

**Comparative planetary mineralogy: basaltic plagioclase from Earth, Moon, Mars and 4 Vesta.** J.M. Karner, (jkarner@unm.edu), J.J. Papike, and C.K. Shearer. Institute of Meteoritics, Department of Earth and Planetary Sciences, University of New Mexico, Albuquerque, NM 87131-1126

**INTRODUCTION** Major, minor and trace element analysis of silicates has allowed for the study of planetary basalts in a comparative planetary mineralogy context [1-3]. We continue this initiative by exploring the chemistry of plagioclase feldspar in basalts from the Earth, Moon, Mars and 4 Vesta. This paper presents new data on plagioclase from six terrestrial basalt suites including Keweenaw, Island Arc, Hawaiian, Columbia Plateau, Taos Plateau, and Ocean Floor; six lunar basalt suites including Apollo 11 Low K, Apollo 12 Ilmenite, Apollo 12 Olivine, Apollo 12 Pigeonite, Apollo 15 Olivine, and Apollo 15 Pigeonite; two basaltic martian meteorites, Shergotty and QUE 94201; and one unequilibrated eucrite, Pasamonte.

**ANALYTICAL METHODS** Major elements were analyzed using a JEOL 733 Superprobe at an accelerating voltage of 15 kV, a beam current of 20 nA, and a spot size of 10  $\mu\text{m}$ . Trace element analysis of plagioclase was performed using a Cameca IMS 4f ion microprobe by focusing a primary beam of O<sup>-</sup> ions with an accelerating voltage of 10 kV onto the sample. A beam size of 30  $\mu\text{m}$  was obtained with a current of 30 nA. Sputtered secondary ions were energy filtered using an offset voltage of -105 V, and an energy window of  $\pm 25$  V in order to reduce isobaric interferences. The analytical procedure involved repeated cycles of peak counting on the trace elements <sup>88</sup>Sr<sup>+</sup>, <sup>89</sup>Y<sup>+</sup>, <sup>138</sup>Ba<sup>+</sup>, <sup>140</sup>Ce<sup>+</sup>, <sup>147</sup>Sm<sup>+</sup>, <sup>151</sup>Eu<sup>+</sup>, and <sup>153</sup>Eu<sup>+</sup>. Absolute concentrations of the trace elements were calculated using the relationship between measured peak/<sup>30</sup>Si<sup>+</sup> ratios normalized to known SiO<sub>2</sub> content and elemental abundance in the feldspar standards.

**RESULTS AND DISCUSSION** Figure 1 is a plot of K vs. Anorthite content (An%) in plagioclase from the four planetary bodies. The plot shows that martian plagioclase has the most Na and K, followed by terrestrial plagioclase. Plagioclase from the Moon and 4 Vesta plot at similarly low Na and K contents. The plot demonstrates the usefulness of comparative planetary mineralogy, as the results mimic the relative volatile budgets of the planets [4], and also reflects the great similarity of basalts from the Moon and 4 Vesta [5].

Figure 2 shows Ce (a proxy for total REE content) vs. An% for planetary plagioclase grains. The plot shows that terrestrial plagioclase has a much larger range of REE content than plagioclase from the Moon, Mars and 4 Vesta. Furthermore, plagioclase from continental and Hawaiian basalts has higher REE concentrations than plagioclase from Ocean

Floor and Island Arc basalts (circled and labeled in Fig. 2). While the continental and Hawaiian plagioclase grains have high REE contents, they pale in comparison to REE values for plagioclase from lunar KREEP basalts (marked in Fig. 2) [6]. Overall, this plot shows that continental crust interaction with basaltic magmas has a large effect on REE content.

Figure 3 illustrates the great range in Y and Ba content for terrestrial plagioclase compared with plagioclase from the other planetary bodies. Plagioclase grains from 4 Vesta and Mars show small Y ranges, while their ranges in Ba are larger. Lunar plagioclase shows increasing Y with increasing Ba; lunar plagioclase is also significantly depleted in Ba compared with plagioclase from 4 Vesta. Figure 3 also shows that plagioclase from the Taos Plateau and Columbia Plateau basalts (circled and labeled) are more enriched in Ba than the other terrestrial suites, a trait also seen in the bulk magma compositions [7]. The Ba enrichment in the former is likely caused by crustal contamination of these flood basalts.

