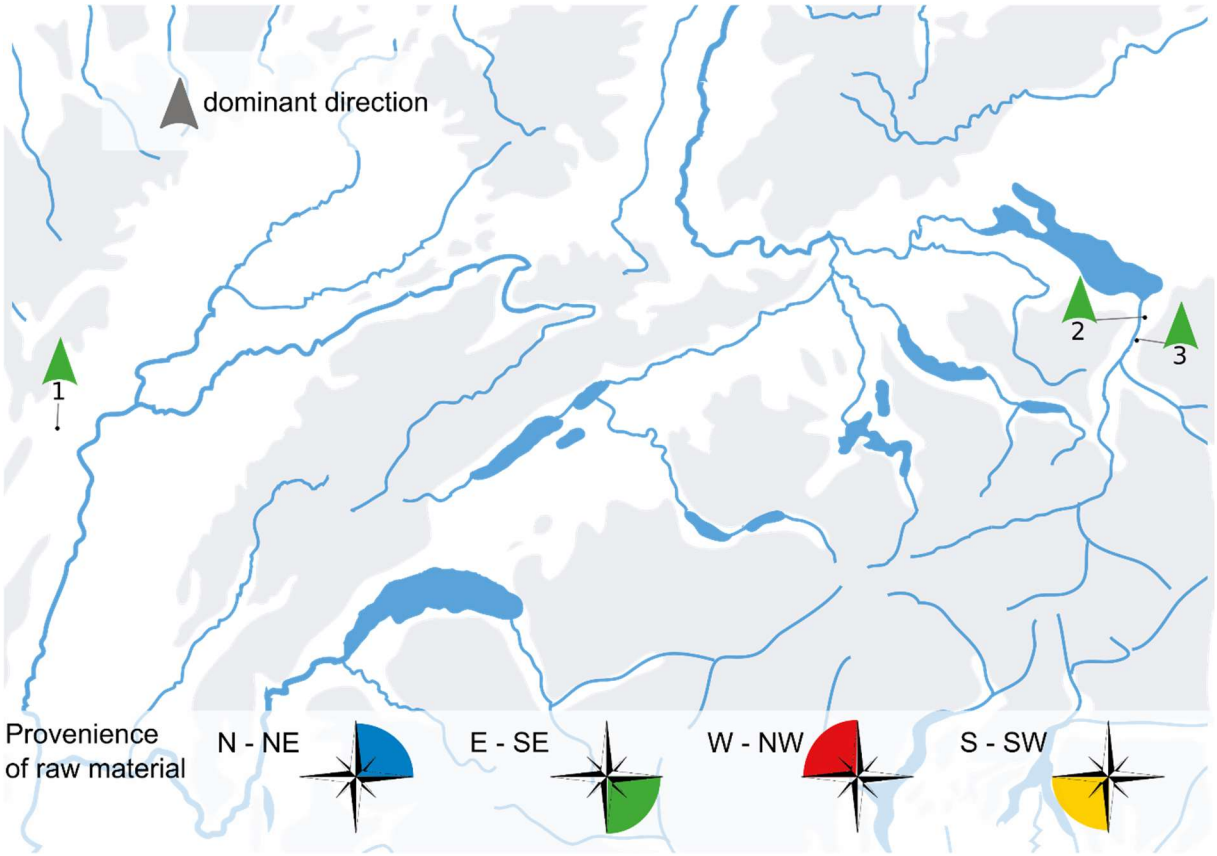

Figure 4. Main directions of networks pointed out by the KSSR proveniences, in the period before 3950 BCE. Each triangle represents a site. The size of the triangles illustrates the semi-quantitative amount of the raw materials.

In western Switzerland sites with quantitative data are missing for the period between 3950 and 3851 BCE. If we consider the main raw materials in each site, it seems that there is no relationship between the regions where the sites are located and the directions from which the materials originated (Figure 5, above). A high degree of independence seems to exist in the supply of siliceous raw materials. It can be assumed that there were no well-established distribution networks. However, in this period, settlements with comprehensive datasets are scarce as only five settlements could be analysed in detail (Figure 5, below). They are located in the North-East of Switzerland at the border to southern Germany. The site Sipplingen-Osthafen (DE) has raw materials whose outcrops can be aligned on a northwest-south-eastern axis with weak relations to the North-East. The settlement communities of the sites Hornstaad-Hörnle IA (DE) and Eschenz, Insel Werd (CH) had mainly relations expanding to the North-West and a few or no relations at all with the South-West. The raw material supply of Egolzwil 4 in Central Switzerland derives from the Olten-Aarau region mainly.

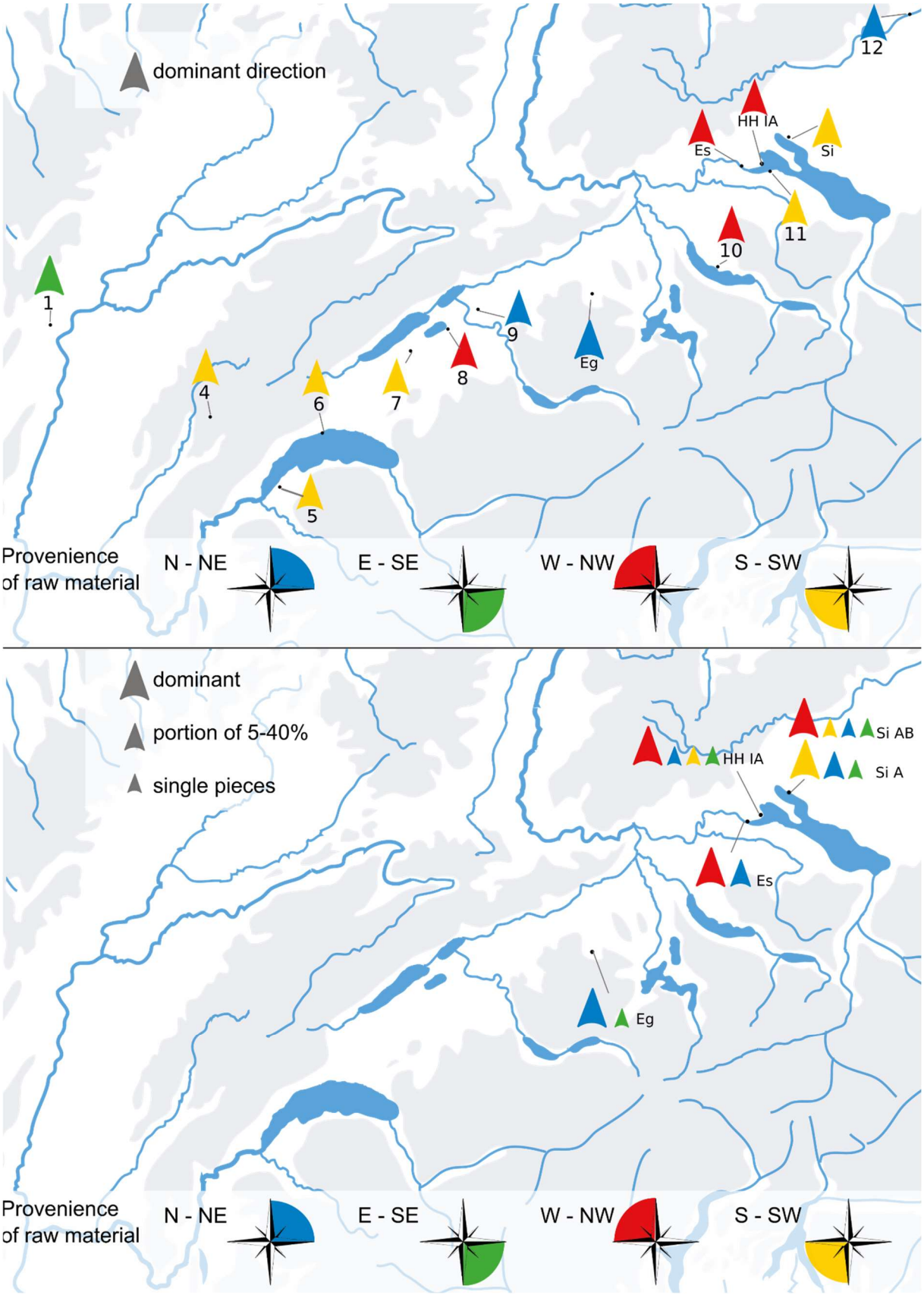

Figure 5. Directions of KSSR proveniences in the period between 3950 and 3851 BCE. Above: main directions, each triangle represents a site. Below: detailed directions, each line of triangles represents a site.

