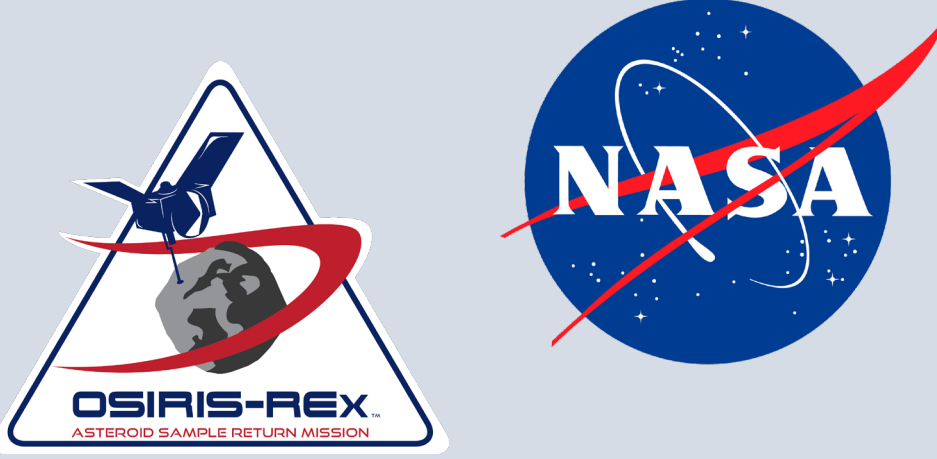


# OSIRIS-REx Sample Processing Tools and Techniques Utilized During Preliminary Examination

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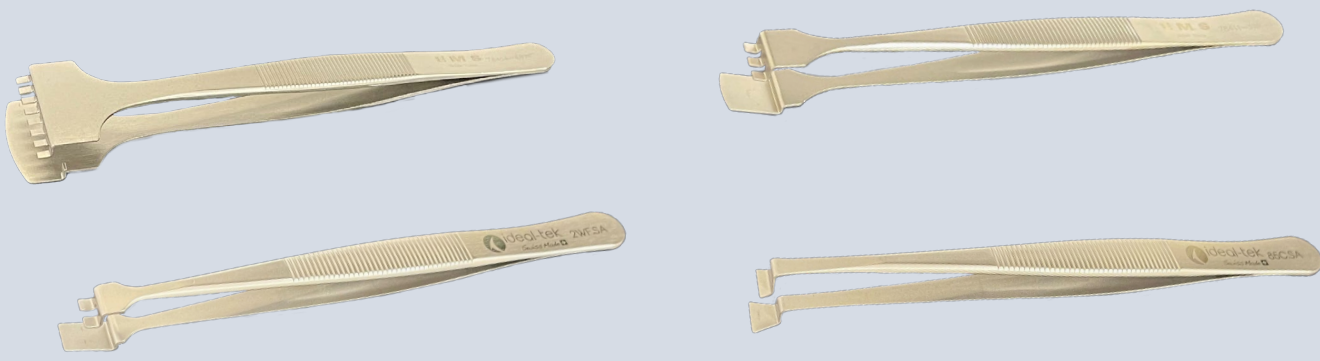


## Introduction

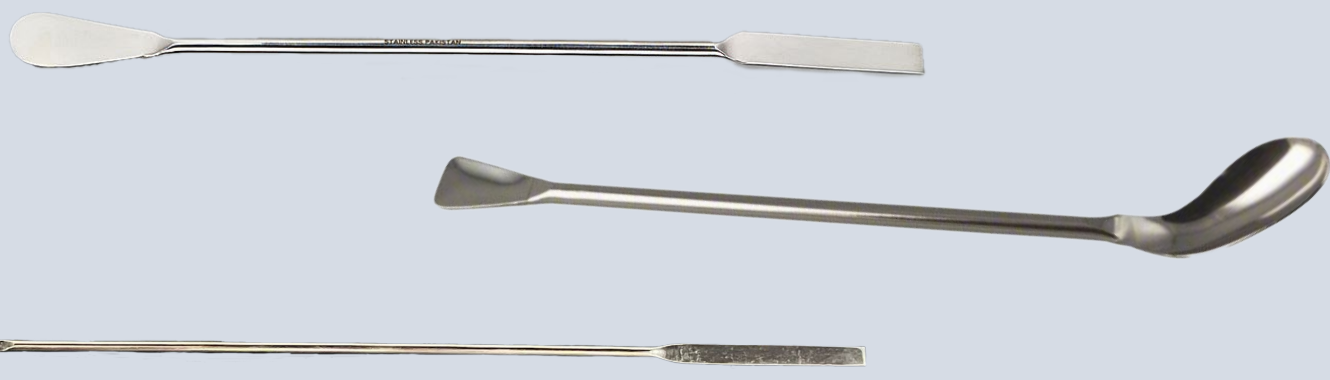
On September 24th, 2023, the Origins, Spectral Interpretation, Resource Identification, and Security Regolith Explorer (OSIRIS-REx) spacecraft delivered over 120 grams of material from near-Earth asteroid Benu [1]. This collection includes a variety of grain sizes ranging from very fine dust to micro-particles to centimeter-sized stones. When faced with unexpected outcomes during the preliminary examination (PE) period, the NASA Johnson Space Center (JSC) curation team prepared to maximize their flexibility in sample handling by utilizing unique sample processing tools and techniques while noting the general physical behaviors of the carbon-rich Benu material [2].

