



Long distance exchanges versus regional rocks use: datas and interpretations for the Neolithic of the Northern French Alps

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We would like to introduce here some aspects of the complexity of the production, the diffusion and the use of stone implements hafted as axeheads during the Neolithic. For this, we have chosen to develop the problem of the prehistoric choices face to the natural availability of tenaceous rocks, in a symptomatic area which is rich in several metamorphic lithologies. Inside the Western Alps, the case of the northern french part of it, i.e. the Haute-Savoie district, takes a good example of this human choices, which can be fully understood only if we replace it in the larger frame of the Western Alps. Four parts will be necessary to explain this human choices: first, the description of the natural availability in tenaceous rocks; then, the presentation of the archaeological implements studied and the methods of characterization; the results of it, i.e. the tenaceous rocks really used in Haute-Savoie to realise polished axe blades; endly, the discussion on the part of the human choices face to the natural resources, which can be clearly revealed by the chronological study of the kind of stones used during each subdivision of the Neolithic.

1. The natural availability in tenaceous rocks in Haute-Savoie

1.1. Geographic introduction

The Haute-Savoie district forms a small part of the French Alps, the northern of it (fig. 1, 2). It is less than 100 km from west to east and quite 70 km from north to south. From east to west, it includes a part of the internal Alps, the higher of it with the Mont-Blanc (4807 m, top of Europe) and the Aiguilles Rouges massifs, which are prolonged in the south by the Belledonne mountain range. Then several depressions drained by rivers form the Val d'Arly and the Faucigny. Then the prealpine reliefs of the Bornes and the Chablais massifs take place. West of it, the hilly forelands can sometimes form some isolated massifs, like the Mont Saleve near Geneva. The river Rhône forms the western boundary of the Haute-Savoie district. Two notable lakes have to be introduced, because of their particular importance for the Neolithic communities: the bow of the Léman lake forms the Haute-Savoie limits on the north; it develops on more

than 70 km from Geneva to the upper Rhône valley (lower Valais). The Annecy's lake, less than 15 km long, forms a natural way of communication between the Val d'Arly and the forelands.

1.2. Regional resources: the tenaceous rocks

If we consider that the more important quality of a stone axeblade is its resistance to the shocks, then the first quality required for the stone used can be defined as the tenacity (Ricq-de Bouard 1987, Thirault et al. 1999). For it, the rock has to be hard enough (but this quality can be highly variable), to have a fine grain and a great coherence between the different types of mineral. So the metamorphic rocks appear as very good materials, especially if they come from volcanic or magmatic protolites. In Haute-Savoie, three main kinds of sources have to be distinguished, for a general review: the crystalline massifs, the Chablais' Flysch and the morainic and alluvial deposits (fig. 2).

In the crystalline areas, the high reliefs dominate strongly the landscapes: they are formed essentially by granites and gneiss, but inside the gneiss formations, can be found "layers" of amphibolites, which sometimes form some great outcrops (Desmons and al. 1980, Broquet and al. 1985). The most important of them are located in the Belledonne mountain range, on the southern part of the map and outside the Haute-Savoie limits, but then can be found also in the Mont-Blanc and the Aiguilles Rouges reliefs. Generally speaking, the rocks of this part of the Alps belong to the Medium Pressure/Medium Temperature metamorphic facies (MP/MT).

The Chablais' Flysch is a part of the internal Alps transported on the external sedimentary layers. A part of this Flysch, called "*Flysch des Gets*" or former "*nappe ophiolitifère*", dated of the lower and upper Cretaceous, is interesting for us. It consists of a flysch with a sandstone and schist texture, containing olistolites of several rocks: diabbases, serpentinites, sometimes radiolarites or granites (Broquet et al. 1985).

The morainic deposits form the most important part of the tenaceous rocks sources. They are broadly developed in the forelands, the shores of the Léman and partly of the Annecy's lake, but they still exist in the alpine val-