In the Northern Alpine Foreland there are more settlements dating to the following period between 3850-3751 BCE and could be included in this study (Figure 6, above). At sites in western Switzerland, the used siliceous raw materials originate mostly from the North-East like the KSSR mine of Olten (for a description of this mine see Lötscher 2015). By contrast, in Eastern Switzerland materials from the North-West prevail. In Central Switzerland, the situation is less clear, but two supply direction patterns seem to emerge, showing a weak margin at the western side of the lake of Zurich: along the eastern foothills of the Jura and the southern part of Central Switzerland, most raw materials originate from the North-North-East, while along the western foothills of the Alps, the raw materials from the North-North-West are more common. The peripheral regions seem to have other patterns of raw material consumption practices in contact to the South and the East.

For six sites with seven settlements in total the raw material use practices could be studied in more detail for this period (Figure 6, below). In Central Switzerland as a whole, relations with the North were the most important. The site Egolzwil (CH) located in between the two supply regions and the siliceous artefacts from Sipplingen-Osthafen (DE) in the North shows different directions of raw material acquisition. In Sipplingen, where we have complexes deriving from many different settlement phases, a change in raw material consumption can be observed compared to the previous period, as after 3850 BCE the north-western sources were mainly used. This change of direction can also be seen in pottery from Sipplingen, where the ties to the Black Forest and the Upper Rhine Valley respectively, Neckar and Kraichgau (Munzingen, Michelsberg) are becoming more important. With the exception of Egolzwil, all sites were connected to all directions. The most outstanding changes seem to have occurred at the margin of the studied area. But unfortunately, it was not possible to take into account in detail the sites on the Alpine side of the Northern Alpine Foreland to check whether the two groups that seem to appear in the general data are actual or whether there is a bias in the research.

In the North-Eastern lakeshore settlements of the Northern Alpine Foreland raw materials from the West and North-West were dominant during the next time slice, between 3750-3650 BCE. The Three-Lakes-Region in Western Switzerland continued to depend on raw material sources from the North and North-East, as KSSR from mining site at Olten (CH) were mostly used (Figure 7, above). In the western Jura Mountain range, raw materials from the South were dominant. The two supposed supply regions in the previous time slice seem to be moving closer together by taking over the networks from the North-Eastern and central part of the Northern Alpine Foreland also further south.

Detailed data from five sites, which contain in total eight settlement layers could be used for this period (Figure 7, below). Settlement communities of the Three-Lakes-Region appear to have retained their supply network of the previous period, changes appear on the outskirts (Seeberg, Burgäschisee-SW and Concise, Sous Colachoz E2 and E3). The importance of raw materials from Olten decreased after 3750 BCE, while relations to the North to North-West became stronger than in the layer E1 of Concise. After this shift, no change between the two layers E2 and E3 can be observed. In concise, these changes are marked in the ceramics too, which become a strong *Néolithique moyen bourguignon* (NMB) character (Burri 2006; see Figure 9b). In Sipplingen-Osthafen (DE) the supply pattern of the first period reoccurs. In Seeberg, Burgäschi SW, where a younger settlement, Seeberg Burgäschisee-N, was re-erected about 100 meters apart from the previous one, the raw material supply pattern remained the same (Tesfaghiorghis 2019). It is therefore unlikely that a change in population caused the displacement of the settlement.

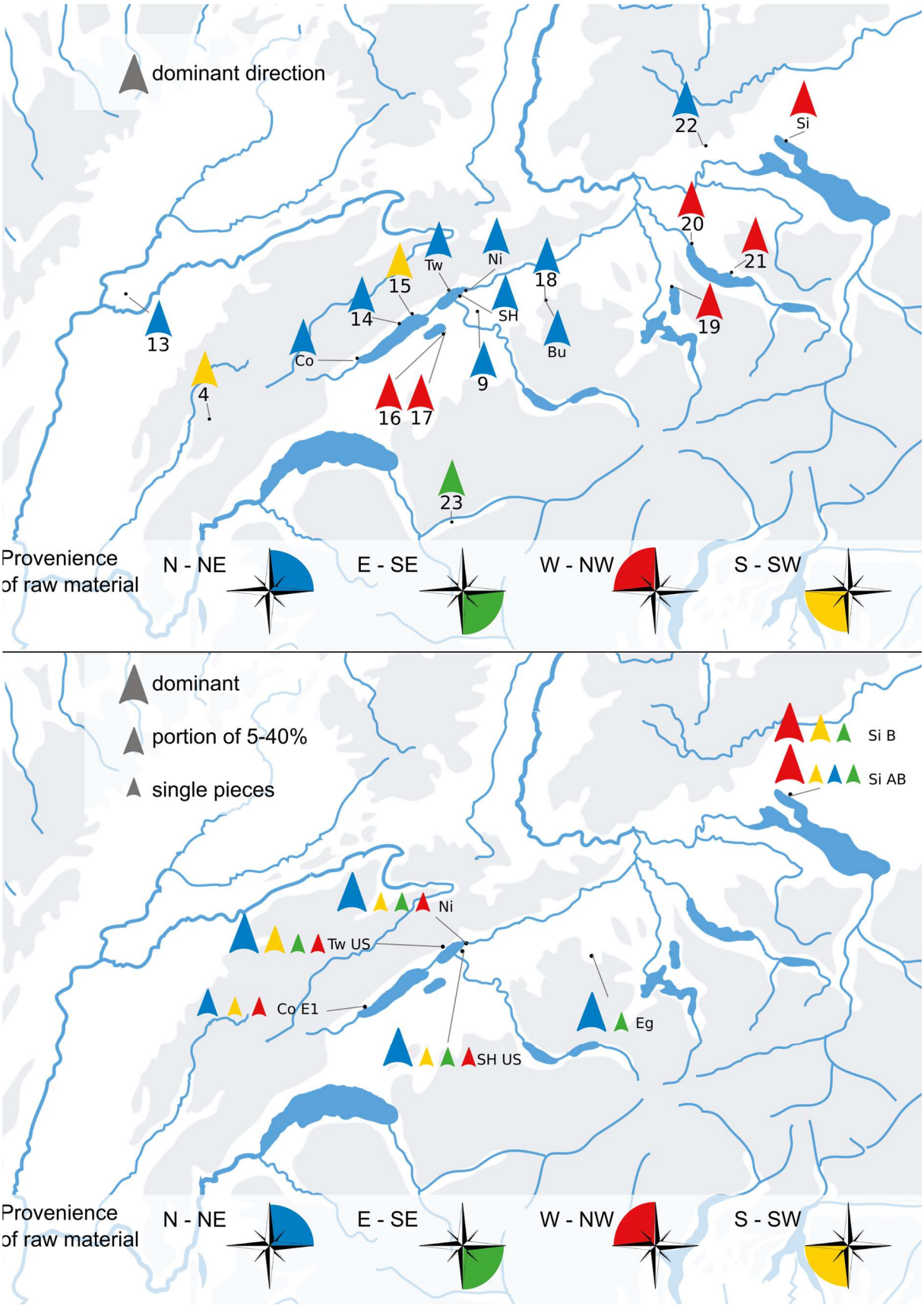

Figure 6. Directions of KSSR proveniences in the period between 3850 and 3751 BCE. Above: main directions, each triangle represents a site. Below: detailed directions, each line of triangles represents a site.

