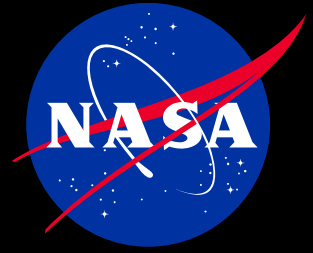
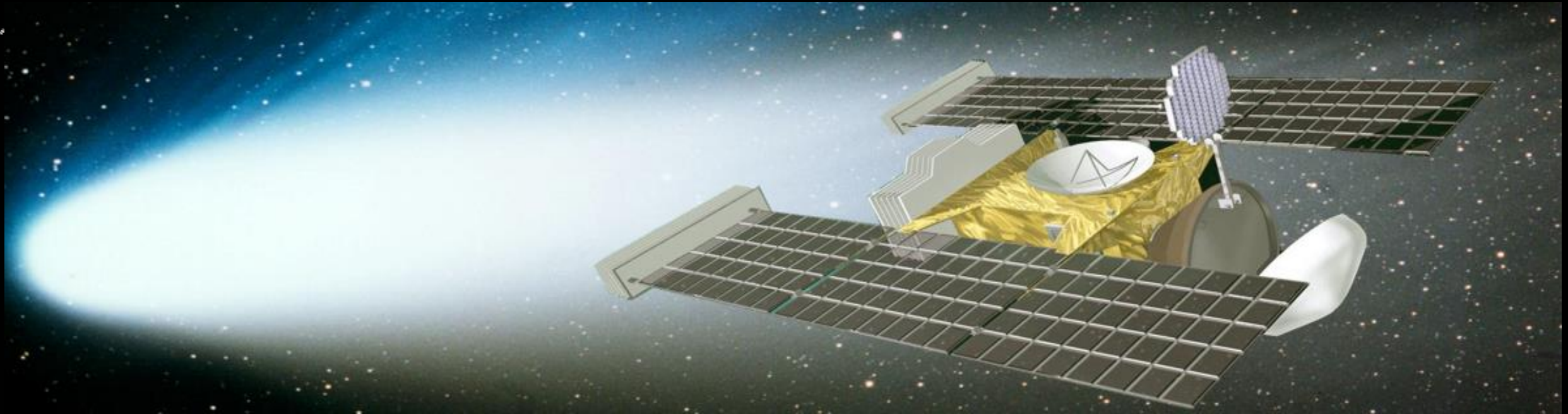


CURATION OF COMET 81P/WILD 2 COMA DUST AND FRESH INTERSTELLAR DUST FROM THE STARDUST MISSION AND COSMIC DUST

National Aeronautics and
Space Administration



ARES/M Zolensky
Johnson Space Center
9/15/2025



- We have archived all spacecraft material with the potential to contact or otherwise affect samples, including many spare aerogel cells, hardware, foils, soil from the landing site, flight witness materials, etc.



- See lab tour on YOUTUBE (google “stardust lab NASA”)



- Initial tray examination in the Stardust ISO class 5 clean room



SAMPLE STORAGE

- All samples are stored in nitrogen cabinets, but samples are processed in air
- Unless being processed these nitrogen storage cabinets are kept in the Lunar Return Sample Vault

