

Electron exchange between V and Cr in silicate glasses

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The oxidation state of a metal in a silicate melt or glass depends not only on the temperature and fO_2 of equilibration but also on interactions with other redox variable elements [1]. Here we report changes in the oxidation state of V due to an electron exchange reaction with Cr.

X-ray absorption near edge structure (XANES) spectra were recorded for V and Cr doped synthetic MORB glasses quenched from melts equilibrated at 1400°C and various fO_2 s. The intensity of the $1s \rightarrow 3d$ pre-edge transition in the V K-edge XANES spectrum is related to the average V oxidation state; the transition decreases in intensity with decreasing oxidation state. If there is no interaction between V and Cr then the V pre-edge intensity of a glass containing both V and Cr should be unchanged from that of a glass which only contains V (for Henry's Law concentrations). The spectra in the Figure (melts equilibrated at $\log fO_2 = -9$; $-IW+1$) indicate a systematic decrease in the V oxidation state with increasing Cr concentration. Cr K-edge XANES spectra were recorded for a similar series of samples and indicate a systematic increase in the Cr oxidation state with increasing V concentration. The results provide evidence for the reaction $V^{3+} + Cr^{2+} \rightarrow V^{2+} + Cr^{3+}$. The reduction of V due to reaction with Cr has implications for V oxidation state oxygen barometry [2].

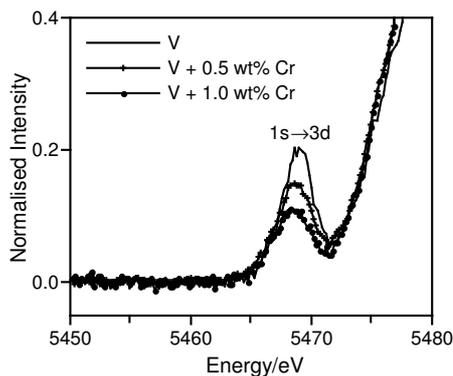


Figure: V K-edge XANES spectra of MORB glasses.

References

- [1] Berry A.J. *et al.* (2003) *J. Syn. Rad.* **10**, 332-336. [2] Sutton S.R. *et al.* (2005) *GCA* **69**, 2333-2348.