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THE GREENSTONE TOOLS FROM THE MIDDLE NEOLITHIC SITES OF FIMON AND VILLA DEL FERRO IN THE BERICI HILLS (VICENZA, NORTHERN ITALY)

RIASSUNTO – Il presente lavoro riguarda la litologia di 23 strumenti Neolitici provenienti dall'insediamento della Cultura dei Vasi a Bocca Quadrata di Fimon-Molino Casarotto e altre due stazioni Neolitiche dei Colli Berici (Vicenza). Gli strumenti sono di dimensioni varie e presentano diverso stato di conservazione. L'associazione delle litologie (13 eclogiti alpine, 6 giade, 1 scisto omfacitico e 2 scisti glaucofanici, identificati in 21 asce/accette ed 1 scalpello e 1 serpentinite: ciottolo levigatore), è tipica del Neolitico dell'Italia settentrionale ed ha la sua fonte geologica primaria nell'Italia nord-occidentale, con un dubbio per la serpentinite che potrebbe provenire anche dal letto dell'Adige nel suo corso alpino. Alcuni specifici caratteri petrografici, fanno ritenere che la provenienza dei materiali sia da ricercarsi nell'officina di Rivanazzano, nell'Oltrepo Pavese al confine col Piemonte, o in analoghe fonti geologiche derivate da conglomerati oligocenici.

ABSTRACT – This paper considers the lithology of 23 Neolithic greenstone tools from the Square-Mouthed Pottery settlement of Fimon-Molino Casarotto, and two other sites located in the Berici Hills (Vicenza, Northern Italy). The implements are of variable dimension and state of preservation. They consist of 21 axes/adzes and 1 chisel obtained from Alpine eclogite (13), jade (6), omphacite schist (1), glaucophane schist (2), and 1 serpentinite polisher. This association is characteristic of the northwestern Italian Neolithic greenstone assemblages, with some doubts that the serpentinite might come also from the Alpine course of the Adige riverbed. A few specific petrographic characters would suggest their provenance from the Rivanazzano workshop, in the Oltrepo Pavese, close to Piedmont, or comparable geological sources derived from Oligocene conglomerates.

Keywords: Berici Hills, Lake Fimon, Greenstone tools, Middle Neolithic, Square-Mouthed Pottery culture

1. INTRODUCTION

This paper presents the results of the characterisation of the raw materials employed for the manufacture of greenstone tools from the Middle Neolithic, Square-Mouthed Pottery culture sites of Fimon and Villa del Ferro in the Berici Hills (Vicenza).

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The discovery of prehistoric remains in the Berici Hills, a unique karstic environment at the foot of the southern Alps (Sauro, 2002), attracted the attention of many scholars already since the second half of the 19th century (Lioy, 1864-1865; 1876; Pigorini, 1866; Meschinelli, 1889a; 1889b; Battaglia, 1958-1959; Barfield and Broglio, 1966; 1986a).

The Neolithic settlement of Molino Casarotto was discovered by G. Trevisiol in 1943, during the exploitation of a peat-bog along the ancient shore of Lake Fimon (Trevisiol, 1944-1945). At the bottom of the peat deposit, G. Trevisiol reported the presence of many structures, among which are a circle of stones surrounded by wooden poles, some 90m from another oval floor of pebbles above a platform of crosswise layered beams, resting on the white lake marl. More finds were brought to light rather close, among which is a layer rich in crushed freshwater molluscs, animal bones, lithic and bone tools, potsherds and traces of wooden structures all around it (Barfield and Broglio, 1966: 55).

After the re-analysis of the Neolithic assemblages recovered by G. Trevisiol, now in the stores of Vicenza Museum, Barfield and Broglio (1966) attributed the finds from Molino Casarotto to the early phase of the Middle Neolithic Square-Mouthed Pottery culture, given the presence of characteristic finds of this aspects, both lithics and ceramics.

Important discoveries were made also in the southern part of the Berici Hills, between S. Germano and Villa del Ferro, where two different localities of Val Liona yielded archaeological material, uncovered during the exploitation of five peat-bogs in 1944-1945, later attributed to the Square-Mouthed Pottery culture (Battaglia, 1958-1959: 323; Barfield and Broglio, 1966: 61)

2. THE NEOLITHIC SITES

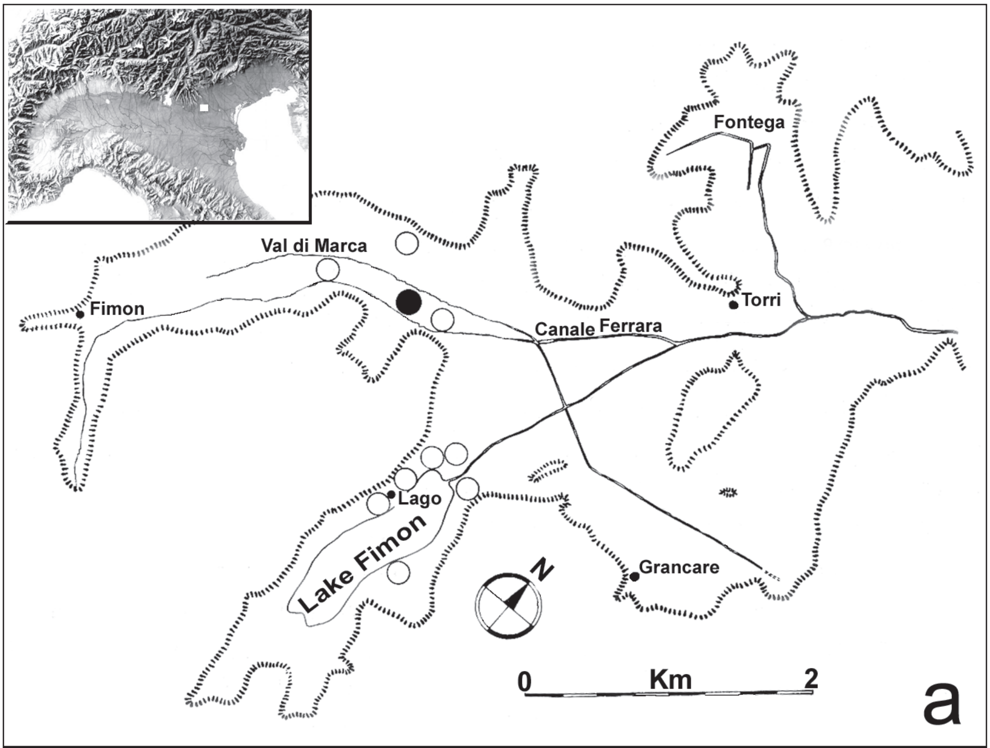
2.1. Lake Fimon

Lake Fimon is located inside a wide depression of the Berici Hills surrounded by hills 50-125m high, at an altitude of some 23m. More precisely it lies at the northern foot of Lapio Mount (Bartolomei, 1985: 17) (fig. 1a). The freshwater basin was much wider in prehistoric and historic times, at least until the beginning of the17th century, when it began to be exploited to feed the local aqueduct.

