

## Influence of solute-solvent interactions on mass discrimination during chemical diffusion

D.J. DEPAOLO<sup>1,2\*</sup>, J.M. WATKINS<sup>2</sup> AND F.J. RYERSON<sup>3</sup>

<sup>1</sup>Lawrence Berkeley National Lab, Berkeley, CA 94720, USA

(\*correspondence: depaolo@eps.berkeley.edu)

<sup>2</sup>University of California-Berkeley, Berkeley, CA 94720, USA

<sup>3</sup>Lawrence Livermore National Lab, Livermore, CA 94550, USA

Chemical diffusion in molten silicates and aqueous solutions leads to stable isotope variations in nature because chemical diffusivities are mass dependent. For diffusion in liquids, there is no general theory that relates cation diffusivity to mass, but mass discrimination during diffusion must be affected by the nature of cation-solvent interactions.

To investigate the relationship between liquid structure and cation diffusion, we measured Ca and Mg isotope diffusivities in silicate liquids using diffusion couples of natural and synthetic compositions. In all experiments, the initial isotopic composition is uniform and each isotope diffuses in the same direction down a substantial concentration gradient, enriching the Ca- or Mg-poor liquids in the lighter isotope by an amount dependent on: (1) the initial concentration contrast between liquids, (2) the relative chemical diffusivities of isotopes, and (3) the efficiency of isotopic exchange or self diffusion superimposed on chemical diffusion. Results from these experiments, in combination with results from natural volcanic liquids, show clearly that the efficiency of isotope separation ( $E$ ) is systematically related to the solvent-normalized diffusivity - the ratio of the diffusivity of the cation ( $D_{cation}$ ) to the diffusivity of silicon ( $D_{Si}$ ).

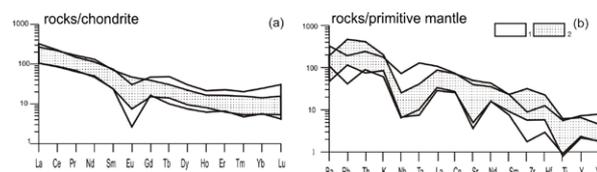
We present an idealized quantitative model to explain the relationship between  $E$  and  $D_{cation}/D_{Si}$ . The model views cation diffusion as a combination of two (or possibly more) distinct mechanisms of transport: “free” cations that site-hop among aluminosilicate structures, and “bound” cations that translate or rotate with aluminosilicate structures in the melt. We assume that the rate of exchange between free and bound cations is infinitely fast to maintain local equilibrium. In this model, the observed or net diffusivity and its mass dependence are determined by the relative abundance ( $K$ ) of free versus bound cations in the liquid. This conceptualization provides a framework for describing mass discrimination in complex liquid systems and for understanding the role of diffusion in contributing to stable isotope variations in minerals.

## Bimodal volcanism of the Northern frames of the Eastern link of the Mongolian-Okhotsk orogenic belt (Russia)

INNA DERBEKO

Institute of Geology and Nature Management FEB RAS, Blagoveshchensk, Russia, (derbeko@mail.ru)

In the Southern frames of Eastern link of Mongol-Okhotsk orogenic belt (MOOB), in the end of early Cretaceous (119 - 97 Ma), a bimodal volcano-plutonic complex was formed. It correlated by a whole number of parameters with bimodal formations of the Western link of the belt [1]. The formations in the Northern frames of the Eastern link of MOOB, that are analogical by the age and petrochemical characteristics, are separated. There are insignificant differences in geochemical characteristics (Fig.1). There are also diversities by isotopic parameters  $^{87}\text{Sr}/^{86}\text{Sr} = 0.70592-0.70620$ , by  $\epsilon\text{Nd}_{\text{T}} = (-11.77) - (-12.20)$  and  $T_{\text{Nd}}(\text{DM-2st}) = 1901-1937$  Ma [2]. Along Southern and Northern borders of the Eastern flank of MOOB the bimodal volcano-plutonic complexes were formed during 119-97 Ma. Their geochemical characteristics show that they were formed in the situation of convergence borders of the platforms (collision of North-Asian and North-Chinese continents).



**Figure 1:** Geochemical characteristics of the rocks of the bimodal complexes framing MOOB: 1 – Northern, 2 – Southern. Concentrations of the rear elements in the Compositions of chondrite C1 and primitive mantle are brought according to the data (Sun, McDonough, 1989).

[1] Derbeko (2010) *GCA*. **74**. Iss. 11. Suppl. 1. A225. [2] Stricha & Rodionov (2006) *Doklady Akademii Nauk*. **406**. P. 375-379.