## Primary Tools

### Fine-Grain Sized Material



- Figure 1:** Aluminum wafer tweezers of various sizes. These were used for sweeping and collecting fine-grain sized material.



- Figure 2:** Stainless steel laboratory spatulas with a scoop. The flat ends of spatulas helped with framing zones of interest for collection as well as sweeping material into collectable piles for scooping. Micro sized scoops worked best for meticulous collection.

### Millimeter to Centimeter Sized Material



- Figure 3:** Stainless steel precision curved-tip tweezers were used to grasp micro to millimeter-sized particles.



- Figure 4:** Stainless steel large straight and curved tweezers were used to collect centimeter-sized stones.

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Sample and Photo Catalog

AIVA Images



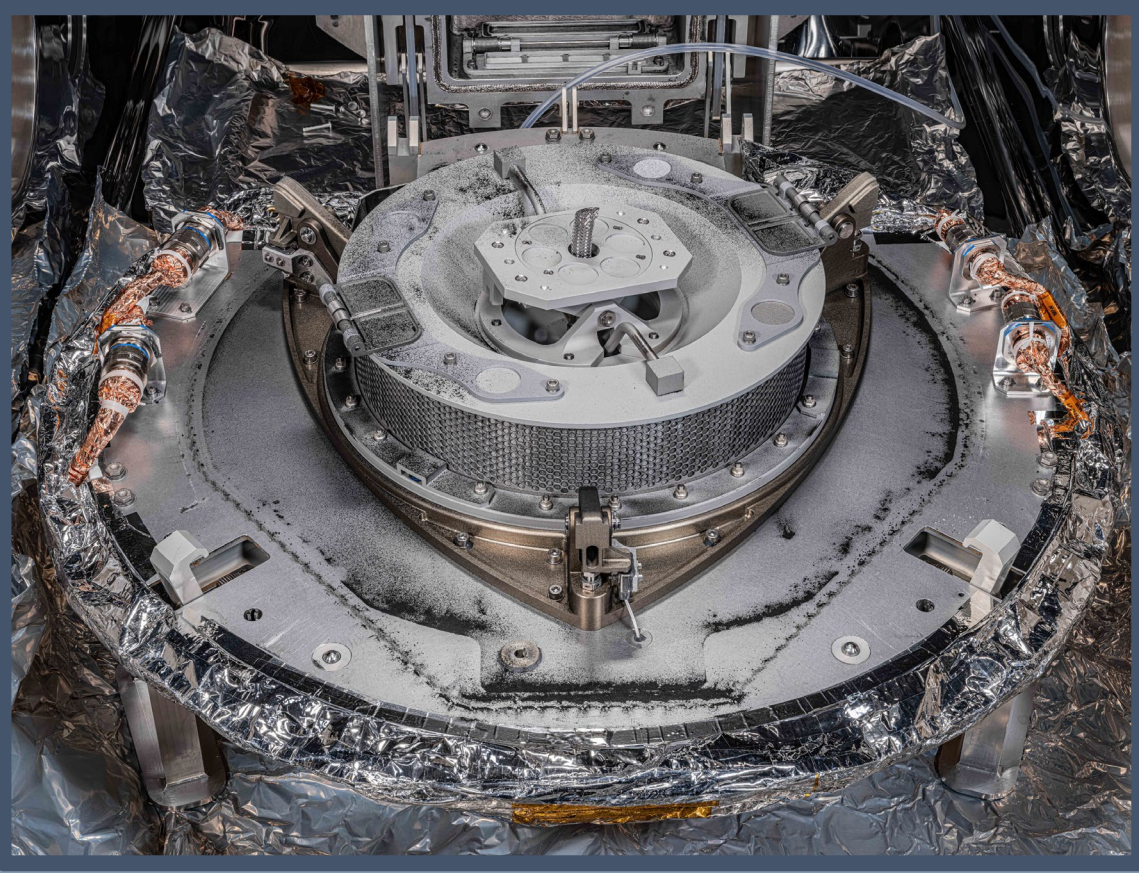
## References

[1] Barry, R. (2024, February 15). *NASA Announces OSIRIS-REx Bulk Sample Mass. NASA OSIRIS-REx Mission.* [2] Lauretta, D. S. et al. (2024, April 18). *Asteroid (101955) Benu in the Laboratory: Properties of the Sample Collected by OSIRIS-REx.* [3] Morton, E. (2023, October 20). *NASA'S OSIRIS-REx Achieves Sample Mass Milestone. NASA OSIRIS-REx Mission.*

