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Variscite, a prestige mineral in the Neolithic-Aeneolithic Europe. Raw material sources and possible distribution routes

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Abstract: In all cases, we have new and interesting data about the possible trade routes of distribution of this mineral, in a broad period of the European prehistory, with the verification that a wide geographical distribution phenomenon of this has existed, with distances of many hundred of kilometres from the extraction site. Raw material areas for this mineral exploitation, at least in specific periods of the European prehistory, not only are placed in the well know mines of Gavá, NE Spain, exploited in a period about 5000-6000 years ago; but we have constancy of the existence of other prehistoric exploitations in the Encinasola area (Huelva, SW Spain) and other mining activity areas, probably prehistoric and reworked in Roman and Muslim times, in Palazuelos de las Cuevas and other sites of the Aliste area, in Zamora (NW Spain). There are no evidences up to the moment, of the existence of other localities with variscite mining activities, in the other geological outcrops cited in the Iberian Peninsula and in the rest of Europe.

Key words: variscite, raw material, Neolithic-Aeneolithic, Spain

Introduction

Variscite ($AlPO_4 . 2H_2O$) is a green mineral that has a great importance and diffusion, as prestige objects, in the South Western European Neolithic-Aeneolithic societies.

Archaeological objects made in this mineral, generally collar beads, appear with relatively frequency. Their size and morphology are variable, within a range between 3 and 50 mm long and plate cylinders, elongated cylinders, barrel or drop shapes; in all cases with orifices made in general by double perforation and 1-3 mm in diameter (Fig. 1).

Mineralogy and geological context of variscite

The colour of these objects are variable, they may vary between a pale green, bluish green to an intense emerald green, and in many cases brownish green or pale green with black veins. Variscite is an hydrated mineral of the phosphate group ($Al PO_4 . 2H_2O$), orthorhombic system, Kniep et al., (1977); with a chemical composition of 32,26 % in Al_2O_3, 44,94 % in P_2O_5 and a 22,80 % of H_2O, approximately; and impurities basically of iron, Rosell et al. (1993). It can present two polymorph varieties; the Messbach type variscite and the Lucin variscite, that only differ in their unit cell dimensions. Other minerals of this group as Strengite $Fe_3+ PO_4 . 2H_2O$, and the monoclinic variables metavariscite and metastrengite, can be present in their paragenesis; furthermore turquoise Cu $Al_6 (PO_4)_4 (OH)_8 . 4H_2O$), can appear, as it occurs in the Gavá-Montcada i Reixac area outcrops, in Barcelona (NE Spain) and in many outcrops of the NW of Spain and North of Portugal. Phosphate mineralization generally appears as nodules of variscite (Fig. 2) associated to primary stratiform deposits, in association with Silurian - Devonian metasediments and silexites from the Hesperico Massif, as occurs in the West of Iberian Peninsula. In general, a secondary mineralization as veins of variscite and other phosphates also appear (Fig. 3A and 3B), that proceed from the remobilisation of the primary deposits, Moro et al., (1992a).

Archaeological remarks

The description of these materials from this historical context, in the archaeological literature, has conduced to a great confusion about the real mineralogy of each object, describing all the beads and pendants with the generic nomenclature of "callaite", term given by Pliny (*Natural History, XXXVIII*) and which has subsisted up to the nineties in the European archaeological literature, Damour (1864); Munoz Amilibia (1971); Edo et al., (1995). Edo et al. (1997). This term has nowadays almost been left out, since in many cases the variscite beads appear associated in the archaeological contexts, with other green beads, but made in other minerals as muscovite, steatite, jade, or rocks as serpentinite, Munoz Amilibia (1971); Salvado Canelas (1973); Vázquez Varela (1975); Fernández and Pérez (1988).

The fact that these mineral associations appear in the European archaeological register, with a great variability of mineral compositions, geological and geographical provenances, but with the green colour as common feature, suggests that the colour of these beads or pendants is the main characteristic search by these communities, independently of its composition, hardness, etc. This intense green colour must constitute a prestige signal or

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Fig. 1. Green and pale bluish green beads of variscite (1,5 to 1,7 cm. long). Alberite Dolmen, Cádiz, SW Spain.

