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Research Article

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Potters' Mobility Contributed to the Emergence of the Bell Beaker Phenomenon in Third Millennium BCE Alpine Switzerland: A Diachronic Technology Study of Domestic and Funerary Traditions

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Abstract: The spread of the Bell Beaker phenomenon across Europe is still strongly debated today. Small-scale technological studies investigating its integration in local contexts remain rare, even though these are crucial to observing disruptions in traditions. In this article, we studied the ceramic technology of Final Neolithic, Bell Beaker period, and Early Bronze Age settlements of the Upper Rhône valley in Switzerland (3300–1600 BCE). We reconstructed and compared their pottery traditions to those from the contemporaneous megalithic necropolis of Sion 'Petit-Chasseur', a major funerary and ritual site located in the centre of the valley. Our findings showed that the Bell Beaker period saw an abundance of simultaneous technical changes, mirroring disruptions identified by other fields, and confirmed that this cultural phenomenon did not blend seamlessly with the local context. More importantly, they revealed the role played by human mobility, with the arrival of potters shortly after 2500 BCE.

Keywords: Final Neolithic, Early Bronze Age, ceramic production, settlements, megalithic necropolis

1 Introduction

The Bell Beaker phenomenon, with its emblematic Beaker and funerary "set", has been the topic of numerous studies and publications since the end of the 19th century. Its geographical origin(s), emergence mechanisms, diffusion, and integration throughout Europe and northern Africa during the 3rd millennium BCE have been strongly debated and are still actively discussed today (Besse, 2015; Bosch-Gimpera, 1926; Delibes de Castro & Guerra Doce, 2019; Gallay, 2014; Harrison, 1974; Lanting, Mook, & van der Waals, 1973; Lemercier, 2020; Salanova, 2004; Sangmeister, 1963; Siret, 1913, among others). Much of the latest research on this phenomenon has been focused mainly on broad aDNA studies on a continental, or otherwise vast, scale (Allentoft et al., 2015; Brotherton et al., 2013; Haak et al., 2015; Marcus et al., 2019; Olalde et al., 2018, 2019).

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Although this genetic approach has brought remarkable results and undoubtedly impacted on the discussion on the phenomenon (Furholt, 2018; Guilaine, 2018; Heyd, 2016, 2017; Kristiansen et al., 2017; Vander Linden, 2016), it has not yet been able to answer these questions of diffusion and integration (Furholt, 2021). For example, the exact relationship between Bell Beaker society and the preceding cultures – a crucial issue when discussing human mobility and the diffusion of cultural features – is difficult to assess through aDNA analyses.

Small-scale regional, diachronic studies centred on one field of research seem to be much more suited to this purpose, allowing researchers to better observe the mechanisms underlying the possible integration, or "cultural entanglement", in local contexts (Fahlander, 2007; Hahn, 2004, 2012; Stockhammer, 2012; Zeebroek, Decroly, & Gosselain, 2009). However, such studies remain quite scarce with regard to the Bell Beaker phenomenon (Besse, 2003; Besse & Desideri, 2005; Blaise, 2010; Cauliez, 2015; Convertini, 1998; Lechterbeck et al., 2014; Lemercier & Strahm, 2018; Vander Linden, 2006), and even fewer look specifically at Switzerland and the Alpine region (Besse et al., 2019a; Desideri, Piguet, Furestier, Cattin, & Besse, 2012).

The Upper Rhône valley (Figure 1) is a particularly interesting and coherent space to study these issues. Enclosed by mountains, it has acted as a crossroads for transalpine crossings since the last deglaciation. The valley has thus been subjected to various cultural contacts and has been an important locus for human and artefact mobility, with known relationships with the Italic Peninsula as well as southwestern and eastern Europe (Besse, 2012; Curdy & Nicod, 2019; Curdy, Leuzinger-Piccand, & Leuzinger, 2003; Hafner, 2015).

It is also home to the renowned megalithic necropolis of Sion 'Petit-Chasseur' (Figure 2, 2900–1600 BCE), whose continuous use and well-preserved Bell Beaker funerary layers, monuments, and engraved stelae are a rarity in Switzerland (Besse, 2014; Bocksberger, 1976, 1978; Favre & Mottet, 2011; Gallay, 1989; Gallay & Chaix, 1984). From 1960 to 2010, archaeological surveys together with planned and rescue

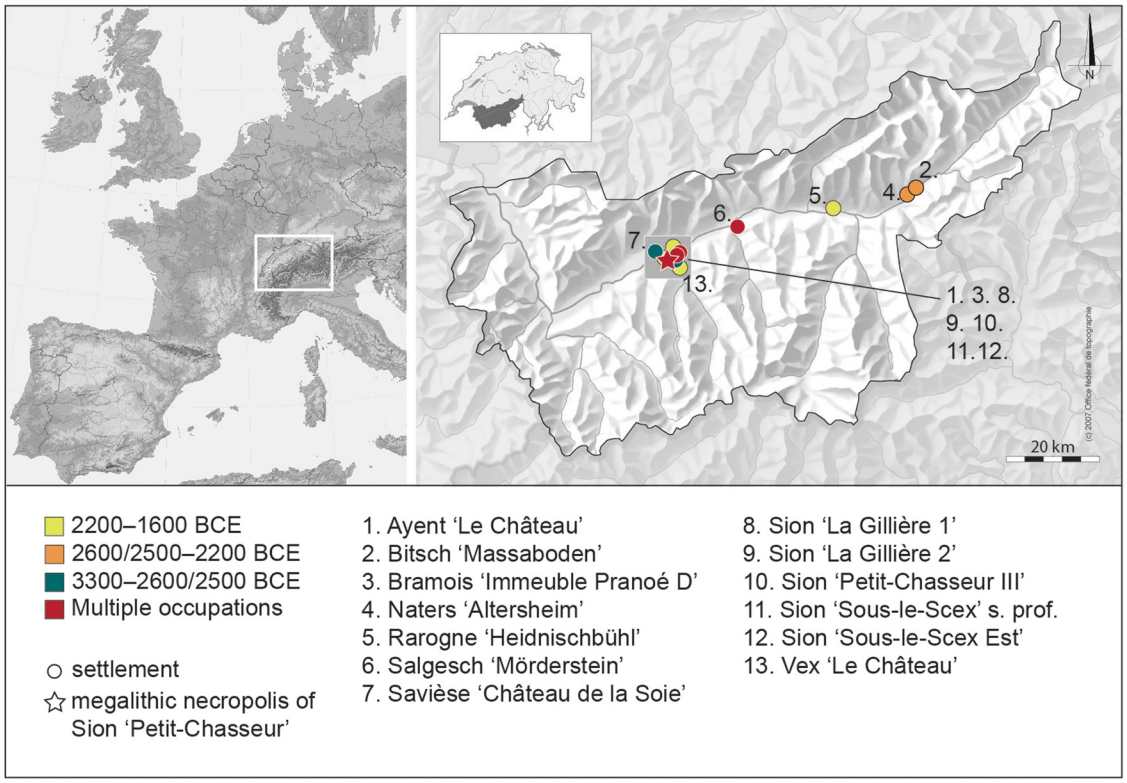

Figure 1: The Upper Rhône valley (southwestern Switzerland) in the Alps and the Final Neolithic, Bell Beaker period, and Early Bronze Age settlements and necropolis included in this study. For a detailed presentation of each settlement, including stratigraphy and radiocarbon dates, see Carloni et al. (2020).

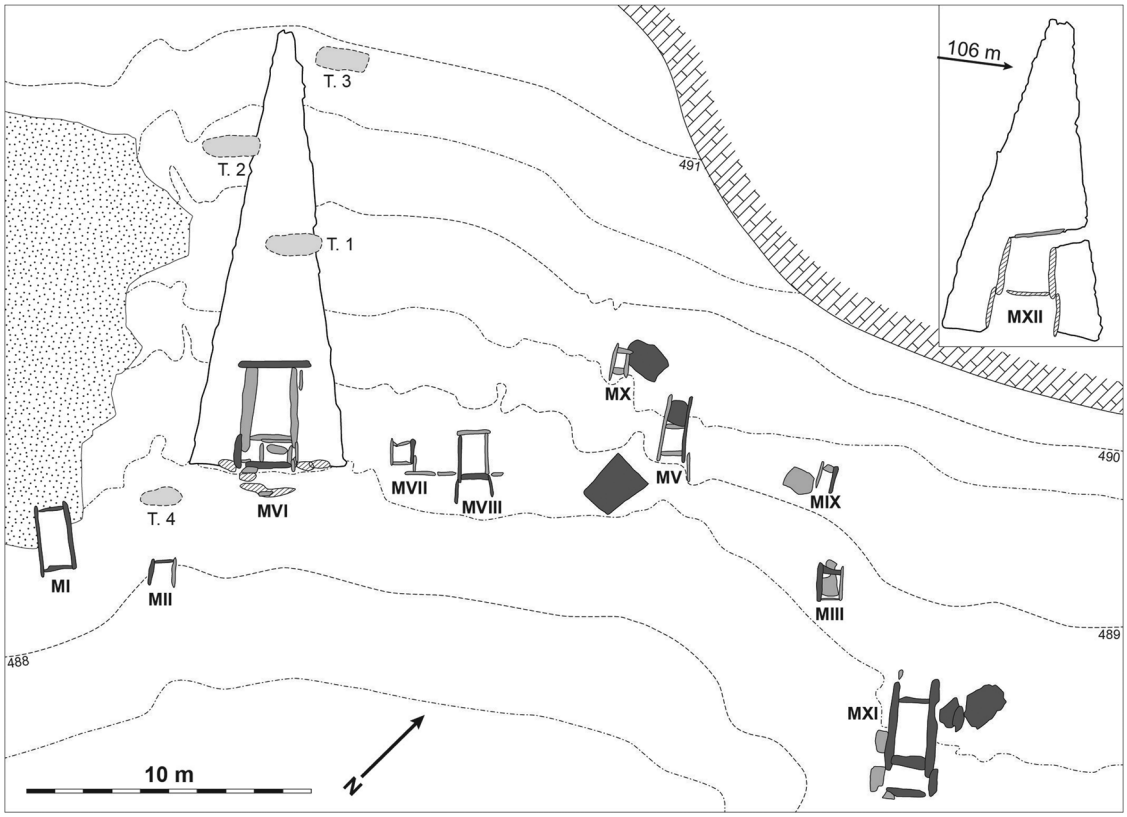

Figure 2: Map of the megalithic necropolis of Sion 'Petit-Chasseur'. In dark grey: dolmens, cists, and stelae. In light grey: Early Bronze Age single graves (adapted from Corboud and Curdy, 2009, p. 20).

excavations in the region have also led to the discovery of contemporaneous settlements. Most of them presented short occupation phases, ranging from the Valaisian Final Neolithic to the end of the Early Bronze Age (Carloni, Derenne, Piguet, & Besse, 2020).