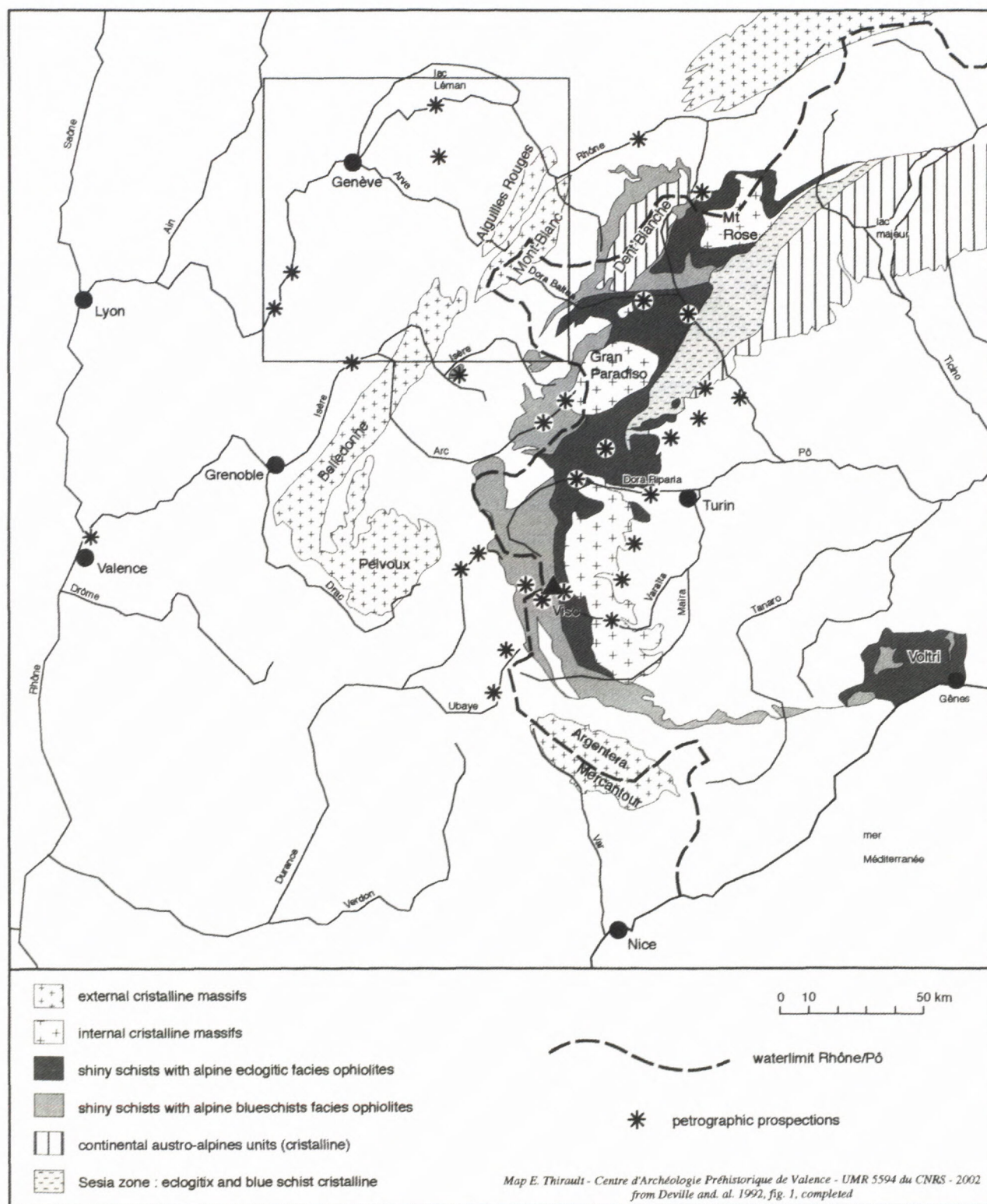


Figure 1. Simplified map of the Western Alps, showing the main tectonic rock outcrops.

leys and in high altitudes. The morains date from the Riss and above all the Würm Ice Ages, and are partly revisited by the former rivers. This phenomenon is still active. We have realised some petrographic sampling inside the morains and the alluvial deposits: the choice in tectonic rocks pebbles is great, and we have find

quite all the lithologies used for the axe blades, excepted the jadeitites (see below; Thirault 2001a). But, one important point is that the alpine eclogitic rocks are really scarce, not more abundant than the over metamorphic lithologies, and they disappear downstream the Léman deposits: we have find some really small pebbles

along the Rhône, but we consider that the dimensions of them and their scarcity forbid to imagine that they could have been used for the axe blades. Instead, around the Léman lake, the eclogitic pebbles could be used for this purpose, as the other tenaceous pebbles.