The recovery of greenstone tools in the Fimon Valley, among which are axes and one spherical mace-head, are reported from different localities (Battaglia, 1958-1959: 324; fig. 121). Two big axes were recovered also by A. Da Schio and later donated to the Vicenza Museum (Barfield and Broglio, 1986b: Fig. 9).

The excavations carried out at Molino Casarotto between 1969 and 1972 (Bagolini *et al.*, 1973) led to the discovery of three complex habitation structures along the ancient lakeshore. They consisted of small wooden poles vertically inserted in the lake marl (fig. 2), above which were placed platforms of horizontal planks with fireplaces at their centre, which had been re-built several times (fig. 3).

The chronological attribution of Fimon lake dwellings has been debated since their discovery with contrasting results mainly by P. Lioy and G. De Mortillet (see Pigorini, 1866: 241), given the uniqueness of their material culture, archaeobotanical and archaeozoological remains, represented mainly by wild species, among which red deer, roe deer and bore predominate (Jarman, 1971; see also Rowley-Conwy, 2003 for a critical view), and rare



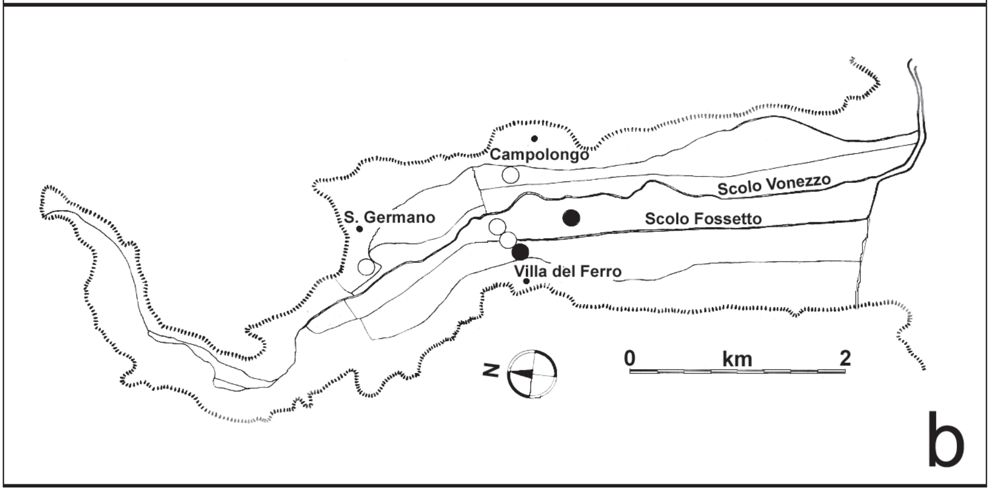


Fig. 1 - a) Distribution of the archaeological sites around Lake Fimon (circles), with the location of Molino Casarotto (dot); b) distribution of the archaeological sites of Villa del Ferro (otherwise called San Germano: circles) with the probable locations of Villa del Ferro (dots) (*drawing P. Biagi from* B*ARFIELD* *and* B*ROGLIO*, *1966: Fig. 1 and Fig. 5, with modifications*).

caryopses of domesticated wheat (Bagolini *et al*., 1973: 205). The presence of freshwater (*Unio* sp.) shell middens around the platforms, and lenses of water chestnuts (*Trapa natans*) inside the fireplaces, water tortoise and a few fish bones (Jarman *et al*., 1982: 130), indicate that hunting, fishing and the collection of wild fruits played an important role in the economic subsistence of the Square-Mouthed Pottery communities that settled at Molino Casarotto during the Middle Neolithic.

Fig. 2 - Fimon-Molino Casarotto: profile of Structure I at the end of 1969-1970 excavations, with the main fireplace in the centre. Small wooden poles inserted in the white lake marl are visible in the foreground (*photograph B. Bagolini*).

Fig. 3 - Fimon-Molino Casarotto: profile of the main fireplace of habitation Structure I at the end of 1969-1970 excavations (*photograph B. Bagolini*).

The abundance of hunting weapons, among which are many bifacial, flat-retouched, long, tanged arrowheads, and end-scrapers for hide processing (Guerreschi, 1986; Bagolini and Scanavini, 1974), would suggest that the site was seasonally, and repeatedly settled for hunting purposes by a community whose base settlement is to be sought elsewhere although not far from the water basin. This observation is reinforced by the study of the landscape surrounding the lake where "*potentially arable soils in the area are virtually non existent*" (Jarman *et al*., 1982: 130).

2.2. Villa del Ferro

As mentioned above, the exploitation of five peat-bogs that took place in 1944-1945, led to the discovery of Neolithic settlements in Val Liona, a few hundred metres south of the village of San Germano (Da Schio *et al*., 1947) (fig. 1b). The presence of Neolithic settlement structures attributable to the Middle Neolithic Square-Mouthed Pottery culture, among which are pebble and wooden features, is represented by material culture remains now in the collection of Vicenza Museum (Barfield and Broglio, 1966: 61-66). Although these authors do not mention the presence of greenstone tools, they are nevertheless reported by R. Battaglia (1958-1959: 324) "*Alle Casette nella Val di Marca, come alla Fontega e a San Germano, si ebbero parecchie accette verdi levigate*".

3. MOLINO CASAROTTO RADIOCARBON CHRONOLOGY

Samples for radiocarbon dating, mainly charcoals (Shotton *et al*., 1970; Shotton and Williams, 1973; Alessio *et al*., 1974), were taken from different levels of the thick fireplace of habitation Structure I of Molino Casarotto. Most results fall within the two centuries preceding the middle of the 6th millennium uncal BP (Bagolini *et al*., 1973: 206; Bagolini and Biagi, 1990: 14) (table 1; fig. 4). A comparable date, from carbonised wood, comes from habitation Structure III (R753a: 5680±50 uncal BP), referred to the "bonifica" discovered by G. Trevisiol (Alessio *et al*., 1974: 561), while three more assays were obtained from habitation Structure II, comprised between 5370±50 (R-764) and 5580±50 uncal BP (R-765a) (Alessio *et al*., 1974: 560, 561).

