

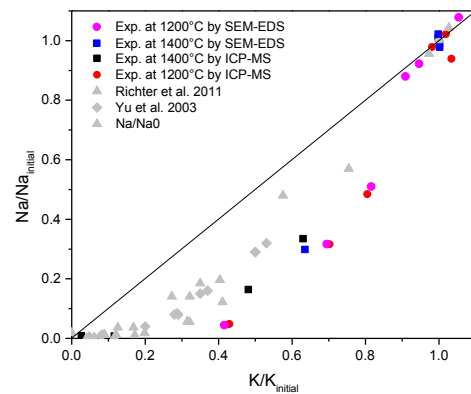
**EXPERIMENTAL STUDY OF POTASSIUM AND RUBIDIUM EVAPORATION UNDER VACUUM CONDITIONS.** Z. Zhang<sup>1</sup>, X. Nie<sup>1</sup>, R. A. Mendybaev<sup>1</sup>, and N. Dauphas<sup>1</sup>. <sup>1</sup>Department of the Geophysical Science, The University of Chicago, Chicago, IL 60637 (Email: zhez@uchicago.edu)

**Introduction:** Potassium and rubidium are moderately volatile elements, which are present in variable concentrations in planetary bodies [1]. Most planets and meteorites have Rb/Sr and K/U ratios (both normalized to CI chondrites) that correlate along a slope  $\sim 1$  line, meaning that the 2 elements have similar volatilities, at least to first order (see Fig. 3 in [1]). However, in detail, Rb seems to be more depleted than K in most planetary bodies, with depletions that are 70% to 400% greater for Rb than K [1,2]. Potassium and rubidium have received renewed attention in the past several years as it became possible to resolve variations in their isotopic compositions, which can provide clues on the underlying mechanisms responsible for those depletions [3,4]. The Moon is depleted in K by a factor of  $\sim 30$  relative to CI chondrites and lunar rocks appear to be enriched in the heavy isotopes of K and Rb relative to terrestrial rocks [3,4]. In order to develop a quantitative understanding of the K and Rb depletions and isotopic fractionations, it is critical to understand their evaporation kinetics and associated isotopic fractionations.

Two previous studies investigated the volatilities of Na and K [5,6]. However, there has been limited work on the volatility of Rb and available data yielded contradictory results [7,8]. We carried out vacuum evaporation experiments from a basaltic melt to investigate the behaviors of K and Rb during vaporization.

**Method:** The starting material has the compositions of mid ocean ridge basalts (MORBs) doped with 2.0 wt% K and 1.8 wt% Rb, as well as 1.3 wt% Na. The experimental samples were prepared following the method described in [3]. Two sets of experiments were conducted at 1200 and 1400°C under vacuum conditions ( $P=10^{-6}$  torr) (see [9] for details). The evaporation residues were characterized for their chemical composition using a Tescan Lyra3 FIB/FE-SEM and a Thermo Scientific Neptune MC-ICP-MS, both located at the University of Chicago.

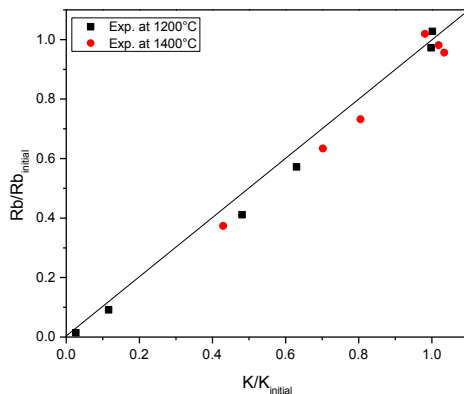
**Result and Discussion:** Only Na, K and Rb loss were observed during the experiments. The evaporation residues were examined by SEM-EDS and we found no concentration gradient. After 40 hrs at 1200°C, 96% Na, 60% K, and 66% Rb have evaporated. Expectedly, the evaporation is faster at 1400°C, where 87% Na, 62% K and 63% Rb have evaporated within 30 minutes.



**Figure 1.** Evaporation trajectories of remaining K and Na in the residues.

Figure 1 shows the fractions of Na and K remaining in the residues in two sets of experiments. The residues have a higher K/Na ratio than the starting material, which suggests that Na evaporates faster than K. Compared with data from [5,6], our results have shown larger relative evaporation rate difference but we are doing more tests. It could be due to a difference in temperature (1400°C and 1200°C in this study vs. 1470°C in [5,6]) or in the composition of starting material (around 0.3wt % K content in [5,6]). The calculated evaporation rates of Na ( $J_{\text{Na}}/[Na]_{\text{initial}}$ ) is larger than those of K by a factor of  $\sim 1.6$  to  $1.8$  at 1400°C, which agrees well with previous data [5,6]. At 1200°C, the  $[(J_{\text{Na}}/J_{\text{K}})/(Na/K)_{\text{initial}}]$  is around 2.2 to 2.5, which suggests that the relative volatilities of Na and K have some temperature dependence.

The fractions of Rb and K remaining are plotted in Figure 2. The evaporation trajectories for K and Rb are very close to the 1:1 line, which shows that they have similar evaporative behavior. The calculated evaporation rates of Rb ( $J_{\text{Rb}}/[Rb]_{\text{initial}}$ ) is close to those of K with a factor of 1.0 to 1.2 at 1400°C. The  $[(J_{\text{Rb}}/J_{\text{K}})/(Rb/K)_{\text{initial}}]$  ratio is around 1.2 at 1200°C. The evaporation trajectories and relative evaporation rates for K and Rb show no obvious difference for the 1200°C and 1400°C runs. Further experiments are underway.



**Figure 2.** Evaporation trajectories of remaining Rb and K in the residues.

Overall results have shown the following volatility sequence:  $\text{Na} > \text{Rb} \sim \text{K}$  for both sets of experiments, but Rb appears to be slightly more volatile than K. Further study will investigate the isotopic fractionations of K and Rb during evaporation. The implications of those results will be discussed at the conference.

#### References:

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