2. Corpus and methods of determination

We have still introduced the principles and the methods used for this broad enquiries (Thirault and al. 1999; Thirault 2001a, b). The work in Haute-Savoie took place in a broad petrographical and archaeological study concerning the whole French Alps and connected with the researches leaded in Southern France and Northern Italy (Ricq-de Bouard and al. 1990, Ricq-de Bouard 1996, D'Amico and al. 1998, D'Amico 2000). The results obtained have been completely published for the laboratory determinations (Thirault and al. 1999, Thirault 2001b) and are to be exhaustively published for the archaeological investigations (Thirault 2001a).

In the Haute-Savoie district, 149 stone axeheads have been studied, both archaeological and petrographical point of view (fig. 3). This represents quite all the artefacts known in the district (155 registred in 2000); 72 of them have been examined in laboratory by thin section and/or by XR, under the responsibility of D. Santallier (University of Lyon I), the other are determined by us, and sometimes remains unspecified. Most of this axe blades come from Neolithic sites (fig. 2): 11 sites are documented, most of them are lakeshore dwellings, yet under water: 7 sites are located on the Léman, 3 on the Annecy's lake, and one is a "dry" site, the shelter of La Vieille Eglise at La Balme-de-Thuy. This sites are documented by old excavations and collections, and for some of them, by recent works: the prospections and excavations under water directed by A. Bocquet then A. Marguet, DRASSM Annecy; Marguet 1995), and J.-P. Ginestet's excavations at La Vieille Eglise (Ginestet 1984). The other axe blades are stray finds or hoards, in which the original context is today unknown. The fig. 3 gives the list of the discoveries documented and details the petrographic numbers of each.

The number of axe blades documented in Haute-Savoie is not so high, even if we consider the large parts of the territory belonging to the highlands. Two other problems limit the present study: the geographic dispersion of this axe blades is greatly heterogeneous, with quite no discoveries in the Alps itself and some local concentrations on the lake shores (fig. 2) and most of them are not dated. Nevertheless the results obtained are significant, are give some good ways of researches and questions for the future enquiries.

3. The rocks used for the polished axe blades in Haute-Savoie

We won't give here a fine description of the lithotypes used for the axeheads in Haute-Savoie; this has still been

done in former publications (Thirault and al. 1999, Thirault 2001b). However, we would like to precise, from an archaeological point of view, the significance of each rock family determined, and the sources that can be identified. For this, we will introduce each family in order of it's sources, from the more distant to the nearest. This review is based on the 149 implements examined (fig. 3). All the stones determined are metamorphic rocks. Nevertheless, we must add two cases of flint axeheads, one polished, the other only flaked. But we did not see this objects, which should be examined in details to certificate their state.

3.1. The non-alpine rocks

Only one lithotype can be related to another origin than the alpine regions. Two black metapelites related to the Vosges, north to the Jura massif, are surely determined on the site of Anthy-sur-Léman/Séhex. With another scarce discoveries on the Léman lakeshore sites, this objects are located at the southern limit of diffusion of the axe blades productions of the Plancher-les-Mines' quarries (Pétrequin and al. 1996). The southern Léman shore is quite at 200 km of the quarries: that means that this implements where really exotic beside the other axe blades. They were also axe blades of good value: one is 18,2 cm long, which is still great, the other is 9,4 cm and both are intact.

3.2. The eclogites and the jadeitites

The eclogites and the jadeitites are the most common rocks used: both represent 62 % of the stone axe blades studied in Haute-Savoie, but the jadeitites are really scarce (4 % of the total). Eclogites are high pression/low temperature metabasites, metamorphised during the alpine orogene and not or quite not retromorphosed. Under this word, we group real eclogites, i.e. rocks associating a pyroxene type omphacite and garnet, and pyroxenites without garnets, i.e. omphacitites. Jadeitites are pyroxenites rich in jadeite, and without garnet.

The primary outcrops of this rocks are located inside the internal Alps, in the blue schists (for the jadéitites) and the eclogites (for all of them) alpine metamorphic facies (Droop and al. 1990). If the jadeitites are extremely scarce as a raw material, the alpine eclogites are common from the Apennines to the Zermatt-Saas region in Valais (fig. 1). The use of the eclogites for the stone axe blades is general in the Western Alps, as in the Rhône basin and Northern Italy (Ricq-de Bouard and al. 1990, D'Amico and al. 1998, D'Amico 2000, Thirault and al. 1999). On more than 200 km around the outcrops or the secondary deposits, this rock family dominates generally the other rocks used. We have demonstrated that this great diffusions are allowed by a real network of production, with the recognition of workshops near by the natural deposits, and "production sites" far from the sources, in the French Prealps (Thirault 2001a, c).

