Picrolite Raw Material on Cyprus

Subjects: Archaeology

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Picrolite is a soft, green massive, banded or crudely fibrous metamorphic rock with a hardness of 3.5, a waxy feel and a conchoidal to subconchoidal fracture (massive), whilst crudely fibrous varieties splinter easily. Picrolite artefacts comprise some of the most distinctive material remains in the prehistory of the island of Cyprus, in the Eastern Mediterranean. Picrolite exploitation dates from at least 12,000 years ago for the manufacture of personal ornaments and items with a symbolic function.

Keywords: picrolite ; X-ray fluorescence ; synchrotron microspectroscopy ; Cyprus

1. Picrolite Use in Cypriot Prehistory

Anthropomorphic figurines in the shape of cruciforms dating to the fourth millennium BC are the hallmark of the use of picrolite in Cypriot prehistory [1][2][3]. Although these striking artefacts mark the epitome of consumption of picrolite on the island, the use of this raw material in the manufacture of objects, such as ornaments, can be dated to the earliest human presence on Cyprus (**Figure 1**). Picrolite artefacts, albeit in small quantities, have been documented from Akrotiri *Aetokremnos* [4] on the southern coast of Cyprus from stratigraphic contexts dating to ca. 12 kyr (~11,000 cal BC). The assemblage comprises six picrolite objects: one bead, three pendants and two small pebbles, probably pendant preforms.

Figure 1. Picrolite artefacts from the island of Cyprus (from Akrotiri *Aetokremmos*, Krittou Marottou Ais Giorkis and Kholetria *Ortos*).

The use of picrolite (**Figure 2**) has been subsequently well attested in Aceramic Neolithic (8900–5300 cal BC) sites, where the raw material was used to carve a range of forms and types of objects: beads, rings, dress-pins, small vessels or containers as well as items whose function remains unknown, such as the “thimbles” from Kritou Marottou Ais *Giorkis* [5]. Occasionally, picrolite reaches archaeological sites in unmodified form, indicating the working of raw materials in settlement sites. Such occurrences are documented across the island, for example in Ayia Varvara *Asprokremnos* and Khirokitia *Vouni*. In the Late Neolithic, picrolite use was less common and the forms carved were less elaborate [6]. Picrolite exploitation was abundant during the Chalcolithic, when the highly distinctive cruciform figurines were made. It was during this time that new carving techniques and a substantial extension in morphology and stylistic repertoires occurred [6].

