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Trace element and isotopic evidence for Bennu's primitive provenance

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The delivery of material from asteroid (101955) Bennu by NASA's OSIRIS-REx mission provides the opportunity to investigate some of the most pristine material from the early Solar System [1]. Our team at Lawrence Livermore National Laboratory (LLNL) utilized the equivalent of 5.0 mg from Bennu sample OREX-803015-100 to quantify the major and trace element contents and investigate major element isotopics (Ca, Ti, Cr, Fe, and Ni). Our 5.0 mg aliquot of OREX-803015-100 was a subsample of dissolved homogenized material representing 20.66 mg [2]. A separate 5.0 mg aliquot was sent to ETH Zürich and is discussed in a companion abstract [3].

Before any chemical separation on our 5.0 mg aliquot, the equivalent of 0.5 mg was removed and analyzed for elemental abundances at LLNL using a Thermo Scientific Element XR. Our data agree exceptionally well with those reported by [2], showing that Bennu is primitive and compositionally similar to CI chondrites, Ryugu [4], and the solar photosphere [5].

The remaining ~4.5 mg underwent purification procedures to chemically isolate and purify Ca, Ti, Cr, Fe, and Ni from one another and the sample matrix. Their isotopic compositions were measured on either the Triton TIMS (Ca) at Johnson Space Center in Houston, Neoma MC-ICPMS (Ti, Cr) at LLNL, or the Neptune MC-ICPMS (Fe, Ni) at LLNL. Results from the Ca, Ti, Cr, Fe, and Ni isotopic compositions suggest that Bennu is closely related to CI chondrites—consistent with conclusions from elemental composition [2] and oxygen isotopics [6] reported for Bennu. The major element isotope compositions that we will present demonstrate that Bennu likely formed in a similar region of the Solar System as CI chondrites and potentially at a similar time of Solar System evolution.

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References:

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