

Nickel isotope fractionation during core formation on large terrestrial planets

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Accretion and core formation are major events that led to the present-day structure and composition of the terrestrial planets. Knowledge of the distribution of core-forming elements and their isotopes during core formation has the potential to make headway on questions such as (1) the physical and chemical conditions of core formation, (2) planetary source materials and genetics and (3) accretion scenarios. Nickel is well-suited tracer of core formation given its strong affinity for the core and insensitivity to volatile processes. Thus, mantle Ni isotope signatures in terrestrial planets ought to be mainly established by core formation. The Ni isotopic composition of the Earth ($d^{60/58}\text{Ni}_{\text{BSE}}=0.11\pm0.06\text{‰}$) is slightly lighter than the average of chondrites ($d^{60/58}\text{Ni}_{\text{BSE}}=0.23\pm0.07\text{‰}$) [1], which could not be inherited from volatilisation processes. Core formation is therefore a good candidate as a process generating these signatures. This study aims to determine both experimentally and via *ab initio* simulations the direction and magnitude of Ni isotopic fractionation between metal and silicate at conditions relevant to core formation on large terrestrial planets. Experiments were performed in a 5000-ton multianvil press from 8 to 14 GPa at superliquidus conditions in order to reproduce the metal–silicate equilibrium occurring during core formation. Quenched equilibrated metal and silicate samples were carefully selected and prepared for Ni isotopic ratio characterisation via MC-ICPMS. Molecular dynamical simulations were computed at conditions matching that of the experiments. These results yield new information on the adequacy of Ni isotopic fractionation as a tracer of core formation and accretion on large terrestrial planets.

[1] Klaver et al., 2020. GCA 268, 405–421.