This general situation in the Upper Rhône valley thus offers a great opportunity for a case study of the integration of the Bell Beaker phenomenon (2500–2200 BCE) in a local, end of the Neolithic context (3300–2500 BCE) and its relationship with the succeeding Early Bronze Age (2200–1600 BCE) (Besse et al., 2019b; Besse, Gallay, Mottet, & Piguet, 2011; David-Elbiali & David, 2009).

In this work, we derived our approach from the situated learning theory (Lave & Wenger, 1991), which has gained significant traction in archaeological research in recent years (e.g., Mills, 2018; Roddick & Stahl, 2016b; Wendrich, 2012). Its most used concept, *communities of practice*, was defined by Wenger (1998) as groups of people involved in a practice, forming close relationships through their mutual engagement to participate in a joint enterprise, and who share knowledge in the form of a specific repertoire of words, tools, gestures, and concepts. However, as our chronological framework and resolution were too vast to consider the observed materialities as the products of practices shared by individuals living at the exact same time, we left this concept aside in favour of that of *constellations of practice* (Roddick & Stahl, 2016a; Wenger, 1998). The latter better encapsulates configurations "too far removed from the scope of engagement of participants, too broad, too diverse, or too diffuse to be usefully treated as single communities of practice" (Wenger, 1998, pp. 126–127). Constellations of practice are thus communities of practice linked through space or time – or both – that are often brought together by *boundary objects*. This notion defines artefacts, places, or ideas that can have different meanings depending on the social group, but the structure of which remains common enough to be easily recognised by all communities (Roddick & Stahl, 2016a,b; Star & Griesemer, 1989; Wenger, 1998). In the context of pottery technology studies, examples of boundary objects include serving bowls (Mills, 2018), pottery raw materials (Gosselain, 2016), and even quarries

(Corniquet, 2011; Roddick, 2016). We also mobilised the concept of *genealogies of practice* (Pauketat & Alt, 2005) to characterise the evolution of constellations of practice through time.

As the first step for our study, we formulate three premises: (1) several communities co-existed in the Upper Rhône valley during the aforementioned time frame (3300–1600 BCE), (2) the contemporary groups probably interacted with one another – with varying degrees of intensity in these interactions – and (3) some of these interactions could have happened within the framework of the funerary and ritual practices taking place at the megalithic site of Sion 'Petit-Chasseur'. The latter could therefore have acted as a boundary object, connecting people from the entire region.

This research thus focuses on two main themes: the connection between domestic and megalithic funerary sites and the emergence of the Bell Beaker phenomenon in the valley. It examines, for each period, the relationship between the local communities and the 'Petit-Chasseur' necropolis. It also explores the evolution of these connections through time. In addition, it seeks to assess whether the emergence of the Bell Beaker phenomenon was accompanied by the arrival of new social groups in the valley or the modification of older ones and evaluate whether this emergence was related to disruptions in other cultural spheres. Ultimately, this study considers what these potential connections, evolutions, and disruptions reveal regarding the integration process of this phenomenon in the local context and the people who may have been responsible for this.

To answer these questions, we chose pottery, and more specifically its technology, as our study subject because the reconstruction of *chaînes opératoires*, both in time and in space, allows for the identification of ceramic traditions, for the observation of continuities or disruptions in knowledge transmission (Roux, 2019), and the evolution of social boundaries (Dietler & Herbich, 1998; Stark, 1998). Pottery is capable of revealing the arrival of exogenous traits and sometimes even new communities of practice in a given region (Gosselain, 1998; Hensler, 2020; Roux, 2011; Roux et al., 2017).

We applied this technological analysis at different scales. The first was chronological, as we studied the technical traditions from each occupation phase, before analysing their evolution over 1700 years. The second was from a spatial point of view, where we searched for interconnections between traditions from contemporaneous settlements and the 'Petit-Chasseur' necropolis, ultimately seeking to identify constellations of practice. To do so, we based our study on the revised chronological sequence of the region for the 3300–1600 BCE time frame, which included the full numerical and typological data from the settlements' ceramic assemblages (Carloni et al., 2020). We also linked domestic and funerary contexts, bringing together the pottery technological data from the settlements and the data from the necropolis' assemblage published in the study by Derenne, Ard, and Besse (2020).

The ceramic technical data of the Upper Rhône valley assemblages reveal, from 2500 BCE onwards, the appearance of new traditions, together with a significant change in the way the local communities interacted with the megalithic necropolis of 'Petit-Chasseur'. These results hint at the arrival of new individuals, among them potters, coinciding with the emergence of the Bell Beaker phenomenon in the valley.

Our results confirmed the importance of comparing the Bell Beaker pottery assemblages and the social practices related to them with those from the previous and succeeding periods to fully highlight the specificities of the phenomenon within a particular region. They also underlined the need to study both domestic and funerary assemblages in parallel, searching for clear links between them, as it provides a complete view of the pottery production at any given time – something that is still rarely done regarding the Bell Beaker phenomenon.

2 Materials and Methods: From Macrotraces to Technical Traditions

Between 2017 and 2021, a large research project examined the ceramic traditions of the late fourth to the mid-second millennium BCE in the Upper Rhône valley (Switzerland). Raw material procurement and selection (Carloni, 2022) were investigated separately from the later steps of the pottery *chaîne opératoire*,

such as forming, surface treatment, and decoration – hereafter referred to as "pottery technology" (Derenne, 2021). A first joint publication already combined a portion of the two datasets to offer insights into the Bell Beaker assemblage of the 'Petit-Chasseur' necropolis (Derenne, Carloni, & Besse, 2022), and a full synthesis should be proposed once both datasets have been published in detail.

The present article constitutes the third and final stage of the complete study on the pottery technology of the area, aiming at investigating the integration of the Bell Beaker phenomenon in this local context. The initial step, published in Derenne et al. (2020), involved the reassessment of the data from the 'Petit-Chasseur' necropolis through a technological analysis of its pottery assemblage and demonstrated the strength of the chosen methodology. A second step then saw the complete revision of the settlements' relative and absolute chronology, as well as their numerical and typological pottery data (Carloni et al., 2020). This updated chronological and typological framework (Figure 3) laid the foundations for the third step. The latter, presented here, focused on combining the pottery technical data from the megalithic necropolis with the data collected for each settlement to obtain an overview of the ceramic technical traditions at the regional scale between 3300 and 1600 BCE.

After re-evaluating the excavation documentation and pottery assemblages from the domestic sites (Carloni et al., 2020), we selected 13 settlements to be compared to the megalithic necropolis (see Figure 1). To obtain reliable results, we did not include the sites whose pottery was found in disrupted layers and thus mixed with ceramic material from other periods. The 13 chosen settlements yielded 16 occupations corresponding to our selected time frame. Fourteen of these occupations belonged to a single chronological period: 3 for the 3300–2600/2500 BCE period, 5 for the 2600/2500–2200 BCE period, and 6 for the 2200–1600 BCE period. Two occupations, from two different sectors of Sion 'Sous-le-Scex', were later found to belong to more uncertain contexts. The necropolis was used continuously during the three aforementioned periods (Besse et al., 2011).

The pottery assemblages (Table 1), amounting to a little over 130 kg and including a total of 281 identified vessels, were studied using the same protocol that was adopted for the detailed pottery technology analysis of the assemblage from Sion 'Petit-Chasseur' (Derenne et al., 2020). This study protocol was thus applied to each settlement occupation to obtain technical data on the domestic ceramic assemblages. Performing a comprehensive study of each assemblage through macroscopic observations under a low-angled light helped find diagnostic attributes related to methods, techniques, tools, and gestures used by the potters to manufacture the pottery. Collecting these data ultimately allowed us to reconstruct segments of *chaînes opératoires* (Ard, 2014; Roux, 2011, 2016, 2019). Looking at a sample of at least 10% of each assemblage with a stereomicroscope (maximum magnification of 40×) then helped validate the macroscopic surface treatment identifications and rule out potential traces tied to taphonomic processes (Figure 4). This was done once the macroscopic observation was completed to allow for a representative selection of sherds, depending on the hypothesised surface treatment. The criteria included microtopography, a description of inclusions' position (inserted, covered by a thin layer of clay, etc.), and a description of the type of striation. A set of photos taken with an optical microscope on the ethnographic and experimental pottery collection of the "Préhistoire et Technologie" laboratory at the University of Paris Nanterre (France) was used as a reference for the technical identification.

This complete technical study of the assemblages from the 16 domestic and 3 funerary occupations revealed that, in addition to presenting varied numbers of vessels (minimum number of individuals (MNI) see Table 1), not all assemblages displayed the same informative levels.

