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A close genetic relationship between Bennu and CI chondrites

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The OSIRIS-REx mission delivered 121.6 g of material from asteroid Bennu to Earth [1]. Nucleosynthetic isotope compositions serve as tracers for establishing connections between different meteorite groups and returned samples [2]. These compositions shed light on the formation of asteroidal parent bodies from diverse dust reservoirs with unique isotope compositions in the early solar system. They also constrain mixing in the protoplanetary disk [e.g., 3,4]. Depending on geochemical properties, these compositions can be modified during aqueous alteration on the parent body [e.g., 5].

Here, we report Ti, Fe, and Zr isotope data for Bennu samples and carbonaceous chondrites analysed at ETH (Ti, Fe, Zr) and Lawrence Livermore National Laboratory (LLNL) (Ti, Fe). For Zr isotopes, we analysed an aliquot of a homogenized aggregate sample (OREX-800117-0) with a total mass of 1.288 g. For Ti and Fe isotopes, we also measured four additional samples in both laboratories: aliquots of an aggregate sample (OREX-803015-0, 20.66 mg) and aliquots representing the angular (OREX-800055-2, 69.5 mg), hummocky (OREX-803231-0, 30.6 mg), and mottled (OREX-800023-1, 131.3 mg) particle types.

The aliquots analysed at ETH and LLNL have indistinguishable Ti and Fe isotope compositions within analytical uncertainties, demonstrating homogeneity in Bennu samples on the scale of 20–1200 mg. The Ti, Fe, and Zr data confirm a close genetic relationship of Bennu to CI and Ryugu samples and combined with other evidence e.g., that Bennu samples incorporated ices from a region where ammonia ice was stable [6], a formation outside the water snowline. Bennu, Ryugu, and the CI chondrite parent bodies may have formed in the same region of the disk. Alternatively, dust with this composition may have been ubiquitous in the outer solar system.

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