

## Planetary-scale electrochemistry: Redox reactions of Fe, Co, and Ni at high pressures and temperatures

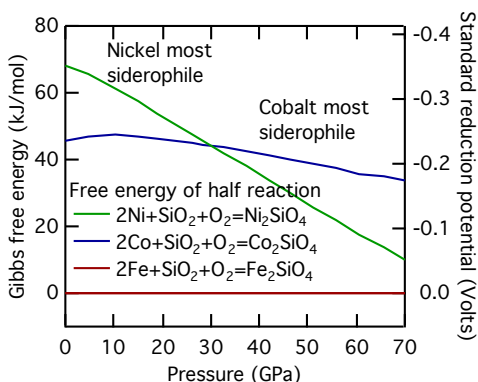
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Redox thermodynamics of core and mantle materials at interior conditions govern which elements tend to be oxidized and which tend to be reduced by their relative positions on a planetary-interior electrochemical series. Here we present the results of synchrotron X-ray diffraction measurements of metals, oxides, and silicates in the laser-heated diamond anvil cell. Using ours and others' data, we measure equations of state of Fe, Co and Ni metals, oxides and silicates, showing their relative redox potentials as a function of pressures and temperatures.

Our results for the relative oxidation energetics of Co and Ni ringwoodite silicates with respect to their metals show a crossover between their relative oxygen fugacities at lower mantle pressures and temperatures (Figure 1). This result agrees with our determinations for the oxide systems, and mirrors measurements of pressure-dependent metal-silicate distribution coefficients.



**Figure 1.** Energetics of the Ni and Co silicate-oxide equilibria relative to the Fe silicate-oxide equilibrium.