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The replacement of plagioclase by albite in hydrothermal experiments: the replacement mechanism and element mobilisation

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Regional scale albitisation of feldspars due to metasomatism is a relatively common phenomenon in the Earth's upper crust. The spatial relationship between large albitite bodies and ore mineral accumulations, which has often been recognized in nature, suggests that albitising fluids are conducive to remobilising elements and are capable of transporting them through crustal rock units.

Hydrothermal experiments on plagioclase (600˚C, 2 kbars, 14-21 days) were performed to further develop our understanding of the albitisation process and associated secondary mineralisation processes. Re-equilibration of oligoclase (An_{22}) and labradorite (An_{58}) crystals in an alkaline, sodium and silica-bearing solution results in reaction rims of albite that are up to 50 μm thick. Scanning electron microscopy (SEM), transmission electron microscopy (TEM) and electron probe microanalysis (EPMA) reveal that the replacement is pseudomorphic and characterised by a sharp chemical interface which moves through the crystal while preserving the crystallographic orientation. Raman spectroscopy on oligoclase crystals that were allowed to re-equilibrate in an ^{18}O-enriched solution demonstrates that the oxygen isotopes within the feldspar framework structure are redistributed during albitisation. The observed features are similar to naturally albitised plagioclase and all indicative to an interface-coupled dissolution-reprecipitation mechanism (Putnis and Putnis, 2007). Chemical analyses of the reaction products by electron microprobe and LA-ICP-mass spectrometry demonstrate that the albitisation is accompanied by the mobilisation of major, minor and trace elements also including elements such as Al, Ti and rare earth elements (REE) which are commonly regarded as immobile during hydrothermal alteration. Our results suggest that albitising fluids that are hot and alkaline have a high capability for mobilisation and transport of a wide variety of trace elements.

References

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