Hydrothermal Alteration of an Alkali Pegmatite from Zomba-Malosa (Malawi)

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The study of the interaction of natural minerals with hydrothermal fluids is very challenging due to the complexity of natural systems. Pegmatites from Chilwa Alkaline Province (CAP), Zomba Malosa district of Malawi have experienced multiple events of hydrothermal-fluid interactions, as is evident by complex reequilibration textures produced in feldspars, aegirine, and accessory minerals such as zircon, pyrochlore, and fergusonite. Reequilibration processes in these minerals have produced pseudomorphic replacement textures and mobilised high field strength elements. Aegirin is partly replaced by riebeckite and K-feldspar by patch perthite and albite. The replaced domains contain fluid trapped as inclusions, where CO_2 and CH_4 bands have been detected by Raman spectroscopy. Fergusonite, which is overgrown by pyrochlore, shows alteration features such as loss of Th and the development of microporosity in altered domains. Textural and mineral chemical features of zircon and pyrochlore indicate at least two alteration events. Curved reaction fronts penetrate in to the crystals producing secondary zircon that is characterised by lower Th concentrations and the presence of microporosity and thorite inclusions. Pyrochlore exhibits two texturally and compositionally distinguishable domains that cross-cut each other. The youngest alteration domains are comprised of concentric rings penetrating into the crystal whereas the older domains are highly porous. The porosity suggests that the replacement of zircon and pyrochlore occurred via an interfacial coupled dissolution-reprecipitation process (see Putnis 2002). The thorite inclusions in the secondary zircon also show later alteration features such as the occurence of the non-formula elements Ca, Al, and Fe. U-Pb data of unaltered and altered domains in zircon and thorite yield indistinguishable ages of ca. 118 Ma. This age agrees with other radiometric ages from the CAP (Eby et al. 1995) and indicates that the main reequilibration event occurred just after emplacement of the rocks. The age of second alteration event can be constrained to recent times.

References

Eby et al. (1995) Geochronology and cooling history of the northern part of the Chilwa
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