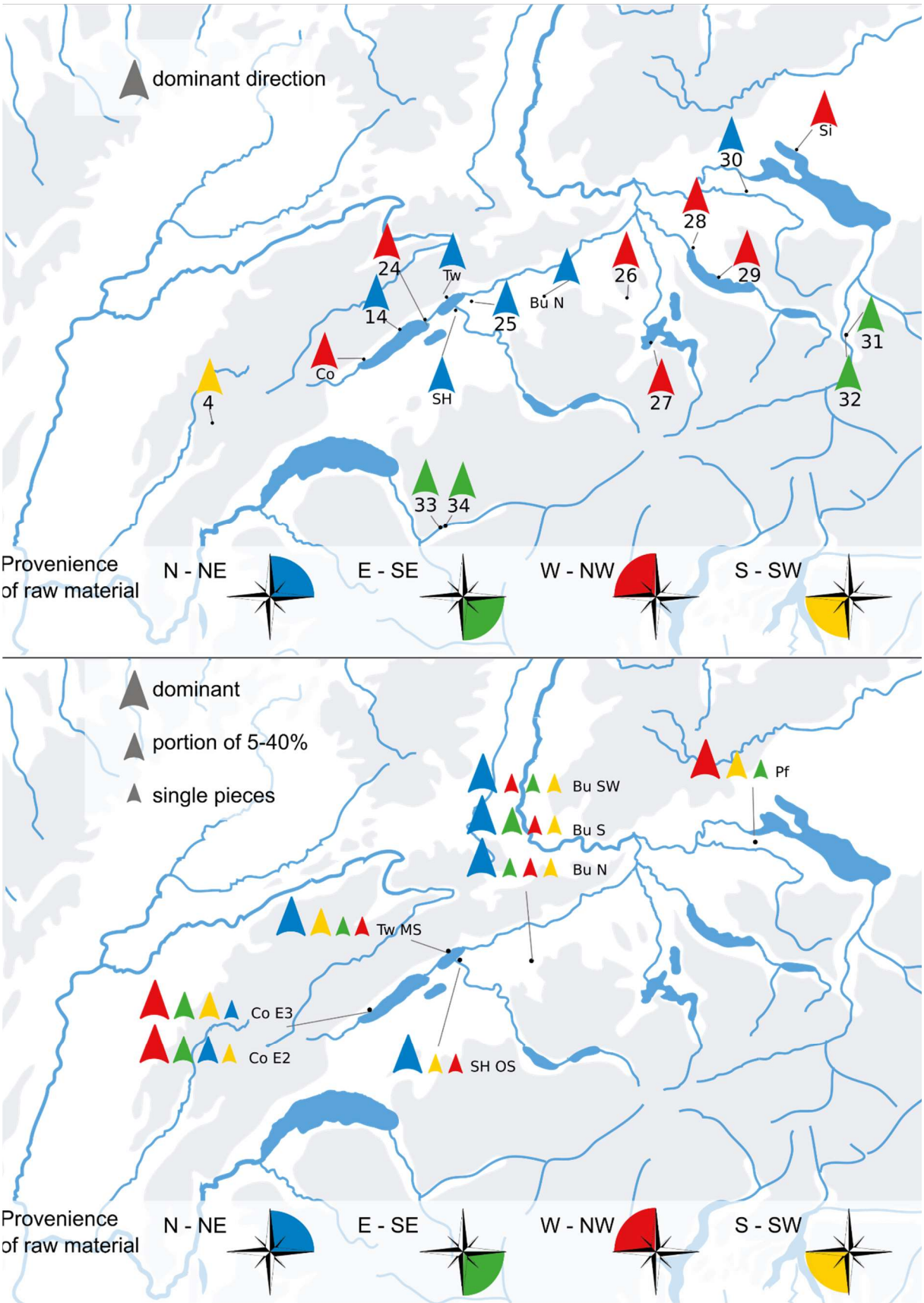

Figure 7. Directions of KSSR proveniences in the period between 3750 and 3651 BCE. Above: main directions, each triangle represents a site. Below: detailed directions, each line of triangles represents a site.

The last time slice studied here dates between 3650 and 3500 BCE. The two supply regions identified in the previous periods seem to persist over time (Figure 8, above). The sites of eastern Switzerland are mainly supplied from the West and the North-West, while the raw material supply seems more various in the Three-Lakes-Region.

Hence, the same model of raw material acquisition as during the previous period seems to persist, but little differences appear between Lake Neuchâtel and Lake Biel. The raw material supply from the Olten mining area seems to lose importance at Lake Neuchâtel.

Five sites with nine layers deliver detailed data (Figure 8, below). The settlements of Concise, Sous Colachoz (CH) show again and again a special pattern in comparison with the other sites of the Three-Lakes-Region: E4 shows the same trend (with materials coming from the Southeast) as the Camp de Chassey (F), which lies on the western side of the Jura range, while the next level E5 should be compared to the complex Gachnang, Niederwil (CH), which is located at the northern end of the Northern Alpine Foreland; both contain raw materials from more than 300 km (South-Italy and northern Paris Basin for Concise E5, Hungary and Italy for Gachnang), and show more contact to the West and the North-West. The reduction of the minor raw materials in Layer E6 from Concise could be interpreted as an interruption of most raw material supply networks at this time. In parallel to these changes in the KSSR procurement, the ceramics suddenly show in the layer E6 of Concise an important component of Cortaillod style. So there seems to have been a complete change in relationships, which some interpret as a complete renewal of the population (Burri 2006).

Taking into account the totality of a series makes it possible to approach spatial mobility. Indeed, Figures 5 to 8 show that taking into account the total (Figures 5b, 6b, 7b, 8b) makes it possible to nuance the approach based on semi-quantitative data (Figures 5a, 6a, 7a, 8a) and reveals influences which, although they are in the minority in terms of numbers, are nonetheless very important in terms of interpreting cultural relations.

6. Synthesis

In general, relations of settlement communities with the North (Malm KSSR: Olten region for the settlements of the Three lake region, Lägern for those of the Lake Zürich area and Randen region for those of the Lake Constance) are most important for the raw materials supply for flint industry on the Northern Alpine Foreland. Around 3900 BCE, each settlement community seems to have managed its own individual arrangements for obtaining the KSSR raw materials it needed. However, the number of sites that can be attributed to this time slice is smaller than to the later ones. Two major regions of raw material supply are recognizable at the timeframe between 3850 and 3750 BCE. For this period, it is possible to assume the existence of regular distribution networks of KSSR raw materials - at least in the area of the Northern Alpine Foreland. But Egolzwil (CH) and Sipplingen-Osthafen (DE) do not fit into this pattern, showing different acquisition directions compared to the other sites of the region in which they are located. In Egolzwil, the ceramics shows a special pattern too. The Three-Lakes-Region differs from other ones because it is more dependent on a supply from the North-East throughout the entire study period. This may correspond to the mining activities in the region of Olten. The raw material supply of the different settlement phases of Concise, Sous Colachoz (CH) alternates between outcrops in the North-West and South-East. The pottery vessels too were made in different styles. The dominant typical local vessels are in some of the settlement phase accompanied by styles that are typical for the North-West and North-East, what also indicates alternating networks of potters and pottery production practices.