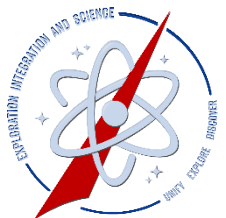
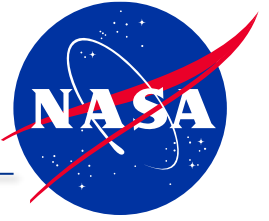
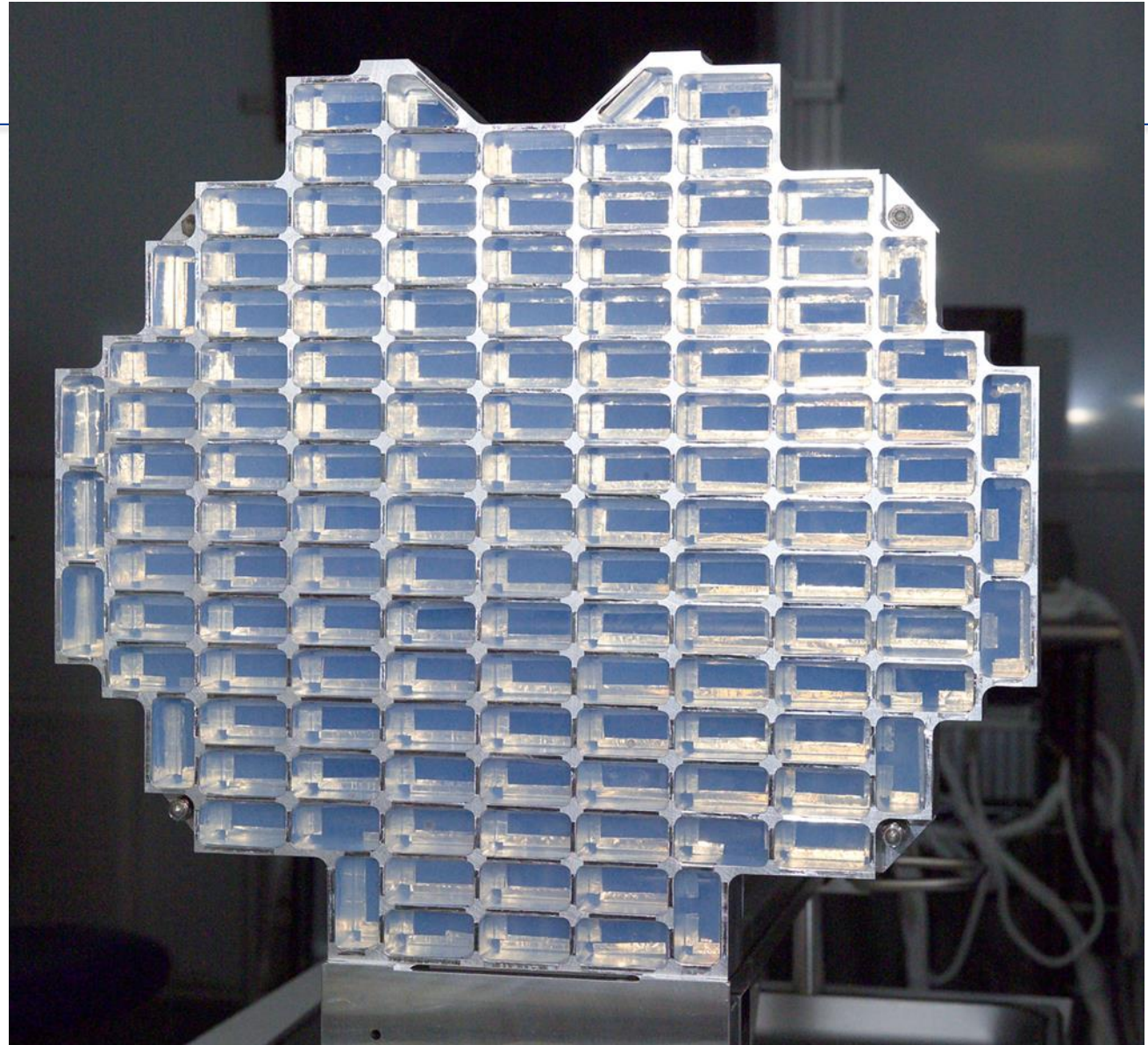
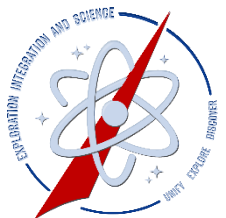
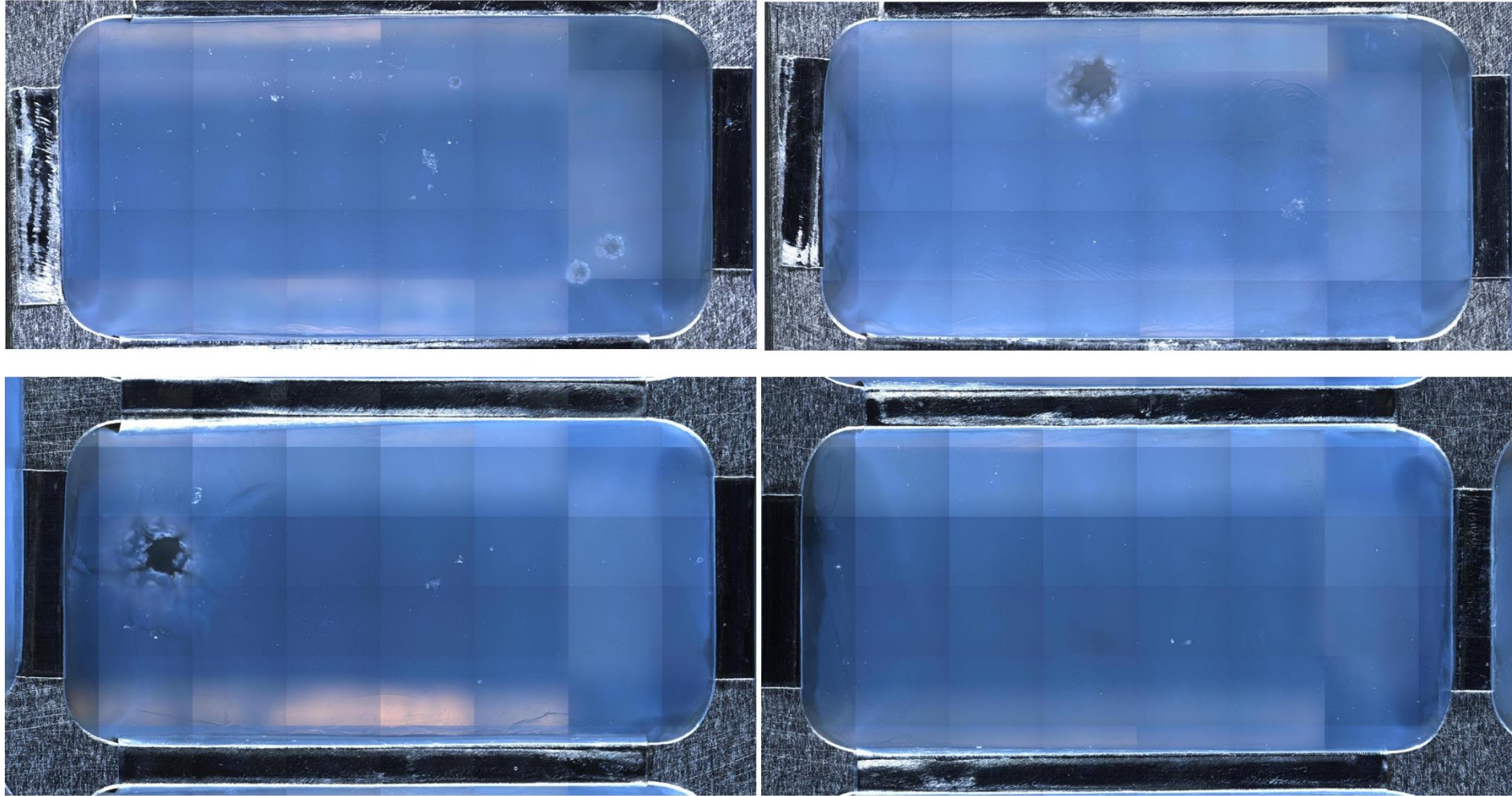
