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Reaction between magnesiowüstite of lower mantle composition and core-forming Fe-Ni alloy at 1–40 GPa

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ABSTRACT

One class of models for the early history of the Earth requires the present-day inventory of siderophile elements in the mantle to have been established by equilibrium partitioning between core-forming metal and mantle minerals at high pressures and temperatures deep inside the Earth. We have accordingly carried out reconnaissance experiments on the partitioning of nickel between model lower mantle magnesiowüstite ($Mg' = 85$ and 1.3 wt% NiO) and a model core-forming alloy, $Fe_{94}Ni_6$ (~7 wt% Ni) at pressures between 1–40 GPa and temperatures ranging from 1200 °C to >2000 °C. Reversal experiments were also attempted. Our results highlight the difficulty of attaining equilibrium partitioning in this system and imply that partition coefficients derived from unreversed experiments should accordingly be viewed with reservation. Our data nevertheless imply that the concentration of NiO in lower mantle magnesiowüstite in equilibrium with core-forming metal with ~7 wt% Ni would be extremely low, e.g., about 0.2 wt% NiO. Moreover, equilibrium seems to be fairly insensitive to the effects of either pressure or temperature, and so it is unlikely that magnesiowüstite could acquire 1.3 wt% NiO simply by equilibrating with core-forming metal under special high *P-T* conditions early in Earth history. Alternative hypotheses for the present-day siderophile element inventory of the mantle are accordingly preferred.