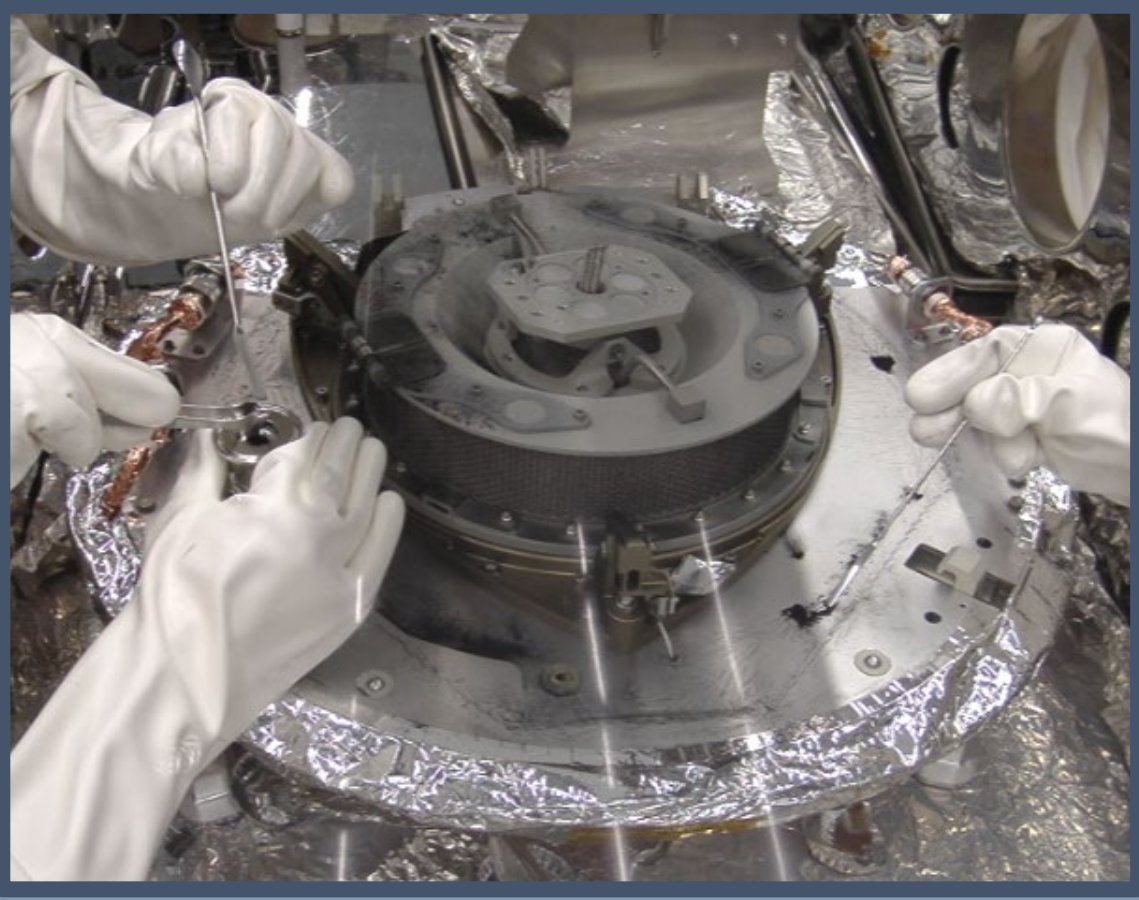


## Sample Collection

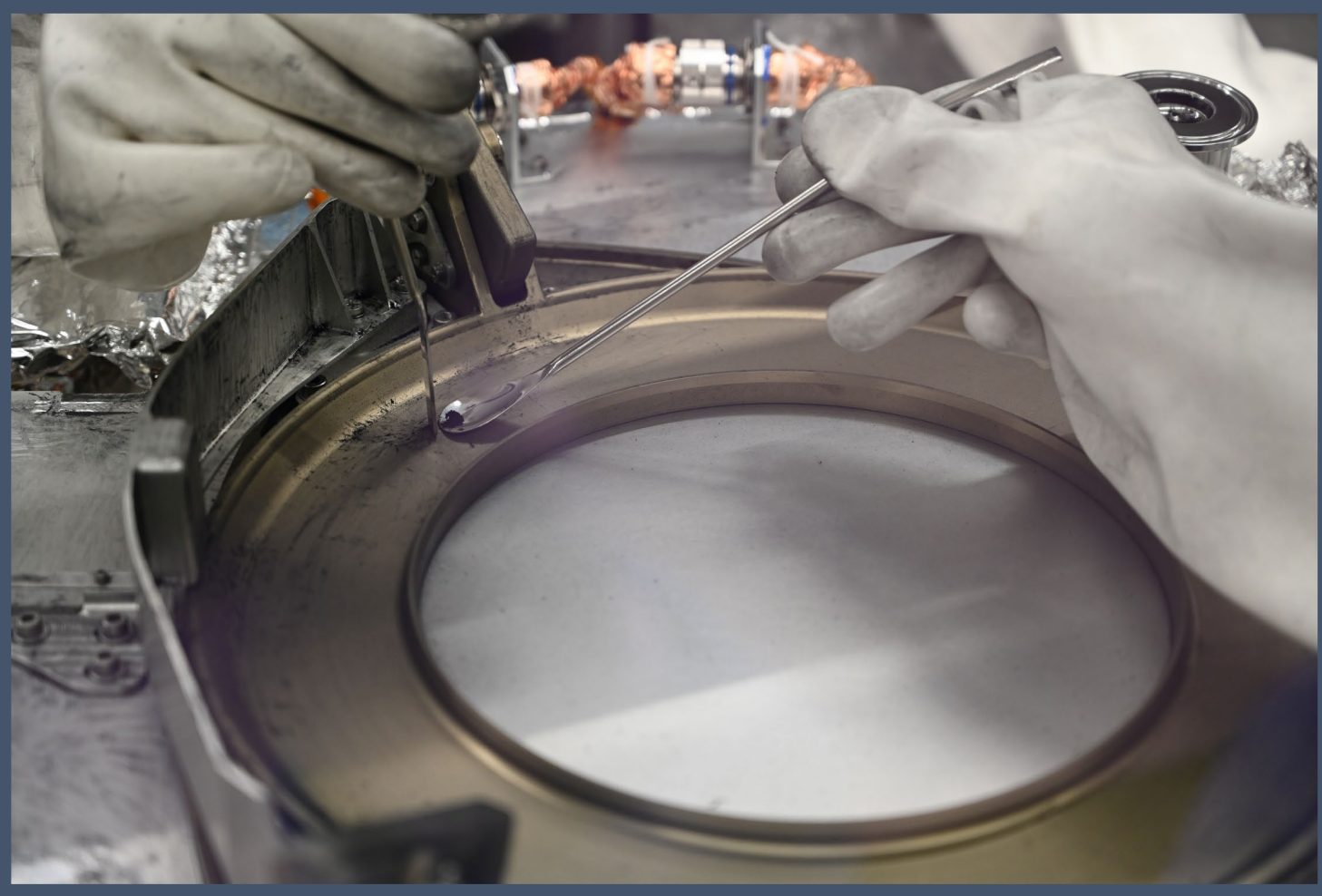
### Avionics Deck



Avionics deck and TAGSAM head after canister lid removal. Photo Credit: NASA/Erika Blumenfeld & Joseph Aebersold



Wafer tweezers [Fig.1] and laboratory spatulas [Fig.2] were