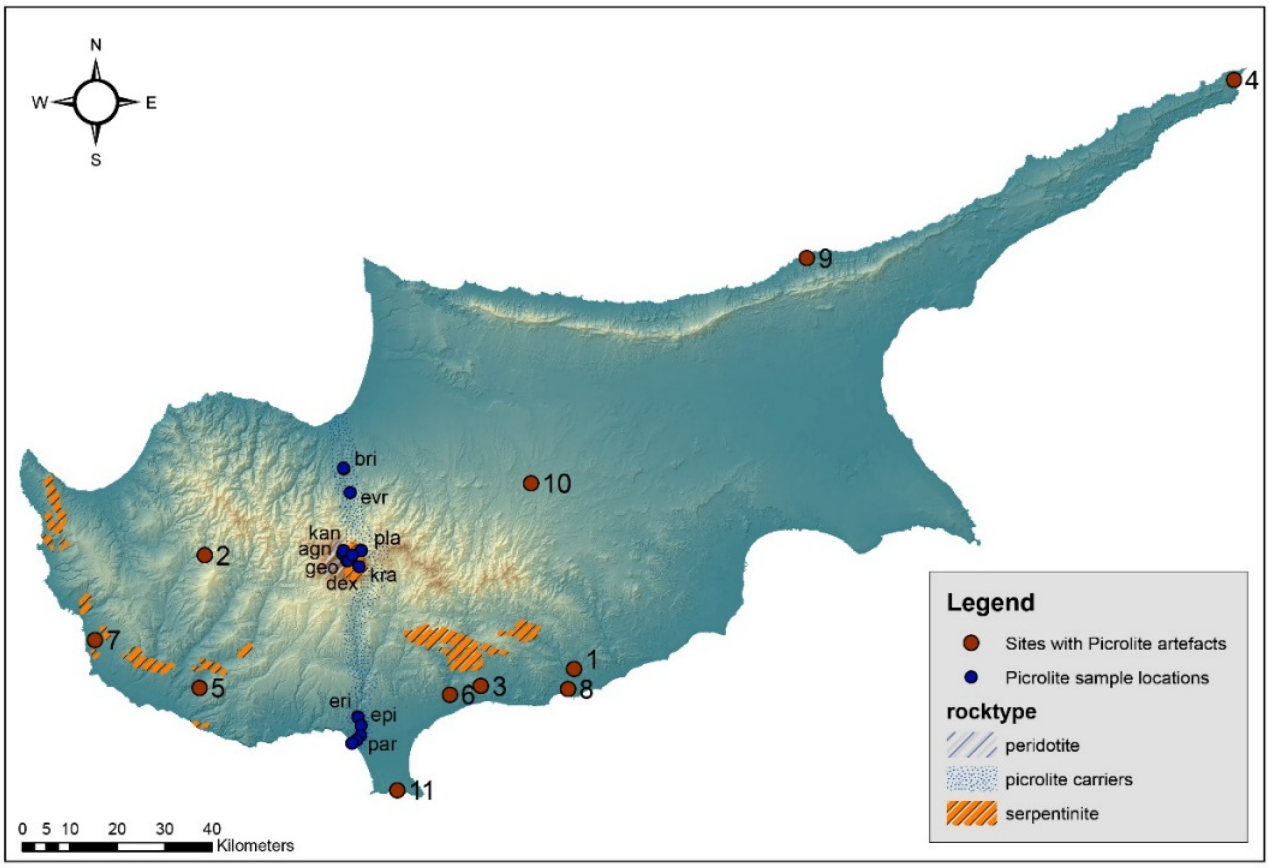

Figure 2. The map depicts the main picrolite carriers (including peridotite and serpentinite outcrops with thin picrolite veins) on Cyprus. Blue dots indicate picrolite sample locations, while red dots show Epipalaeolithic and Aceramic Neolithic archaeological sites with picrolite artefacts (1 = Khirokitia *Vouni*, 2 = Kritou Marottou *Ais Giorkis*, 3 = Ayios Tychonas *Klimonas*, 4 = Apostolos Andreas *Kastros*, 5 = Kholetria *Ortos*, 6 = Parekklisia *Shillourokambos*, 7 = Kissonerga *Mylouthkia*, 8 = Kalavasos *Tenta*, 9 = Akanthou *Arkosyko*, 10 = Ayia Varvara *Asprokremmos*, 11 = Akrotiri *Aetokremmos*).

2. Picrolite Raw Material

Picrolite is a soft, green massive, banded or crudely fibrous metamorphic rock with a hardness of 3.5, a waxy feel and a conchoidal to subconchoidal fracture (massive), whilst crudely fibrous varieties splinter easily [7]. Picrolite is the product of hydrothermal alternation of ultrabasic rocks, consisting of the serpentine minerals lizardite, chrysotile and antigorite, or any combination of these (for a discussion on serpentine mineral classification see [8][9]). The Cypriot variant contains predominantly lizardite and/or chrysotile with little or no significant proportions of antigorite. While serpentine (Mg, Fe, Ni, Mn, Zn)2-3(Si, Al, Fe)2O5(OH)4 mineral deposits are well documented around the globe, picrolite itself is much less frequently encountered in a geological setting, e.g., [10].

In Cyprus, primary sources (seams) of good quality picrolite occur in the Troodos Mountain Range and specifically east of the Mount Olympus summit at an elevation of about 1400 m. Here picrolite is found in veins within seprentinised harzburgite; based on geological observations it appears that serpentisation took place in situ, possibly after its emplacement with little post-alteration penetrative deformation. Joints and fractures were filled by chrysotile and picrolite and remained intact [11] p. 132. Picrolite veins, varying in thickness from a few millimetres to a few centimetres and ranging in colour from light blue-green to dark olive-green (GY7/10 light greenish grey to G6/5 greenish grey of the Munsell Color Chart), can extend for several meters on Troodos' north and south slopes. The two main rivers—namely the Kouris and Karkotis Rivers—that drain the Troodos Massif erode picrolite material, depositing it in pebble form on the north and south sides of Troodos all the way to the sea. Serpentinite outcrops are also noted in the Limassol Forest area, Akamas Peninsula, Mavrokolymbos and Diarizos and in other small serpentine bodies within the Mamonia Complex (**Figure 2** and **Figure 3**). In these instances, the outcrops are heavily deformed and sheared in such a way that no usable vein material was produced. Although picrolite veins are present, these are rarely more than a few millimetres thick and, thus, unlikely to have been used by prehistoric people.

