Valle Lagorara (I 28): a quarry of radiolarite (jasper) exploited during the Copper and Early Bronze Ages

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This paper presents the Copper and Early Bronze Age quarry and workshop of the Lagorara valley, located at 750 m a.s.l. in the Apennine mountains, some 15 km inland from the coast of the Gulf of Genoa (Italy).

The western, almost vertical slope of the valley is formed by a continuous sequence of hundreds of layers of radiolarite rock, varying from 3 to 20 cm in thickness. Here two main areas have been exploited by prehistoric man, where imprints of hammering to extract slabs are visible over a surface of several hundreds of square metres wide.

The detritus lying at the bottom of the slope largely consists of waste flakes and debris from the quarrying and chipping activities that were carried out.

Two workshops were located in rock shelters on the opposite side of the valley; they were utilised for the production of bifacial specimens with flat-sommaire retouch, which appear to have been the commonest and more characteristic artefacts manufactured in Valle Lagorara.

KEY-WORDS: quarry, workshop, jasper, radiolarite, bifacial artefacts, hammerstones, Copper Age, Early Bronze Age

1. LOCATION OF THE SITE

The site of Valle Lagorara is located (Fig. 1) in the middle of the Eastern Ligurian Apennines, between Genoa and La Spezia (CTR 232030/232070: 9°31'37''E, 44°21'00'' N).

In this area the landscape is very hilly. The seaward slopes rise rapidly from the coast, and often exceed 1000 m just over 10 km inland. The main watershed of the Apennine chain is situated at a short distance from the sea, to a minimum of 25 km, providing very short and steep valleys.

The region has a complex geology, dominated by ophiolithes and schist formations.

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2. THE JASPER IN EASTERN LIGURIA

The Formation of Jasper (Titonian) is widespread in Eastern Liguria. It is constituted (Del Soldato 1990:213–5 and pers. comm.) by layers of:

- siliceous clay-schists ("fitaniti" in the Italian literature), not suitable for chipping technology.

- stratified flint with radiolarians (also quoted as "diaspro" lithotype). In thin section they show micro-crystalline structure, similar to that of flint nodules, but with coarser grain. The fracture is conchoidal. The surface is often quite bright and translucent. The content of not-detritic SiO₂ is above 70%. Microfractures are filled by micro-crystalline quartz.

- radiolarite (also quoted as "diaspro" lithotype) layers. They mainly consist of a siliceous matrix, with intergrain opaque minerals, containing differentially preserved radiolarians, belonging to the Liosphaericae superfamily. The radiolarite is a hard and homogeneous rock, with conchoidal fracture, and bright surface. It has a good flaking capacity. The colour is usually dark "wine" red, or sometimes green.

In the geological terminology, "jasper" normally denotes a geological formation, rather than a lithotype (Del Soldato 1990:213). This does not fully apply to the
archaeological literature, where “jasper” often denotes a lithotype. In this paper “jasper” and “radiolarite” are used synonymously.

In the Ligurian Apennines jasper outcrops are of various dimensions. Most of the times they are massive, and appear as series of thousands of thin layers.

3. JASPER IN THE REGIONAL ARCHAEOLOGY

Since the middle Palaeolithic most of the chipped artefacts of eastern Liguria were made of jasper. Percentages vary from 98% in the Mousterian assemblages, to 85% in the Copper/Early Bronze Age (Del Soldato, Garibaldi and Maggi 1987). Besides jasper, flint occurring in the local “Calpionelle” limestone was also exploited. Therefore the chipped stone industries of eastern Liguria exploited local siliceous resources, with the exception of a small amount of exogenous flint and some obsidian during the Neolithic (Maggi and Garibaldi 1986).

Red jasper tools have been found also in many Palaeolithic sites of the western part of the region. Since western Liguria lacks jasper outcrops, it has been assumed that eastern red jasper was exchanged up to more than 200 km away from the sources (Vicino and d’Errico 1985).