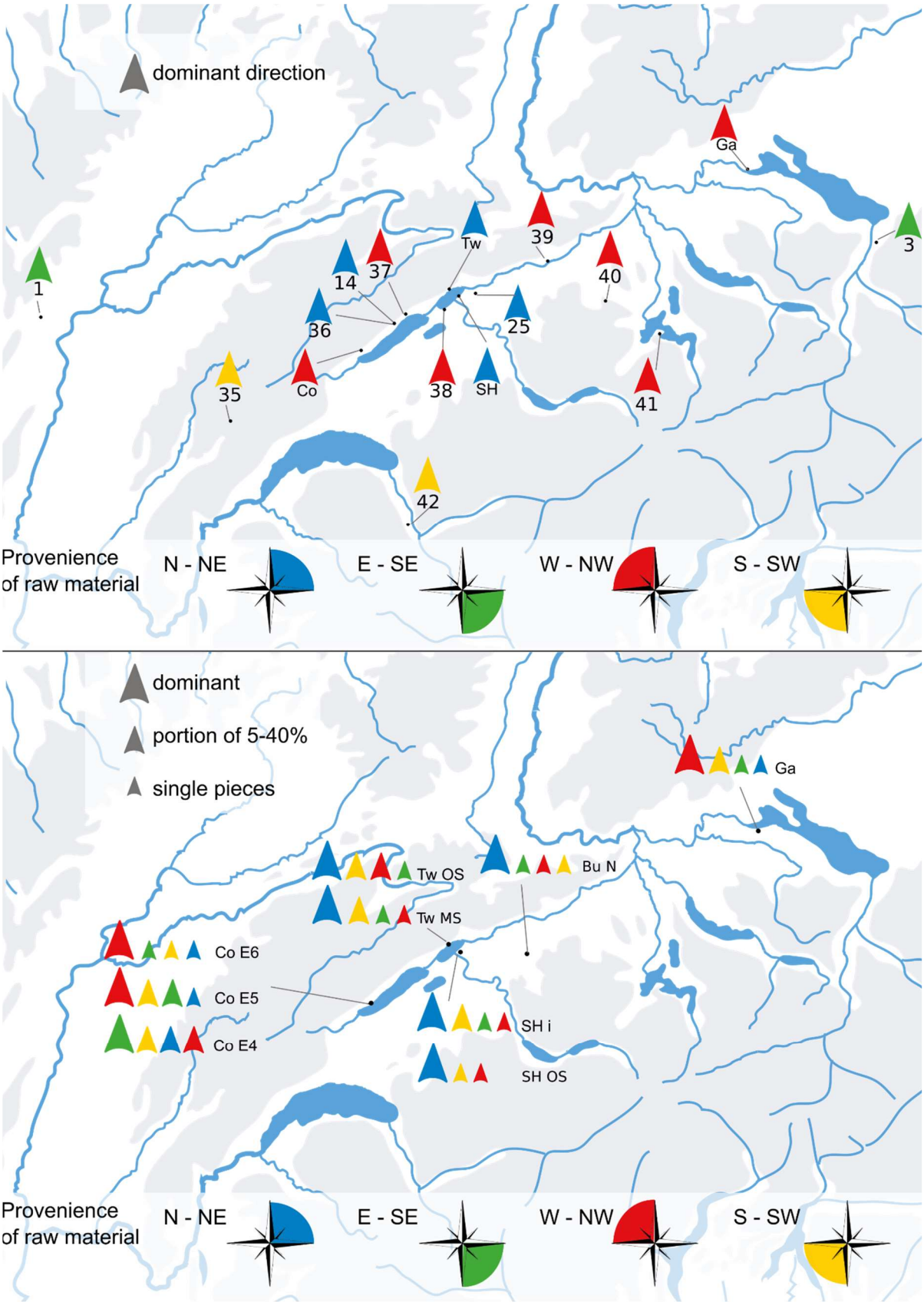

Figure 8. Directions of KSSR proveniences in the period between 3650 and 3500 BC. Above: main directions, each triangle represents a site. Below: detailed directions, each line of triangles represents a site.

The approach to variations in cultural influences through the displacement of materials is in itself not new since the work of Renfrew (1977). In Europe, his work was mainly developed for the study of the Palaeolithic (*e.g.*, Féblot-Augustins 2002: 22-23, 2009: 38). For the Neolithic period, researchers focused mainly on ceramics (*e.g.*, Stöckli 2009; 2016). With the stylistic and material provenance analyses conducted in the scope of the MET-project, it becomes possible to compare the processes observed in the two categories of finds in terms of pattern of spatial mobility for the first times.

When comparing the main directions of flint provenances with the major distribution of the main pottery styles during the period under study, the following aspects stand out: in general the directions of material entanglements or - in other words - pattern of spatial mobility based on pottery styles and siliceous raw materials are spatially not fully congruent, as can be seen in Figures 9 and 10 that illustrate the data for the sites Hornstaad-Hörnle and Sipplingen-Osthafen at Lake Constance in the periods around 3900 BCE as well as between 3850 and 3750 BCE.

At Hornstaad-Hörnle IA and Sipplingen A (Figure 9) the pottery vessels show a similar stylistic plurality that refers to complex material entanglements and spatial mobility pattern, expanding into all directions (Heitz 2018: 259-260, 276-278, 303-325; Matuschik 2011: 210-257). This might be reflected in the large variety of the siliceous raw materials too (Affolter et al. 2022a). However, while KSSR from outcrops located in the West to North-West dominate in Hornstaad-Hörnle IA, in pottery the local style (Hornstaad) is the most abundant followed by the style known to be typical for Upper Swabia in the North-East of Lake Constance (Schussenried). Furthermore, vessels similar to the non-local pottery styles that can be attributed to the typochronological units Michelsberg (North-West), Munzingen A (West) and Cortaillod and NMB (South-East) are rarely present too (Heitz 2017; 2018; Heitz & Stapfer 2021; with slightly different view Matuschik 2011: 210-257). The many different stylistic combinations show that vessels of non-local styles were not only imported to the settlement (translocal vessels) but that potters with different cultural practices (habitus) most likely moved to the Lake Constance too, which led to creative appropriations between pottery productions practices (intermediate vessels). While the mobility pattern of the pottery at the contemporaneous site Sipplingen A is very similar to the one of Hornstaad-Hörnle IA, the siliceous raw materials show a quite different picture: there, materials from outcrops located in the South-West seem to be dominant. However, the material from the mixed layer Sipplingen AB and the dominance of flints from the Northwest there indicates that the much smaller data basis of Sipplingen A might have a negative influence on its representativity.

The stylistic entanglements of the pottery vessels found in the settlements Hornstaad-Hörnle II and Sipplingen B that date a few years later to the time slice between about 3850 to 3750 BCE show a very different pattern of spatial mobility compared to the older settlements at Lake Constance (Figure 10). The stylistic plurality is reduced to non-local pottery features typical for the Michelsberg typochronological units (North-West) beside a few features that are still typical for the Schussenried typochronological unit (North-East). Furthermore, some Michelsberg features were appropriated and integrated into the local pottery style Pfyn (Heitz 2018: 328-337; 340-341; Matuschik 2010; Schlenker 1998). The KSSR seem to reflect this change in the direction of predominant relations, as those from outcrops in the North-West are still dominant while the ones deriving from locations in the North-East are missing. However, the flint sample of Sipplingen B is again rather small.

For the Lake Constance region one can conclude that rhythms and directions of spatial mobility involved in the acquisition of flints were not the same as those of pottery producers and users. Still it is interesting to see that the material entanglements in pottery and KSSR in which the settlement communities at Lake Constance were integrated were generally different when compared to the ones in the Three-Lake-Region.