This influenced the analysis, which was subsequently led in three main steps (Figure 5). To distinguish technical groups in a way that would enable comparisons between them (see Roux, 2011), four technical criteria were selected. The latter were the only technical characteristics allowing the comparison between all pottery assemblages, in view of their fragmentation and their variable levels of preservation. These criteria were, by order of importance (Figure 6): (1) surface treatment, (2) colours in cross-section, to help identify the implementation of consistent firing procedures (Class 1: fully dark; Class 2: fully light; and Class 3: various colour combinations), (3) decoration technique, and (4) thickness (thin: below 7 mm; medium: 7–9 mm; thick: over 9 mm). Whenever possible, information regarding the two main stages of the fashioning process – resulting in a roughout, then a preform (Roux, 2019, p. 41) – was added.

Figure 3: Chrono-typological framework used as a basis for this technological study of Upper Rhône valley ceramic assemblages (adapted from Carloni et al., 2020, p. 73, Figure 12).

Table 1: Ceramic assemblages from the Upper Rhône valley (Switzerland) studied in this article

Ref. Fig. 1	Site	MNI 3300–2600/ 2500 BCE	MNI 2600/ 2500–2200 BCE	MNI 2200–1600 BCE	MNI uncertain chronol.	Total MNI	Total # sherds	Typological elements	Weight (g)
1	Ayent 'Le Château'			5		5	9	5	112.9
2	Bitsch 'Massaboden'		54			54	332	57	1,178.2
3	Bramois 'Pranoé D'	5				5	393	8	2,474.7
4	Naters 'Altersheim'		8			8	138	15	1,130.7
5	Rarogne 'Heidnischbühl II'			14		14	14	14	1,158.7
6	Salgesch 'Mörderstein'	4	3	4		11	150	17	6,573.4
7	Savièse 'Château de la Soie'	11				11	217	37	1,665
8	Sion 'La Gillière 1'		2			2	37	2	138.3
9	Sion 'La Gillière 2'		14			14	80	16	2,696.7
10	Sion 'Petit-Chasseur III'			61		61	1,224	62	12,807.3
11	Sion 'Sous-le-Scex s. prof.'			6	12	18	455	18	1,920.5
12	Sion 'Sous-le-Scex Est'				8	8	128	14	679.9
13	Vex 'Le Château'			9		9	10	8	259.2
	***Total* (*settlements*)**	***20***	***81***	***99***	***20***	***220***	***3,191***	***273***	***32,795.5***
Star	***Sion 'Petit-Chasseur' necropolis***	***3***	***28***	***30***	***0***	***61***	***3,242***	***320***	***98,038.5***
	TOTAL	**23**	**109**	**129**	**20**	**281**	**6,433**	**593**	**130,834**

MNI: minimum number of individuals (referring to the number of published vases). Typological elements: number of sherds classified as "rim", "handle or lug", "base", and "decorated".

Figure 4: Surface treatment verification on a stereomicroscope. Examples of pictures taken and associated technical interpretations. Further details are provided in Supplementary file.

On this basis, as part of the first analytical step, technical groups were identified within each occupation's assemblage (Figures 5(1.2)), and given an identifier based on the site's name (see Supplementary file for the complete list of these 43 technical groups and a detailed account of the corresponding vessels' inventory numbers). Information regarding chronology and style for each of these groups facilitated further analyses and discussions. All technical groups were then compared, and the ones with identical or extremely similar characteristics – again following the hierarchy of the four criteria mentioned earlier – were gathered to form technical traditions (Figure 5(1.3)), irrespective of any geographical or chronological information.

The second step summarised within which sites each of these technical traditions was present. The chronological occupation (3300–2600/2500 BCE, 2600/2500–2200 BCE, or 2200–1600 BCE) was specified for all sites, as several of them were used during two or more consecutive periods. The proportion of vessels corresponding to the tradition within each occupation's pottery assemblage was also indicated (divided in five classes, from "less than 15% – extremely low" to "over 85% – extremely high"), to offer information as to whether it represented the main production or should rather be considered anecdotal. This chronological summary created the foundation on which to base the observation of these traditions' evolution over time (Figure 5(2)). Analysing these traditions in terms of both presence/absence and their relative proportion to each occupation's assemblage helped identify not only their appearance but also increases or decreases in their use in the valley.

The third and last step concerned the relationship between the sites themselves during each of the three periods, investigated from this point of view of pottery traditions. The main objective of this final analysis

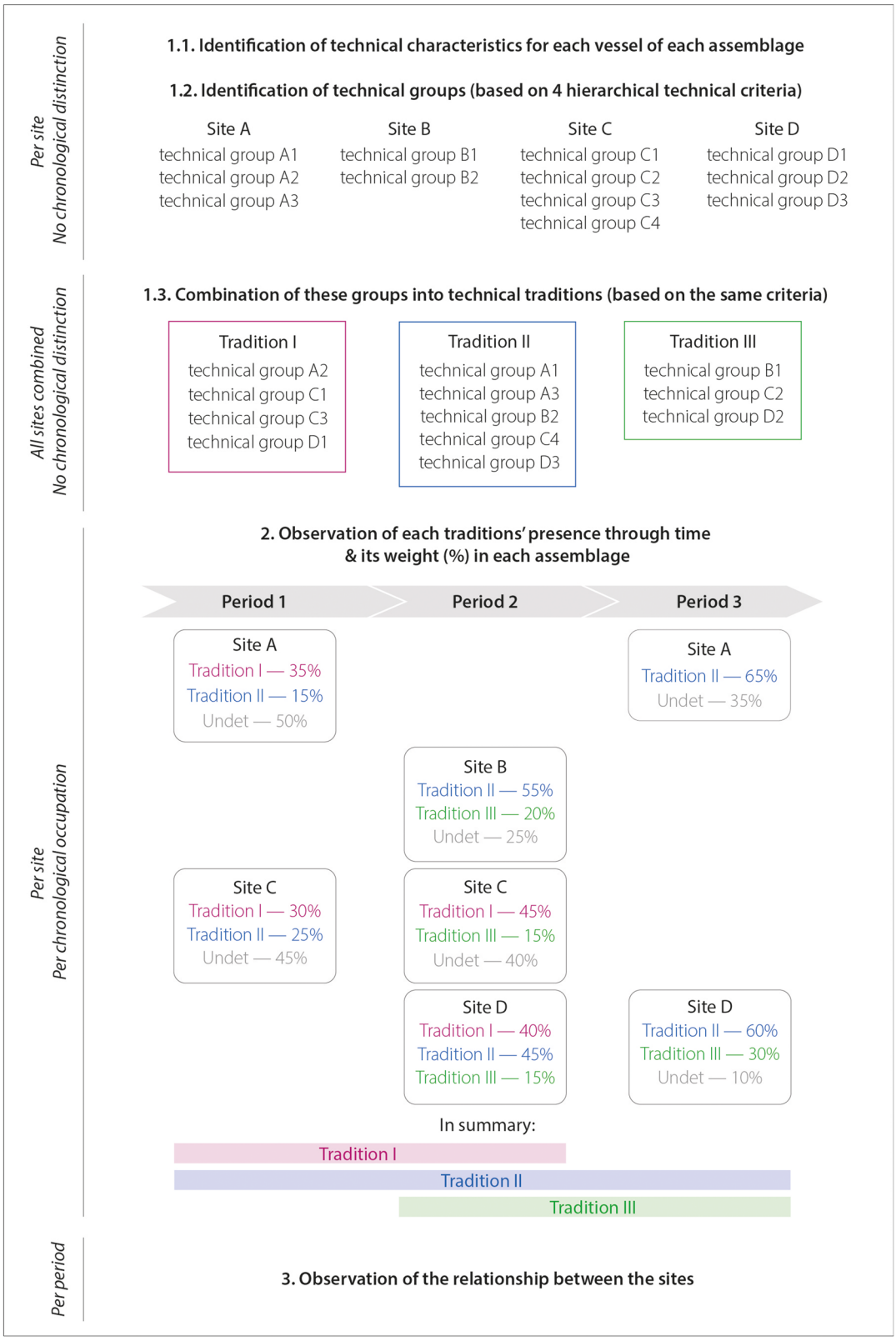

Figure 5: Synthetic representation of the analytical process followed during this study.

Figure 6: Technical criteria selected to compare the pottery assemblages of the Upper Rhône valley (Switzerland, 3300–1600 BCE). In hierarchical order: surface treatment, colours in cross-section, decorating technique, wall thickness (not depicted). Further details are provided in Supplementary file.

was to identify potential constellations of practices at the regional level and try to understand the dynamics of the settlement/necropolis relationship.

Table 2: Ceramic technical traditions in the Upper Rhône valley (Switzerland) between 3300 and 1600 BCE

Techn. Trad.	Surfaces	Fashioning	Cross-sections	Decoration	Thickness class	Handle or lug	Morphology	Techn. groups encompassed	3300–2600/ 2500 BCE	2600/ 2500–2200 BCE	2200–1600 BCE	N
T1	Burnished	Unknown or Coiling + periph. coil	Class 3 (rarely: class 2)	Impressed – Indented tools (+stamp); Applied/finger impressed cordons, buttons (+ocelles?)	Thin or Medium		Beakers; closed shapes; everted shapes; Cups; Likely: "Amphora"	BH1; BH2; SG2-1; SSSE1; Na1; probably PCIII1; maybe SG2-3; PC1-3	—	xx PC	—	76
T2 (variant T1)	Burnished	Coiling	Class 3	Undecorated	All		Open shapes, flat bases; closed shapes, flared rim	Sav1; Mor1	x	—	—	3
T3 (variant T1)	Burnished	Coiling (+moulding?)	Class 3	Impressed—Stamp or Undecorated	Thin	Handles (tenon)	Cups with handle, rounded base; everted or upright rim	Mor3; Ay1; Mor5?; PCIII3?; PC1-4	—	xx PC	x	8
T4 (variant T1)	Burnished	Coiling	Class 1	Undecorated	Thin—Medium	Lugs; Handles	Closed shapes, thinned rims; everted shapes, rounded rims; cups; flattened rims	SSS1; SSS5; Vex1; SSSE2; PC1-5	—	xx PC	x	9
T5 (variant T1)	Burnished	Unknown	Class 1	Applied/finger impressed cordons & lips	Medium		Open shapes, flat, protruding bases	BH3; Vex2; HB1	—	xx	x	6
T6	Smoothed	Coiling + periph. coil	Class 3 (rarely: class 2)	Applied – Cordons; Applied/ impressed – Cordons (various shapes and tools), buttons; finger impressed lips	Medium–Thick	Lugs (tenon); handles	Large, thick jars, flat, protruding bases, various rim morphologies	PCIII2; SG2-2; Sav2; Mor4; Mor6; Mor7; Bram1; SSS2; SSS4; SG1-1; HB2; Na2; Vex3; PC1-2; PC1-6	x PC	—	x PC	106
T7 (variant T6)	Smoothed		Class 1	Applied – Cordons (large)/	Medium	Lugs			x PC	—	—	8