The above results are of problematic interpretation because 1) they were obtained often from groups of unidentified charcoal fragments, sometimes collected from different square metres, or 2) the results sometimes contrast with the sequence from which the samples were taken. For instance this is the case of the main fireplace of Structure I that, as mentioned above, was rebuilt many times just before the middle of the 6th millennium uncal BP. It is also difficult to state whether the three excavated Structures I-III are "contemporaneous" or represent subsequent habitation periods by members of the same (?) Square-Mouthed Pottery community, given also the limited number of radiocarbon datings from habitations II and III.

It is important to point out that the pottery assemblage from Structure I confirms the view that Molino Casarotto was settled during an advanced period in the development of the ancient phase of the Square-Mouthed Pottery culture, otherwise called Finale-Quinzano by L.H. Barfield (1972: 194), characterised by fine vessels with scratched, linear geometric patterns (Bagolini *et al*., 1979: 11), given the presence of a few incised, recurrent spiral

Lab n.	Reference n.	Uncal BP date	Habitation Structure I, Sample Location
R-750a	Fimon-MC 5	5140±50	Site 4, Sq 37J, Cut 3, Anthropic level
R-750	Fimon-MC 5	5260±50	Site 4, Sq 37J, Cut 3, Anthropic level
R-748	Fimon-MC 3	5440±50	Site 4, Sq 38K, Cut 5, Phase D main hearth
R-749a	Fimon-MC 4	5490±50	Site 4, Sq 38J, Cut 3, Anthropic level
R-747a	Fimon-MC 2	5510±50	Site 4, Sq 38kK, Cut 5, Phase E main hearth
Birm-263	Fimon-MC 18	5525±200	Site 4, Sq 38K, Cut 8B, Phase A main hearth
Birm-266	Fimon-MC 21	5555±130	Site 4, second hearth
R-749	Fimon-MC 4	5560±50	Site 4, Sq 38J, Cut 3, Anthropic level
R-746a	Fimon-MC 1	5570±50	Site 4, Sq 39K and 38-39L, Cut 4, Phase F main heart
R-748a	Fimon-MC 3	5570±50	Site 4, Sq 38K, Cut 5, Phase D main hearth
R-763a	Fimon-MC 35	5570±50	Site 4, Sq 31O, Cut 3, peripheric hearth
R-761	Fimon-MC 33	5610±50	Site 4, Sq 35-36O, Cut 3B, shell midden
R-762	Fimon-MC 34	5640±50	Site 4, Sq 34-35-36/S-T-U, Cut 3B, peripheric hearth
R-746	Fimon-MC 1	5690±50	Site 4, Sq 39K and 38-39L, Cut 4, Phase F main hearth
R-756a	Fimon-MC 27	5690±50	Site 4, Sq 38L, Cut 11, Phase A main hearth
Birm-267	Fimon-MC 22	5700±130	Site 4, 2nd settlement area
R-758a	Fimon-MC 30	5730±50	Site 4, Sq 41L, Cut 6, shell midden around main hearth
Birm-264	Fimon-MC 19	5750±135	Site 4, lowest level main midden
Birm-261	Fimon-MC 16	5780±135	Site 4
R-757a	Fimon-MC 28-29	5800±50	Site 4, Sq 38K, Cut 8B, Phase A main hearth
Birm-262	Fimon-MC 17	5820±135	Site 4, Sq 38L, Cut 11, Phase A main hearth
Birm-265	Fimon-MC 20	5930±130	Site 4, main midden, upper level

Table 1 - Fimon-Molino Casarotto: list of the radiocarbon dates from Structure I (*from* Shotton *and* Williams*, 1973;* Alessio et al.*, 1974*).

motifs, and square-mouthed open bowls, which both characterise the pottery assemblages of the mid 6th millennium uncal BP (Bagolini, 1984: 386). The above data show that, although Molino Casarotto has always been considered a typical settlement of the ancient phase of the Square-Mouthed Pottery culture (Barfield and Broglio, 1966: 87), it is undoubtedly more recent than Quinzano Veronese (Zorzi, 1955; Biagi, 1974), the assemblages from which have always been thought to characterise the early phase of this culture in the Veneto.

No radiocarbon dates are currently available for Villa del Ferro. Most of the ceramic assemblage is undoubtedly to be attributed to the early phase of the Middle Neolithic Square-Mouthed Pottery culture, due to the presence of characteristic vessel shapes, and scratched, linear decorations on a few pots, possibly indicating a habitation period slightly older than that of Molino Casarotto.

4. THE GREENSTONE TOOLS AND THEIR SCIENTIFIC STUDY

Axes/adzes, chisels and other greenstone tools from the Neolithic sites of Northern Italy are mostly manufactured from HP-metaophiolites (alpine eclogites, jades and associated minor lithologies). Ornaments are rarer, while reutilised tools are rather common. Other objects, among which are arm rings and other ornaments, hammers or polishers, are sometimes obtained from the same, or more frequently other lithologies, chosen according