used to sweep and collect fine-grain sized material from the avionics deck.

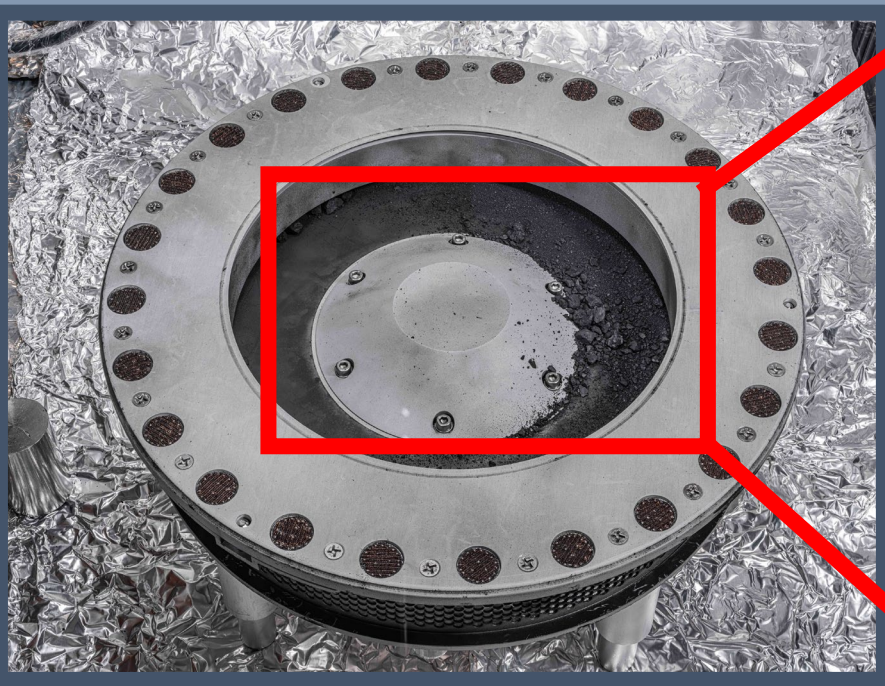


Flat, blunt-end tools such as laboratory spatulas [Fig.2] were ideal for sweeping and collecting fine-grain sized material from the capture ring after TAGSAM head removal.

