

LETTER

Partitioning of Eu between augite and a highly spiked martian basalt composition as a function of oxygen fugacity (IW-1 to QFM): Determination of $\text{Eu}^{2+}/\text{Eu}^{3+}$ ratios by XANES

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ABSTRACT

We have determined D_{Eu} between augite and melt in samples that crystallized from a highly spiked martian basalt composition at four f_{O_2} conditions. D_{Eu} augite/melt shows a steady increase with f_{O_2} from 0.086 at IW-1 to 0.274 at IW+3.5. This increase is because Eu^{3+} is more compatible than Eu^{2+} in the pyroxene structure; thus increasing f_{O_2} leads to greater $\text{Eu}^{3+}/\text{Eu}^{2+}$ in the melt and more Eu (total) can partition into the crystallizing pyroxene. This interpretation is supported by direct determinations of Eu valence state by XANES, which show a steady increase of $\text{Eu}^{3+}/\text{Eu}^{2+}$ with increasing f_{O_2} in both pyroxene (0.38 to 14.6) and glass (0.20 to 12.6) in the samples. Also, pyroxene $\text{Eu}^{3+}/\text{Eu}^{2+}$ is higher than that of adjacent glass in all the samples, which verifies that Eu^{3+} is more compatible than Eu^{2+} in the pyroxene structure. Combining partitioning data with XANES data allows for the calculation of specific valence state D -values for augite/melt where $D_{\text{Eu}^{3+}} = 0.28$ and $D_{\text{Eu}^{2+}} = 0.07$.

Keywords: XANES, Eu partitioning, $D_{\text{Eu}^{2+}}$, $D_{\text{Eu}^{3+}}$, augite