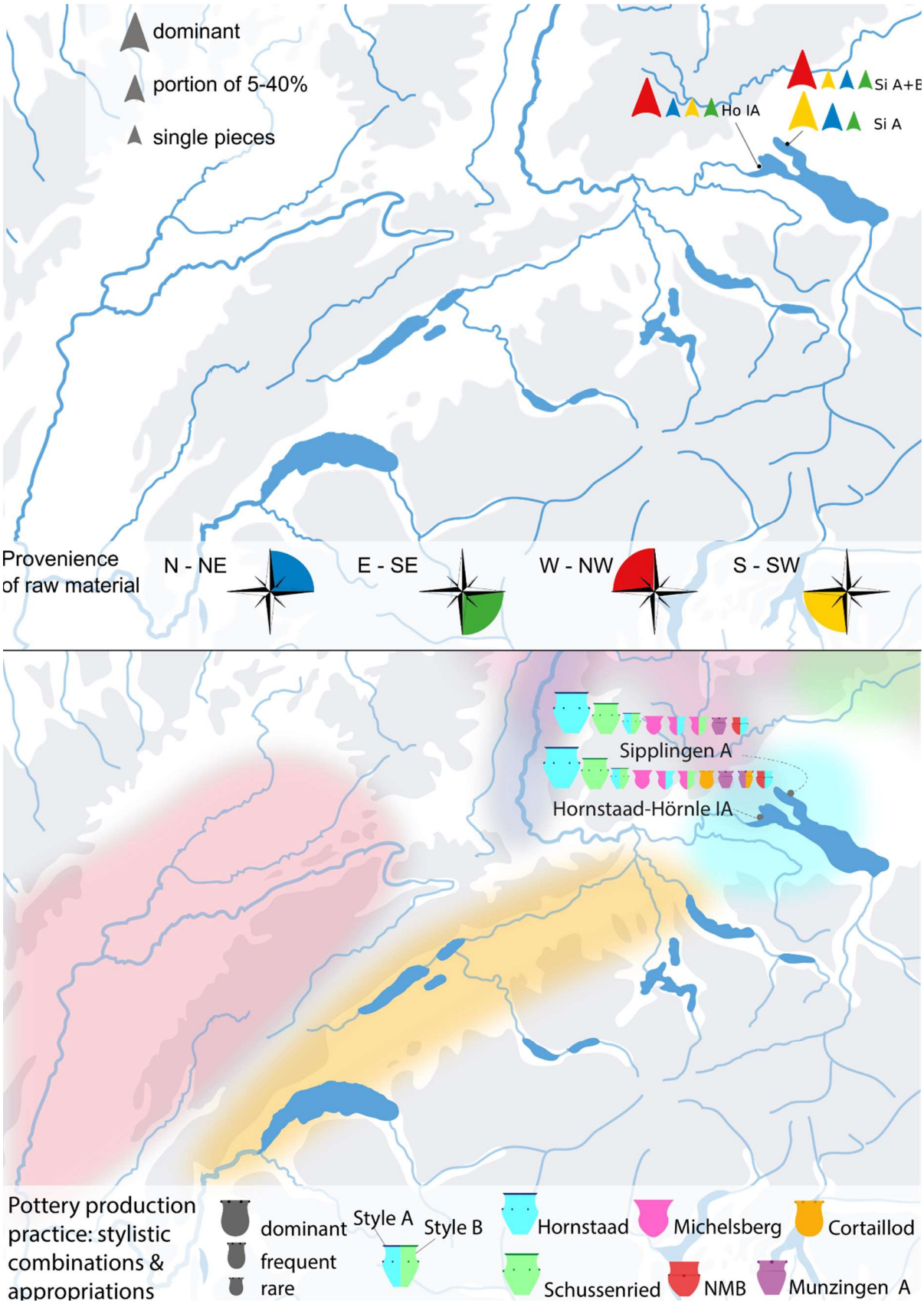

Figure 9. Comparison of the provenience directions of the main siliceous raw materials (KSSR) and stylistics entanglements in pottery at the sites Sipplingen-Osthafen as well as Hornstaad-Hörnle around 3900 BCE (data on pottery: Heitz 2018: 211-288).

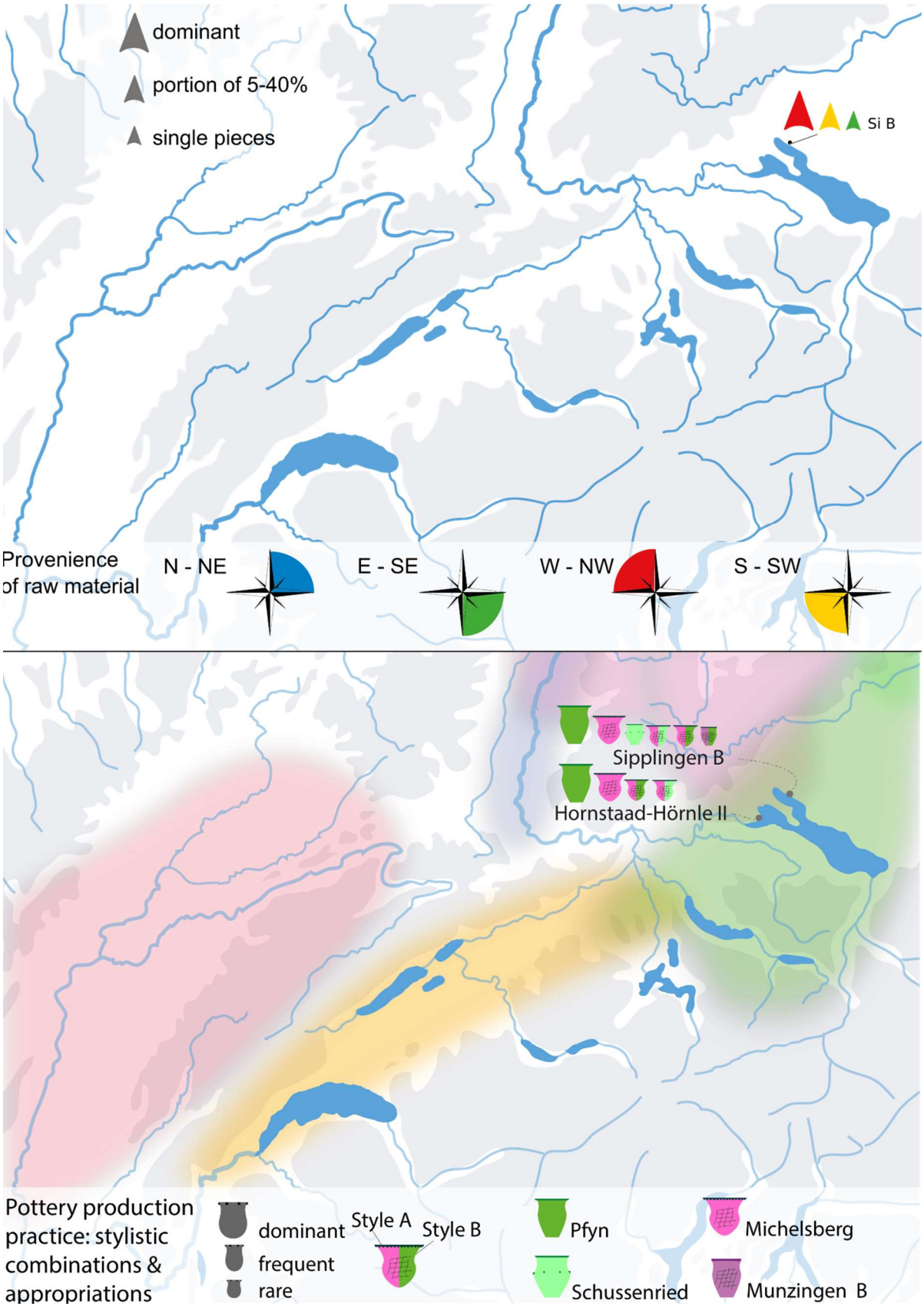

Figure 10. Comparison of the provenience directions of the main siliceous raw materials (KSSR) and stylistics entanglements in pottery at the sites Sipplingen-Osthafen as well as Hornstaad-Hörnle between 3850-3750 BCE (data on pottery: Heitz 2018: 211-288).

Comparing two sites in the Three-Lakes-Region, one can notice differences between Lake Neuchâtel and Lake Biel (Figures 11-13, above). The supply of siliceous raw material changes little in the settlements of Twann between 3838 and 3539 BCE (layers US to OS). The KSSR from the Olten region dominates in all settlements. The pottery is dominated by ceramics produced in the Cortaillod style, which is typical for this region and time (Figures 11-13, below). In addition, there are a few vessels that were potted in a different production practice or that combine different techniques, raw materials and or stylistic elements. Although these make up only a small part of the pottery, they are regularly found in all settlements. Non-locally produced vessels, which were brought to the settlement from another place, are very rare. The pottery thus shows that the community that made pottery in the settlement was interconnected by networks expanding to the West (*Néolithique moyen Bourguignon* NMB) and North (Munzingen and Pfyn respectively). Flint supply networks and mobility patterns that can be reconstructed on the basis of the pottery thus show a similar picture.