4. THE SITE OF VALLE LAGORARA

The little valley of the Lagorara stream is oriented North to South at 7–800 m in altitude. It is incised along the contact between the jasper formation of the Scogliera mountain (991 m) to the east, and clay-schist formation to the west, while the very valley bottom erodes serpentinite and basalt formations (Figs 2–3).

The jasper outcrop of the western slope of the Scogliera mountain is massively exposed up to about 200 m. It forms an almost vertical bank of thousands of layers of red jasper, varying from about 5 to about 20 cm in thickness (Fig. 4). Many of them are homogeneous, with high silicious content and few microfractures, therefore providing rock with good flaking capability. They are separated by bands of pelithic schists. Suggestively the surface of each of them still preserves the aspect of the ancient sea-bottom.

The jasper of this outcrop was widely exploited by prehistoric communities. In fact imprints of the hammering to quarry slabs are visible over large areas of the outcrop (Fig. 5;2,3), and tonnes of waste flakes, chipped blocks and debris are embedded in the detritus accumulated at the bottom of the outcrop.
Fig. 2. The jasper outcrop of Valle Lagorara seen from the west bank of the valley. Quarrying areas LG3 to the right, and LG1 to the left are separated by a gully (in the middle) of brittle rock.

5. HISTORY OF RESEARCH

Despite the well known evidence of exploitation, no quarrying sites had been found before 1987, when the site of Valle Lagorara was discovered due to the opening of a new country road. The first test-excavation carried out in the following year, made clear that the site belonged to the Copper/Early Bronze Age period (Campana et al. 1988), with no evidence of any Palaeolithic exploitation.

In the following years (1989–91, 1993–94), five campaigns, of about one month each, explored different areas of the site with flexible excavation techniques. According to the character of the loci we used different techniques, from the mechanical excavator to the plotting of each single artefact with three coordinates. However most of the excavation was manual and stratigraphic, with units of 1 square
Fig. 3. I 28 Valle Lagorara. Geological scheme: A — location of workshops LG2; B — Detritus; C — Clay-Schist formation; D — Calpionelle Limestone formation; E — Jasper formation; F — Basalt; G — Serpentinites and ophicalcites. H — 19th century mines. Drawn by M. del Soldato.

Fig. 4. I 28 Valle Lagorara. View of the southern bank of the jasper outcrop.
Fig. 5. I 28 Valle Lagorara. 1: one of the niches due to exploitation technique described in Fig. 7A; 2-3: imprints and conchoid fractures originated by hard hammering quarrying.
m or 33 cm, all of the retouched artefacts and other relevant objects (pottery, soapstone) being plotted with three coordinates. All of the soil was wet sieved with 2 mm mesh.

Up to date the excavation has explored a small part of the deposit (Fig. 6). However about 3 tons of artefacts are stored in the Archaeological Museum of Chiavari, to be studied. One more excavation campaign is scheduled for July 1993. Thereafter the publication of a comprehensive report is planned for the following year. This will include also palaeoenvironmental aspects, either pre- and post-occupation, that are not mentioned in the present paper. Preliminary notes about the discovery were published in 1988 (Campana et al. 1988). In 1991 a report was submitted to the VI International Flint Symposium of Madrid; unfortunately it is still in press (Maggi, Campana and Negrino forthcoming). An opuscula has been published in 1993 by the Soprintendenza Archeologica della Liguria.

6.1. QUARRYING AREAS

Two main quarrying areas have been recognised, where the traces of prehistoric hammering are concentrated, namely LG1 and LG3 of Fig. 6. They correspond (obviously) to the zone where the rock is of better quality (in terms of flaking capacity), and are separated by a deep gully, where the jasper is heavily fractured and has lower siliceous content.

The northern area (LG1) contains ledges and niches concentrated in a restricted zone, while in the southern area LG3, traces are scattered all over the slope, up almost to the top.

