

LETTER

**Valence state partitioning of Cr between pyroxene-melt: Effects of pyroxene and melt composition and direct determination of Cr valence states by XANES. Application to Martian basalt QUE 94201 composition**

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ABSTRACT

$D_{Cr}$  augite/melt is approximately double that of  $D_{Cr}$  pigeonite/melt in synthetic Martian basaltic samples equilibrated at the same  $f_{O_2}$ . This increase is not related to changing  $f_{O_2}$  and the valence of Cr, but rather to the increased availability of elements for coupled substitution with the  $Cr^{3+}$  ion, namely Na and Al. The availability of Al and Na to partition into pyroxene is due to delayed nucleation of plagioclase for the QUE 94201 Martian basalt composition. Direct valence state determination by XANES shows that  $Cr^{3+}$  is the dominant valence state in pyroxene at IW-1, IW, and IW+1. Trivalent Cr is apparently much more compatible in the pyroxene structure than divalent Cr, and thus an increasing  $D_{Cr}$  for both augite/melt and pigeonite/melt with increasing  $f_{O_2}$  is a function of the increased activity of  $Cr^{3+}$  in the crystallizing melt.

**Keywords:** Chromium, partitioning, multivalent elements, pyroxene, XANES, QUE 94201