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A convenient method for measuring ferric iron in magnesiowüstite (MgO-$Fe_{1-x}O$)

David P. Dobson,[1,*] Neil S. Cohen,[2] Quentin A. Pankhurst,[2] and John P. Brodholt[1]

[1] Department of Geological Sciences, University College London, Gower Street, London WCE6BT, U.K.
[2] Department of Physics and Astronomy, University College London, Gower Street, London WCE6BT, U.K.

Abstract

We present a new oxybarometer for magnesiowüstite-bearing systems, which is easily applied using widely available techniques. A scale relating the proportion of Fe^{3+} [$\alpha = Fe^{3+}/(Fe^{3+} + Fe^{2+})$] to the position of the (220) reflection and total Fe (y) in magnesiowüstites $(Mg_{1-y}\cdot Fe_y)_{1-x}O$ has been derived from measured values in samples equilibrated at various oxygen fugacities:

$$\alpha = 13.0047 - 39.4829f + 40.0540f^2 - 13.5701f^3(\pm 0.007 + 0.09\alpha),$$

$$f = (d_{220} - 1.4890)/(0.0510y + 0.0206y^2)(\pm 0.0001).$$

Previously established partition coefficients can then be used to relate estimated Fe^{3+} content to equilibrium oxygen fugacity (f_{O_2}) in the composition range $0 < y < 0.2$. Equilibrium oxygen fugacities of $\log f_{O_2} \leq -1.7$ can be estimated to ± 0.5 log units using just X-ray powder diffraction and electron microprobe analytical techniques.