We define as quarrying niches several concavities generated by the extraction of jasper where the stratification is sub-vertical. In this case the attitude of the layers determined the extraction technique. That consisted of demolishing by hard hammering, one by one, the succession of layers, enlarging the extraction front both sideways and in depth (Fig. 7A). Several conical recessions obtained by this technique are recognisable on the bank surface. When the niche reached larger dimensions, a small ledge can be formed at the bottom of it (Figs. 5:1 and 10).

It seems this was the most popular method, however if the attitude of the jasper layers were sub-horizontal, they were exploited by demolishing, with hard hammer, the front of the list (Fig. 7B); this applied especially where faults occur, or to boulders collapsed from the slope. In those cases where the jasper layers were already partially detached, we can argue some levering technique was employed (Fig. 7C).
Fig. 6. I 28 Valle Lagorara: topographic map. Quarrying banks LG1 and LG3 are shown, as well as the detritus at the bottom of them. Workshops in the rock-shelters created by boulders are located in LG2. Excavated areas are in black.
Fig. 7. I 28 Valle Lagorara. Scheme of the quarrying strategies.
6.2. ARCHAEOLOGICAL DEPOSITS CAUSED BY QUARRYING ACTIVITY

As already said, the waste of quarrying activities accumulated at the bottom of the outcrop. However, minor quantities are preserved also by the small ledges of the quarrying niches, as well in some breaks of the slope, providing archaeological deposits much different in size and timing of accumulation.

The archaeological deposits of **LG1** area were explored by five trenches (Fig. 6). In all of them most of the deposit is constituted by waste material due to the quarrying and chipping of the jasper (Figs 8–9), up to two metres in depth. The artefacts consist

![Fig. 8. I 28 Valle Lagorara. The excavation LG1b, in the deposit below LG1 that yielded the bronze-pin of Fig. 14:7.](image)

both of the waste of the quarrying activities that collapsed from the bank, and of the in situ chipping of the slabs extracted. Evidence of stratification is somewhat weak, and very simple. It appears so far that the accumulation of the material was due to relatively “short” episodes.

There are many characteristic specimens with flat or blunted retouch, either bifacial or unifacial, that are the most significant non-waste chipped artefacts of all of the site. There are also some stone hammers, and a few sherds of pottery. Of major importance is the recovery in the top layer of the loci **LG1b** of the
head of a so-called disc-head bronze pin, belonging to the end of the Early Bronze Age.

As already said, in some zones the archaeological deposit is quite thick, and the top layer is very close to the present day surface or is being eroded. Within a distance of a few metres, however, the deposit may appear much thinner, and buried below a thick detritus originated after the Bronze Age by the thermoclastic weathering of the rock. This suggests the depositional and post-occupation story of the site was quite complicated.

The excavation explored also the deposit of two of the ledges (Fig. 10), as well as that of a tectonic crack located just below a heavily chipped wall. These deposits are
mainly constituted of waste fragments of jasper resulting from hammering. There are also several fragments of stone hammer, while the flat-retouched artefacts are very rare. No sherds of pottery were found here.

Fig. 10. I 28 Valle Lagorara. The excavation of one of the ledges of a major extraction niche.

In the deep crack, the deposit is thick (1.5 m excavated so far). Here the stratification is alternatively rich or lacking in waste flakes. This suggests the quarrying was not continuous but occurred in several subsequent episodes. Since some of the layers preserve charcoal, it will be possible to achieve an idea about the time-duration of such episodes.
7. WORKSHOPS

Some 300 metres to the North of LG1, on the opposite side of the river, there are a few big boulders, of several tens of metres diameter, probably collapsed from larger jasper outcrops located at higher altitude to the north-east of the valley. The largest boulder creates two rock-shelters. The area is labelled LG2, and the rock-shelters “Shelter South” (or LG2a) and “Shelter East” (or LG2b).

