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Garnet polycrystals

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Electron backscattered diffraction (EBSD) studies have revealed complex microstructures in garnet, including features developed during crystal growth and/or deformation. New data show that garnets commonly grow as clusters of grains (polycrystals) juxtaposed by high-angle boundaries. Garnet polycrystals may form at any stage of metamorphism following nucleation of garnet: polycrystals may form early as a result of close spacing of nuclei, or later via impingement of larger grains. EBSD analysis of garnets in metamorphic rocks from 9 localities in the US, Canada, Turkey, Iran, and Colombia detected polycrystals at every site. Evidence for internal deformation of garnet was observed in only one sample, a calc-pelite dominated by plagioclase; all other samples are mica schists. Three sites displayed garnet shape-preferred orientation, but none had a crystallographic preferred orientation of garnet. In some samples, polycrystals comprise ~20-30% of garnets analyzed. Some early-coalescing polycrystals exhibit growth zoning concentric about the geometric center of the polycrystal; i.e., zoning is unrelated to the location of internal grain boundaries. In other polycrystals, Fe-Mn-Mg zoning has a different pattern than that of Ca. Some polycrystals are characterized by high-angle misorientation boundaries in special orientations, indicating that these polycrystals are not random clusters of grains. Special boundaries were detected in 0-60% of garnets analyzed. Polycrystal formation may relate to the presence of chemical or textural heterogeneities (e.g. precursor phases, deformation features) that allowed close spacing of garnet nuclei. It is important to recognize polycrystals because internal grain boundaries may affect diffusion pathways and length scales and may facilitate communication of garnet interiors with matrix phases, thereby influencing reaction history and garnet composition and zoning.