THE POTASSIUM ISOTOPE COMPOSITION OF AGGREGATE MATERIAL FROM ASTEROID BENNU. K. Wang (王昆)[1], P. Koefoed[1], P. Haenecour[2], J. J. Barnes[2], A. N. Nguyen[3], H. C. Connolly Jr.[2,4,5], D. S. Lauretta[2], [1]McDonnell Center for the Space Sciences, Dept. of Earth, Environmental, & Planetary Sciences, Washington University in St. Louis, One Brookings Drive, St. Louis, MO 63130, USA (piers.koefoed@wustl.edu), [2]Lunar and Planetary Laboratory, University of Arizona, Arizona, USA, [3]Astromaterials Research and Exploration Science Division, NASA Johnson Space Center, Houston, Texas, USA, [4]Department of Geology, School of Earth and Environment, Rowan University, Glassboro, NJ, USA, [5]Department of Earth and Planetary Science, American Museum of Natural History, New York, NY, USA.

Introduction: NASA's OSIRIS-REx mission returned material from asteroid Bennu on September 24, 2023, marking the first time a U.S. mission has delivered asteroid samples to Earth, and the largest asteroid sample return to date. Due to the pristine nature of these primitive carbonaceous-rich samples [1], they allow us a rare opportunity to study our solar system's formation to a degree not previously possible.

Isotopes of moderately volatile elements (MVEs) have been recently developed as robust tracers for tracking different volatilization events within our Solar System [2,3,4,5]. Of the MVEs, K has gained significant interest in recent years due to its ideal chemical and physical properties combined with technique improvements [4,5,6,7]. Due to this, several recent studies have investigated the K isotope systematics within bulk chondrites and found an isotopic dichotomy between the carbonaceous and non-carbonaceous chondrites (Figure 1), likely reflecting their different reservoirs which formed in the inner and outer protoplanetary disk respectively [6,7]. Furthermore, systematic K isotope variations across the different carbonaceous chondrite groups and correlations with mass independent isotope systems such as Cr, Ti, and Ni, have also been observed [7]. As a result, establishing the K isotope composition of bulk Bennu can be used to test the mission hypothesis that *"Bennu's parent asteroid accreted in the outer protoplanetary disk, beyond Jupiter, as recorded by distinct isotopic anomalies in a variety of elements"* [8].

In addition to early solar system processes, K isotopes can also be fractionated by space weathering as shown by comparisons between mature and immature lunar regolith [9]. The degree of K isotope fractionation caused by space weathering correlates with the regolith maturity index and is an order of magnitude larger than what is observed in bulk meteorite samples which have not undergone strong space weathering processes [9]. As such, the K isotope systematics of Bennu samples could provide an independent assessment of regolith maturity of the asteroid surface, helping to directly test the mission hypothesis that *"Space weathering changed the chemistry and mineralogy of optically active surfaces"* [8]. In order to test both this hypothesis, and the hypothesis relating to Bennu's accretion location, we aim to conduct high-precision K isotope analysis on bulk Bennu aggregates.

Samples: Potassium isotope analysis of Bennu aggregates will be undertaken on sample OREX-803015-0 (20.66 mg), which was separated from the parent sample OREX-800033-0. This data will then be assessed in relation to the range of chondrite samples presented in [7].

Analytical Methods: Dissolution of the Bennu aggregate sample was undertaken using concentrated HF and HNO_3 at a 3:1 ratio, with HCl and H_2O_2 also used to remove fluorides and organics, respectively. The planned K separation and analysis will be undertaken following the procedures described in [7]. Briefly, the K separation will be performed by means of a triple pass column chemistry procedure using Bio-Rad AG50W-X8 100-200 mesh cation exchange resin with 0.5 M HNO_3 used as the elution liquid. The K isotope analyses will be conducted using a Thermo Scientific Neptune Plus MC-ICP-MS equipped with an Elemental Scientific APEX Ω high sensitivity desolvation system. The sample-standard bracketing technique will be used for all analyses with NIST SRM 3141a used as the standard. BHVO-2 will also analyzed alongside to monitor data quality.

