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Volatile compound capture and characterization during curation of the OSIRIS-REx sample from asteroid Bennu

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The soluble and insoluble organic inventory of carbonaceous chondrites points toward myriad reaction pathways important for the synthesis of molecules connected to prebiotic reactions [1]. Their source may be ices and volatile precursors that experience extensive chemistry, driven by ionizing radiation, in presolar and interstellar regions [2]. Meteoritic volatile analysis can be challenging since loss and contamination may occur during transit and after the fall [3]. Samples collected from the surface of the B-type asteroid Bennu, delivered to Earth by the Origins, Spectral Interpretation, Resource Identification, and Security–Regolith Explorer (OSIRIS-REx) mission, provide a pristine record of early solar system chemical processes. These samples offer a unique opportunity to measure volatile species in material unaltered by direct exposure to Earth's atmosphere [4].

To collect volatile molecules during sample off-gassing, we designed an array of passive adsorbent materials to collect the outflow of the nitrogen-purged OSIRIS-REx sample glovebox [5]. The design goals were primarily to ensure sample integrity by not allowing contact with or backflow to the sample, and secondarily to optimize collection of gases with a minimal footprint in the curation facility. Adsorbent materials included solid-phase microextraction fibers with coatings designed for molecules ranging from highly volatile aromatics to polar semi-volatiles. To capture molecules smaller than 30 Da, reagent-impregnated polyethylene cartridges were also installed in the collector. These adsorbents trap ammonia, hydrogen sulfide, and formaldehyde, among other volatiles. The collector also included a hydrocarbon trap optimized for the capture of C2-C5 aliphatic molecules. Together with canister air filter results and experiments on Bennu subsamples, this capture device will help provide a more complete picture of the volatile chemistry of Bennu [6].

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