At Lake Neuchâtel in the settlements of Concise, the situation between 3868 and 3530 BCE is quite different (Figure 11). In the oldest settlement, the KSSR supply is comparable to Twann, except that no KSSR from East-South-East occur. The pottery is shaped in the Cortaillod style, but one third contains carbonate fragments of shells or fossils as a tempering of the clay. Carbonatic tempering does not occur frequently in the Three-Lakes-Region, but is very common on the far side of the Jura mountains in eastern France, specifically in pottery of NMB-style (Burri 2006; Pétrequin et al. 2016; Stapfer 2017; 2019a: 216-220). The pottery could therefore still show an older relation to the west, the KSSR supply, on the other hand, is clearly oriented towards the Three-Lakes-Region.

In the subsequent, younger settlements, the origin of the siliceous artefacts and the pottery show strong changes (Figures 12 and 13). With regard to KSSR, materials from the West-North-West are becoming more important, the outcrops in Olten are now playing only a minor role. In E4 it seems rather special that there is a lot of flint from the East-South-East. Regarding pottery, vessels of NMB style or those combining elements of Cortaillod and NMB represent half of all ceramics in settlements E2 and E4 (Burri 2006). KSSR and pottery thus both show a strong orientation towards the West and North-West. In the latest settlement E6, the previous network seems to persist for the KSSR. In the case of the ceramics, on the other hand, the orientation towards the Three-Lakes-Region is becoming stronger, with ceramics in the Cortaillod style being overabundant.

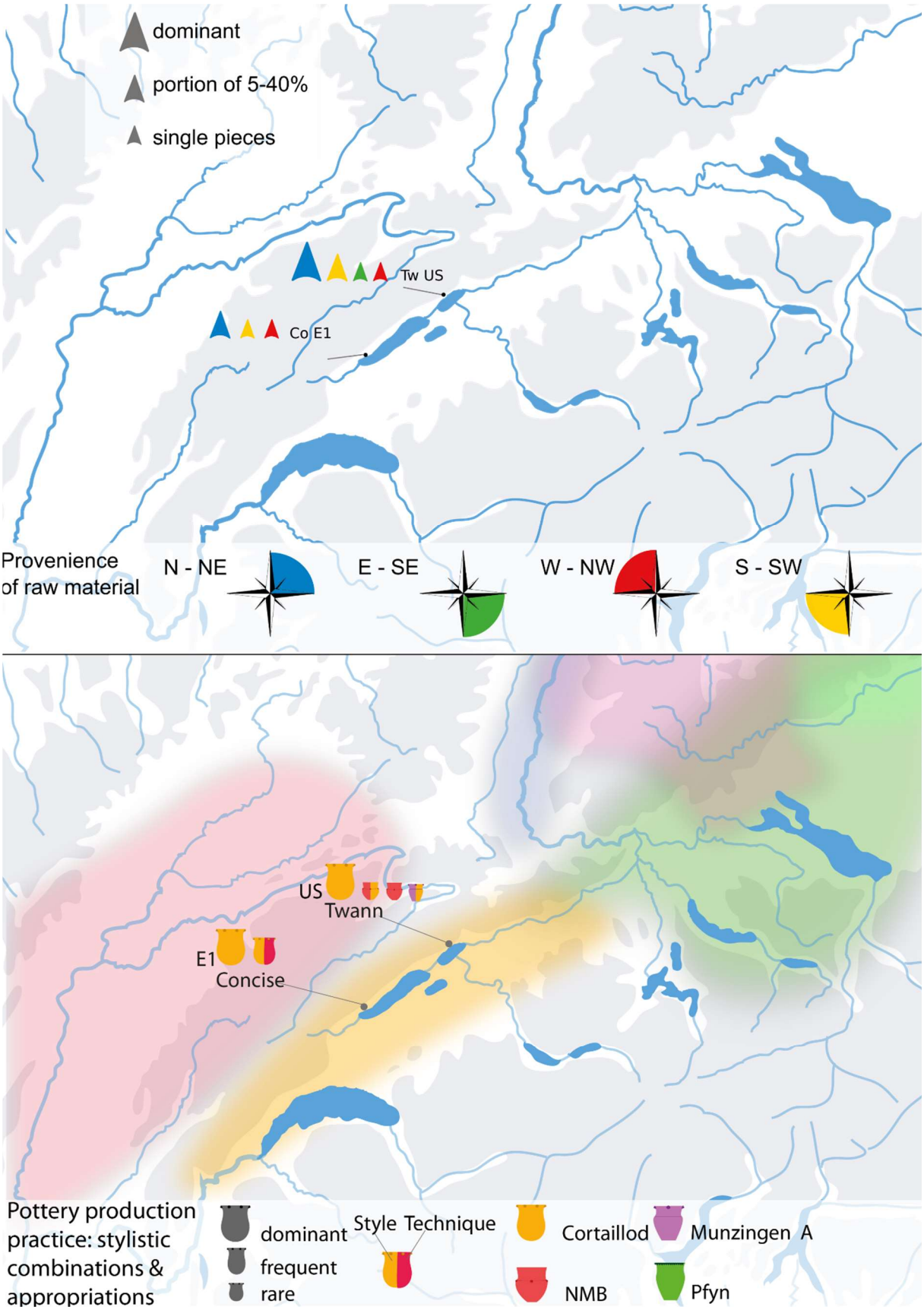

Figure 11 Comparison of the provenience directions of the main siliceous raw materials (KSSR) and stylistics entanglements in pottery at the sites Concise at Lake Neuchâtel as well as Twann at Lake Bienne between 3850-3750 BCE (data on pottery: Stapfer 2017; 2019a: 242-254, Fig. 282).