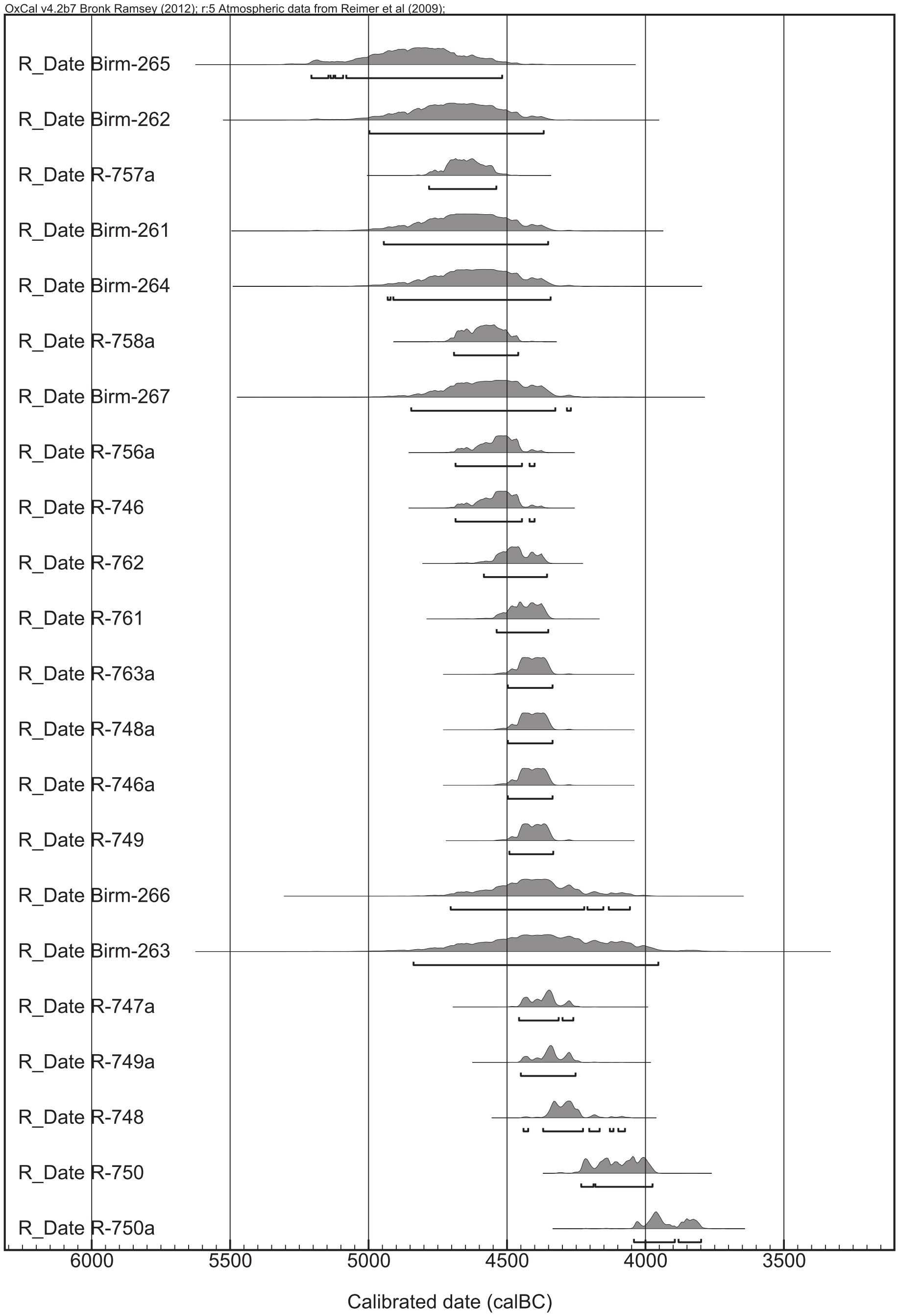


Fig. 4 - Fimon-Molino Casarotto: scatterplot of the calibrated dates from Structure I at 2 sigmas: see table 1) (*courtesy T. Fantuzzi*).

to their specific function (serpentinites, chlorite-schists, paragonite-schists, sandstones, porphyries, basaltic rocks, limestones etc.).

The HP-metaophiolites are generally of green colour (from very bright to very dark), and therefore they are called "*pietre verdi*" ("greenstones") in the Italian archaeological jargon. This term is used also for many other less abundant, or in a few cases absent, stones of green colour, which were employed during the Neolithic, among which are serpentinites, chlorite-schists, nephrites, fine-grained green tufites, and also glaucophanic rocks, whose colour is commonly bluish with green variegations. Wide information concerning the above lithologies is available from several reviews (D'Amico *et al*., 2004; 2005; 2011; D'Amico and Starnini, 2000; 2006b; 2012a; 2012c) and specific papers (Compagnoni *et al*., 1995; 2007; Chiari *et al*., 1996; D'Amico *et al*., 1997; 1998b; 2000; 2006a; 2013; Pessina and D'Amico, 1999, Perrone *et al*., 2002; Giustetto and Compagnoni, 2004; Starnini *et al*., 2004), all with a rich reference literature.

A few characters necessary for the archaeologists to distinguish and correctly define the different lithologies are listed below.

The eclogites (13 specimens from Fimon-M.C.: see table 2) recur in the compositional/textural range of all the axe/adze alpine eclogites[1] so far analysed. They are composed of Na-pyroxenes (Na-Px), usually omphacite, with a low percentage of jadeite (usually 60-75%: range 50-90%), whereas their remaining composition consists of garnets (usually 15-40%: range <5-50%), as well as many minor accessory or occasional minerals (1-10%). The garnets are often visible on the tool surface as red or brown-red grains, which make eclogites easy to distinguish from jades and other lithologies without garnets. This is not possible when a complete pseudomorphic alteration of garnets into chlorites, a green mineral, has occurred, unless the pseudomorphosis has retained the original roundness of the garnets, commonly visible through petrographic analysis.

The alpine eclogites are often fine-grained (Na-Px always submillimetric <0.01 mm up to 0.4-0.6 mm, exceptionally 0.8 mm). The garnets have a wider size range, sometimes up to 1 cm or more in diameter. The eclogite texture can be granular crystalline, though it is more frequently tectonically deformed, crushed to a finer oriented Na-pyronenic matrix, with sporadic crystalline micro-aggregates. An extreme crushing deformation characterises the mylonitic eclogites.

In a few cases whitish inserts are present within the eclogites, sometimes clearly evident as original crystals (e.g. D'Amico, 2005: fig.1; 2011: fig. 6) although stretched and shaded off. They are probably pseudomorphic, blastoporphyritic, magmatic residuals more or less deformed.

According to their Na-Px composition, the eclogites can be bright (Mg-eclogites), or dark up to nearly black (Fe-eclogites), because Mg and Fe are inversely correlated in their components, and the abundance of elementary iron produces dark colours. Intermediate cases are also frequent, due to either the gradual shaded compositions of the previous two, or the presence of a third group (see D'Amico *et al*., 2000). This distinction is impossible without a chemical bulk analysis. Obviously the Na-Px composition is a very complex: mineralogical

[1] The semiquantitative data of Molino Casarotto greenstone lithologies are not provided because of the absence of thin section analysis.