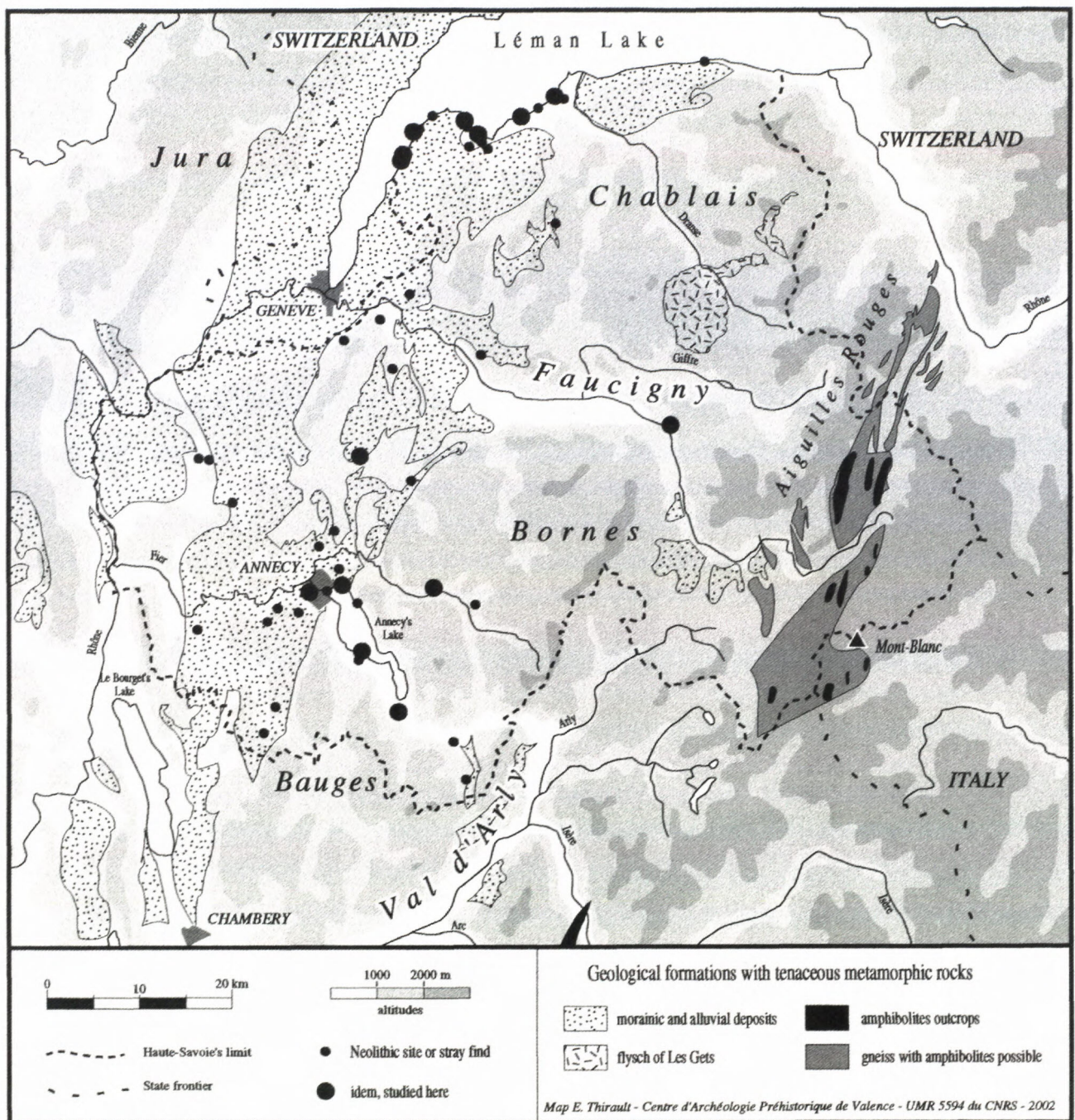


Figure 2.

Simplified map of the Haute-savoie district, showing the main tenaceous rocks outcrops and the sites and stray finds documented for the neolithic axe blades. List of discoveries studied here (see also fig. 3): 1. Annecy; 2. Doussard; 3. Vétraz-Monthoud; 4. La Balme-de-Thuy/shelter of La Vieille Eglise; 5. Saint-Jorioz/Les Marais; 6. Magland; 7. Annecy/Le Port; 8. Annecy-le-Vieux/Le Petit Port; 9. Messery/Crozette; 10. Anthy-sur-Léman/Séchex; 11. Chens-sur-Léman/Beauregard; 12. Chens-sur-Léman/Tougues; 13. Excenevez; 14. Sciez/Coudrée; 15. Thonon-les-Bains/A Corzent.

