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Nephrite jade from Val Malenco, Sondrio, Italy: review and new data

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Nephrite jade is an almost monomineralic rock, mainly a tremolite [$Ca_2Mg_5Si_8O_{22}(OH)_2$]- actinolite [$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$] composite, valued for ornamental carvings and gems. Major nephrite sources include the Kunlun Mountains of Xinjiang, China; the East Sayan Mountains of Siberia, Russia; Chuncheon in South Korea; South Westland in the South Island of New Zealand; and Cowell, Australia.

A deposit of gem-quality nephrite jade has been discovered some years ago at Mastabia, in Val Malenco, in the Sondrio province, northern Italy. Nephrite is hosted in a talc-tremolitic orebody, associated with dolomitic marble and calc-silicate rocks (Nichol and Giess, 2005).

This study aims to provide a review and an update of nephrite jade from Val Malenco investigating a suite of gem-quality samples from this locality by means of X-ray powder diffraction, combined with quantitative full-phase analysis using the Rietveld method, EMP and LA-ICP-MS chemical analyses, and mid-IR spectroscopic measurements.

According to the classification scheme of Leake et al. (1997), the nephrite jade from Val Malenco is predominately composed of pure tremolite, with an almost stoichiometric values of Si, Ca and Mg a.p.f.u.. The space group is $C2/m$ with unit cell parameters a(Å)=9.839(4)-9.842(5), b(Å)=18.046(2)-18.054(5), c(Å)=5.278(3)-5.279(2), $\beta(^\circ)$=104.73(4)-104.77(2) and V(Å^3)=906.62(9)-906-96(8). The XRPD data and the bulk mid-IR spectra are consistent with pure tremolite, although show, in some cases, the occurrence of minor amount of calcite, quantified by means of Rietveld analysis as less than 5 wt%. An exceptional value of 30 wt% was measured only in one sample. The nephrite jade shows a micro- to crypto-crystalline texture that consists of a fibrous intergrowth of about 10-20 μm long tremolite crystals, that occur together with other accessory constituents including calcite, talc, diopside, apatite and opaque iron minerals. Color ranges from white to white-green, with color variation most related to the calcite content, rather than to the concentration of Fe, Mn, and Cr, which are the major coloring elements of nephrite (Liu et al., 2010). They are indeed present at very low trace levels (<0.1 wt%) as are the other elements of the first transition series (Sc, Ti, V, Co, Ni, Cu, Zn), the alkaline earth metals (Sr and Ba) and the alkaline metals (K, Rb, Cs). The only exception is sodium which ranges from 0.12 to 0.22 wt% as Na_2O. All the nephrite samples have low total rare earth elements (ΣREE) ranging from 0.15 to 0.80 ppm, with the major contribution to the total budget given by light and middle REE (i.e. La, Ce and Nd). On the basis of the low Fe/Fe+Mg ratio (<0.002) and the low content of Co (0.07-0.27 ppm), Cr (1.86-4.36 ppm), and Ni (0.22-1.53 ppm), the nephrite from Val Malenco can be classified as dolomite-related nephrite (Siqin et al., 2012).

The compact and fine-grained microstructure, as well as the low content of coloring agents, confer to nephrite from Val Malenco an agreeable aspect, making it noteworthy as gemmological material.

References

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