The advancement of cleaning procedures for the curation of the Bennu sample at the Canadian Space Agency

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On October 20, 2020, the OSIRIS-REx mission collected a sample from the asteroid Bennu, which was delivered to Earth on September 24, 2023. Studying the sample will allow scientists to address fundamental questions about the solar system formation and evolution, its early composition, potential water delivery to early Earth, and the source of its organic compounds [1, 2]. In exchange for contributing the OSIRIS-REx Laser Altimeter (OLA) instrument, which collected data to produce a 3D model of the asteroid that helped identify the sampling site, Canada will receive a portion of the Bennu sample. The Canadian Space Agency (CSA) is currently developing its Curation Facility, which will be the first laboratory of its kind in Canada (see the abstract by Morisset et al. at this conference).

Beyond the clean rooms, the CSA is actively working on the cleaning, monitoring, and handling protocols to ensure best practices are maintained throughout sample handling steps. Specifically, the CSA has also begun developing its cleaning procedures for all stainless steel, glass, and Teflon tools that would be used to manipulate the sample. The basic cleaning procedure uses a series of high-purity solvents (Citranox®, dichloromethane, isopropyl alcohol, and hydrogen peroxide) and ultra-pure water to clean and sterilise handling and storage materials. In addition to this basic cleaning, a cleaning procedure has been developed for the cleaning of trace metals from Teflon tools. This cleaning procedure uses a series of high-purity acids (hydrochloric acid, nitric acid, and hydrofluoric acid) to remove any potential trace metal contamination.

To ensure no adverse reactions or degradation occurs between the solvents used in the basic cleaning and the materials that will be used in the storage and handling of the sample, a series of tests are being conducted. These tests involve a portion of each material type found in the various sample transport containers as a start (i.e. stainless steel, Kovar, Viton, sapphire) being bathed in a cleaning solvent over several time periods (30 minutes, 24 hours, and a week). In addition, a piece goes through the whole basic cleaning procedure and is therefore exposed to all the solvents. After each solvent bath, each portion is examined in detail under stereomicroscope and scanning electron microscope (SEM) and compared to a control sample that has not been exposed to any processing to document any evidence of physical degradation.

While no physical changes were observed when each component went through the whole cleaning procedure, reactions were documented for certain materials when they were left in some of the solvents over extended periods of times. In particular, Kovar, that is used as a sleeve in a commercial sapphire window flange container, reacted strongly with the 2% Citranox® and changed from a metallic grey to dark black in both the 24 hours and weeklong trials. In addition, the stainless-steel nuts and bolts also of the flange container (not in contact with the sample), showed some discolouration when left in the dichloromethane for a week; however, 316-grade stainless showed limited reaction with any of the solvents. Finally, in all the weeklong trials, bubbles formed on the materials when they were left in the hydrogen peroxide; however, no major changes in the materials were observed. The formation of the bubbles was mostly due to the oxidisation of the hydrogen peroxide producing oxygen.

Further testing of the basic cleaning procedure is still ongoing as the cleaning procedures are refined. Additional testing and work will be conducted to evaluate the effectiveness of the trace metal cleaning procedure.

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References
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