In the case of the Haute-Savoie, the closer outcrops are located in Val d'Aoste, at quite 100 km if we consider the western part of the district. But we know very little about the rock supplies in this valley, and we can't assume that the eclogites outcrops could have been exploited during the Neolithic. So it is possible that the eclogites used for the polished implements of Haute-

Savoie come in fact from a farther valley. Anyway, it is demonstrated that this rocks have been carried through the alpine passes: the role of the eclogites pebbles recognized in the lemanic morains have to be questioned, but at this day very few indications can allow us to imagine an intensive use of them. No pebble surfaces can be recognized on the stone axeheads studied, and no rough-

houts are known. The only exception could be, close to the Haute-Savoie, in the lakeshore dwellings of the Geneva's bay where plenty of polished implements have been collected in the XIXth century. But a more detailed study should be done on this sites before any conclusion.

3.3. The morainic pebbles: ultrabasites, metabasites and cataclasites

We group here all the rocks identified by detailed examination, with a geological origin in the alpine metamorphism or not. The stone axeheads concerned often got clearly the marks of the pebble surfaces and so, the morainic origine can be surely assumed. Anyway, the alpine origin can't be demonstrated from a geological point of view and we can only precise that they come from secondary deposits when the pebbles surfaces are visible. We don't exclude that for some implements, another farther origin could be proposed. Three main families have been identified. All this rocks represent 23 % of the polished axeheads examined.

The ultrabasite rocks represent 15 % of the total. Most of them are chloritites and serpentinites (antigorites). The metabasites are very diversified: in laboratory, epizonal metabasites (amphibolites and/or prasinities), mesozonal metabasites (amphibolites, metadolerites) and MP/MT retromorphosed eclogites (amphibolo-pyroxenites) have been identified. Lastly, few cataclasites are former grinded metabasites silicified (Thirault and al. 1999).

If we consider the distribution of the morainic deposits in Haute-Savoie (fig. 2), we realise that most of the sites and the stray finds documented are located on them or quite near. Especially those where the axeheads are realised in pebbles. So, in that case, the rock supplies are quite local, maybe not always on the site itself, but never farther than few kilometers. The amphibolites located in the cristalline external mountain ranges (aiguilles Rouges, Mont-Blanc, Belledonne) could have been used, but we've got absolutely no evidence for the exploitation of such rocks on their outcrops or near by. In fact, the neolithic population of this regions remains unknown and this lack of knowledges stops the thought.

3.4. Conclusion

This short overview of the tenaceous rocks used by the Neolithics allows us to underline two main attitudes for the supplies in polished implements: whether this people get their implements directly from the local sources, i.e. the morainic deposits, with a broad rock spectrum; whether they get them by long distance diffusions, coming from the the South-East across the alpine passes (eclogites and jadeitites), or sometimes from the North (metapelites). This second choice imply the connection with strong diffusion networks, which are better known on the south (Thirault 2001a, c). If we consider that most of the axeheads in Haute-Savoie are in the second case, we can assume that the rock supplies in this district were strong-

ly organised. The chronological review of the facts gives a comprehensive key for it.

4. The human choices

The chronological datas for the axeheads are given by to ways: the classical archaeological attributions on the sites, by physical (C14 ou dendrochronology) or chronological datation; and the axeheads typology, based on the technological processes of manufacturing and the morphology (Thirault 2001a). In Haute-Savoie, few sites have given both fine chronological datas and axe blades. For the present study, we can considere three main phases (fig. 4): the first part of the Middle Neolithic (*Neolithique moyen I*, circa 4800-4300 B.C. calibrated ?); the second part of it (*Néolithique moyen II*, circa 4000-3400 B.C. calibrated) and the end of the Neolithic (*Néolithique final*, circa 3400-2500 B.C. calibrated).

