

LETTER

SPECIAL COLLECTION: NANOMINERALS AND MINERAL NANOPARTICLES

Protoenstatite: A new mineral in Oregon sunstones with “watermelon” colors

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ABSTRACT

Al-Fe-bearing protoenstatite was discovered in Oregon sunstones with unusual pleochroic/dichroic red to green coloration using high-resolution transmission electron microscopy (HRTEM) and X-ray energy-dispersive spectroscopy (EDS). The empirical formula calculated on the basis of 6 O apfu is $(\text{Mg}_{1.17}\text{Fe}_{0.43}\text{Al}_{0.26}\text{Ca}_{0.03}\text{Na}_{0.10}\text{Ti}_{0.01})_{\Sigma 2.00}(\text{Si}_{1.83}\text{Al}_{0.17})_{\Sigma 2.00}\text{O}_6$. The protoenstatite has a space group of *Pbcn*; its unit-cell parameters refined from selected-area electron diffraction patterns are $a = 9.25(1)$, $b = 8.78(1)$, and $c = 5.32(1)$ Å. Protoenstatite nanocrystals are quenchable to low temperature. The crystallographically oriented nanocrystals of protoenstatite and clinoenstatite in association with copper nanocrystals are responsible for the unusual green and “watermelon” coloration of the labradorite gemstone.

Keywords: Oregon sunstone, labradorite, new pyroxene, clinoenstatite, protoenstatite, HRTEM, native copper, dichroic, Nanominerals and Mineral Nanoparticles