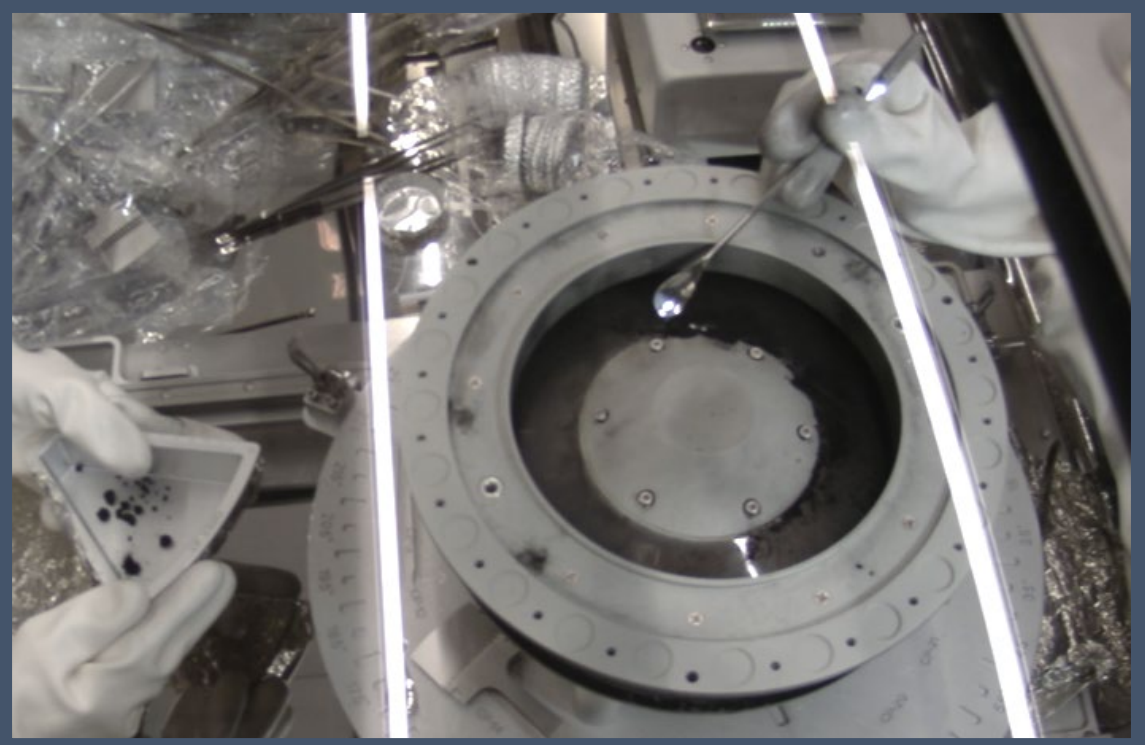
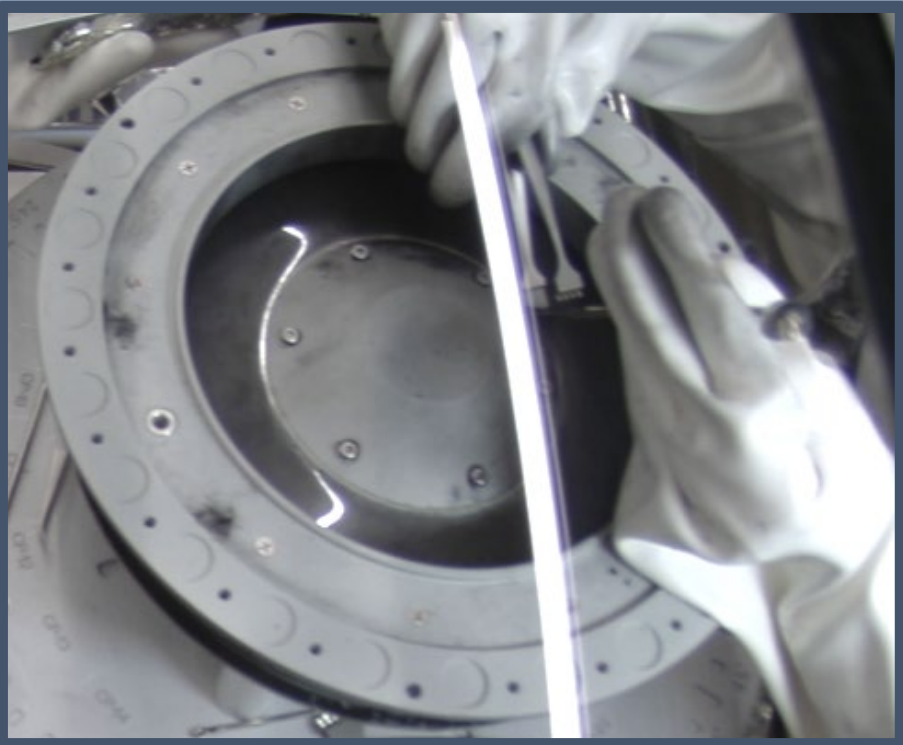


Particles on the micro to millimeter-size scale are more rounded and prone to jumping out of the tweezers grip. Precision curved-tip tweezers [Fig.3] were used to collect individual particles. It is necessary to grip these particle with as little force as possible.

