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An evaluation of Re, as an alternative to Pt, for the 1 bar loop technique: An experimental study at 1400 °C

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ABSTRACT

Previous investigators have shown that, at high pressure, Re is a good capsule material and that Fe loss to Re under these conditions is minimal (e.g., Herzberg and Zhang 1997). We present here the first systematic low-pressure study of Re loop stability and of Fe loss from silicate melts to Re loops as a function of f_{O_2}. Experiments were performed at 1400 °C and one bar pressure over a range of f_{O_2}. For f_{O_2} values as low as QFM-2, Fe loss was found to be negligibly small, even for a charge/loop ratio of only about 2. According to our calculations, for the same conditions, Fe loss to a Pt loop could reach 70% of the initial FeO content. We have also estimated the diffusion coefficient of Fe in Re and found it to be very small ($\approx 10^{-12}$ cm^2/s), which is an additional factor in preventing Fe loss.

At values of f_{O_2} near QFM, Re metal reacts to form volatile Re oxides. But at f_{O_2} below QFM-1.7, Re loops were found to be stable for any reasonable experimental run duration at 1400 °C. At lower temperatures Re may be stable to even higher values of f_{O_2}. These conditions are similar to or slightly more reducing than the accepted redox states for the mantles of the Earth and Mars. Consequently, for many experiments, Re may be a more convenient loop material than Pt.