Fig. 2. Variscite nodule of a intense green colour. Silurian meta-sediments from Palazuelos de las Cuevas (Zamora, NW Spain).

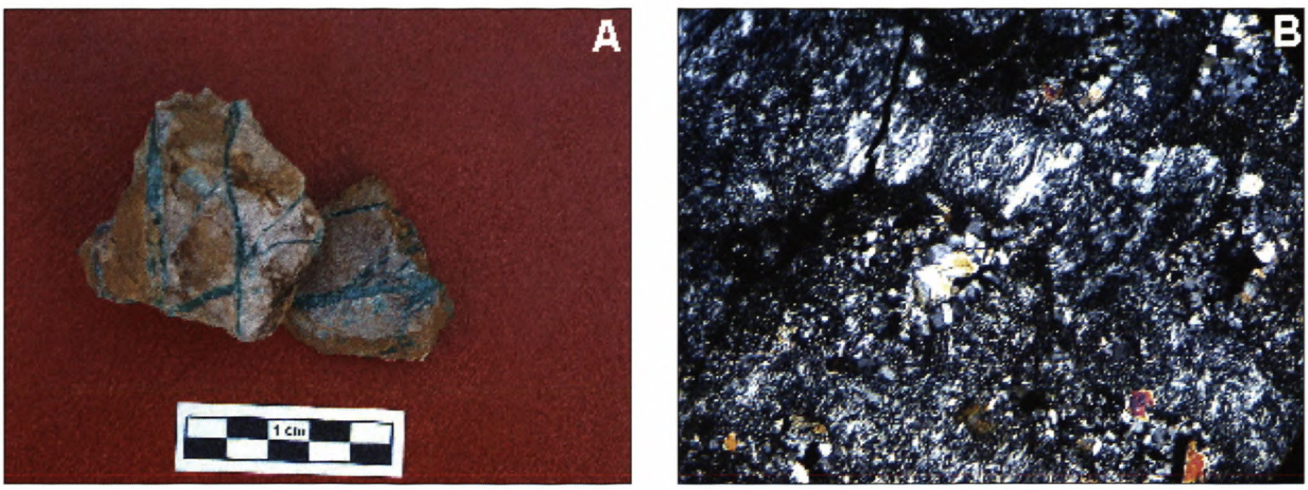

Fig. 3.
A: variscite vein in Silurian shale from Palazuelos de las Cuevas (Aliste area, Zamora province, NW Spain). B: Micrograph of the same variscite sample. Cross polars. Diameter = 1,2 mm.

has been a certain ritual significance, much esteemed by the dominant members of the communities or the power elites in these. This idea confirms the fact that in general, the big collars of these green minerals only appeared in the burials of the members of the elites, as occurs specially in a 2500 years period, in the west of France, specially in Bretagne, Damour (1864); Forestier et al. (1973); Querré et al. (2001); Sherrat (1990); also in Le Midi (SE France), Arnal (1970), and in the Iberian Peninsula in Galicia (NW Spain), Vázquez-Varela (1975); Portugal, Huet B. Gonçalves (1980); Extremadura and Andalucía, Ramos Munoz and Giles (1996); Martínez and Pereda (1991), Nocete et al. (1999); or in the culture of "sepulturas en fosa" in Catalonia, Munoz Amilibia (1965). This phenomenon remain just the early Bronze Age, green beads can appear in Campaniform contexts, Pozo et al. (2002). In the nineteenth century, green beads are also cited in the Neolithic burials from Brittany. Therefore, variscite and turquoise at these funerary environments between the Neolithic and the beginning of the Bronze Age, appear associated with other minerals and materials, that should have had a prestige or ritual significance, as the cinnabar, amber, quartz crystals, ivory and jet, Domínguez-Bella and Morata (1995). Big knifes made in flint, are also present in these trousseaus; and axes, chisels and gouges, in polished stones, as occur in Alberite (V th and IV th millennia B.C.) Ramos-Munoz & Giles (1996) and Tomillo dolmens (IV-III th millennia B.C.), Martínez and Pereda, (1991); from Cádiz province (SW Spain) and at a great number of archaeological sites in west Europe.