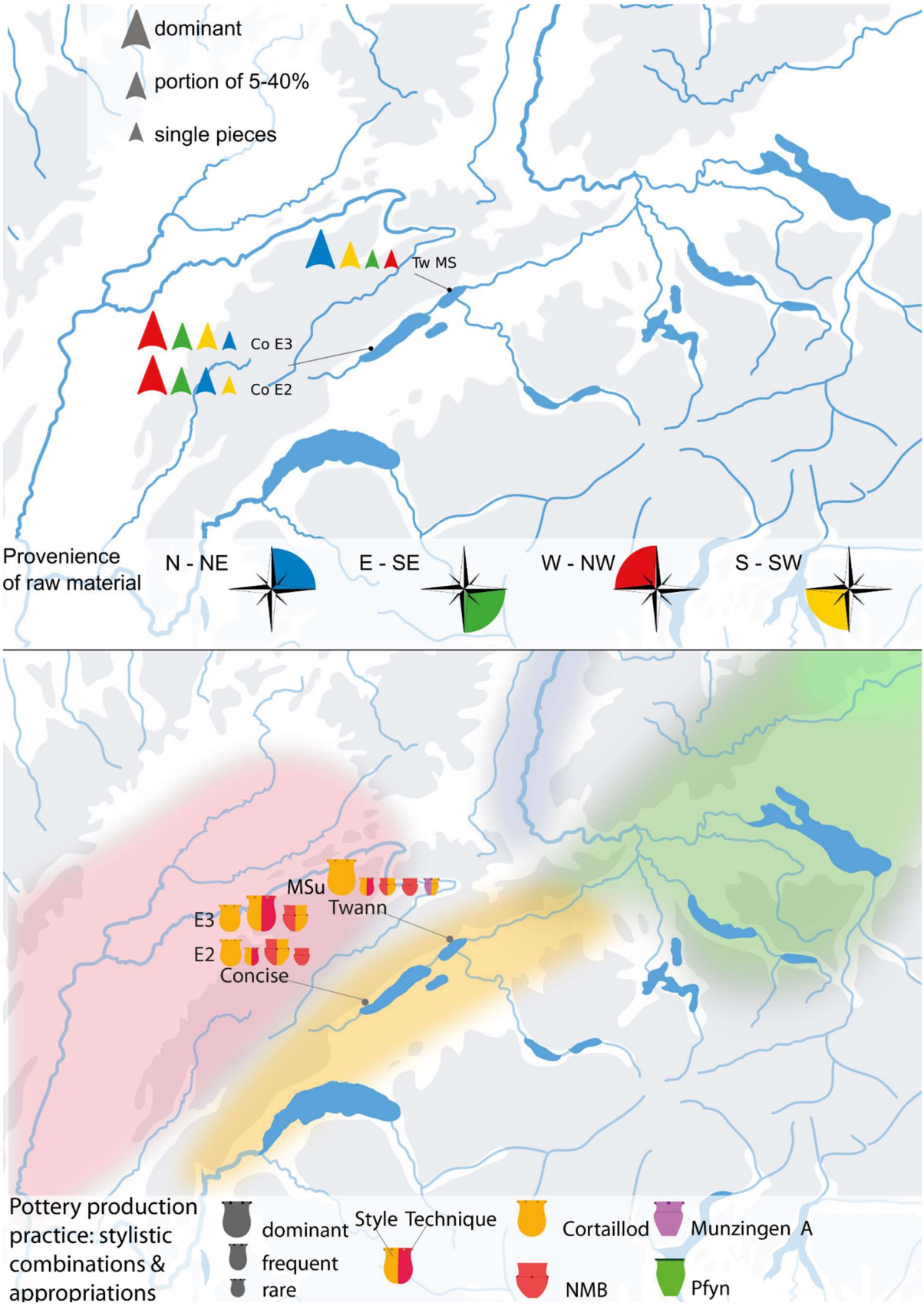

Figure 12 Comparison of the provenience directions of the main siliceous raw materials (KSSR) and stylistics entanglements in pottery at the sites Concise at Lake Neuchâtel as well as Twann at Lake Bienne 3750-3650 BCE (data on pottery: Stapfer 2017; 2019a: 242-254, Fig. 282).

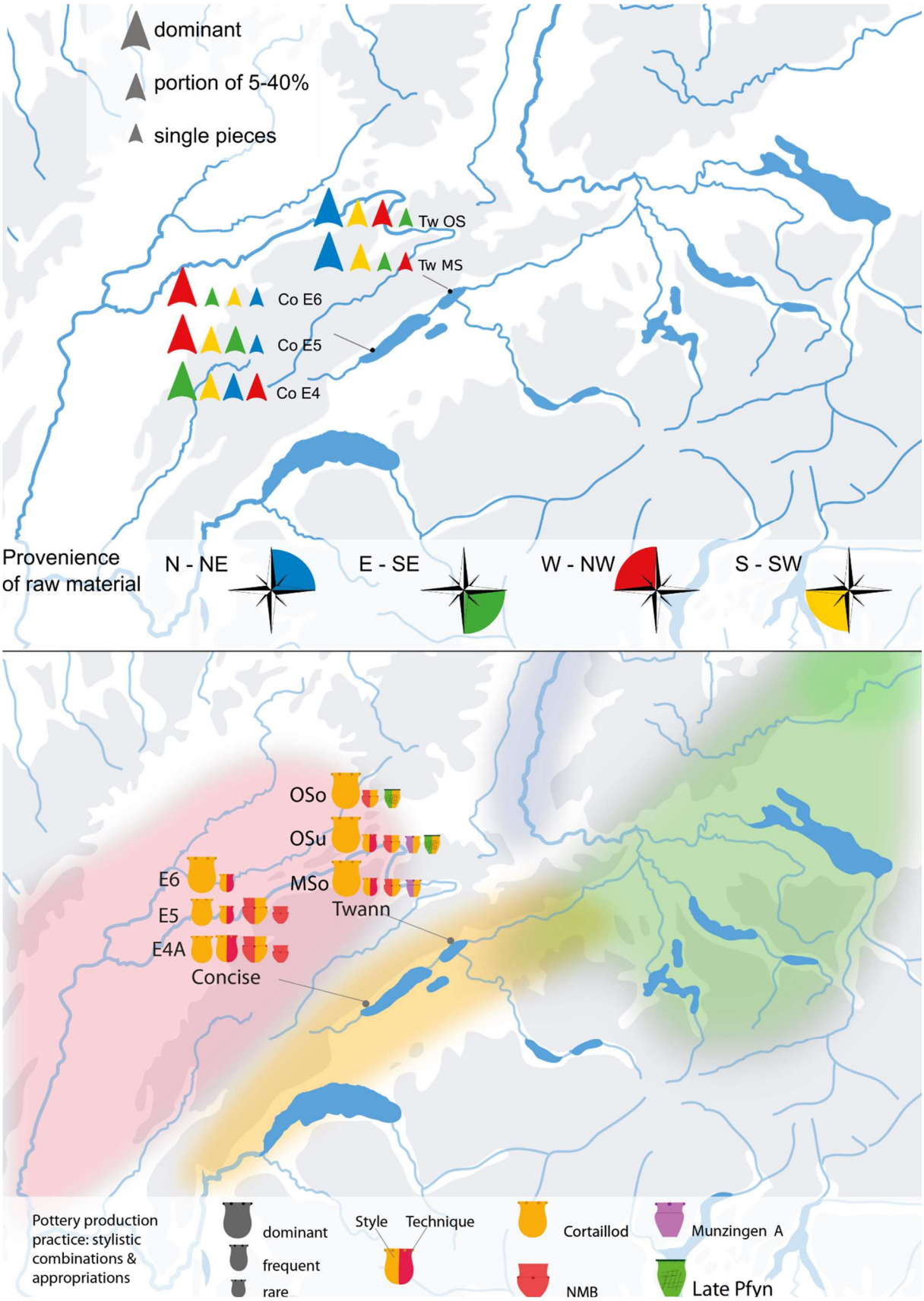

Figure 13. Comparison of the provenience directions of the main siliceous raw materials (KSSR) and stylistics entanglements in pottery at the sites Concise at Lake Neuchâtel as well as Twann at Lake Bienne between 3650-3500 BCE (data on pottery: Stapfer 2017; 2019a: 242-254, Fig. 282).

7. Conclusion - Projects and further questions

The scarcity of suitable raw materials on the Northern Alpine Foreland forced Neolithic settlement communities to obtain the raw material elsewhere. Therefore, their networks of relationships can be traced over long distances. Despite the small number of sites included in this study, a change in the direction of raw material acquisition used for knapped stone tools can be observed. While analyzing the siliceous raw material provenances allows to infer pattern of spatial mobility that were first and foremost linked to networks of supply, the inquiry of pottery production practice (style, material and technique) reveals different mobility patterns that were linked to temporary or permanent change of residence as well as changes in the cultural and social configuration of settlement communities (see Heitz 2017; Heitz & Stapfer 2017a; 2021; Stapfer 2017). This could explain why the relationships pointed to by both categories of archaeological remains do not follow exactly the same scheme. As we were able to show, examining the materiality of siliceous tools (geological provenance) and ceramics (geological and stylistic provenances) allows to explore different contexts and pattern of spatial mobilities of Neolithic wetland settlement communities. KSSR and pottery related mobilities unfolded in each region into different directions, over different distances and were subject of different rhythms of change and thus evidence clearly against the presupposition of cultural homogeneity as presumed by the culture-historical paradigm. Despite not being spatially fully congruent, the material entanglements of KSSR and ceramics still share some generalities: for both artefact categories regional different patterns occur, which indicates that contemporaneous settlement communities in, for example, the Three-Lakes-Region and at Lake Constance, were integrated and part of different social networks that were produced and reproduced by spatial mobility. In this respect the material entanglement does not reflect the premise of clearly separated and culturally homogeneous blobs (archaeological cultures) but still regionally different entangled socio-spatial configurations that were most likely shaped by economic and political practices.

To gain a deeper understanding of the material entanglements and the socio-spatial configurations between settlement communities of the first half of the 4th millennium BCE in the northern Alpine foreland, two further analytical steps are proposed here for future research: on the one hand, it will be necessary to take into account a greater number of sites, including those in neighboring regions, and on the other hand the typo-technological data of KSSR production practices should be integrated into the inquiry. This will allow to gain a deeper understanding of the question whether the lithic artefact production practices unfolded in parallel cultural entanglements to those identified by drawing on pottery.