(*Continued*)

Table 2: *Continued*

Techn. Trad.	Surfaces	Fashioning	Cross-sections	Decoration	Thickness class	Handle or lug	Morphology	Techn. groups encompassed	3300–2600/ 2500 BCE	2600/ 2500–2200 BCE	2200–1600 BCE	N
		Unknown or Large coils/ slabs		applied – buttons/ undecorated			Open or everted shapes; large, thick jars	Mor2; SSS3; SSSE3; Ay2; PC1-1				
											Total	**216**

Technical groups corresponding to each tradition are detailed in the Supplemental data. Colours in cross-sections: Class 1 (fully dark), Class 2 (fully light), Class 3 (varied combinations). Thickness classes: thin (below 7 mm), medium (7–9 mm), thick (over 9 mm). Chronological specification: present (x), absent (–), with a confirmed cultural attribution to the Bell Beaker phenomenon (xx). The abbreviation “PC” is indicated when the tradition is present in the funerary assemblages of Sion ‘Petit-Chasseur’.

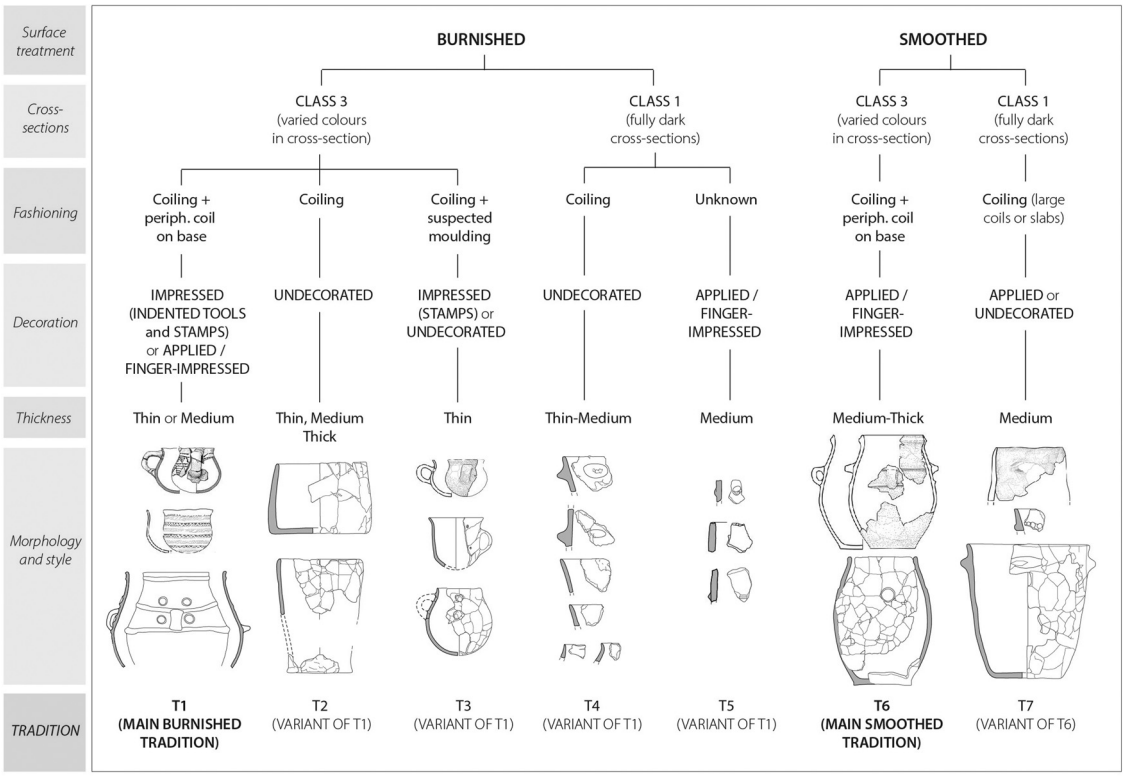

Figure 7: Techno-morphological tree of the ceramic traditions from the Upper Rhône valley (3300–1600 BCE).

3 Pottery Technical Traditions in the Upper Rhône Valley (3300–1600 BCE)

Once the technical and typological data had been gathered – vessel shapes and sizes being used as a secondary analytical key – the identified groups were categorised into two main technical traditions, one featuring burnishing as the surface finish and the other featuring smoothing (Table 2 and Figure 7). The burnished tradition (n = 102, Figure 8) could be divided into five branches: a main burnished tradition (T1, n = 76) and four variants (T2–T5, n total = 26). The smoothed tradition (n = 114, Figure 9) included one main tradition (T6, n = 106) and one variant (T7, n = 8). The choice to not consider these variants as traditions *per se* stemmed from the fact that they represented fewer than ten vessels each. Their existence thus needs to be checked by examining a larger corpus of pottery.

T1 is the most prominent tradition characterised by burnished surfaces, present in six different sites, both domestic and funerary. Colours in cross-sections are varied, but notably with a huge predominance of dark cores combined with light inner and outer margins. This tradition distinguishes itself from T2 and T3 by its techniques of decoration, which allows the identification of two sub-traditions: one featuring impressed decoration made using a variety of tools (sub-tradition T1-A, thin thickness class) and applied/applied and impressed decorations (sub-tradition T1-B, medium thickness class). The most notable morphologies for tradition 1 are Beakers and cups, as well as larger vessels, either closed or everted.

T2 is characterised by varied colours in cross-sections, no decorations, and thicknesses encompassing the full spectrum. Open vessels with flat bases and closed shapes with a flared rim are the morphologies most frequently observed.

T3, also characterised by varied colours in cross-sections, is separated from T1 – with which it presents many similarities – by two technical features: (1) the sole use of a stamp to create discrete impressed decorations, and (2) the suspected use of moulding for the base and bottom parts of the body, followed

Figure 8: Burnished ceramic traditions in the Upper Rhône valley (3300–1600 BCE). Detailed pictures of characteristic traits and macrotraces. Surfaces: inserted grains, compact microtopography, and slight shine (1–6). Colours in cross-sections: varied (class 3), with a predominance of dark cores accompanied by light inner and outer margins (7–10). Impressed decoration: indented tools (12–13), cord (14), stamp (15), indented tool and stamp (11). Applied and sometimes impressed decoration: buttons (16), *ocelle* and cordons (17), finger-impressed cordons (18). Further details are provided in Supplementary file.

Origin of sherds and vases depicted: Petit-Chasseur necropolis (2, 4, 6–7, 12–13), Rarogne 'Heidnischbühl II' (16), Salgesch 'Mörderstein' (11, 14), Sion 'La Gillière 2' (1), Sion 'Petit-Chasseur III' (3, 5, 9–10, 17), Sion 'Sous-le-Scex' « sondage profond » (8, 15).

Figure 9: Smoothed ceramic traditions in the Upper Rhône valley (3300–1600 BCE). Detailed pictures of characteristic traits and macrotraces. Surfaces: fluidified aspect with protruding grains covered by a thin clay layer, and striation with ribbed (1–3, 5) or threaded edges (4). Colours in cross-sections: fully dark (class 1, no. 6), or varied (class 3, nos. 7–10). Undecorated vessels (11) or applied and sometimes impressed decoration (12–17). Further details are provided in Supplementary file.

by coiling to complete the roughout. The main morphology for tradition 3 is the thin cup with a rounded base.

T4 has dark or black cross-sections and is undecorated. Its vessels, of various shapes and sizes, belong to the thin to medium thickness classes.

T5 is also characterised by dark or black cross-sections but has applied and/or finger-impressed decoration and a thickness classified as medium. The main morphology is straight or barrel-shaped, with a flat, protruding base.

T6 is the most prominent tradition characterised by smoothed surfaces. Its major technical traits are varied colours in cross-sections, applied and/or impressed decoration (made using fingers or various tools), and a thickness ranging from medium to thick. This tradition's principal morphology is that of large, barrel-shaped jars. The roughout of the latter was achieved through coiling and the addition of a peripheral coil on the outer part of the base to make it protrude more.

Finally, T7 is differentiated from T6 on the basis of its cross-sections (Class 1, dark or black). Its vessels, large open jars or vases with an everted profile, are either undecorated or decorated with applied cordons and buttons.

4 Evolution of Ceramic Technical Traditions at the Transition Between the Neolithic and the Bronze Age

The diachronic observation of these technical traditions' presence within each site revealed important shifts in their significance through time. This was particularly visible when considering the percentage they represented in the assemblages from each chronological occupation (see Supplementary file for the exact number of vases per site and per occupation corresponding to each tradition).

Only two sites dating to the 3300–2600/2500 BCE period, the settlement of Savièse 'La Soie' and the shelter of Salgesch 'Mörderstein', located approximately 20 km from each other, yielded vessels belonging to the burnished tradition (Figure 10, bottom map). The latter, variant T2, was represented by only 1 of the 11 identified vessels from the settlement and only 2 vessels found in the shelter's disturbed layers. Further detail on these three vases, particularly regarding their raw materials and paste preparation recipe, would be needed to determine whether these might have been exogenous productions from outside of the valley. As Salgesch 'Mörderstein' is suspected to have been a shelter used periodically during transalpine crossings (Mottet & Giozza, 2005), this question deserves to be investigated. It should also be mentioned that the discovery contexts of these vessels remain unsure and are insufficiently published in the case of the site of Savièse, which means that their attribution to the 3300–2600/2500 BCE period needs to be treated with caution until it can be verified.

