Magmatic or hydrothermal epidote?

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Epidote is a common mineral in the Rolvsnes granodiorite and associated granitoids in the northern parts of Bølmo island, W Norway. It is useful as an indicator of the extent of early hydrothermal alteration, as the green discoloration of the granodiorite is largely connected to epidote replacing calcic amphibole and biotite and sericitization plagioclase. Macroscopically, epidote occurs as veins cutting all rock types, a pervasive alteration assemblage of the granodiorite, and in miarolitic cavities in granites. Microscopically, epidote occurs together with albite and muscovite as replacement of calcic plagioclase cores, weakly zoned overgrowths on euhedral titanite and allanite, patchily zoned with small titanite inclusions, epidote-quartz symplectites commonly associated biotite, and euhedral inclusions in plagioclase and K-feldspar phenocrysts. With the exception of one grain with >20 wt% MnO, the major element composition varies from endmember epidote to clinozoisite, mostly with Fe/(Fe+Al) ratios between 0.25 and 0.35. Clinozoisite is mostly observed in zoned alteration products of plagioclase. Only a weak correlation between host rock and major element chemistry is observed, with epidote in granites being slightly more Fe-rich than in granodiorite. The minor element vary distinctly with microtextures. Epidote from miarolitic cavities may have >5wt% SrO, and the euhedral inclusions in plagioclase have up to 2 wt% MnO. One epidote grain from the granodiorite has an REE-rich core, an REE-poor overgrowth with sharp contacts towards K-feldspar, and a subsequent zone of epidote-quartz symplectite. The two inner growth zones are comparable to the reports of magmatic epidote from the nearby Drøni monzogranite (Torgersen & Jansen 1987). The occurrence of magmatic epidote is compatible with the pressure estimates from Al-in-hornblende barometry at 400-450 MPa and moderate to high *f*O2. However, the textural evidence indicates that if epidote crystallized from a melt, it is late in the crystallization sequence. The amount of epidote in the samples correlate with the extent of breakdown of amphibole and biotite, and quartz inclusions in biotite resulting from breakdown of amphibole crosscut the border to epidote, indicating that the vast majority of epidote in the samples is the result of hydrothermal replacement of primary minerals.

References

Andersen, T.B. & Jansen, Ø.J., 1987: The Sunnhordaland Batholith, W. Norway: Regional setting and internal structure, with emphasis on the granitoid plutons. *Norwegian Journal of Geology 67*, 159-183.