Results: Results and interpretation of the Bennu aggregate K isotope data will be presented at the conference. Nevertheless, elemental analyses of the Bennu aggregate sample OREX-803015-0 has already been completed and shows K elemental concentrations similar to the average CI chondrite, and thus solar photosphere, composition [10]. As such, a comparison between the CI chondrite average $\delta^{41}K$ composition of -0.21 ± 0.05‰ (Figure 1) and the Bennu aggregate will be of special interest.

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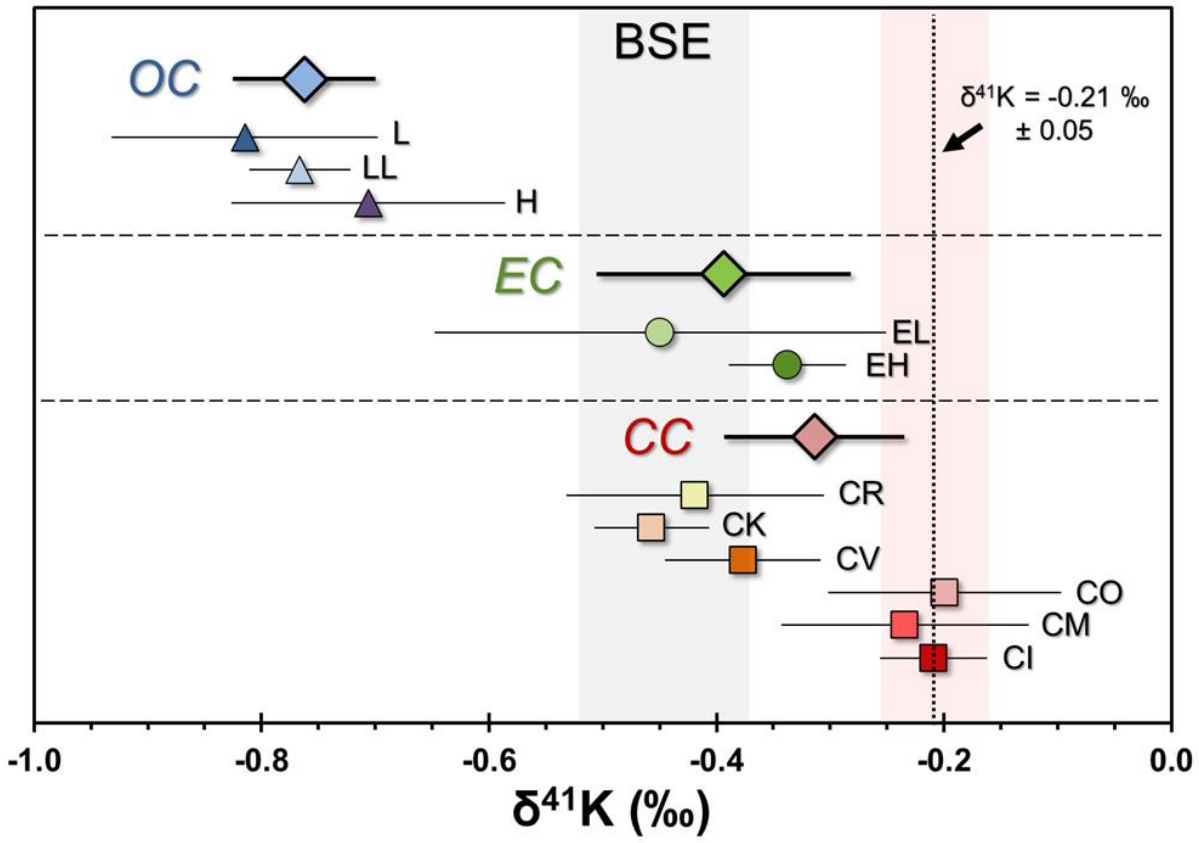

Figure 1. Mean K isotope compositions of all chondrite groups and classes for which data is available. The CI chondrite $\delta^{41}K$ value is shown as the red shaded area, while the bulk silicate Earth (BSE) K isotope composition is shown as a grey shaded area. Errors shown are 2 SE. Figure reproduced from [7].

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