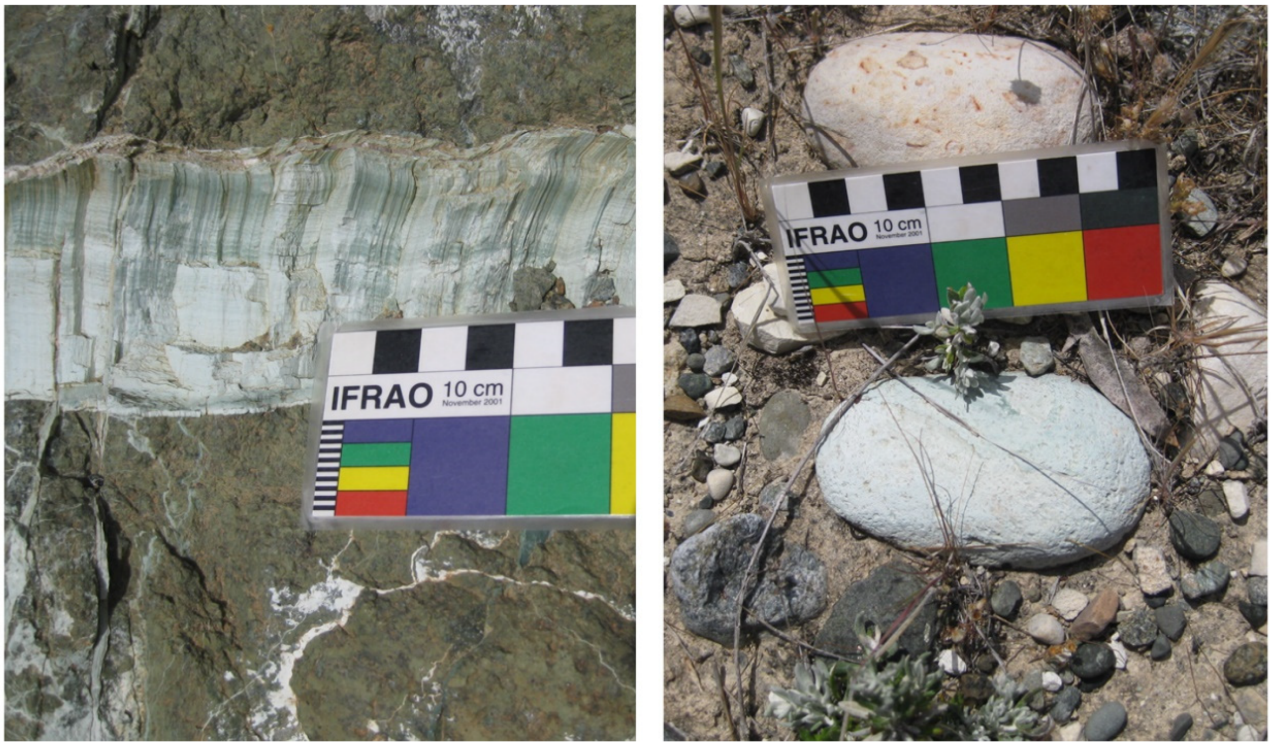

Figure 3. Picrolite in primary exposures (veins) and in secondary deposition (river pebbles).

3. Analytical Work on Cypriot Picrolite

Costas Manglis in [12] p. 441 was the first geologist who identified picrolite in archaeological contexts. Nevertheless, Xenophontos was the first researcher to analytically investigate Cypriot picrolite [7][11] and his work, conducted thirty years ago, remains the definitive study on picrolite raw material. Xenophontos applied neutron activation analysis (NAA) and X-ray diffraction analysis (XRD) to determine its basic mineralogical and geochemical characteristics [11]. For that he used thin sections from partly worked and unworked waterworn picrolite pebbles found at the Aceramic Neolithic site of Kholetria Ortos [13] and geological samples from the two main picrolite carriers, Kouris and Karkotis Rivers. He further subdivided the picrolite raw material into three different textural types see [11] (pp. 128–129), although no clear distinctions were made between source localities.

The new knowledge resulting from Xenophontos' work had a direct and long-lasting impact on the archaeology of Cyprus. Prior to his work, Archaeological artefacts made of green stones and recovered from multiple archaeological contexts across the island were invariably identified as 'steatite' [7]. Xenophontos demonstrated the inadequacy of such broad-stroke characterisations of raw materials based on purely visual features and documented the inclusion of picrolite in the raw material repertoire exploited by prehistoric populations on Cyprus. However, despite the important change in terminology and raw material association, little effort has since been placed in understanding picrolite exploitation in Cypriot prehistory. The consumption of picrolite is commonly interpreted as an expedient phenomenon, whereby the raw material was collected in pebble form from secondary deposits (riverbeds) rather than being quarried from in situ seams in upland locations (e.g., [6] but see also [14]). Although this may on occasion be the case, for example a cache of 25 picrolite pebbles is known from Khirokitia [pers. obs.], the assumption that all archaeological material derives exclusively from the nearest secondary deposits needs to be tested. This is particularly important considering that multiple picrolite carriers occur in various distinct localities across the island. Delineating primary picrolite outcrops, their geochemistry and potential division into distinct geochemical units is likely to elucidate distinct acquisition and circulation patterns with important implications for the social organisation of prehistoric communities.