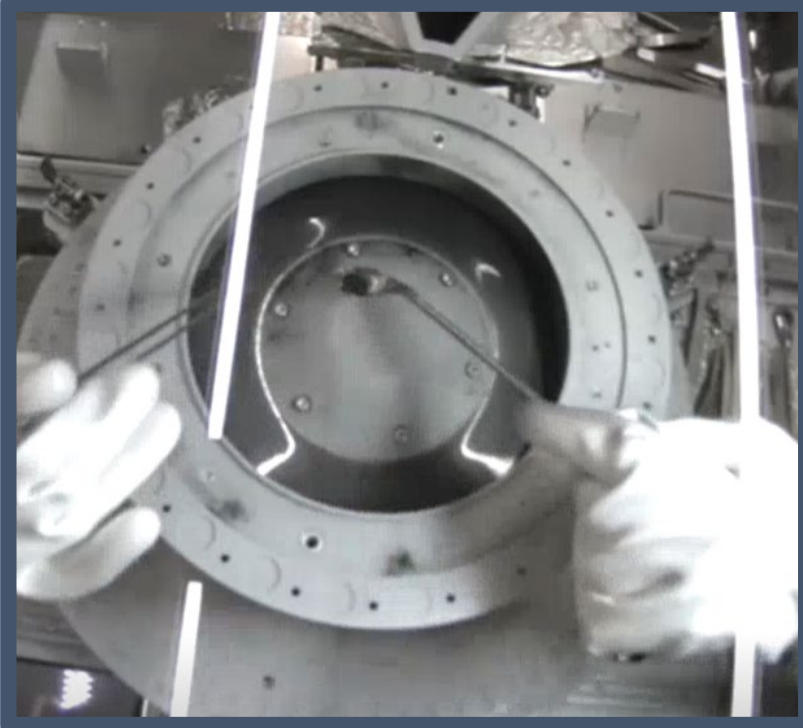
### Mylar Flap



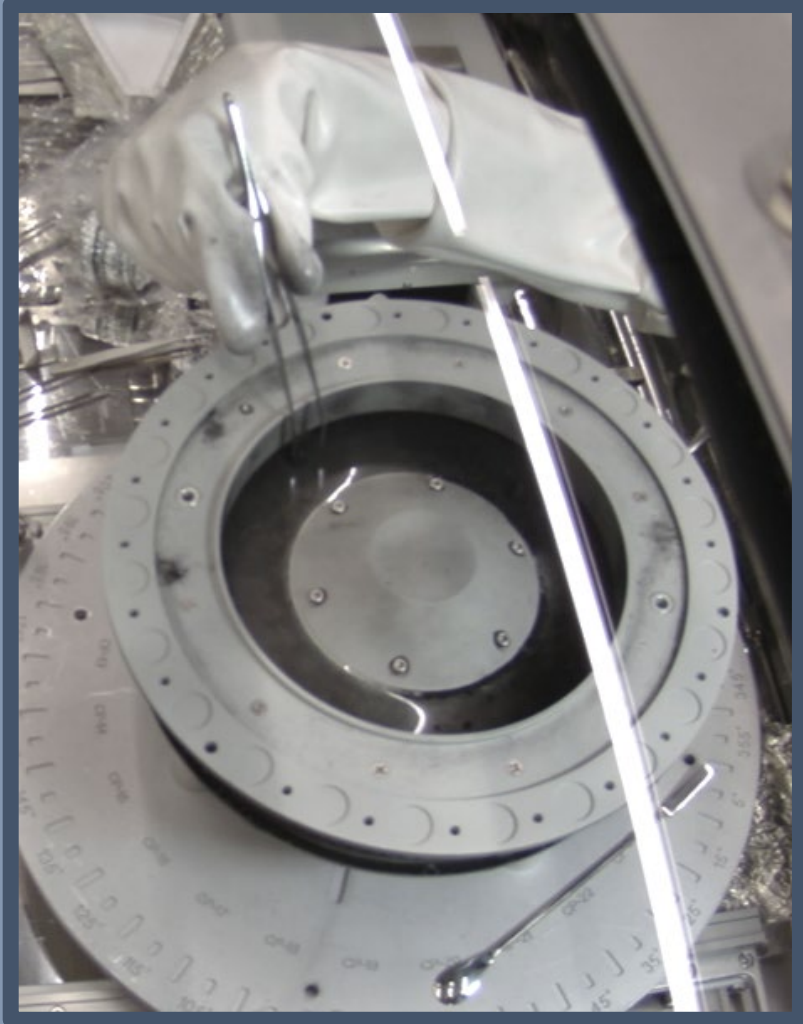
Bulk sample material on TAGSAM head deflector cone and mylar flap. Photo Credit: NASA/Erika Blumenfeld & Joseph Aebersold