VICENZA MUSEUM NUMBER, TOOL	COLOUR, ASPECT AND TEXTURE	XRD MINERALOGY	DEFINITION	PROVENANCE	MEASURES (mm)	WEIGHT (gr)	REFERENCE	FIGURE
30601 – Nearly complete medium-large axe	Dark green, ultrafine, shear-streaked, small garnets/chlorite pseudomorphoses	Omp>>>Jd, Chl, Grt, Qtz?	**Fe-eclogite** retromorphic, mylonitic?	Fimon-MC, Structure I, Site 4, Square 41L	125x47x29	272	BAGOLINI *et al.*, 1973, fig. 22, n. 1; Table, n. 1	5, n. 1
30602 – Nearly complete medium axe	Medium dark green, fine grained, blastoporphyritic motifs	Heterog, Omp, Chl, Ttn, Ms, Ep?	**Omphacite schist**	Fimon-MC, Structure I, Site 4, Square 36O	88x48x22	134	BAGOLINI *et al.*, 1973: fig. 22, n. 2; Table, n. 7	5, n. 2
30603 – Nearly complete medium axe	Dark green, fine grained, schistose	Heterog, Omp, Chl, Grt, Ab, Act, Glf	**Fe-eclogite** retromorphic	Fimon-MC, Structure I, Site 4, Square 42M	76x46x19	103	BAGOLINI *et al.*, 1973: fig. 22, n. 5; Table, n. 9	5, n. 7
30604 – Medium-small thin axe	Blackish green, fine grained, a few garnets	No XRD	**Fe-eclogite** fine-grained	Fimon-MC, Structure I, Site 4, Square 42O	67x45x12	56	BAGOLINI *et al.*, 1973: Table, n. 10	
30606 – Nearly complete medium-large, flat axe	Blackish green, massive, crystalline, evident garnets	Omp, Grt, Qtz?, Ilm	**Fe-eclogite**	Fimon-MC, Structure I, Site 4, Square 42K	120x51x28	209	BAGOLINI *et al.*, 1973: Table, n. 2	
30607 – Complete medium-large axe	Medium bright green, maculated, fine, blastoporphyritic, garnets up to 1mm	No XRD	**Mg-eclogite** blastoporphyritic	Fimon-MC, Structure I, Site 4, Square 38H	110x52x26	244	BAGOLINI *et al.*, 1973: Table, n. 3	
30608 –.Nearly complete medium size axe	Speckled, dark-bright green (bluish?), intersertal texture, possible garnets	Glf, Act, Ab, Chl, Zo, Ep, Grt, Ilm	**Glaucophanic rock** metabasaltic texture	Fimon-MC, Structure I, Site 4, Square 36P	90x49x23	145	BAGOLINI *et al.*, 1973: Table, n. 5	
30609 – Nearly complete medium size axe	Very dark green, many garnets	Omp, Chl, Grt, Rt	**Fe-eclogite** moderately retromorphic	Fimon-MC, Structure I, Site 4, Square 37L	86x38x19	113	BAGOLINI *et al.*, 1973: Table, n. 8	
30610 – Complete medium-large, convex axe	Medium bright green, maculated , crystalline blastoporphyritic, oriented, small garnets	Omp+Jd tr, Chl, Grt, Zo/Ep, Ab, Pg, Glf, Rt	**Mg-eclogite** blastopor-phyritic, retromorphic	Fimon-MC, Structure I, Site 4, Square 40K	111x48x26	211	BAGOLINI *et al.*, 1973: Table, n. 4	
30612 – Small axe fragmented and worn-out	Light green, fine crystalline, translucent, evident rutile	Jd>>Omp >95%, Rt	**Mixed jade** shading to jadeitite	Fimon-MC, Structure I, Site 4, Square 35L	58x42x9	32	BAGOLINI *et al.*, 1973: Table, n. 12	
30613 – Nearly complete medium size axe	Bright green, dull, homogeneous, finely crystalline	Jd about 100%, tr Pg	**Jadeitite**	Fimon-MC, Structure I, Site 4, Square 38H	86x43x24	136	BAGOLINI *et al.*, 1973: Table, n. 6	
30614 – Small, worn-out axe	Bright green, speckled, schistose, crystalline	Heterog Omp, Grt, Chl, tr Pg	**Mg-eclogite** retromorphic	Fimon-MC, Structure I, Site 4, Square 39O	45x34x7	20	BAGOLINI *et al.*, 1973: fig. 22, n. 8; Table, n. 13	5, n. 5
30615 – Small chisel, broken at one end	Medium bright green, evident garnets, blastoporphyritic	Omp, Grt, Ab, Ep, Pg, tr Chl, Zrn,	**Mg-eclogite** a little retromorphic	Fimon-MC, Structure I, Site 4, Square ?	53x22x11	23	BAGOLINI *et al.*, 1973: fig. 22, n. 3	5, n. 3
30616 – Small axe butt	Dark green, ultrafine	Na-px (Fe-Jd or Fe-Omp) >95%, Zrn	**Fe-jade** Fe-jadeitite grading Fe-omphacitite	Fimon-MC, Structure I, Site 4, Square 36J	28x27x9	10	BAGOLINI *et al.*, 1973: fig. 22, n. 4	5, n. 4
30617 – Fragment of axe/adze butt	Medium green, crystalline	Jd >95%, Zrn	**Jadeitite**	Fimon-MC, Structure I, Site 4, Square 39H	18x21x7	4	BAGOLINI *et al.*, 1973: 189, not illustrated	
32197 – Complete, medium sized, convex axe	Light green, maculated, translucent, ultra-fine, weighty, a dark mylonitic stripe	No XRD	**Jade** not specified	Fimon-MC, Structure III, Site 3, Square 40I	19x21x7	4	BAGOLINI *et al.*, 1973: Table, n. 15	
32199 – Nearly complete small axe	Medium green, evident diffuse garnets	Omp, Grt, tr Chl, Rt	**Eclogite** (Mg-?)	Structure 3, Site 3, Square 37F	64x35x11	50	BAGOLINI *et al.*, 1973: fig. 22, n. 6; Table, n. 17	5, n. 6
133873 – Fragment of pebble used as polisher	Brown peckled (oxidized)	Spt, a few Mgt	**Serpentinite** oxidized	Fimon-MC, Structure II, Site 4, Square 28CC	49x42x28	Not taken	Unpublished	
164013 – Rough-out of large adze, harsh, curved blade	Medium dark green, schistose, rich in garnets, evident white mica	Omp>>Jd, Grt, abund. Chl, Rt, Pg, Ab?, Qtz?	**Eclogite** (intermediate?) chloritized	Valli di Fimon, Surface	255x91x11	Not taken	BARFIELD and BROGLIO, 1986: 32, upper left	6, n. 1
164014 – Big axe broken and reconjoined, without cutting edge	Very dark green, visible garnets and pyrite, shear/laser texture	Fe-Glf (crossite ?), Chl, Ab, Grt, Rt	**Fe-glaucophanic garnetiferous schist**	Valli di Fimon, Surface	257x70x28	Not taken	BARFIELD and BROGLIO, 1986: 32, upper right	6, n. 2
80323/1 – Intact, medium -small squat axe	Medium-dark green, massive, irregularly distributed garnets	No XRD	**Eclogite** (Fe-?)	Villa del Ferro	72x48x21	Not taken	Unpublished	
80323/2 – Complete medium-large axe	Medium green, speckled, schistose by shear, small garnets in laminae	Omp, Grt, Chl, Ilm	**Eclogite** (intermediate?)	Villa del Ferro	110x51x24	Not taken	Unpublished	
80323/3 – Small axe	Dark green dotted with blastoporphyritic remanants, no garnet visible	No XRD	**Fe- jade?**	Villa del Ferro	41x28x10	Not taken	Unpublished	