4.1. The *Néolithique moyen I*

At this date, no site as given a sure information about this phase. But our typological seriations and the broad review of the alpine and western european contexts allow us to attribute at this old phase of the Neolithic a very specific type of axe blade, the *Bégude type* (Cordier and Bocquet 1973, Pétrequin et al. 1998, Thirault 1999, 2001a). The *Bégude type* axes are long to very long objects (to 35 cm long), very well realised and perfectly polished. They were probably not used as tools but had a non utilitarian function, probably related to social exhibitions. The important point for us is that they are always realised in alpine eclogites. So the *Bégude type* demonstrates that the transalpine networks or eclogites diffusions were still established at this time. Considering the non-utilitarian function of this long axe blades, we can assume that this diffusions have been realised as exchange networks.

In Haute-Savoie, we have identified three stray finds of the *Bégude type*, all in alpine eclogite: Annecy (fig. 2 no 1), Doussard (no 2) and Vétraz-Monthoud (no 3). The last discovery was probably an intentional hoard: two *Bégude type* axe blades have been discovered together. If we rely on this datas, the eclogite were the only rocks used during this phase in Haute-Savoie. But the number of objets is too low for a real demonstration, and it is also possible that this beautiful long axe blades represent a special part of the whole ground stone implements of the *Néolithique moyen I*.

4.2. The *Néolithique moyen II*

Three sites can be related to this period (fig. 2). Two of them have provided precised informations by archaeological excavation: Les Marais at Saint-Jorioz (no 5) and the La Vieille Eglise shelter at La Balme-de-Thuy (no 4). At Saint-Jorioz, dated by dendrochronology at 3783-82 B.C. (tree-felling dates), 11 axeheads have been studied (fig. 3). All of them, excepted one (an ultrabasite), are in

eclogite or in jadeitite. At La Balme-de-Thuy, not so well dated but belonging to the Middle Neolithic, 3 of the 4 axeheads are in eclogite. So on both sites, the dominant rocks come from the Val d'Aoste or the Piemonte sources. The scarce over rocks belong to the ultrabasic sequence, but it isn't certain that they have a regional origin. In fact, this two axe blades haven't got any pebble surface and their precise origin remains unknown.

The third site isn't directly dated, but some stone implements of it can be attributed to the recent phases of the Middle Neolithic. At Anthy-sur-Léman/Séchéx, the typology of the two axeheads realised in metapelites is clearly related to the vosgian productions, and especially those dated from the Middle Neolithic (Pétrequin et al. 1996). This time is the most important phase of diffusion for this implements, and their presence at Anthy-sur-Léman gives a good clue to suggest that this site could be occupied at this time (were is no absolute or cultural dating on it; the objects come from underwater prospections).

So the recent part of the Middle Neolithic is characterized by a ground rock supplies quite exclusively structured by long distance exchanges with the north and the south-east. Even if the datas are not so plentiful, they suggest strongly that the morainic resources were not used for the axe blades.

4.3. The *Néolithique final*

Three lakeshore sites can be related to the end of the Neolithic, in a general meaning (fig. 2): Le Port at Annecy (no 7) and Le Petit-Port at Annecy-le-Vieux (no 8), both on the lake of Annecy, and Crozette at Messery on the Léman Lake (no 9). The first one isn't precisely dated; Le Petit-Port is dated by dendrochronology at 3058–3025 B.C. (tree-felling dates), and Crozette at 2900–2300 B.C. by C14. On the three sites, the eclogites and jadeitites rate is lower as for the former periods: less than 2/3, that remains however high. The other rocks identified are some epizonal metabasites and serpentinites. On each site, a part of the axeheads are not determined because of the lack of petrographic analyses, but we can assume that this unknown rocks are quite not eclogites nor jadeitites. They have to be associated with the other metabasites or ultrabasites from regional sources.

Another informations are given by some stray finds which can be related to the *Néolithique final* by the technology of manufacturing. We have listed six of them in Haute-Savoie, and all are in alpine eclogite and in jadeitite (one case). One of them is a long polished axe blade, probably coming from an hoard (Magland, no 6). This objects demonstrate that the use of the transalpine rocks is still well developed during the end of the Neolithic, even if the local resources are worked.

4.4. The Léman Lake problem

In this chronological review, less has been said about the sites located at the Léman shore. Nevertheless, the

neolithic sites have given good samples of the axeheads productions, many of them studied in laboratory. The six sites studied have provided 68 polished axe blades, but unfortunately, only one, Corzette at Messery, is dated from the *Néolithique final*. On the other sites, we've got no clear information. At Anthy-sur-Léman/Séchéx only, we have suggested that the two pieces in metapelites could be dated from the Middle Neolithic. But for all of them, we can assume that they have been occupied during the Middle and/or the Final Neolithic.