The appearance and extension of the variscite collars and pendants are present in the Neolithic of the west and south-west of Europe, starting from the VI millennia B.C. and their use were extended at least until the II millennia B.C. After, in the Roman Empire, their mining exploitation in many mineral outcrops at the west of Spain continues, Campano et al. (1985).

Geological source areas of variscite in Europe.

The geological features of the variscite bearing rocks outcrops that are located specially in the Iberian Peninsula present in general two types of deposits, primary stratiform deposits and secondary vein deposits, in both cases associated to metasediments (shales with black cherts and quartzites) of Silurian-Devonian age.

These types of outcrops are cited in the Palaeozoic of the Transmontana region at the North of Portugal, Meirelles et al., (1987); provinces of Zamora and Huelva (Moro et al., 1992a; Moro et al., 1992b; Moro et al., 1995b) at the West of Spain; Galicia at the NW Spain (Moro et al., 1995a) and the Coastal Cordillera of Catalonia, in Barcelona area, NE Spain, Mata et al. (1983) (Fig. 4). Others geological outcrops with variscite presence are cited in Pannecé, Loire-Atlantique (France), Forestier et al. (1973) and in Cerdena, Gimeno (1988). This mineral receives its name from the region of Variscia (Vogtland), in Germany, where it appears as nodules in little outcrops of aluminous shales in Messbach and Dornsdorf; is cited also in Brandberg, Leoben, Austria and in Trénice (Czech Republic).

According to the studies that were made up to the moment, it seems that the unique variscite and turquoise outcrops, mined in the prehistory of Europe, are located in the Iberian Peninsula. The prehistoric mines of variscite and turquoise with black flint, are well known in Can Tintorer, Gavá (Barcelona, NE Spain), Rosell et al. (1993), although they are clear signs of the existence of a prehistoric mining of variscite in Encinasola (Huelva, SW Spain), Nocete and Linares (1999: Fig. 5). In Palazuelos de las Cuevas (Zamora, West Spain), the manufacture of collar beads in Roman and Muslim periods have been documented, and also the presence of many beads that present different technology, that appear to be oldest, Campano et al. (1985). At the hill of Teso

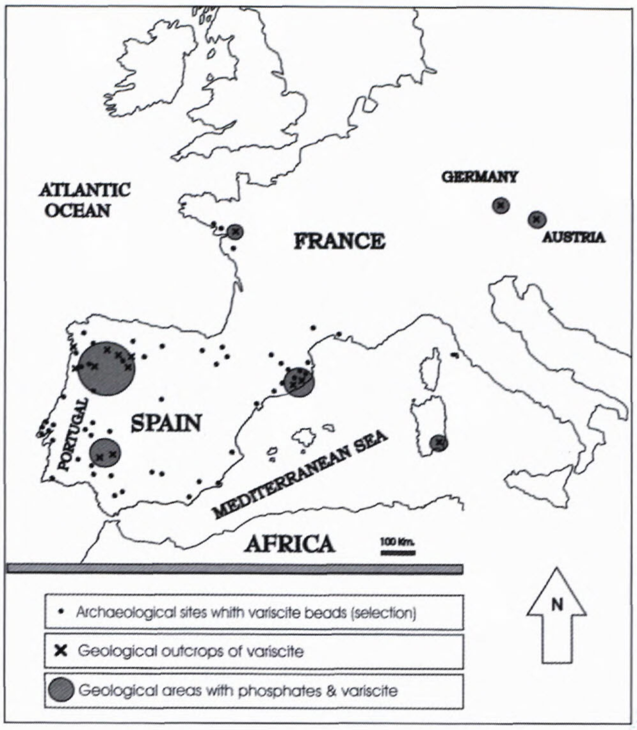

Fig. 4. Geographical emplacement of many of the most important archaeological founds of variscite and geological outcrops in Europe

del Diablo, in Palazuelos area, we can observe clear vestiges of mining, specially by the open air trench method (Fig. 6), with use of stone tools to work the variscite veins (Fig. 7), that were signalled also by other authors as Arribas et al. (1971) and Campano et al. (1985), and that have, for the early steps of the exploitation development, a chronology probably pre-Roman.