Figure 4 is a plot of Sr vs An% for plagioclase from the Earth, Moon, Mars and 4 Vesta. Terrestrial plagioclase is enriched and shows great variability in Sr concentration compared to plagioclase from the three other planets. Plagioclase from the Moon and Mars show some variation in Sr content, while plagioclase from 4 Vesta is fairly constant and more depleted than plagioclase from the Moon. Similar to Figure 1, there is a distinct compositional separation of terrestrial basalts, wherein plagioclase from continental and Hawaiian basalts are enriched in Sr relative to plagioclase from Ocean Floor and Island Arc basalts (circled and labeled in Fig 4).

**CONCLUSIONS** This paper shows that the chemistry of plagioclase grains records planetary parentage signatures, as well as igneous processes that affect basaltic magmatism. These preliminary results on plagioclase demonstrate that for Earth, continental crust interaction with basaltic magmas is a very important process that affects the concentration of the REE, Ba and Sr in plagioclase.

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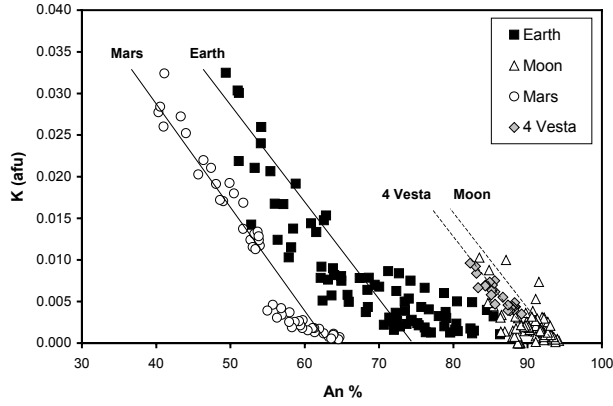


Figure 1. K (afu) versus %An for plagioclase from planetary basalts.

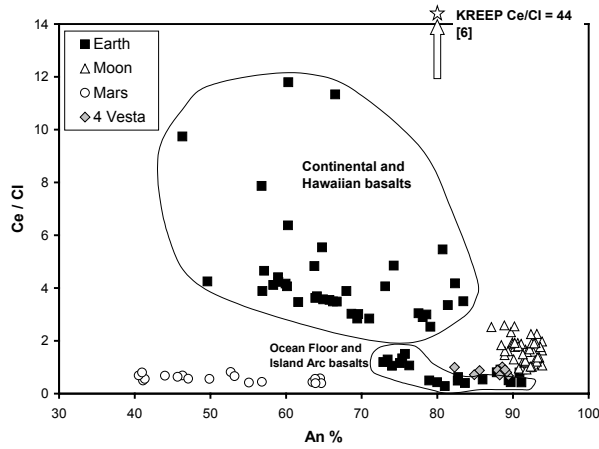


Figure 2. Ce (normalized to CI) versus %An for plagioclase from planetary basalts. Lunar KREEP value (star) is taken from [6].

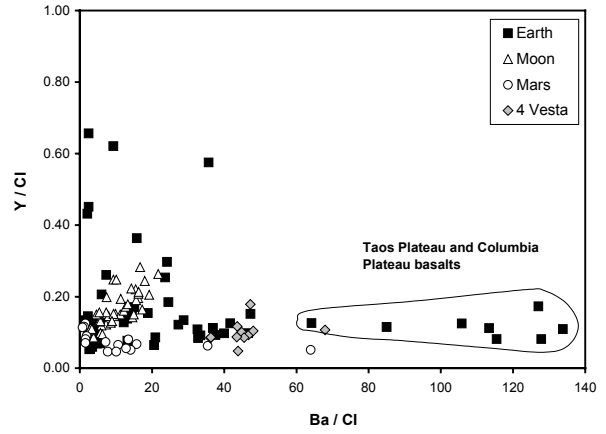


Figure 3. Y versus Ba (both normalized to CI) for plagioclase from planetary basalts.

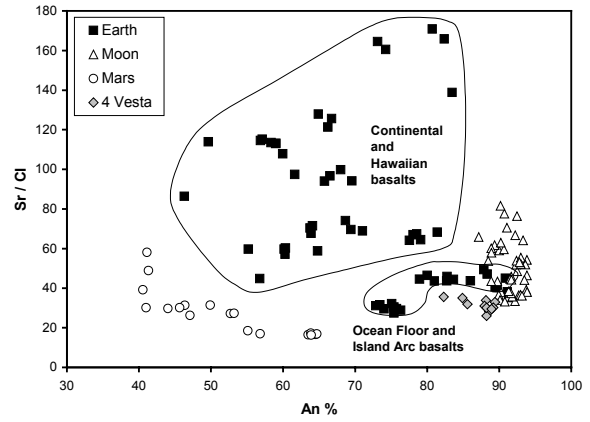


Figure 4. Sr (normalized to CI) versus %An for plagioclase from planetary basalts.