Anyway, the laboratory's results are quite interesting (fig. 5). On all the sites, the eclogites and jadeitites rate is low, always below half of the total, and is very different between the sites. The ultrabasites (serpentinites and chloritites) are almost always used, and the other rocks are less common. For all this rocks and the unspecified, the sources can be related in the lemanic morains; that is indicated also by that pebbles surfaces on some of the objects. The only problem concerns the eclogites and the jadeitites: if we can assume, for the eclogites, that the raw material can be found in the morainic deposits, we haven't got the proof that this source was really used. And the problem of the jadeitites remains unsolved. So we have to assume that the eclogites and the jadeitites used on the Léman's sites came partly or entirely from the Italian Alps.

This results are in opposition with the facts established for all the dated sites in Haute-Savoie. The explanation can follow two hypotheses: it could be a opposition in the choice of the raw materials between the Léman shore sites and the neolithic sites located in the forelands and inlands of Haute-Savoie; or it could be a chronological variation, if we consider that we've got only few informations about the chronology in this regions. We don't exclude the second hypothesis, but we think that the chronological informations are still enough to give reliable informations. The first hypothesis seems better, and this interpretation can be replaced in the general knowledges about the tenaceous rocks supplies in the Western Alps and the Swiss Forelands. In the Western Alps, in Northern Italy and South-Eastern France, the alpine eclogites and, in a much less part, the jadeitites, are the dominant rocks, and they are broadly diffused across the Alps. On the opposite, on the Swiss Forelands, in the lakeshore sites dated from the Middle Neolithic to the end of the Neolithic, the axe blades are essentially manufactured from local morainic pebbles, i.e. ultrabasites (with the serpentinites first) and metabasites (Buret and Ricq-de Bouard 1982; Thirault and al. 1999). Moreover, the metapelites from the Plancher-les-Mines' quarries in the Vosges are well diffused in the Swiss Forelands during the Middle Neolithic, and this kind of objects reaches the southern lemanic lakeshore.

If this interpretation is true, the Haute-Savoie district would be a frontier territory with two separated areas for the tenaceous rocks supplies: on the Léman, the exploitation of the morainic pebbles, as in the lakeshore sites located on north to the Léman Lake; on the inland, the

	n°	site or stray find	rocks						TOTAL
			metapelites	eclogites	jadeitites	ultrabasites	various metabasites	cataclasites	
Middle Neolithic I	1	Annecy		1					1
	2	Doussard		1					1
	3	Vétraz-Monthoud		2					2
Middle Neolithic II	4	La Balme-de-Thuy/La Vieille Eglise		3		1			4
	5	Saint-Jorioz/Les Marais		9	1	1			11
Final Neolithic	6	Magland		1					1
		stray finds NF		4	1				5
	7	Annecy/Le Port		12	1		1		20
	8	Annecy-le-Vieux/Le Petit Port		4					6
	9	Messery/Crozette		1		1			2
undated	10	Anthy-sur-Léman/Séchex	2	6		6	2		16
	11	Chens-sur-Léman/Beauregard				1	3	2	6
	12	Chens-sur-Léman/Tougues		12		1	1		13
	13	Excenevez		1		3		1	6
	14	Sciez/Coudrée				2			3
	15	Thonon-les-Bains/A Corzent		3	1	4			8
TOTAL sites and/or dated			2	60	4	20	7	3	119
other discoveries undated				19	2	1	1		30
TOTAL all discoveries			2	79	6	21	8	3	149

Figure 3. Petrographic datas for the Neolithic sites and stray finds of the Haute-Savoie axe blades.

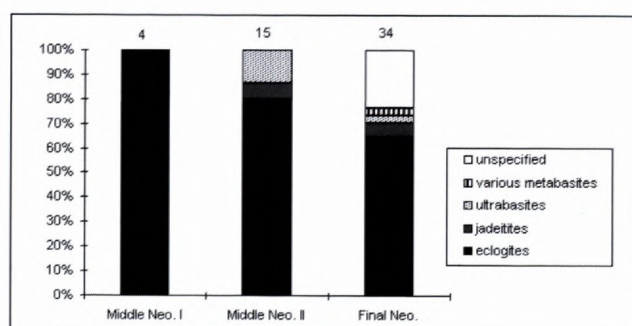


Figure 4. Chronological evolution of the rocks used for the neolithic axe blades in Haute-Savoie.