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Data accessibility statement

The majority of the data is freely accessible, the corresponding literature is listed. Some data originate from (not yet) published works, especially from university theses. This data can be requested by the authors.

List of supplementary files

Supplementary file 1
"Affolter_et_al_supplementary_file_1.xlsx"
List of the treated sites with additional information and literature.

Supplementary file 2
"Affolter_et_al_supplementary_file_2.xlsx"
List of raw material determination (KSSR) of the treated sites studied in detail.

Supplementary file 3
"Affolter_et_al_supplementary_file_3.xlsx"
Data relating to the roughly studied comparative sites.

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Beziehungsgeflechte zwischen neolithischen Seeufersiedlungen anhand von Rohmaterialien der Silices

Jehanne Affolter [1,2], Helena Wehren [1,2], Caroline Heitz [3], Regine Stapfer [1,4], Lea Emmenegger [1], Martin Hinz [1], Gisela Thierrin-Michael [5], Albert Hafner [1,6]

1. Institute of Archaeological Sciences, University of Bern, Hochschulstrasse 6, 3012 Bern, Switzerland. Email: Affolter: affolterjs@bluewin.ch; Wehren: wehren@gmx.ch; Stapfer: regine.stapfer@iaw.unibe.ch; Emmenegger: lea_emmenegger@outlook.com; Hinz: martin.hinz@iaw.unibe.ch; Hafner: albert.hafner@iaw.unibe.ch
2. Ar-Geo-Lab, Dîme 86, 2000 Neuchâtel, Switzerland.
3. Institute of Pre- and Protohistory, University of Kiel, Johanna-Mestorf-Straße 2-6, 24118 Kiel, Germany. Email: cheitz@sfb1266.uni-kiel.de
4. Archaeological Service of Canton Bern, Brünnenstrasse 66, 3018 Bern, Switzerland.
5. Department of Geosciences, University of Fribourg, Chem. du Musée 4, 1700 Fribourg, Switzerland. Email: gisela.thierrin-michael@unifr.ch
6. Oeschger Centre for Climate Change Research (OCCR), University of Bern, Hochschulstrasse 4, 3012 Bern, Switzerland.

Abstract:

In diesem Beitrag werden die Ergebnisse der Provenienzanalyse kieselhaltiger Artefakte (Silices) aus neolithischen Seeufersiedlungen vorgestellt, die im Rahmen des vom Schweizerischen Nationalfonds unterstützten SNF-Projekts MET ("Mobilities, entanglements and transformations in Neolithic societies on the Swiss Plateau (3900-3500 BCE)") untersucht wurden (Projektnummer 100011 156205). Das Ziel dieser Arbeit ist es, die kulturellen Verflechtungen, wie sie durch die Keramikanalysen hausgearbeitet wurden, mit den Herkunftsregionen der Silicium-haltigen Sedimentgesteine zu vergleichen, welche für die Herstellung von geschlagenen Steinwerkzeugen verwendet wurden. Die untersuchten Silices wurden in Kulturschichten von Feuchtgebietssiedlungen im nördlichen Alpenvorland gefunden, von denen die meisten dendrochronologisch jahrgenau datiert werden konnten. Durch Analyse der sedimentären Mikrofazies der in den Fundstellen vorhandenen Silices wurden die Herkunftsorte der für die Artefaktherstellung verwendeten Rohmaterialien bestimmt. Das ermöglichte die genaue Lokalisierung der während des Neolithikums genutzten Aufschlüsse, ohne die Artefakte zu zerstören. Dadurch konnten anhand der Nutzung von Rohmaterialien Erkenntnisse zu den komplexen materiellen Verflechtungen, Beziehungsnetzen und Mobilitätsmuster zwischen den Siedlungsgemeinschaften im Schweizer Mittelland, Süddeutschland und Ostfrankreich erzielt werden. Zudem wurden diese Ergebnisse visuell mit stilistischen Verflechtungen in der Keramik des 4. Jahrtausends v. Chr. verglichen. Durch die vorliegenden Untersuchungen konnten folgende zentralen Erkenntnisse gewonnen werden:

Die Knappheit an geeigneten Rohmaterialien im nördlichen Alpenvorland zwang die neolithischen Siedlungsgemeinschaften, ihre Silizium-haltigen Rohstoffe für die Produktion von auf Schlagtechnik beruhenden Steinwerkzeugen anderswo zu beschaffen. Ihre Beziehungsnetze lassen sich über weite Entfernungen zurückverfolgen. Trotz der geringen Anzahl von Fundstellen, die in diese Untersuchung einbezogen wurden, lässt sich ein Wechsel in der Richtung der Beschaffung von Rohmaterialien feststellen. Die Herkunftsanalyse der Silizium-haltigen Materialien lässt Rückschlüsse auf räumliche

Mobilitätsmuster zu, die in erster Linie mit Versorgungsnetzwerken verbunden waren. Die Untersuchung der Produktionspraxis bei Keramikgefässen (Stil, Material und Technik) zeigt unterschiedliche Mobilitätsmuster, die mit der temporären oder dauerhaften residenzbezogenen Mobilität sowie mit Veränderungen in der kulturellen und sozialen Konfiguration von Siedlungsgemeinschaften verbunden waren. Dies könnte erklären, warum die jeweiligen Fundkategorien auf Beziehungen hinweisen, die nicht genau demselben Schema folgen. Wie wir zeigen konnten, ist es möglich, auf Basis der Materialität von Silices (geologische Provenienz) und Keramik (geologische und stilistische Provenienz), unterschiedliche Kontexte und Muster räumlicher Mobilität neolithischer Siedlungsgemeinschaften zu untersuchen. Beide Mobilitätspraktiken entfalteten sich in jeder Region in unterschiedliche Richtungen, über unterschiedliche Entfernungen und waren Gegenstand unterschiedlicher Veränderungsrhythmen, was eindeutig gegen die Annahme kultureller Homogenität spricht, wie sie vom kulturhistorischen Paradigma vorausgesetzt wird. Die materiellen Verflechtungen, die anhand der beiden Fundkategorien herausgearbeitet wurden, sind zwar räumlich nicht völlig deckungsgleich, weisen aber dennoch einige Gemeinsamkeiten auf: Beides, die Silizium-haltigen Steinartefakte und die Keramik verweisen auf regional unterschiedliche Mobilitätsmuster, was darauf hindeutet, dass zeitgleiche Siedlungsgemeinschaften z.B. im Drei-Seen-Land und am Bodensee Teil unterschiedlicher sozialer Netzwerke waren, die durch räumliche Mobilität produziert und reproduziert wurden. Insofern spiegeln die materiellen Verflechtungen nicht die Prämisse klar voneinander getrennter und kulturell homogener Blöcke (archäologische Kulturen) wider, sondern regional unterschiedliche, verflochtene sozialräumliche Konfigurationen, die höchstwahrscheinlich durch wirtschaftliche und soziopolitische Praktiken konstituiert waren.

Um ein tieferes Verständnis der materiellen Verflechtungen und der sozialräumlichen Konfigurationen zwischen Siedlungsgemeinschaften der ersten Hälfte des 4. Jahrtausends v. Chr. im nördlichen Alpenvorland zu gewinnen, schlagen wir für die zukünftige Forschung zwei weitere Analyseschritte vor: Zum einen wäre es wünschenswert zukünftig, eine größere Anzahl von Fundstellen, auch in benachbarten Regionen, in die Untersuchungen einzubeziehen, und zum anderen sollten die typologisch-technologischen Daten der Produktionspraktiken von Steinwerkzeugen in die Untersuchung integriert werden. Dies wird es ermöglichen besser zu verstehen, ob die sich Herstellungspraktiken lithischer Artefakte auf ähnliche Art und Weise durch Beziehungsgeflechte (trans)formierten wie etwa die Keramikpraktiken.

Keywords: Neolithikum; Silex; schlagbare silikatische Sedimentgesteine; Beschaffung und Austausch von Rohmaterialien; Nördliches Alpenvorland; Feuchtbodenarchäologie; Mobilitätsforschung