Table 2 - Archaeometric and other data of the greenstone tools from Fimon-Molino Casarotto, Valli di Fimon and Villa del Ferro.

problem (for an exhaustive explanation for non-specialists see D'Amico *et al*., 2004; 2013; D'Amico, 2011 and other papers mentioned above).

Only 1 tool made from omphacite(-jadeite) schist comes from Fimon (table 2: fig. 5, n. 2). This specimen is similar to others made from of this uncommon lithology, which recurs from many assemblages (see D'Amico *et al*. 2004; D'Amico and Starnini, 2006; D'Amico, 2011). They are often very deformed, distinguishable from the eclogites because of the absence of garnets (or pseudomorphic chlorite), and from the jades for the relative abundance of mineral components other than Na-Px.

The 6 jades (or Na-pyroxenites) are the second lithologic group, with some 90% (range 85-99%) Na-Pyroxenes (Na-Px: jadeite or omphacite or a very complex mixture of the two). Jadeitites and omphacitites are jades with >90% of one of the two main components, whereas mixed jades contain both components in quantities conventionally higher than 10% each. The Na-Px mineralogical system is very complex along a variation continuum in composition (see D'Amico *et al*., 2004; 2013 note in 3.1; D'Amico and Starnini, 2006; D'Amico, 2011), and a rigid separation between jadeitites, correspondently omphacitites and mixed jades is rather conventional and shaded. From an archaeometric point of view, these distinctions are irrelevant for a general or preliminary interpretation of their provenance, although they can be useful for more advanced archaeometric considerations, regarding extended comparisons and circulation patterns (see D'Amico, 2011; D'Amico and Starnini, 2006b; 2012a; 2012b).

Only the following considerations are considered to be relevant. Most eclogites can be easily distinguished from jades and omphacite schists thanks to the presence of garnet, if they are not too small or totally altered to chlorite. In these case eclogites cannot be distinguished from jades or omphacite schists at naked eye but only through thin sections and/or XRD. Similarly the presence of jadeite instead of, or with omphacite, and textural differences, presence and abundance of minor minerals etc. are impossible to be detected without a more complete petrographic study.

The green colour of eclogites and jades can considerably vary from very bright to very dark according to their iron content, or more precisely the variable ratios Al/Fe and/or Mg/Fe (see D'Amico *et al*., 2004: 24-27; 2013, footnote of 3.1; D'Amico, 2011: 2.3). Both Fe-rich jades and eclogites are dark, and Fe-poor lithologies bright, with many gradations. Thus, it is incorrect to define the bright tools jadeitites, and the dark ones omphacitites (see D'Amico and Starnini, 2006b; 2012a; 2012b; D'Amico, 2011; D'Amico *et al*., 2013).

To sum up, a confident lithological attribution of a stone can be provided only after a specific petrographic description. In the other cases one must be aware of the fact that discrete limits exist, and it is safer to use more generic terms, such as eclogites (garnets definable) and jades (garnets invisible), and Fe-jades or Fe-eclogites, according to their chromatic characteristic. Furthermore archaeologists must be aware of the fact that generic definitions can produce minor statistical errors, because at naked eye so-called "jades" might sometimes look like omphacite schists, chloritized eclogites etc.. The experience of a petro-archaeometer, and the petrographic analysis of an entire assemblage can reduce the error rate to less than 1%. The definitions given in table 2 follow the above criteria.

Two other HP-ophiolitic lithologies are present among the Fimon polished tools (table 2). One is serpentinite, an ultramafic, low-medium temperature, metamorphic rock, derived by hydration of original mantle peridotites. They are composed of one or more serpentine minerals and magnetite in various proportions, less frequently by other minor minerals of various significance (pyroxenes, amphiboles, spinel, chlorite, talk etc.). Serpentinites may be relatively abundant in some Neolithic sites of Northern Italy.

The second different lithology of table 2 consists of glaucophanic rocks, more sporadic or absent from several North Italian Neolithic sites, except for the Rivanazzano workshop (D'Amico and Starnini, 2006a; 2007; 2012b). It consists of HP-metaophiolites of lower pressure than that of the preceding ones, which was much lesser utilised for the manufacture of Neolithic tools. Nevertheless their presence in a low quantity might be an index for comparison and a better understanding of circulation models (see paragraphs 5. and 6. below).

5. THE FIMON-MOLINO CASAROTTO GREENSTONES

Table 2 and fig. 5 show the characteristics and provenance of 23 greenstone tools taken into consideration in this paper. The most important assemblage comes from the excavations carried out at Fimon-Molino Casarotto, a lake-dwelling site located along the ancient shore of the homonymous lake (18 tools), while the other two sites, Villa del Ferro and Valli di Fimon yielded only 3 tools, and 2 big axes respectively, which makes the comparison between the three assemblages difficult. This is why the above complexes have been considered together.

According to their lithology, all the 23 tools show the petrographic characteristics described in paragraph 4. They can be closely compared with those of the greenstones from many other Neolithic sites in Northern Italy (see D'Amico *et al*., 2004; D'Amico and Starnini, 2006; D'Amico, 2011 with references), for both the nature of the stones, and the quantitative ratio between prevalent eclogites and less abundant jades (13=54% vs. 6=25% respectively), as well as the lower recurrence of other lithologies among which are omphacite schist (1), glaucophane schists (2), and serpentinite (1).