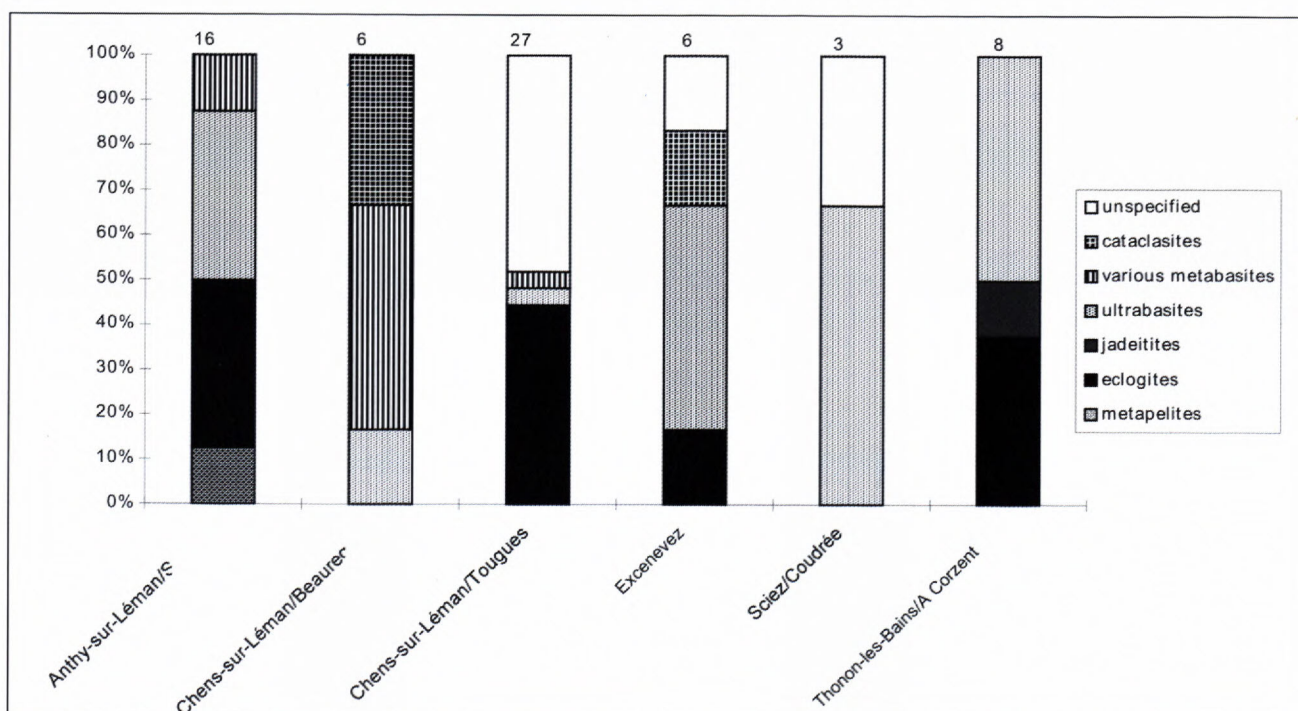


Figure 5. Petrographic composition of the axe blades coming from the Léman neolithic sites.

connection with the transalpine exchanges networks during all the Middle and Final Neolithic, with an evolution during the end of the Neolithic, with the use of some morainic pebbles. Unfortunately, we can't know if this opposition is valid during the whole Neolithic or not: we can imagine that the evolution on the Léman is similar (but stronger) to the inland evolution, with a decrease of the eclogite use at the end of the Neolithic.

5. Conclusion

This short introduction to the complexity of the tenaceous rocks use authorise us to propose some general conclusions about the neolithic behaviours. In Haute-Savoie, the availability in good qualities tenaceous rocks is great, especially in the morainic deposits broadly developed in the Rhône valley, the Léman basin and the alpine forelands. But this availability was not always used by the neolithic communities. For the main part of the territory considered, the rocks supplies was linked to the long distance exchanges coming from the Italian Alps. This mighty networks were active during the Middle Neolithic and decreased partly during the end of the Neolithic. This observation, valid for the whole Western Alps, suggest that at least, the human choice was directed by the network of social relations between the communities. This network was linked to the cultural geography of the communities, which should have strongly changed during the Neolithic. Even if our cultural knowledges remain scarce in this region, we can imagine that the variations in the rocks supplies reflect more the modalities of peopling that the regional geology.

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