Around the mid-third millennium BCE, the burnished tradition expanded considerably, both in the number of sites where it was present and in the proportion that it represented within the assemblages (Figure 10, middle map). All the domestic and funerary occupations known for the 2600/2500–2200 BCE period presented at least one variant of the burnished tradition and in the two largest ones (Bitsch 'Massaboden' and the 'Petit-Chasseur' necropolis), they made up over 75% of the assemblage. This abrupt surge coincided with the arrival of the Bell Beaker phenomenon in the valley. It should be noted that two vessels from the settlement of Sion 'Petit-Chasseur III' were included here, although the site mostly covers the 2200–1600 BCE period. Uncovered in the oldest layer of this occupation – with a date of 2274–1772 cal. BC (at 95.4% probability) (Carloni et al., 2020) – these vessels bear a close resemblance to other vessels from T1 and variant T3 discovered in other sites. They are thus likely to have been produced during the transition between the two periods and should be seen as the last remnants of these burnished traditions within this site.

As a general rule, this preference for burnished surfaces tended to fade from 2200 BCE onwards, when the Bronze Age began (Figure 10, upper map). The burnished tradition represented rarely more than 40% of

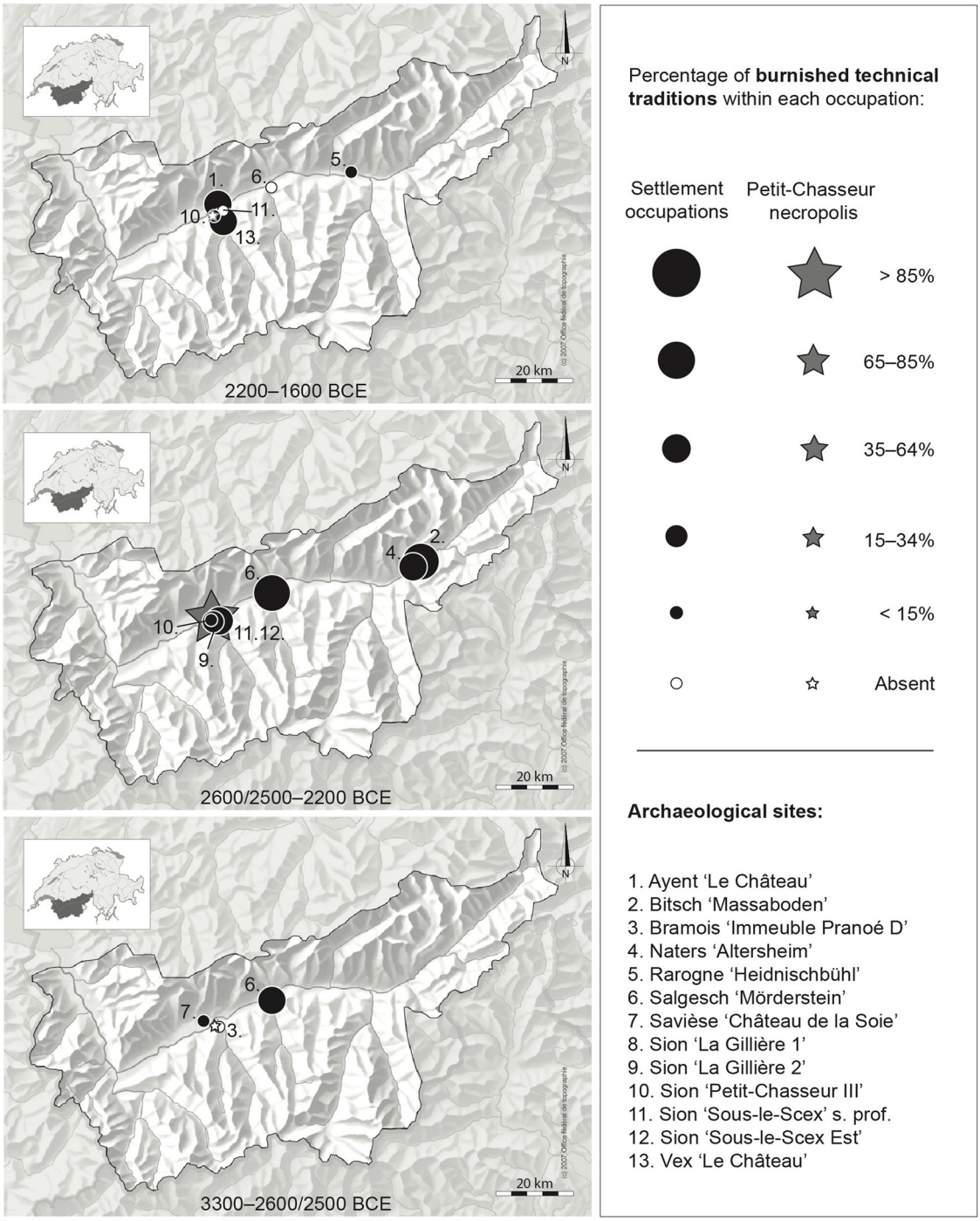

Figure 10: Evolution of the presence of ceramic traditions characterised by burnished surfaces in the Upper Rhône valley (3300–1600 BCE), in domestic and funerary contexts.

assemblages and lay at below 10% in the two main settlements, Sion 'Petit-Chasseur III' and Rarogne 'Heidnischbühl II'. Furthermore, it was absent from the funerary assemblage of 'Petit-Chasseur' and two settlements dating to the 2200–1600 BCE period.

The smoothed tradition seemed to have been much more stable, as it was continuously and steadily present throughout the three periods (Figure 11). The median for the percentage of smoothed vessels within

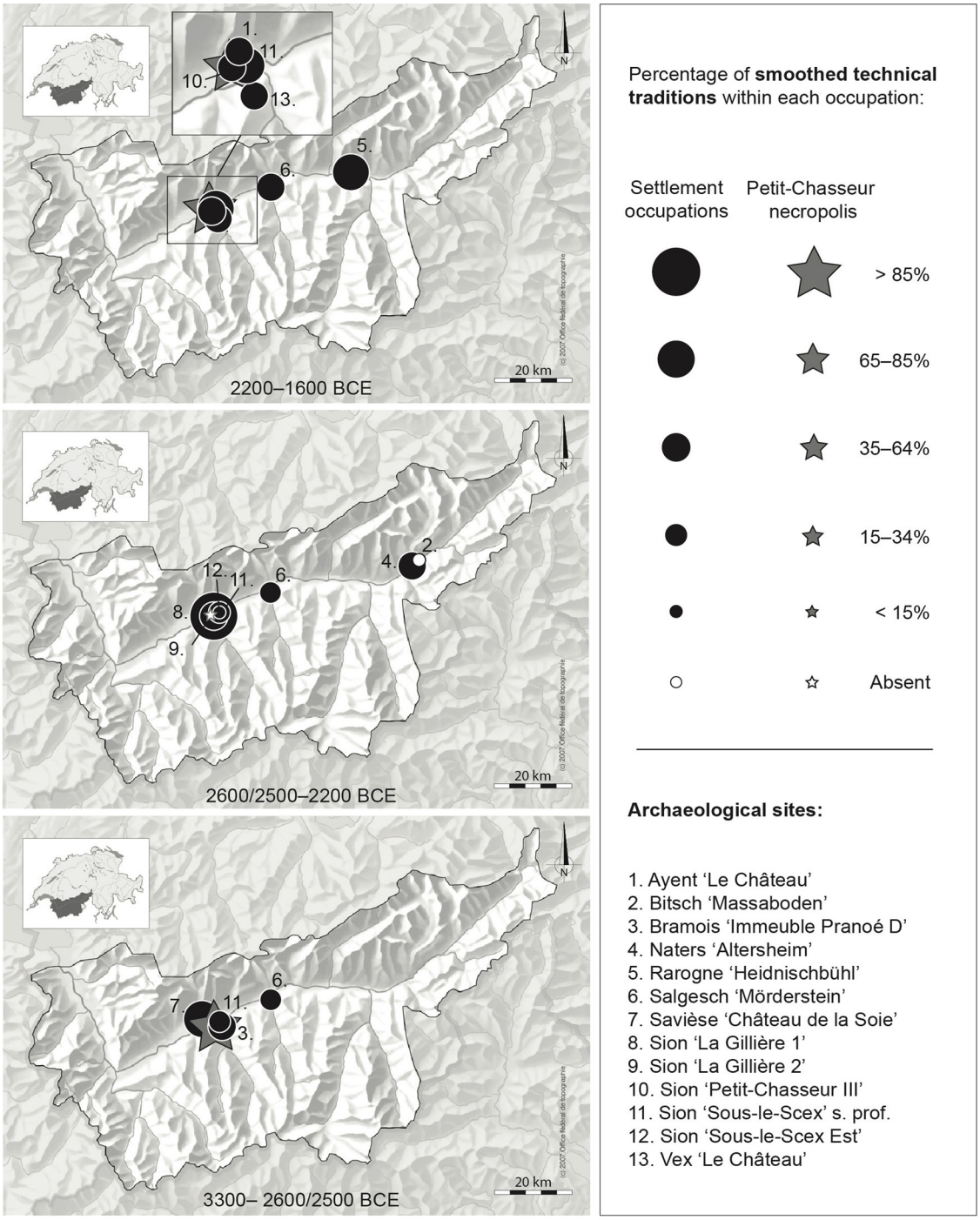

Figure 11: Evolution of the presence of ceramic traditions characterised by smoothed surfaces in the Upper Rhône valley (3300–1600 BCE), in domestic and funerary contexts.

assemblages across all sites lay at 56% versus 39% for burnished vessels, showing that the smoothing tradition was much more predominant.