Possible distribution routes of variscite in Europe during the Prehistory.

Mineralogical characterization of samples from different outcrops in the Iberian Peninsula were made by different authors (Huet B. Gonçalves (1980); Huet B. Gonçalves et al. (1982); Meirelles et al. (1987); Edo et al. (1998), Moro et al. (1992b); Moro et al. (1995 a); Moro et al. (1995b); Salvado Canelas, (1973) and geochemical analysis (Rosell et al. (1993), Domínguez-Bella et al. (2002) and (2003); Rojo et al.(1995); Querré et al. (2001); Blanco et al. (1995) so we can realize comparative studies with archaeological materials (Table I) and establish the possible trade routes and the mobility of this material during the European prehistory, Whittle (1996). In this line, different authors have studied collar beads from the culture of the "sepulcros en fosa" in Catalonia, Edo et al. (1995 and 1998); from the Spanish Pyrenees, Utrilla et al. (1998); Domínguez Bella et al. (2002); from the Midi in SE France, Chantret et al. (1970); from the Bretagne (West of France), Querré et al. (2001); from the North of Spain, Rojo et al. (1995); Edo et al. (1997); from the Southwest of Spain (Domínguez-Bella et al. 2002) and from the Southeast of Spain (Pozo et al. 2002).

The mineralogical, petrological and geochemical characterization of the different outcrops with variscite

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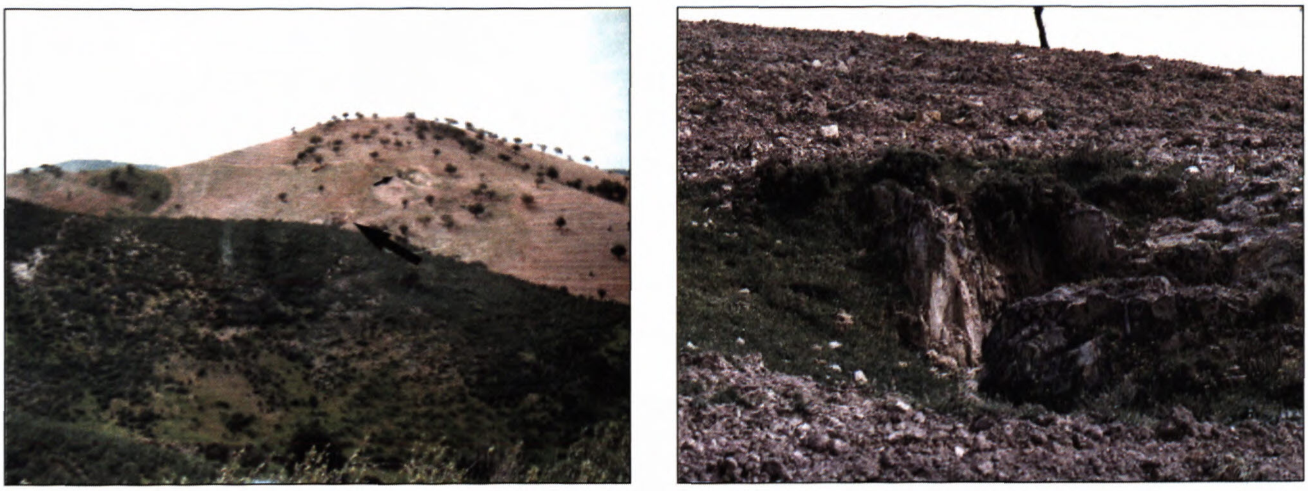

Fig. 5. Prehistoric open air mining activity for the variscite extraction remains, in Pico Centeno, Encinasola area (Huelva, SW Spain).

