Nickel isotopes as a tracer of planetary differentiation processes?

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Nickel isotopes have been used to tentatively date iron meteorites [1,2] and to trace processes, including their cooling rate [e.g. 3]. Besides, knowing the exact abundance of ^{60}Fe when the parent bodies differentiated allows refining their thermal evolution modeling. Nickel is expected to behave similarly to Fe, yet being much less sensitive to redox processes. Hence, Ni isotope data for a variety of planetary reservoirs should permit to disentangle volatility related processes and redox reactions, at least for the silicate portion of planets. Carbonaceous chondrites as well as samples from the Earth, the Moon, Mars, and Vesta have been analyzed. It appears that martian meteorites and HED are slightly lighter than lunar meteorites or terrestrial samples, the latter being indistinguishable from chondrites. Nickel stable isotopes do not seem to register metal-silicate differentiation, which is further supported by experimental work [4,5] showing that metal-silicate differenciation induces no Ni isotope fractionation at equilibrium. Thus, core formation is not the main process reponsible for the differences observed between planetary reservoirs. Nickel and its isotopic composition is probably controlled by volatility-related processes, most likely taking place in the nebula, as recently proposed for Si [6] and Fe [7].

[1] Quitté et al. (2006) EPSL 242, 16-25. [2] Cook et al. (2008) GRL 35, L01203. [3] Watson et al. (2016) EPSL 451, 159-167. [4] Lazar et al. (2012) GCA 86, 276-295. [5] Guignard et al, this meeting. [6] Dauphas et al. (2015) EPSL 427, 236-248. [7] Sossi et al. (2016) EPSL 449, 360-371.