Recent work that applied handheld prtoable X-ray fluorescence (HHpXRF) and synchrotron-based X-ray fluorescence spectroscopy (SR-μXRF) to the analysis of picrolite raw materials highights key micro-structural differences between two distince source regions on the Troodos Massif in western Cyprus. Picrolite source characterisation is expected to contribute significant new knowledge to the study of rare raw material consumption, prehistoric social organisation, networking and possible long-distance exchange of this idiosyncratic raw material within and beyond the island's geofeaphic boundaries.

References

1. Peltenburg, E. The Evolution of the Cypriot Cruciform Figurine. Report of the Department of Antiquities, Nicosia, Cyprus; Getty Publications: Los Angeles, CA, USA, 1982.
2. Campo, A.L. Anthropomorphic Representations in Prehistoric Cyprus: A Formal and Symbolic Analysis of Figurines, c. 3500–1800 BC. (Studies in Mediterranean Archaeology Pocket-Book 109); Paul Åström Förlag: Jonsered, Sweden, 1994.
3. Crewe, L.; Peltenburg, E.; Spanou, S. Contexts for cruciforms: Figurines of prehistoric Cyprus. Antiquity 2002, 76, 21–22.
4. Simmons, A.H. Akrotiri-Aetokremnos (Cyprus) 20 years later: An assessment of its significance. Eurasian Prehistory 2013, 10, 139–156.
5. Simmons, A.H. Ais Giorkis: An unusual early Neolithic settlement in Cyprus. J. Field Archaeol. 2012, 37, 86–103.
6. Peltenburg, E. Local exchange in prehistoric Cyprus: An initial assessment of picrolite. Bull. Am. Sch. Orient. Res. 1991, 282–283, 107–126.
7. Xenophontos, C. Steatite vs. picrolite. P.59 in Early copper-work in Cyprus and the exploitation of picrolite: Evidence from the Lemba archaeological project, by E.J. Peltenburg. In Early Metallurgy in Cyprus, 4000–4500 B.C.; Muhly, J.D., Maddin, R., Karageorghis, V., Eds.; Pierides Foundation: Larnaka, Cyprus, 1981; pp. 41–62.
8. Whittaker, E.J.W.; Zussman, J. The characterization of serpentine minerals by X-ray diffraction. Mineral. Mag. J. Mineral. Soc. 1956, 23, 107–126.
9. Wicks, F.J.; O'Hanley, D.S. Serpentine minerals: Structures and petrology. In Hydrous Phyllosilicates: (Exclusive of Micas); Bailey, S.M.W., Ed.; De Gruyter: Boston, MA, USA, 1988; pp. 91–168.
10. Chidester, A.; Albee, A.; Cady, W. Petrology, Structure, and Genesis of the Asbestos-Bearing Ultramafic Rocks of the Belvidere Mountain Area in Vermont; Geological Survey Professional Paper 1016; United States Government Printing Office: Washington, DC, USA, 1978.
11. Xenophontos, C. Picrolite, its nature, provenance, and possible distribution patterns in the Chalcolithic period of Cyprus. Bull. Am. Sch. Orient. Res. 1991, 282–283, 127–138.
12. Dikaios, P. Khirokitia: Final Report on the Excavation of a Neolithic Settlement in Cyprus on Behalf of the Department of Antiquities 1936–1946; Oxford University Press: Oxford, UK, 1953.
13. Simmons, A.H. Preliminary Report on Multidisciplinary Investigations at Neolithic Kholetria Ortos, Paphos District; Report of the Department of Antiquities; Department of Antiquities: Nicosia, Cyprus, 1996; pp. 29–44.
14. Peltenburg, E. Picrolite, procurement, manufacture and use. In Figurine Makers of Prehistoric Cyprus: Settlement and Cemeteries at Souskiou; Peltenburg, E., Bolger, D., Crewe, L., Eds.; Oxbow Books: Oxford, UK, 2019; pp. 233–248.
