Rb-Sr dating of microsamples: applications to crystallization and deformation in the amphibolite facies

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Recrystallisation during deformation under amphibolite facies is often localized and incomplete even on thin section scale causing problems for dating such processes. Nevertheless local well-equilibrated microstructural domains can often be identified and earlier work has shown that microsampling from polished sections allows precise Rb-Sr dating of white mica [1]. The approach has now been extended to hornblende, feldspars and biotite allowing investigation of the Rb-Sr isotope systematics of a wider range of rocks that have been deformed under mid-crustal conditions. Experimental kinetic data [2] suggest that Sr isotope mobility in feldspars and amphiboles is restricted under amphibolite facies conditions so that Rb-Sr ages are expected to date crystallisation rather than cooling. Rb/Sr ratios in hornblende are typically 1-2 orders of magnitude greater than in plagioclase and partitioning between K-Feldspar and plagioclase is even more favourable.

In a marginally amphibolitised dolerite dyke from Finland K-feldspar + plagioclase from the unaltered core has an Rb-Sr age of 1.94±.04 Ga whereas hornblende from the altered zone close to the sheared margin is significantly younger at 1.81±.02 Ga.

An attempt to date amphibolite facies deformation and retrogression of Proterozoic eclogites from the Usagaran of Tanzania yielded relatively consistent data for hornblende but plagioclase compositions were highly variable. Analysis of a biotite microsample from one specimen gave an Rb-Sr age of 0.63 Ga indicating significant Pan-African disturbance of the Rb-Sr systems. The modal abundance of biotite suggests there was insufficient radiogenic Sr in individual samples to account for the elevated ratios of plagioclase, implying larger scale migration of Sr-rich fluids. Taking the least disturbed (least radiogenic) plagioclase microsamples as the best control on initial Sr in hornblende leads to hornblende ages of 1.91±.04 and 1.86±.04 Ga in two specimens; in a third the maximum hornblende age is 1.70±.04 Ga.

This study shows the potential of microsampling to date hornblende and feldspar in microstructural context and to trace the grain-scale pathways followed by fluids.

References

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