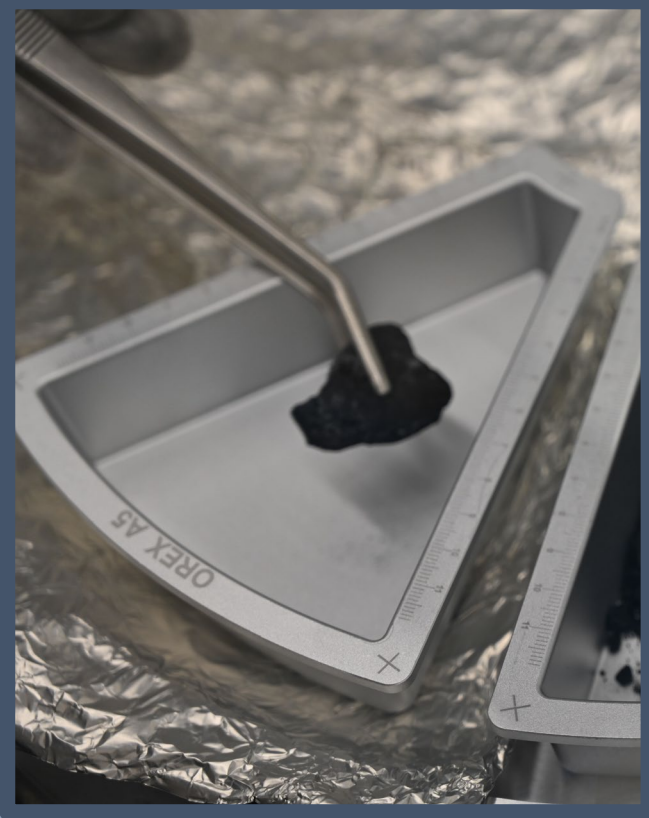
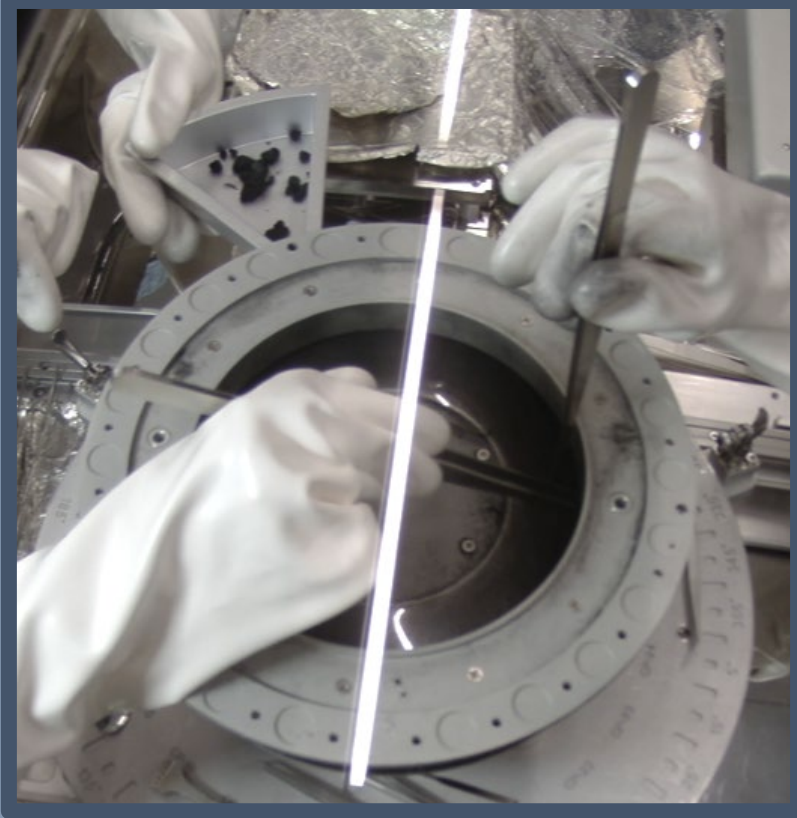
Wafer tweezers [Fig.1] and laboratory spatulas [Fig.2] were used to lightly sweep and scoop material towards the center of the TAGSAM head, where the mylar flap is less flexible.



Laboratory spatulas with a curved scoop on the end [Fig.2] were used to collect fine to millimeter-sized aggregates within the TAGSAM head.