In LG2a (South), the deposit is preserved over a two-metre strip, parallel to the bottom of the boulder (Fig. 11). The excavation, carried out over 23 square metres,
many unifacial and bifacial artefacts chipped by flat and/or *sommaire* (blunted) retouch (Fig. 13:3–6), left at different stages of the chipping process, some of them also broken during the manufacturing,

— five arrowheads (Fig. 14:3,6)

— thousands and thousands of waste flakes of every dimension. Due to wet sieving, a lot of small chips and micro waste-flakes have been recovered. In some units the percentages of flaked artefacts reach some 80% of the total amount of soil. The typological analysis of samples of the waste-flakes and experimental tests (Maggi, Campana and Negrino forthcoming), suggest stages of chipping with hard hammer, followed by soft hammer (antler and/or hard wood).

— a few broken hammers, which corroborates the indication of *in situ* chipping activity.

A few sherds of pottery and some soapstone objects have also been recovered. Charcoal from layer 2b provided the following radiocarbon date: Beta-45751: 3930 ± 190 BP.

Also the east rock-shelter LG2b, excavated over an area of 17 square metres, yielded evidence of intense chipping activity.

Different units of the deposit witness different aspects of chipping (Fig. 12). Layer 2d yielded an enormous amount of micro-chips due to retouch. In layer 2d, one unit of 1 square m yielded 638,500 chips smaller than 1 cm (Campana 1994). Analysis to
Fig. 13. I 28 Valle Lagorara. 1, 2 — cores; 3–6 — bifacial specimens with blunted retouch (4), flat retouch (6), flat and blunted (3, 5).
Fig. 14. I 28 Valle Lagorara. 1, 2, 5 — flat-retouched bifacials finished by a soft hammer; 4 — pick; 3, 6 — arrowheads; 6 — soapstone bead; 7 — head of a head-disc bronze pin; 8 — example of pottery vessel.
determine the relative percentages of different aspects of chipping (hard/soft hammer, flat/simple/steep retouch) are in progress. Other units, specially in layers 2 and 2b, preserved major evidence of the first chipping of the slabs: i.e., larger and thicker flakes with “hard hammer” platform-type.

Layer 2 also preserved some sherds of pottery (Fig. 14:8), as well as soapstone beads (Fig. 14:6) and pendants.

8. MINING TOOLS AND OTHER FINDS

8.1. MINING TOOLS

Most of the mining tools found so far are hammerstones of amphibolitic diabase (S. Sfrecola pers. comm.), a heavy, hard and tenaceous rock that can be found in the local ophiolithe formation.

Most of them are broken or just flakes, specially those from the ledges in area LG1. The entire specimens are spherical, around 10 cm in diameter and about 0.5 kg in weight (Fig. 15). However the large dimension of some scars suggest that much bigger hammerstones were also used. In fact, one larger typical grooved-hammer has been recently found. It weighs 1.65 kg.

8.2. CHIPPED ARTEFACTS

As already mentioned, the most significant artefacts of the site are specimens with flat and/or sommaire retouch (Fig. 13:3-6). Usually the retouch is bifacial, however also unifacial specimens occur. Up to date we have found over 400 and are by far the most frequent retouched artefact. This applies to the whole deposit tested so far, with the exception of that of the ledges, where retouched artefacts are almost absent. Therefore the activity of the Valle Lagorara quarry was mainly devoted to the production of such artefacts. They can be attributed to different stages of a rather simple operational chain (Maggi, Campana and Negrino forthcoming), that started from the quarried slabs (Fig. 16). There are many mid-way cases, where both flat and sommaire retouch occur, also as intermediate modes, on the same specimen.

There are also better refined pieces, that are ogival in shape, with bi-convex longitudinal and transversal cross-sections; length from 50 to 110 mm (Fig. 14:1,2,5); with flat retouch due to a soft hammer. We interpret these specimens as the final product of the operational chain.

Microwear analysis of a sample of 104 pieces does not show any systematic wear (L. Calani pers. comm.), showing they were not utilised as tools in the site.

