NICKEL ISOTOPIC COMPOSTION OF RYUGU SAMPLES RETURNED BY THE HAYABUSA2 MISSION.

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Introduction: Initial analyses of samples returned from the Cb-type asteroid 162173 Ryugu by JAXA's Hayabusa2 mission provide mineralogical and chemical evidence for a close link to CI chondrites [1,2]. However, these similarities do not necessarily imply that Ryugu and CI chondrites formed in the same region of the solar accretion disk. Such a genetic link can instead be best established using nucleosynthetic isotope signatures, which arise through the heterogeneous distribution of presolar material in the disk and, as such, provide firm constraints on the nebular source region of meteorites and their components. Consistent with the chemical and mineralogical evidence, ^{54}Cr and ^{50}Ti anomalies in Ryugu [2] confirm that Ryugu belongs to the carbonaceous (CC) meteorite reservoir [3]. However, the ^{54}Cr and ^{50}Ti anomalies in Ryugu do not only closely resemble those in CI chondrites, but also overlap with those of CB and CR chondrites as well as with some CC achondrites and the ungrouped C2 chondrite Tagish Lake [2]. Thus, analyses of nucleosynthetic isotope anomalies in other elements is needed to firmly assess the genetic link between Ryugu and CI chondrites. Nickel isotopes hold considerable promise to establish this potential genetic link, because CI chondrites do not only display the largest ε^{62}Ni and ε^{64}Ni anomalies among carbonaceous chondrites, but they also have a distinct ε^{60}Ni composition compared to all other known CC materials (Fig. 1). To test whether Ryugu exhibits the same characteristic Ni isotopic composition as CI chondrites, we initiated a systematic Ni isotopic study on a comprehensive set of carbonaceous chondrites and as part of this study will also analyze samples of Ryugu.

Methods: We obtained four Ryugu samples (A0106–A0107, A0106, C0108, C0107) along with six carbonaceous chondrites including the CI chondrites Orgueil and Alais, which have been chemically processed alongside the Ryugu samples [2]. In addition, we also measured several carbonaceous chondrites from all major groups together with several ungrouped carbonaceous chondrites. Chemical purification of Ni involved a 3-step ion-exchange chromatographic procedure following the protocols as described in [4]. This method achieves sufficiently low ^{58}Fe/^{58}Ni and ^{64}Zn/^{64}Ni ratios in the final purified Ni cuts and allows for accurate and precise correction of isobaric interferences [4–6]. The total yield of the entire chemical procedure typically is ~80-90%. Total procedural blanks were <10 ng Ni and, hence, negligible given the amount of Ni analyzed. All isotope measurements are performed on the Thermo Scientific Neptune Plus MC-ICP-MS at the Institut für Planetologie, University of Münster. Instrumental mass bias is corrected by internally normalizing to either ^{61}Ni/^{58}Ni = 0.016744 or ^{62}Ni/^{61}Ni = 3.1884, using the exponential law. All data are reported in the ε-notation as the parts per 10^4 deviation relative to the terrestrial Alfa Aesar solution standard.

Results and discussion: Preliminary results of an Orgueil sample from our own collection agree well with reported literature values (Fig. 1), demonstrating that Orgueil can indeed be distinguished from other carbonaceous chondrites by its Ni isotopic composition. The analyses of Ryugu samples are still in progress and the results will be presented at the conference.

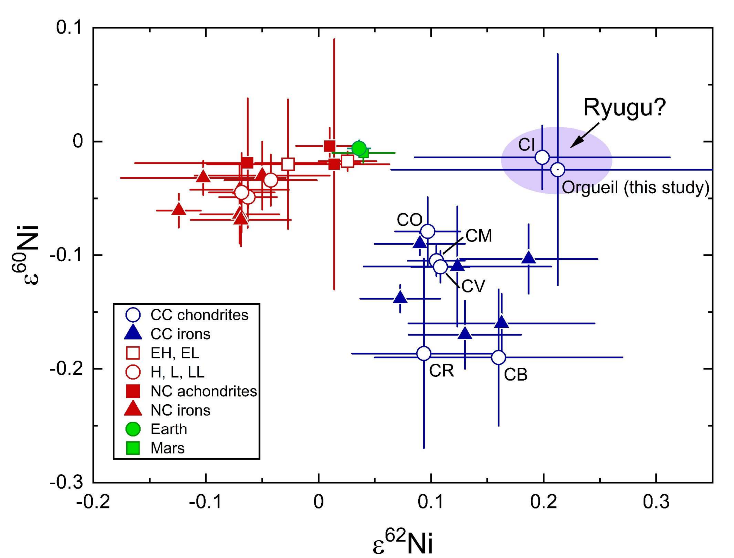

Fig. 1: Diagram of ε^{60}Ni vs. ε^{62}Ni normalized to ^{61}Ni/^{58}Ni modified after [6]. CI chondrites show no resolved anomaly in ε^{60}Ni making them distinct from all other known CC materials.

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