The sole exception to this general rule concerned the 2600/2500–2200 BCE period, during which several occupations presented little or no smoothed vessels (Figure 11, middle map). In Sion 'Sous-le-Scex Est', they lay at below 15%, and they were absent from the funerary assemblage of 'Petit-Chasseur' dating to this phase and within the contemporaneous domestic assemblage of Bitsch 'Massaboden'.

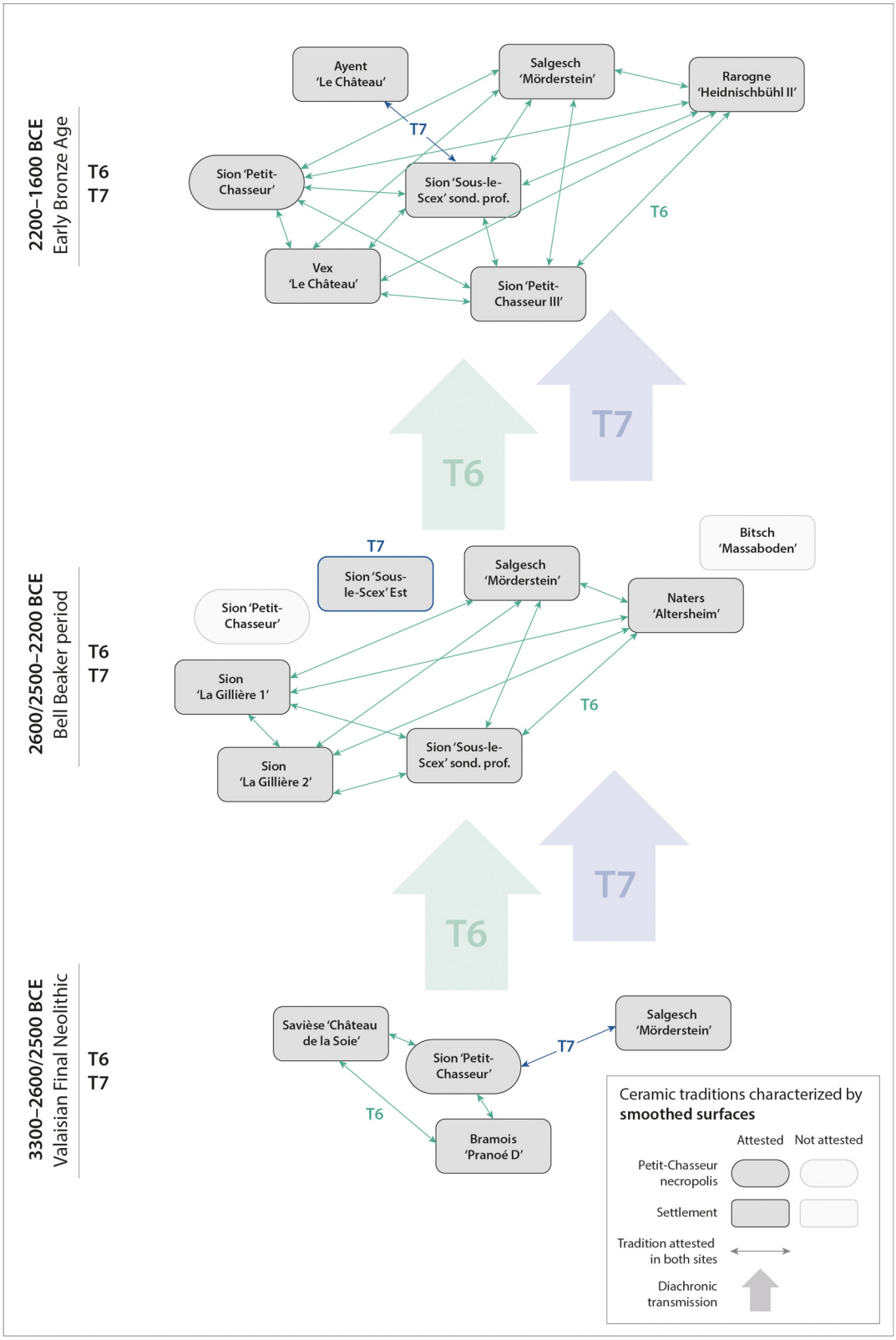

Figure 12: Shared ceramic traditions characterised by smoothed surfaces (T6, variant T7) and associated constellations of practice in the Upper Rhône valley (3300–1600 BCE).

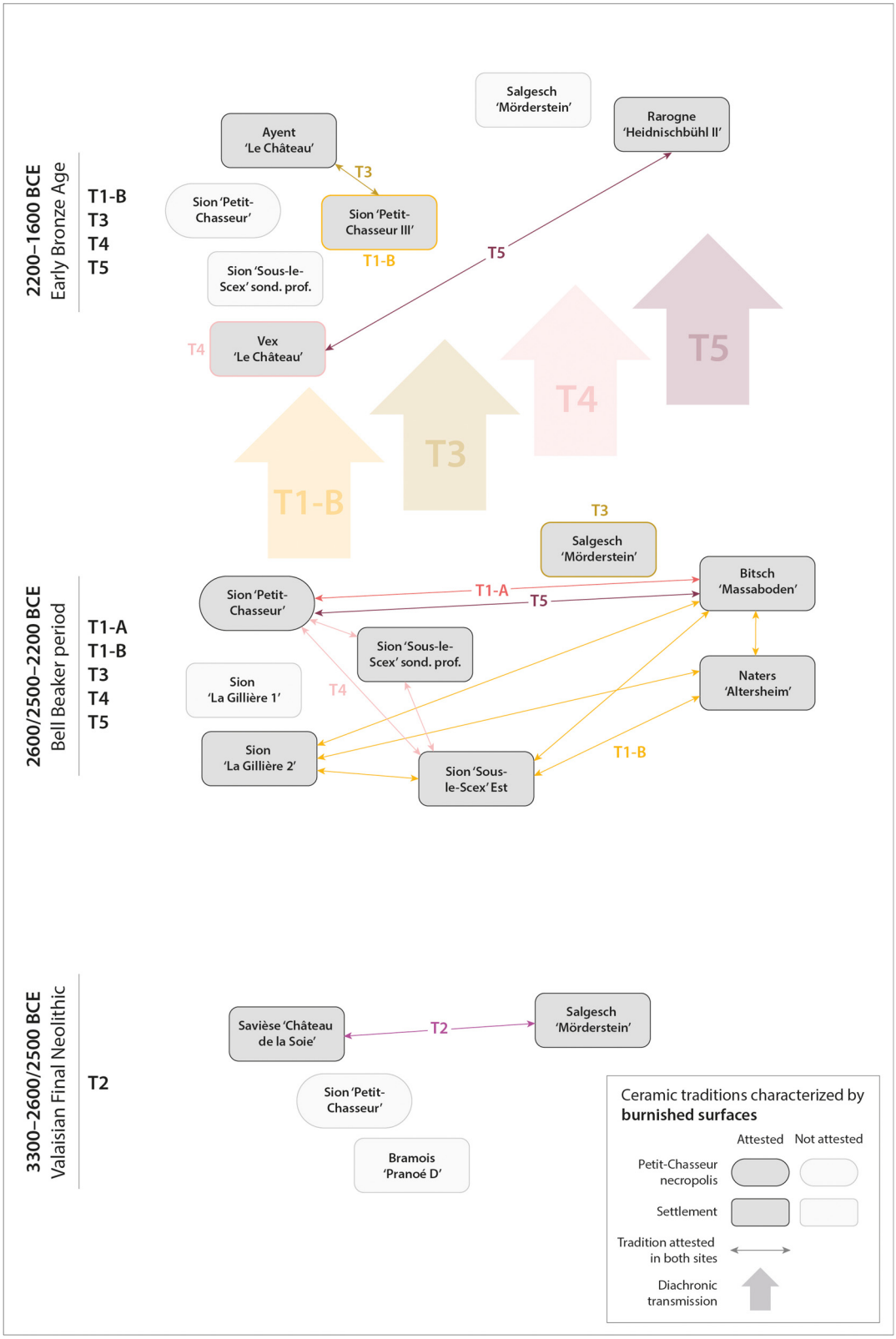

Figure 13: Shared ceramic traditions characterised by burnished surfaces (T1-A, T1-B, variants T2, T3, T4, and T5) and associated constellations of practice in the Upper Rhône valley (3300–1600 BCE).

5 Constellations and Genealogies of Practice

The creation of two diagrams (Figures 12 and 13) showing the interconnections between the sites revealed the constellations of practices that shared the same technical traditions during each period. To this synchronous approach was added a diachronic view that uncovered the evolution of these constellations – emergence, continuity, transformation, or disappearance – and the transmission of each tradition from one period to the next.

These diagrams show a strong dichotomy between smoothed and burnished traditions. The main smoothed tradition (Figure 12) formed constellations of practice during each period, connecting many sites. It thus integrated itself into broader learning and production networks at the scale of the Upper Rhône valley. Its steady presence between 3300 and 1600 BCE also showed that potters passed on this solid, local tradition from generation to generation, forming a true genealogy of practice across time. Burnished traditions, to the contrary, were not at all as well interconnected, either chronologically or geographically (Figure 13). Strikingly, no tradition connected the 3300–2600/2500 BCE and the 2600/2500–2200 BCE periods, revealing, in the current state of knowledge, a complete lack of technical transmission for burnished traditions between them. Five new burnished traditions emerged after 2600/2500 BCE, but sub-tradition T1-B solely formed a constellation of practice, interconnecting four different settlements, two from the Sion area and two located further east in the valley. Otherwise, the most prominent relationship occurred between the settlement of Bitsch and the 'Petit-Chasseur' necropolis: two out of the three technical traditions characterising the funerary vessels (representing 27 out of the 28 vessels) were exclusively found in Bitsch, and one sub-tradition (T1-A) particularly highlighted this strong bond. It is thus remarkable that out of the five burnished traditions and variants produced between 2600/2500 and 2200 BCE, potters transmitted all but T1-A to their successors. During the next period (2200–1600 BCE), these four burnished traditions constituted a small portion of the domestic assemblages across the valley. In this case, however, one cannot speak of constellations of practices, as their presence after 2200 BCE remained sporadic. Each tradition or variant never connected more than two sites, which probably indicates a minor continuation of old ways in a few settlements or the transmission of a few older vessels.