Besides the flat/blunted retouched artefacts, a minor number of “ordinary” tools are also present, such a few “picks” (Fig. 14:4), six arrowheads (Fig. 14:3,4), some
Fig. 15. I 28 Valle Lagorara. Hammerstones.
Fig. 16. I 28 Valle Lagorara. Scheme of the in-site and off-site working process.
perforators and several scrapers. Analysis is to be done to determine whether such tools were utilised on the site or not.

The numeric disparity between flat/blunted bifacial and all of the other artefacts, as well as the typometric and technological analysis of significant samples of waste flakes (Campana 1994), and the typological analysis of the retouched specimens (Maggi, Campana and Negrino forthcoming) suggest the main goal of the site was the production of flat/blunted bifacial artefacts.

Considering the large amount of material processed and the comparatively small number of unbroken and finished specimens, it can be argued that most of the product was exported. In fact, according to publications, examples of artefacts of this type have been found at several Copper and Early Bronze Age sites. The small number of pieces usually found in the sites corroborate the hypothesis that the bifacial flat/blunted retouched pieces were pre-forms suitable for further chipping, in order to obtain proper tools, such as arrowheads, scrapers and so on (Fig. 16).

8.3. POTTERY

Several sherds of pottery have been found (Fig. 14:8). Only few of them belong to the same vessel and join together. This suggests quite dynamic depositional processes (soil micromorphology investigations currently in progress will contribute to the matter). This pottery has simple shapes and decorations, the quality is low and the temper usually quite coarse. It resembles in all aspects the low-quality pottery production of Copper and Early Bronze Age of Eastern Liguria and Northern Tuscany.

8.4. SOAPSTONE

Several soapstone objects should also be mentioned. They are beads of various dimension (from a few mm up to 3–4 cm), some trapezoidal plates and pendants. A soapstone outcrop is located a few hundred metres south of the site.

9. CHRONOLOGY

Arrowheads, pottery, soapstone objects and the bronze pin, point to a Copper/Early Bronze Age chronology. In Liguria the material culture of these two periods is not clearly separate, and several sites show continuity of occupation (Maggi and Del Lucchese 1988).

As already mentioned only one radiocarbon date is available so far for Valle Lagorara. It concerns the workshop of the LG2a rock-shelter (Beta-45751: 3930 ± 190 BP). Due to the high standard-deviation the calibrated range with two sigmas (95.4% of probability) spans from 2920 to 1890 BC. Despite the fact that it is more than one
millennium, the interval fits well into the calibrated chronology of Copper/Early Bronze Age of Eastern Liguria (Fig. 17).

![Figure 17: Calibrated BC radiocarbon chronology of Copper/Early Bronze Age sites of Eastern Liguria.](image)

The bronze pin (Fig. 14:7) belongs to a type chronologically attributed to the late Early Bronze Age (Carancini 1975:92–3; Del Lucchese 1984:157–60), that is about 17th century BC. Up to date this can be retained as the latest prehistoric period of exploitation of the jasper of Valle Lagorara. The beginning, while waiting for further radiocarbon measurements, can be assigned to the early third millennium BC.

10. CONCLUSIONS

Since the late fourth millennium BC, copper ores of Eastern Liguria were exploited (Maggi and Del Lucchese 1988); contemporaneously, in the northern Apennines, the pastoral economy introduced the exploitation of highland pastures
(Maggi and Nisbet 1991; Lowe et al. 1994). The number of sites and finds increased considerably, suggesting a correspondent increase of population. Therefore the exploitation of the jasper of Valle Lagorara can be regarded as a response to the increasing demand of siliceous material for the chipped stone industry.

The archaeological record suggests that in Liguria during the Late Bronze Age the use of flint sharply decreased, to the advantage of bronze. This is also consistent with the proposed abandonment of the quarry at the end of the Early Bronze Age.

REFERENCES