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Genetic relationship of chondrites and ungrouped iron meteorites based on their nucleosynthetic Ni isotope compositions

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The analysis of nucleosynthetic isotope variations is a valuable technique to identify genetic relationships of different solar system materials. Nickel shows moderately siderophile and moderately refractory characteristics and is relatively abundant (mostly wt.%) in both stony and iron meteorites. Here, we apply high precision Ni isotope analyses to identify potential genetic relationships between ungrouped iron meteorites and chondrites.

We report new Ni isotope data obtained from metals of 16 ungrouped irons. Two analytical procedures were applied. Six irons were purified using a procedure modified from [1]. In addition, we established a new ion exchange protocol for Ni purification based on [2, 3, 4], which was performed on ten samples. This protocol comprises four column steps and achieves Ni yields of >90%. The isotope analyses were performed on a Neptune Plus MC-ICP-MS at ETH Zurich. External reproducibility (2SD) was assessed with the IAB iron meteorite Canyon Diablo yielding (n=24) $\varepsilon^{60}Ni/^{58}Ni_{61/58}$=20ppm, $\varepsilon^{62}Ni/^{58}Ni_{61/58}$=39ppm and $\varepsilon^{64}Ni/^{58}Ni_{61/58}$=65ppm.

The Ni isotope data reveal that some ungrouped irons overlap within analytical uncertainties with established meteorite groups. One cluster falls within the non-carbonaceous reservoir shared with some IC and IIIE irons [5] as well as ordinary chondrites [6], which suggests they formed at similar heliocentric distances from similar material. Another cluster of ungrouped irons plots close to the CR chondrite NWA 801 [6] in the $\varepsilon^{60}Ni$-$\varepsilon^{64}Ni$ space. However, there is only one data point for CR chondrites so far and we will obtain new Ni isotope data for CR chondrites to verify this relationship. In summary, our Ni isotope data imply a relation between iron meteorites and chondrites, which supports the findings of [6].

[1] Steele *et al.* (2011) *GCA* 75, 7906–7925. [2] Cook *et al.* (2020) *Met. & Plan. Sci.* 55(12), 2758-2771. [3] Vance *et al.* (2016). *Phil. Tran. Roy. Soc.* 374(2081), 20150294. [4] Klaver *et al.* (2020) *GCA* 268, 405-421. [5] Nanne *et al.* (2019) *EPSL* 551, 44-54. [6] Steele *et al.* (2012) *Astrophys. J.* 758(1), 59.