One particular pattern emerged when focusing on the technical traditions linking the 'Petit-Chasseur' necropolis with the contemporaneous settlements during each period. Within the framework of smoothed traditions, the megalithic site was always well connected to several settlements situated closer or further away, except during the 2600/2500–2200 BCE period, during which its assemblage did not include any smoothed vessels. The analysis of burnished traditions revealed the exact opposite, as 'Petit-Chasseur' connected solely with settlements during the 2600/2500–2200 BCE period and with many fewer sites. A single funerary vessel belonged to a variant of the burnished tradition (T4) shared by two domestic sites located a few hundred metres from the burial grounds; all the remaining vases connected with the settlement of Bitsch 'Massaboden', although established the furthest east from the necropolis, around 50 km away. This evidence is in line with the results of Carloni et al.'s (2021) study of Petit-Chasseur's pottery raw materials, which showed various paste recipes and raw clay compositions for the 2900–2600/2500 and 2200–1600 BCE periods, in contrast with the Bell Beaker ceramics that were made from only two types of raw clay and all tempered with similar material.

In the current state of knowledge about the Upper Rhône valley, the ceramic technical data would thus either indicate that: (1) more communities interacted with the necropolis during the Final Neolithic and the Early Bronze Age than during the Bell Beaker period, or (2) Bell Beaker communities favoured ceramic productions from a few sites for deposition in the necropolis.

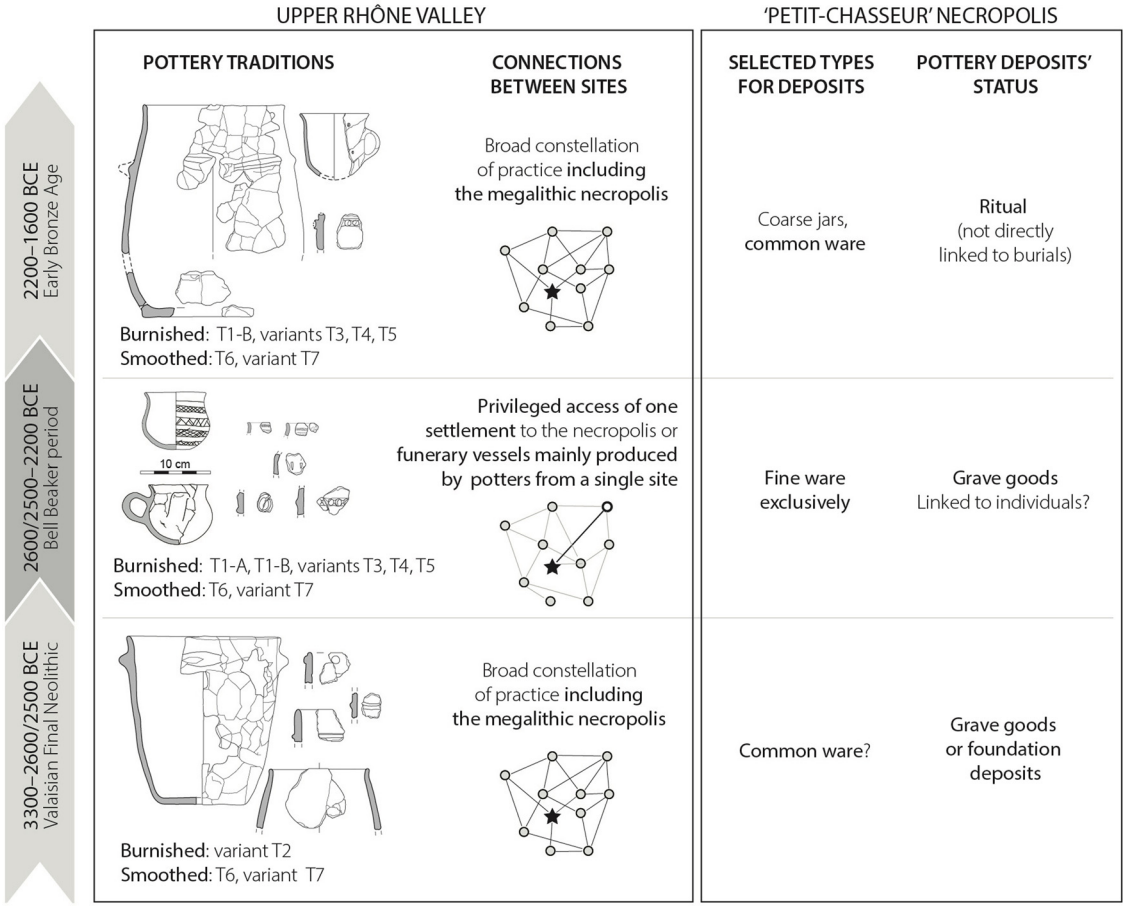

Figure 14: Evolution of the Upper Rhône valley (Alpine Switzerland) pottery traditions and associated social practices inside the necropolis of Sion 'Petit-Chasseur' (3300–1600 BCE).

6 Bell Beakers and the 'Petit-Chasseur' Necropolis: Continuity and Change

The results presented in this article attest to ceramic technical traditions and constellations of practices undergoing major modifications at the transitions into and out of the Bell Beaker period. But the integration of these data within the general context of the Upper Rhône valley highlights that the emergence of the phenomenon in the region affected more than simply pottery manufacturing techniques.

Pottery *chaînes opératoires* and production networks are for instance not the only ceramic features revealing disruptions; breaks can also be seen in the type of pottery selected for deposition inside the necropolis of 'Petit-Chasseur' and in the pottery deposits' status within the megalithic site (Figure 14).

The analysis of the relationship between the pottery from 'Petit-Chasseur' and the settlements showed that throughout the necropolis' history, people selected particular vessels from the general assemblages for deposition. Indeed, during each of the three periods, all of the traditions found in the necropolis could also be found in the settlements, but the opposite did not hold. The settlements' ceramic assemblages displayed a greater variety in technology, morphologies, and types of production than the ones from 'Petit-Chasseur'. Such a selection was not uncommon at megalithic sites during most of the western European Neolithic (Delibes de Castro, Benet Jordana, Pérez Martin, & Zapatero Magdaleno, 1997; Salanova, 2000, 2019; Sohn, 2008). What singles out the Bell Beaker period, however, is the type of pottery chosen to be placed in the dolmens. Whereas the vessels deposited during the 2900–2600/2500 BCE and 2200–1600 BCE periods

seemed to be closer to common ware (e.g., large, rather coarse, thick-walled vases and jars), the deposits made between 2600/2500 and 2200 BCE only included extremely fine ware (i.e., the emblematic Bell Beakers and small cups).

Another important element of disruption concerned the status of the pottery deposits in the 'Petit-Chasseur' necropolis. As discussed by Fontijn (2012), an artefact deposited in a funerary or ritual site can be meaningful in itself, but it might also only have been meaningful while in use, or because of its content, or for all these reasons. For artefacts found inside collective graves, the question of this status is even more relevant. The study of many such funerary structures from the western European Neolithic led to the hypothesis that some deposits were either considered "collective" or "individual" by the people burying their dead (Sohn, 2007, 2008). These Neolithic deposits mainly included a small number of vessels usually placed at the monuments' entrances in association with stone axeheads as a kind of "foundation ritual" or community offering. In contrast, Bell Beaker vessels found in collective graves seemed to be more related to each individual's social status or kinship links (Sohn, 2007, 2008).

Following these observations, we argue that the pottery deposited in Sion 'Petit-Chasseur' before 2600/2500 BCE probably constituted "collective" rather than individual grave goods. Such an interpretation seems particularly appropriate regarding the three pots placed in dolmen MVI, which accompanied no fewer than 33 individuals buried in the monument during its first occupation (Bocksberger, 1976). However, it is not currently possible to prove this proposition categorically because the exact primary location of the pottery remains unknown; reuse during the Bell Beaker period disrupted the preceding Final Neolithic layers and displaced the vases outside of the dolmen (Bocksberger, 1976, vol. 1, p. 144).

In contrast, the Bell Beaker pottery appeared to be part of the "individual" grave goods offered by the communities using the necropolis from the mid-third millennium BCE up to 2200 BCE. For example, dolmen MVI contained eight Beakers, which roughly corresponds to the nine interred adults – although this grave group also included five children (Bocksberger, 1976).

This rather "individual" status of the pots as part of the grave goods was not continued during the Early Bronze Age. The pots found inside and outside of the megalithic monuments were not formally linked to human bodies and have thus never been considered as grave goods *per se*, although they were undoubtedly deposited in a funerary space as 12 more individuals were added to the necropolis between 2200 and 1600 BCE (Bocksberger, 1976, 1978; Gallay, 1989; Gallay & Chaix, 1984; Favre & Mottet, 2011). Two elements lead us to believe that these pottery deposits materialised during a specific ritual, whether linked to ceremonies for the dead or not. The first is the fact that they were characterised by recurring deposits of highly standardised jars (Derenne et al., 2020; Gallay & Chaix, 1984). This phenomenon has also been identified around Scandinavian megaliths (Madsen, 2019) and prominent British sites that had previously been abandoned (Ard & Darvill, 2015). The second indication is the fact that these jars were accompanied by numerous faunal remains as well as heaps of stones, neither of which is uncommon in combination with pottery deposits characterised as "ceremonial" (Ard & Darvill, 2015; Madsen, 2019).