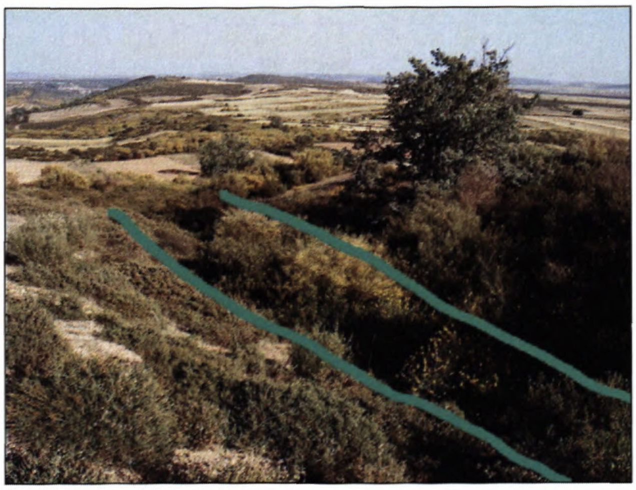

Fig. 6. Open air trench for variscita mining, probably pre-roman, in Palazuelos de las Cuevas area (Zamora, NW Spain). Trench excavations allows the verticals veins of phosphate minerals.

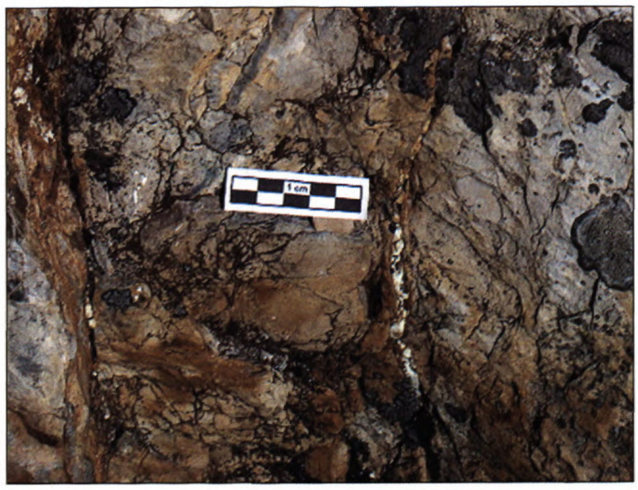

Fig. 7. Vertical vein (1,5 cms wide) of variscite in the open air trench. Palazuelos de las Cuevas, Zamora, Spain.

show, in general, quite paragenetic and geochemical similitude between them, at least in the outcrops from the west of Iberian Peninsula.

The obtained results up to this moment (Fig. 8) show the existence of different production and distribution areas for these lithic products. The variscite mining in Catalonia (Gavá Mines) seems to supply the North zone, Guerra et al., (1995), Edo et. al. (1997) and at least, a part of the northeast of Spain (Blasco et al. 1992) and the south and southeast of France.

Variscite outcrops from the west of Iberian Peninsula, seem to distribute materials to the south west and the west half of Iberian Peninsula, Domínguez-Bella and Morata (1996), Domínguez-Bella et al. (2002); Blanco et al. (1995); Nocete and Linares (1999), even also at the north zone of Spain and maybe at the north of the Pyrenees, in the west coast of France, Querré et al. (2001).

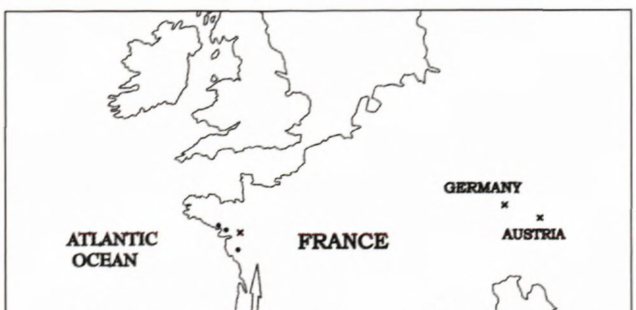

Fig. 8. Geographical distribution of a selection of most important archaeological sites with presence of variscite, the known geological outcrops and the possible trade routes along SW Europe.