Therefore the Molino Casarotto greenstones fit well into the general pattern of the North Italian greenstone assemblages, with the same problems of interpretation briefly discussed below.

It is important to point out that the methods utilised for the analysis of the implements from Molino Casarotto are less complete than those employed for the study of the greenstones from other Neolithic sites, among which are the large assemblages from Sammardenchia, Udine (D'Amico *et al*., 1997), Alba, Cuneo (D'Amico *et al*., 2000), Gaione, Parma (Bernabò Brea *et al*., 1996; Andò, 1997), and the smaller collections from Ponte Ghiara, Parma (Bernabò Brea *et al*., 2000), Brignano Frascata, Alessandria (Zamagni, 1996; D'Amico *et al*., 1996; 2000; D'Amico and Starnini, 2012), Vhò and Ostiano, Cremona (D'Amico, 1995; Starnini *et al*., 2004), Brescia-Mantova provinces (Starnini *et al*., 2004) S. Lazzaro di Savena, Reggio Emilia (D'Amico *et al*., 2013), and other unpublished finds from Trentino and Friuli.

All the above assemblages were analysed not only with simple methods, such as naked-eye, lens, surface microscopy, density evaluations, but also systematically with instrumental methods such as X-Ray Diffraction (XRD) and thin section, and less systematically bulk chemical and mineral SEM-EDS analyses. The critical use of all these methods provides a

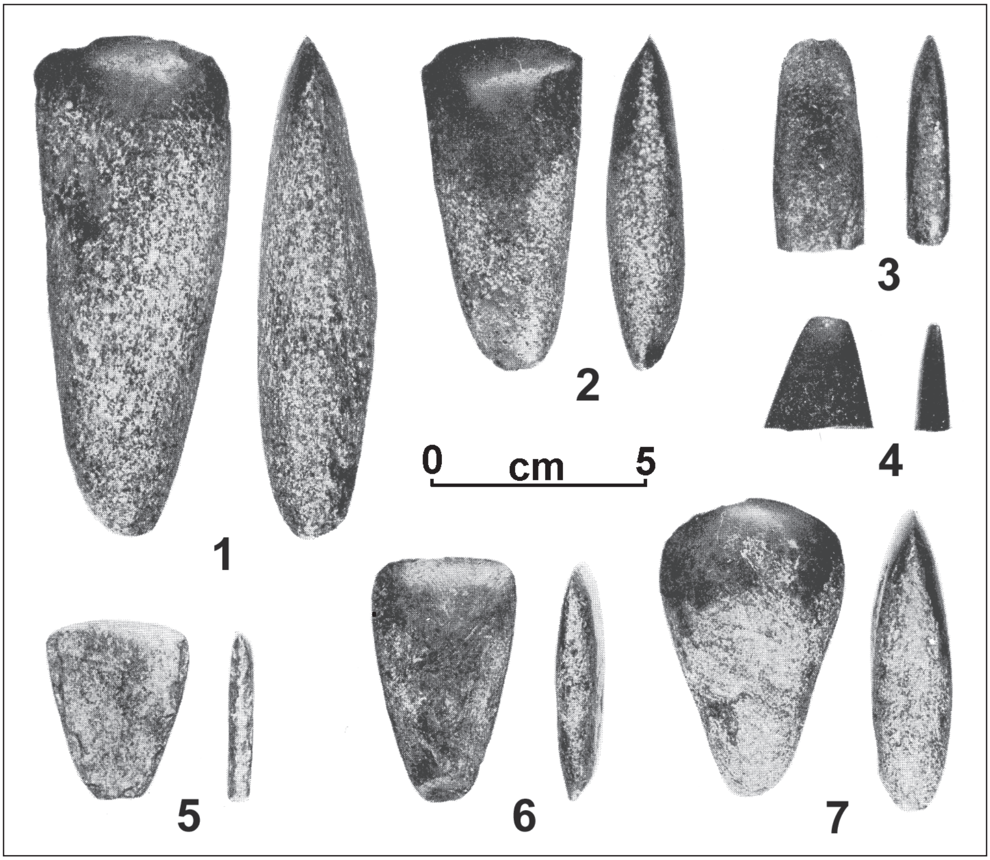


Fig. 5 - Fimon-Molino Casarotto: Greenstone tools from Structures I (nn. 1-5, 7) and III (n. 6) (*from* Bagolini et al., *1973: Fig. 22*).

well-founded, general definition for making secure comparisons. Their absence would lead to uncertainty or ambiguity about several details, among which are texture and chemical characters, presence of minor minerals, detailed distinction of jades etc., making the comparison between assemblages more uncertain.

A similar limit does exist for the Molino Casarotto greenstones, for which instrumental methods have not been employed in most cases, except for XRD (see table 2). However, we believe in satisfactorily confident definitions, given the author's (C.D'A.) long experience in correlating simple optical data with XRD identifications, based on the analysis of some 1000 greenstone HP-metaophiolites. Consequently not all the characteristics (e.g. fine textures, minor minerals, etc.) which might be useful for more detailed comparisons can be provided, but those essential to compare the Molino Casarotto implements with all the other Neolithic greenstone tools of Northern Italy are there. The cases that follow illustrate the nature of the above-mentioned limits, which do not hinder a confident essential definition and interpretation from both archaeometric and archaeological point of views.

Three eclogites have not been analysed by XRD because of the presence of garnets characteristic enough for their precise definition at naked eye and stereo-microscopic observation. Mg- and Fe-eclogites have been distinguished respectively according to their bright and dark colour. The eclogites of intermediate colour are more uncertain in absence of chemical analysis, though this characteristic is less important in the general framework of the study assemblage compared to other collections.

Two intact jades have not been examined by XRD because of preservation reasons, in order to avoid their damage during the extraction of powder for XRD analysis. Nevertheless their attribution is certain on the basis of an experienced eye. Given the absence of any XRD identification, they have been reported simply as jades (table 2; see also paragraph 4.), without any further specification, except for one dark tool easily definable as a Fe-jade. The other jades have been defined through XRD analysis, thanks to which 2 jadeitites, 1 mixed jade and 1 Fe-jadeitite grading to a Fe-omphacitite at the compositional limit of the two were identified (see D'Amico *et al*., 2013 footnote of paragraph 3.).

