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The origin of jadeitite-forming subduction-zone fluids: CL-guided SIMS oxygen-isotope and trace-element evidence

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ABSTRACT

Jadeitite, a rare high *P/T* rock, is associated spatially with blueschist and/or eclogite terranes. Scanning electron microscope (SEM) and cathodoluminescence (CL) petrography of jadeitite samples from several major occurrences [in Burma (Myanmar), Guatemala, Japan, Kazakhstan, and the U.S.A.] show that grains were deposited from fluids. Jadeite grain compositions indicate these fluid compositions changed with time.

CL imagery guided the acquisition of oxygen-isotope and trace-element analyses with the ion microprobe. Jadeite grains in each rock grew in cycles that began with red- and/or blue-luminescent and ended with green-luminescent zones. The CL images were used to order the data into crystallization sequences. These data and electron-microprobe, major-element analyses document the association of green CL with increases in Ca, Mg, and Cr: (1) toward grain exteriors; (2) in fine-grained matrix around porphyroblasts; (3) in shear zones that cut grains; (4) in former open spaces now filled with jadeite; or (5) in veins. Abundances of many trace elements are greater in green-CL jadeitite compared with the red- or blue-CL zones. Some of these elements—in particular Li, Rb, Sr, Ti, Hf, Zr, Y, and REE—are unlikely to have been derived from serpentinite. Although crystal-chemical effects may explain some of the trace-element systematics (e.g., preferential incorporation of REE into Ca-richer jadeite), some kinetic control is suggested by sector-zoned, rhythmically zoned grains. The oxygen-isotope data suggest that jadeitite-depositing fluids either had multiple sources or evolved in composition along their flow paths (or both).

Keywords: Gems and gemstones, metamorphic petrology, analysis, chemical, major and minor elements, trace elements and REE, stable isotopes, petrography