Beyond the pottery assemblages, a review of the funerary and ritual practices in 'Petit-Chasseur' further highlights the shifts accompanying the arrival of the Bell Beaker phenomenon. The necropolis was founded around 2900 BCE and used continuously until the mid-second millennium BCE, thus remaining a locus of important social and funerary events, even during the Bell Beaker period. However, from 2500 BCE, significant changes affected at least six different spheres related to the use of the necropolis.

The first was the construction of new megalithic monuments with a different architecture, without the triangular ground plan that had been the marker of the previous period.

The second change was the emptying of the primary funerary layers from the oldest dolmens to place individuals accompanied by Bell Beakers inside them. This practice was also frequent during the Bell Beaker period in Iberia and France, and several scholars interpret it as a willingness to re-appropriate the monuments and legitimise new power dynamics (Jiménez-Jaimez & Marquez-Romero, 2016; Rojo-Guerra, Garrido-Pena, & García-Martínez De Lagrán, 2010; Sohn, 2009; Sommer, 2017).

A third element was the modification of grave goods. Besides the three vessels, the Final Neolithic assemblage from dolmen MVI included three flint daggers, a set of spindle whorls, several boar tusk pendants, and a smoother made from deer antler. Apart from the finely crafted Beakers and cups, the

Bell Beaker grave goods also included arrowheads, grooved polishing stones, crescent-shaped shell pendants, v-perforated buttons, perforated shells, a gold spiral ring, a silver ring, quartz flakes, flint flakes, and flint circle segments (Bocksberger, 1976, 1978; Gallay, 1989).

The diachronic study of flint provenance revealed a fourth change: the Bell Beaker period marked a shift in procurement sources and thus a modification of exchange networks. The distant sources preferred during the Final Neolithic, such as the Grand-Pressigny flint mines located more than 600 km away in the Paris basin, were abandoned in favour of closer sources (Affolter, 2014).

The fifth shift relates to stela engraving, as bow depictions and extensive geometric motifs representing clothing succeeded to much simpler designs of spiral ornaments and daggers (Gallay, 1995).

Finally, the arrival of the Bell Beaker phenomenon in the region has demonstrated changes in human health and mobility, with studies identifying several non-local adults interred in the necropolis and potential changes in individual well-being (Abegg, Desideri, Dutour, & Besse, 2021; Desideri & Besse, 2010; Desideri et al., 2012; Desideri, Price, Burton, Fullagar, & Besse, 2010).

7 Bell Beaker Integration in the Upper Rhône Valley: Final Considerations

This study's ceramic technological data revealed how exogenous traits characterised pottery traditions produced in the second half of the third millennium BCE and how, as shown in the previous section, these findings corroborated the conclusions of other studies on Bell Beaker material from the Upper Rhône valley.

All these lines of evidence point to the arrival of new people or communities in the western Alps around 2500 BCE, and they suggest that some of these individuals were potters. We thus argue that some of the actors responsible for bringing the Bell Beaker phenomenon to the Upper Rhône valley were craftspeople. Bell Beaker artisan mobility has already been considered for other regions in Europe, such as southern Britain with the case of the Amesbury Archer (Brodie, 1997; Fitzpatrick, 2011; Sheridan, 2008), but rarely in relationship with pottery making, which this work has now successfully proven.

Such conclusions advance our knowledge of the mechanisms underlying the advent of the phenomenon in our research area, but they inevitably lead to additional questions. Once attested to, human mobility and population influxes necessarily pose the question of how those individuals, having left their homeland, might be integrated into their adopted territory. Were they known by the local communities before their move, through communication or exchange networks, or seasonal mobility? Were they complete newcomers? If so, how were their arrival and establishment perceived? These broader questions are not new and have troubled archaeologists for more than a century. Over the years, diffusionist theories argued that the "Beaker people" (or "Beaker folk"), a culturally (and perhaps also genetically) homogenous group, migrated and often took control of the territories they entered, forcing local communities to adopt their way of life (e.g., Brotherton et al., 2013; Harrison, 1974; Kunst, 2001). This thesis has, of course, been challenged many times, even though, as several researchers have pointed out in recent years, the archaeogenetics "revolution" has tended to revive this type of argument. Although some publications focused on ancient DNA tried to highlight the different ways in which the Bell Beaker phenomenon spread across Europe (Olalde et al., 2018), a more nuanced approach is still necessary to answer the question of the origins of the phenomenon and *especially* its mechanisms of integration. Critical assessments on the topic of archaeogenetic studies have been published by various researchers (e.g., Furholt, 2018, 2019, 2021; Heyd, 2017; Lemercier, 2020; Vander Linden, 2016).

In the focus region of this study, the Upper Rhône valley, the term "Bell Beaker populations" should refer to the communities that produced or used Bell Beaker artefacts – or both – during the second half of the third millennium BCE. As bioanthropological and isotopic analyses hinted at, only *some* of the individuals within these communities were non-local (Desideri et al., 2010). The "Beaker people" thus combined individuals whose traditions and way of life were rooted in the Alpine context of southwestern Switzerland

and others for whom this was not the case. Furthermore, one should keep in mind that the individuals buried in the dolmens were probably not representative of society as a whole. This observation applies to any study on human remains with a specific focus on mobility, as Parker Pearson et al.'s study (2019, p. 436) reminds us, and confirmed by bioanthropological analyses in the case of the 'Petit-Chasseur' site (Perréard Lopreno, 2014). By acknowledging the intrinsic heterogeneity of the communities who buried their dead in 'Petit-Chasseur', we can therefore propose a more refined interpretation of the evolution seen within the necropolis and its associated social, funerary, and ritual practices.

It seems that the traits of the Bell Beaker phenomenon are connected with power – the power and social status of the people who had access to this particular funerary site. But nothing in this observation strictly establishes that this power was exogenous to the valley. It solely indicates that the powerful, whoever they were, adopted part of the Bell Beaker norms and applied them within the context of the megalithic site. These individuals may very well have been the descendants of the people who built and used the triangular dolmens during the Valaisian Final Neolithic period. The changes observed in 'Petit-Chasseur' may thus be related to a Bell Beaker cultural influx partially brought by migrating individuals, the norms of which were then adapted and re-appropriated by the local communities who reinvented their way of interacting with the site accordingly. Throughout history, powerful people adopting new cultural norms, ideologies, political systems, or religions often had a strong impact on their diffusion and integration among the populations for whom they were the elite, highly accelerating this process.

For all these reasons, our final interpretation on this topic is much closer to the one reached by Grupe et al. (1997), who proposed that the Bell Beaker phenomenon was brought to Bavaria not by warriors or invaders, but by families who subsequently integrated into the local communities. Conclusions drawn by Parker Pearson et al. (2019) also went in a similar direction, as they discussed and subsequently qualified some of the migration hypotheses developed from aDNA studies regarding Britain (Olalde et al., 2018).

8 Conclusion

This pottery technology study investigated the connection between short-term settlements and a megalithic funerary and ritual site in the Upper Rhône valley in southwestern Switzerland (3300–1600 BCE). It then discussed the integration of the Bell Beaker phenomenon in the archaeological context of the area. The comparison of domestic and funerary ceramic productions across 1700 years revealed both continuities and discontinuities in knowledge transmission as well as shifts in the structure of pottery constellations of practice between each period. The social practices related to the use and deposition of pottery in the megalithic necropolis of Sion 'Petit-Chasseur' also changed significantly through time.

The juxtaposition of data on pottery traditions from the Bell Beaker period (2500–2200 BCE) with those from the preceding Valaisian Final Neolithic context (3300–2600/2500 BCE) and the succeeding Early Bronze Age (2200–1600 BCE) highlighted the arrival of new traditions with the emergence of the Bell Beaker complex. During this period, the 'Petit-Chasseur' necropolis seemed to be less connected to the local constellations of practice and to share a particular bond with a settlement located over 50 km east of its grounds: Bitsch 'Massaboden'. These findings confirm the breaks pointed out by other fields such as megalithic architecture, symbolic depictions, grave goods, and bioanthropology.

In light of these elements, we argue that individuals moved to the Upper Rhône valley around 2500 BCE, bringing the Bell Beaker phenomenon with them. We propose that some of these individuals were craftspeople, among whom potters, the latter being responsible for the sudden development and multiplication of burnished traditions in the area and the reorganisation of production and exchange networks. We further hypothesise that some of these Bell Beaker potters settled in Bitsch 'Massaboden' and had the prerogative to produce the Beakers – the eponymous vessels inherently associated with the phenomenon – deposited inside the 'Petit-Chasseur' necropolis. However, the exact reason for this privileged position is yet to be explained.

Nevertheless, the continuous use of the megalithic site represents a point of stability, as its enduring presence testifies to its persisting symbolic value over 1700 years, despite the disruptions brought by the arrival of foreigners in the region around the mid-third millennium BCE. In a sense, the necropolis acted as a "boundary object" through both time and space, bringing together the communities of the Upper Rhône valley during more than a millennium and a half.

To conclude, this research underlines the value of diachronic, regional case studies and the relevance of examining and comparing pottery from domestic and funerary contexts when investigating the integration mechanisms of extensive cultural phenomena. This technological study of ceramic assemblages confirms that human mobility probably drove the emergence of the Bell Beaker phenomenon in Alpine Switzerland. Above all, it reveals that this mobility seemingly included potters, an hypothesis discussed several times in the literature, now corroborated by archaeological data.

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Author contributions: ED, VA, and MB conceptualised the study, which was supervised and managed administratively by MB. ED and MB acquired funding for the research. ED and VA designed the methodology, ED collected the data, and VA validated the study protocol. Subsequently, ED and VA performed the formal analysis. ED produced the visualisation for the results and wrote the original draft. Finally, VA, MB, and ED revised and edited the article. The authors applied the "first-last-author-emphasis" (FLAE) approach for the sequence of authors.

Conflict of interest: The authors state no conflict of interest.

Data availability statement: The data corresponding to this study is fully available and can be found in the Yareta digital repository, via the following link: https://yareta.unige.ch/home/detail/e854ead7-f6b3-4f98-bde5-d0440285ad59.

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