6. DISCUSSION

The petrographic characteristics of all the Molino Casarotto tools fit fairly well into the parameters already established for all the other North Italian Middle Neolithic greenstone assemblages (D'Amico *et al*., 2004; D'Amico and Starnini, 2006; D'Amico, 2011 and references), showing that they belong to the same model of circulation and trade.

The prevalence of eclogites over jades (E/E+J=70), the presence of a few omphacite schist and glaucophane rocks characterises the polished stone assemblages of the Square-Mouthed Pottery culture sites located east of Rivanazzano (D'Amico and Starnini, 2006b; 2007; 2012a; 2012b, in which the provenance of greenstones is widely discussed). These features are fundamental for the interpretation of the greenstones trade and circulation concerning all the Middle Neolithic Square-Mouthed Pottery sites located east of this important production centre. This model contrasts with the pattern at present available for the Early Neolithic settlements in general, as well as for the Middle Neolithic sites known west of Rivanazzano, as is shown from the data from the few available cases. According to the above information, Rivanazzano workshop (or similar sites so far undiscovered, eventually located along the north-west Apennine foothill) is at present considered the most important greenstone supplier of all the northeast Italian Middle Neolithic sites. Only the unpublished serpentinite pebble-polisher in table 2 (n. 133873) might have been sourced from in the detritus of the Adige riverbed (Lunardi, 2003).

Rivanazzano is located along the northern fringes of the Apennine foothills of Oltrepo Pavese (southwestern Lombardy). The area is very rich in HP-metaophiolitic detrital stones derived from the Oligocene conglomerates of the northwestern Apennine. Similar deposits are known all over the surrounding territory (e.g. Brignano Frascata in southeastern Piedmont: Zamagni, 1996; D'Amico *at al*., 2000; D'Amico and Starnini, 2012), where other greenstone sources, similar to those from Rivanazzano, are expected to be located, within the so-called "Rivanazzano model", given the key role played by this workshop as the most important production and distribution centre so far discovered. The above data (D'Amico and

Starnini, 2006a; 2006b; 2007; 2012a; 2012b; 2012c; D'Amico, 2011) show that most of the greenstones recovered from the sites located east of Rivanazzano were supplied from this centre, and/or other sites located in its surrounding territory. This suggestion can be applied also to the Fimon assemblage.

Molino Casarotto yielded a great variety of greenstone axes/adzes, from very small to large specimens (table 2), most of which were recovered around the large fireplace of Structure I (Lunardi, in prep.). Many tools are complete or almost complete, while a relatively low number is fragmented. The assemblages include also one chisel (fig. 5, n. 3).

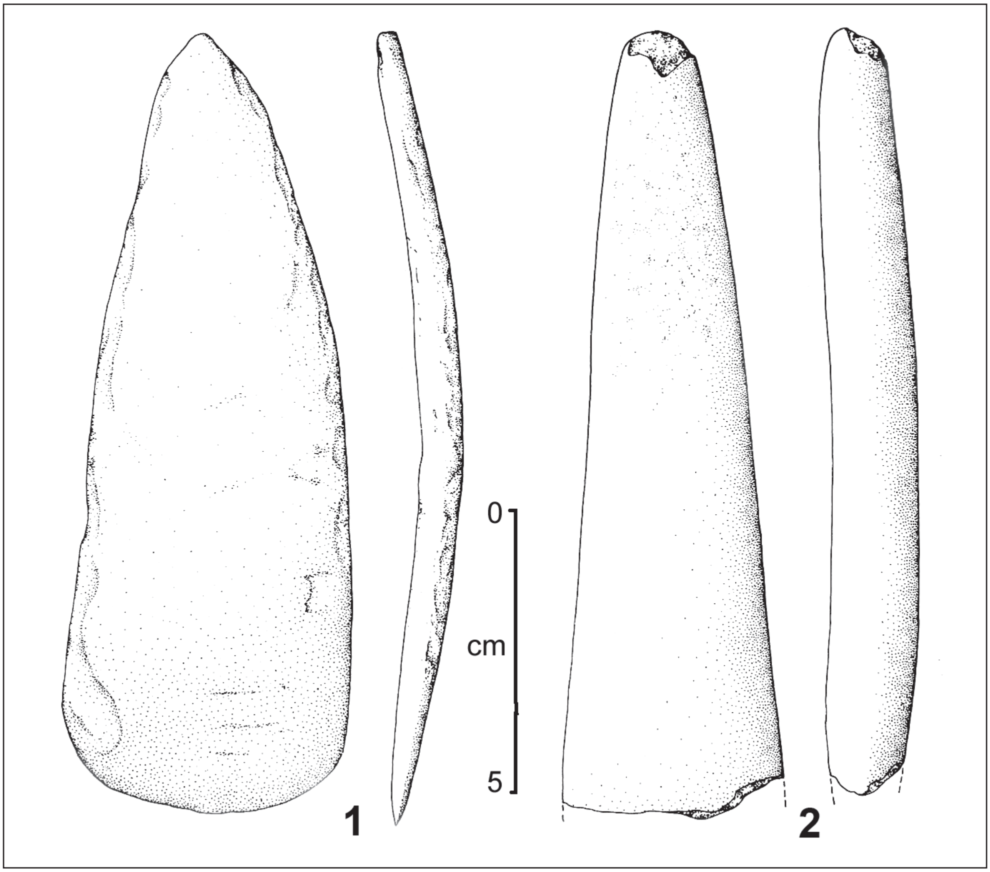


Fig. 6 - Valli di Fimon: Rough-out of large, curved adze (n. 1) and large, broken axe (n. 2) (*from* Barfield *and* Broglio, *1986b: 32*).

It might be important to point out that the only two very large tools obtained from eclogite (fig. 6, n. 1) and glaucophanic schist (fig. 6, n. 2) are old surface finds from unknown localities of Valli di Fimon (Barfield and Broglio, 1986b: 32), which makes the definition of their age most problematic.

Acknowledgements

The authors are very grateful to Drs. A. Dallago, Director of Vicenza Museum, A. Lunardi and E. Starnini (Archaeological Superintendency, Genoa) for their assistance in the reanalysis of the greenstone tools, the useful information, and the critical reading of the manuscript. Special thanks are due to Dr. B.A. Voytek (Berkeley University, USA) for the revision of the original English text.

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