An Experimental Study on the Albitisation of Plagioclase

Hövelmann, Jörn[1] Putnis, Andrew[1]
[1]Universität Münster, Institut für Mineralogie, Corrensstraße 24

Metasomatic albitisation of plagioclase is a very common reaction in the shallow crust of the Earth. The replacement of plagioclase by albite implies consumption of Na and Si and release of Ca and Al. Thus albitisation describes a mass transfer, which can also be accompanied by mobilization of trace elements and may therefore be a key reaction in the formation of ore deposits. Hydrothermal experiments (T: 600°C, P: 2 kbar, 21 days) on natural oligoclase (An_{22}) and labradorite (An_{58}) were carried out to provide a better understanding of the processes involved in albitisation reactions. In this study sodium silicate solution was chosen to provide an excess of Na and Si. The reaction products were investigated using scanning electron microscopy (SEM) and transmission electron microscopy (TEM). Changes in major element chemistry were determined by electron microprobe (EMP) and trace element concentrations were measured using LA-ICP mass spectrometry. Back scattered electron images (BSE) as well as major element distribution maps of the run products revealed pseudomorphic replacement of plagioclase by nearly pure albite (An_{0-1}). The inwards moving replacement interface is sharp on a scale of a few nanometers. Textural characteristics are very similar compared to natural albitised plagioclase and indicate an interface-coupled dissolution-reprecipitation mechanism (Putnis & Putnis, 2007). The Ca released from the plagioclase reacts with the fluid to form pectolite ($NaCa_2Si_3O_8OH$), whereas an additional Al phase was not found in the run products suggesting that Al may remain immobile. The replacement reaction is accompanied by losses of Ca substituting elements such as Sr, Ba, Mg and Eu. Furthermore Pb as well as the LREE and high field strength elements such as Ti and Hf are mobilized during the reaction. These results could be used to help explain the close association between large scale albitisation and ore deposits, which has often been recognized in nature.

References

Putnis A and Putnis C V (2007) The mechanism of reequilibration of solids in the presence of a fluid phase. J. Solid State Chem. 180: 1783-1786

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