American Mineralogist, Volume 89, pages 1822–1825, 2004

LETTER

Coupled cation and oxygen-isotope exchange between alkali feldspar and aqueous chloride solution

THEODORE C. LABOTKA,[1,*] DAVID R. COLE,[2] MOSTAFA FAYEK,[1] LEE R. RICIPUTI,[2] AND FRANK J. STADERMANN[3]

[1]Department of Earth and Planetary Sciences, University of Tennessee, Knoxville, Tennessee 37996-1410, U.S.A.
[2]Chemical Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6110, U.S.A.
[3]Department of Physics, Washington University, St. Louis, Missouri 63130, U.S.A.

ABSTRACT

Nanoscale isotope and chemical images of grains of Amelia albite that were reacted with 2 *m* ^{18}O-enriched solution of KCl show a correspondence between O-isotope exchange and K-Na exchange. Experiments were conducted for 4–6 d at 600 °C and 200 MPa. After 6 d, the 150 μm diameter albite grains had 5–20 μm rims in which Na was nearly completely replaced by K and in which the O was strongly enriched in ^{18}O. The boundary between the core albite and the K-feldspar replacement is sharp and decorated with numerous pores. The distribution of Na and K, determined by electron probe microanalysis, is uniform within the core and rim and has an abrupt discontinuity at the interface. No evidence exists for K-Na interdiffusion at the resolution of electron probe. The NanoSIMS shows that the interface is also sharp in the distribution of ^{18}O and ^{16}O. The NanoSIMS image data and the electron probe data were coregistered; principal components analysis of the merged data set shows that 86% of the total variance in the data result from a single principal component loaded by the replacement of Na by K and ^{18}O. The combined electron probe and NanoSIMS analyses indicate that both cation and isotope exchange occurred during solution and reprecipitation of the feldspar.