Tab. 1. Geochemical analysis of geological variscites in Europe. (after Edo et al., 1998 and others; and Domínguez-Bella).*

ELEMENTS	PALAZUELOS AREA (NW Spain)	ENCINASOLA AREA (SW Spain)	CAN TINTORER MINE (Catalonia, NE Spain)*	VARISCITE ARCHAEOL. BEADS (Catalonia)*	PANNECE (France)*	SARRABÚS (Sardinia)*
P_2O_5	43,32 %	46,20	42,47	42,65	45,63	39,26
AL_2O_3	30,20	30,40	26,73	28	30,91	35,18
Fe_2O_3	1,09	1,64	6,03	4,23	0,08	1,97
SiO_2	1,90	0,74	1,07	1,20	Tr.	–
CaO	–	–	1,77	1,16	–	–
K_2O	0,02	0,02	0,21	0,27	Tr.	–
MnO	–	–	<0,01	<0,01	Tr.	–
TiO_2	0,14	0,09	0,03-0,42	–	–	–
MgO	–	–	<0,14	0,14	Tr.	–
CuO	0,03	0,02	0,02	0,31	–	1,52
Cr	0,54	0,13	0,07	0,13	0,01	0,01
As	–	–	0,34	0,21	–	–
Ni	0,005	–	<0,003	0,0026	Tr.	–
V	–	0,25	0,047	0,12	–	–
Na_2O	–	–	–	–	0,14	–
H_2O	21,50	21,90	21,51	21,63	23,28	21,89

Forestier et al. (1973), did not discard a local origin for the variscite from the Neolithic sites of the west of France, specially after the discovering of the phosphate ore outcrop at Pannecé (Loire-Atlantique, France); however, after the study of Querré et al. (2001), a allochtonous provenance for these beads of variscite appears clear, in short, with an origin in the Iberian Peninsula, which implies distribution routes of many hundred of kilometres for the variscite beads.

Different studies about the geochemistry of mayor, minor and trace elements have been carried out, with a classification matrix after the Discriminant Function Analysis of complete analysed samples by ICPMS-LA, MEB-EDX, FTIR spectroscopy, optical microscopy (Domínguez-Bella et al. 2002), with a model of 13 geochemical variables (SiO_2 , Al_2O_3 , P_2O_5, FeO, CaO, Cr_2O_3, Cr, Ti, Sm, Eu, Dy, Tm, Yb), both of geological representative from all Iberian Peninsula as well as, archaeological samples, specially from the South half of this, Domínguez-Bella et al. (2002). New analysis, with ICP-MS, XRF and isotopic analysis are nowadays in course, Domínguez-Bella et al. (2003). Similar works with the use of PIXE techniques were made by Querré et al. 2001, on french archaeological samples and many geological outcrops in france and Spain.

Final Remarks

In all cases, we have new and interesting data about the possible trade routes of distribution of this mineral, in a broad period of the European prehistory, with the verification that a wide geographical distribution phenomenon of this has existed, with distances of many hundred of kilometres from the extraction site.

Raw material areas for this mineral exploitation, at least in specific periods of the European prehistory, not only are placed in the well know mines of Gavá, NE Spain, exploited in a period about 5000-6000 years ago; but we have constancy of the existence of other prehistoric exploitations in the Encinasola area (Huelva, SW Spain)(excavated by F. Nocete), Nocete and Linares (1999); and other mining activity areas, probably prehistoric and reworked in Roman and Muslim times, in Palazuelos de las Cuevas and other sites of the Aliste area, in Zamora (NW Spain).

There are no evidences up to the moment, of the existence of other localities with variscite mining activities, in the other geological outcrops cited in the Iberian Peninsula and in the rest of Europe.

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