Large, curved tweezers [Fig.4] were used to firmly grasp lodged particles that wedged the mylar flap open.



Long, straight tweezers [Fig.4] were used to hold the mylar flap down while a second processor used large, curved tweezers [Fig.4] to individually grab centimeter-sized stones.



70.3g of material from within the TAGSAM head was extracted before it was fully disassembled; surpassing the mission mass requirement of at least 60 grams of material [3]. Photo Credit: NASA/Erika Blumenfeld & Joseph Aebersold

## Aggregates for Sample Analysis Team, International Partners, and White Sands Complex

Laboratory spatulas with a micro scoop on the end [Fig.2] were used for collecting sample from a desired area where precise masses needed to be achieved.



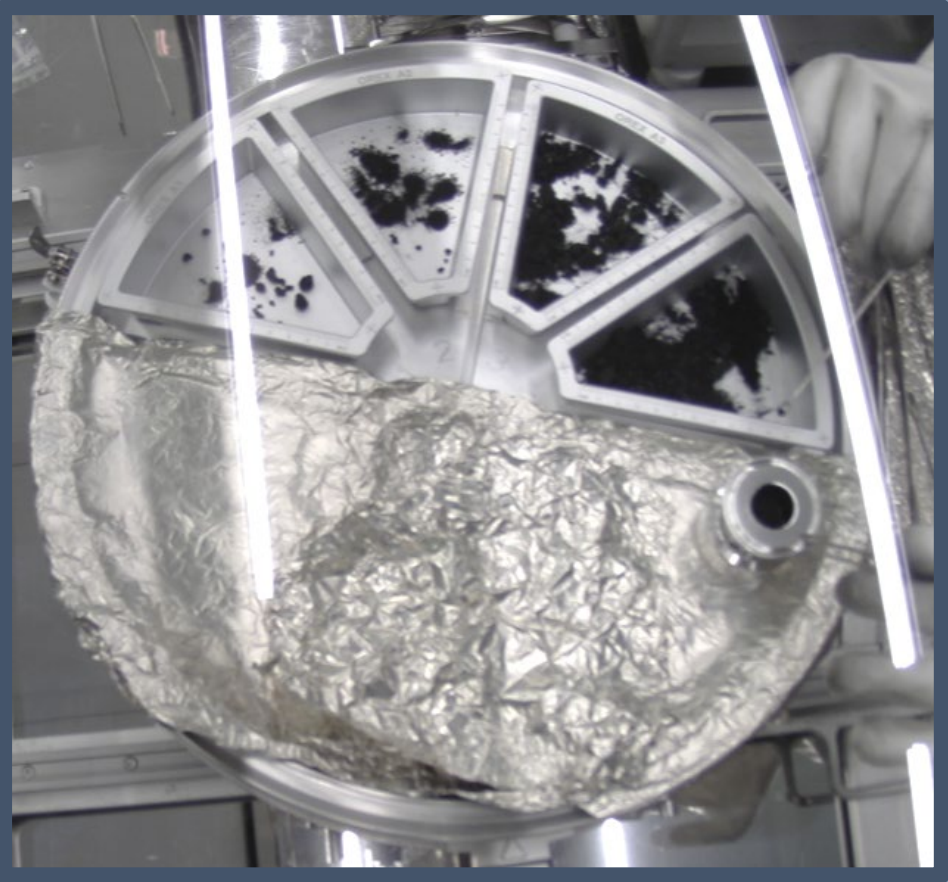
Sample Analysis Team Sample Collection



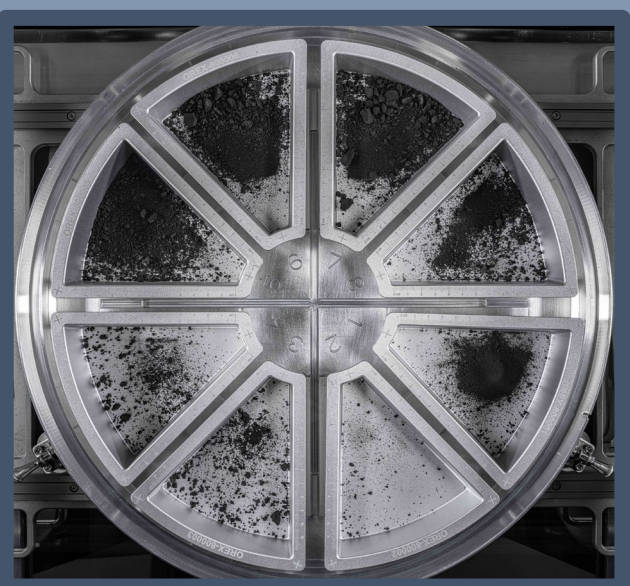
International Partner Sample Collection



JAXA



White Sands Complex Sample Collection



View of bulk material after sample pour. Photo Credit: NASA/Erika Blumenfeld & Joseph Aebersold