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# Epidote forming reactions in calc-alkaline rocks monitored by trace elements

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Epidote is a common magmatic mineral in intermediate plutonic rocks. Over the last years, the occurrence of primary epidote in TTG was confirmed by numerous experiments performed at different pressure, temperature and X-$fO_2$. These experiments establish a minimum pressure of crystallisation of epidote around 0.3-0.7 Gpa depending mainly on the bulk composition and on the oxygen fugacity. However, few data are available on epidote stability in gabbroic rocks at $H_2O$-undersaturated conditions and in volcanic dykes.

Rare examples of epidote phenocrysts in volcanic rocks of dacitic to ryhodacitic composition are known from Sutter Buttes, California and Boulder, Colorado in the USA. The phenocrysts show complex and fine oscillatory zoning with a general decrease in allanite components towards the rim. Many dissolution and recrystallisation feature are observed in a single crystal indicating that epidote is a near-liquidus phase in dacitic to rhyodacitic compositions. The core of the phenocryst is often composed by a nucleation centre associated with a complex irregular zoning pattern. Relics of quartz in the core and the vermicular aspect of the zoning resemble to what could be observed in epidote found in plutonic rocks.

Magmatic epidote in mafic rocks is widespread in the Kohistan Arc Complex in Northern Pakistan. In the Jijal complex, which is interpreted as the crust mantle transition of the Kohistan Arc field evidence such as magmatic layering, garnet and hornblende cumulates strongly indicate that the magmatic origin of the complex is preserved. Hence

the Jijal Complex is one of the few places in the world to study epidote bearing mafic plutonic rocks (P around 1.5 Gpa) in a K-poor natural system and to understand the phase relations involving epidote in gabbroic rocks. Epidote occurs as primary phase in garnet hornblende bearing gabbros and in some pegmatites together with quartz, rutile and paragonite. The vermicular texture of epidote and quartz is similar to the cores of volcanic epidote and strongly support a magmatic origin. Preliminary trace element geochemistry demonstrates important variations inside a single grain. In the core, the pattern shows a strong enrichment in LREE compared to HREE ($(La/Yb)_N$ =14.8) with a large positive europium anomaly (Eu* = 5.3) whereas the trend in the rim is rather flat ($(La/Yb)_N$ =1.1) or even depleted in LREE ($(La/Yb)_N$ =0.29) with a weak europium anomaly (Eu* = 1.6). These variabilities might be used to monitor epidote-forming reactions in mafic systems at high pressure.