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Nickel isotope evidence for the origin of the K-Pg impactor

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The Cretaceous-Palaeogene (K-Pg) mass extinction, which has led to disappearance of approximately 70% of all existing genera including most dinosaurs, is best explained via an asteroid impact that resulted in the Chicxulub impact structure [1]. The origin of the impactor is important for understanding the impact-extinction link. The existing isotope evidence points to a carbonaceous chondrite impactor [2, 3, 4]. However, it is not easy to distinguish between the specific chondrite groups. Nickel stands out as a potential isotope tracer, because CI chondrites have markedly different compositions compared to the rest of the carbonaceous chondrites [5]. It is a siderophile, compatible element and is depleted in the Earth's crust relative to chondrites, which increases the measurable impactor contribution to the particular element's budget in a given sample.

To constrain the nature of the impactor we report high-precision mass-independent Ni isotope data for K-Pg boundary layer samples containing dust-sized ejecta from the impact [1]. The samples come from Stevns Klint, Caravaca, Furlo, Frontale and Fornaci. These samples are supplemented with 11 carbonaceous chondrites, including CT, CY and CZ types, which lack Ni isotope data so far. In $\mu^{60}Ni_{62/61}$-$\mu^{58}Ni_{62/61}$-space, the new chondrites have compositions typical of other carbonaceous chondrites, forming a weakly correlated array. Specifically, CZ chondrites have low $\mu^{58}Ni_{62/61}$- and $\mu^{60}Ni_{62/61}$-values also typical of CR and CV chondrites. CT chondrites and ungrouped samples have higher values, similar to CO chondrites. Finally, CY chondrites have very anomalous compositions typical of CI chondrites. K-Pg boundary samples display relatively scattered compositions that overlap with terrestrial mantle compositions, non-carbonaceous chondrites and some carbonaceous chondrites, namely the CV, CM, CO, CB, CH and CZ groups. While we found a small-scale Ni isotope heterogeneity within K-Pg boundary samples, our data suggest exclusion of CI and CY chondrites as potential impactors, and, combined with literature [2, 3, 4], favour a CV- or CM-impactor.

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