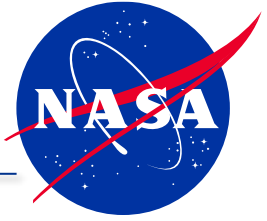
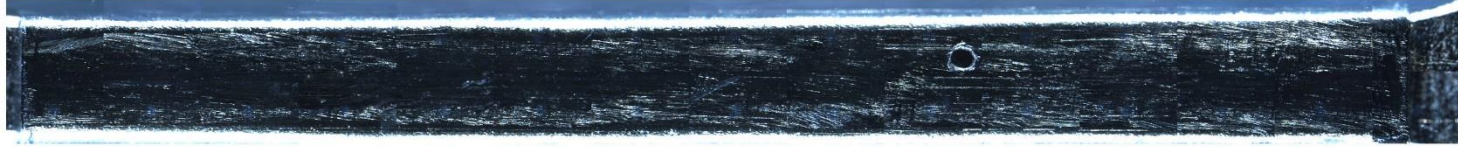
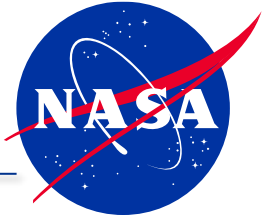


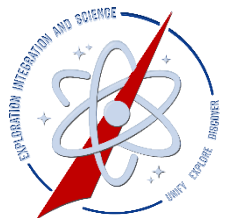
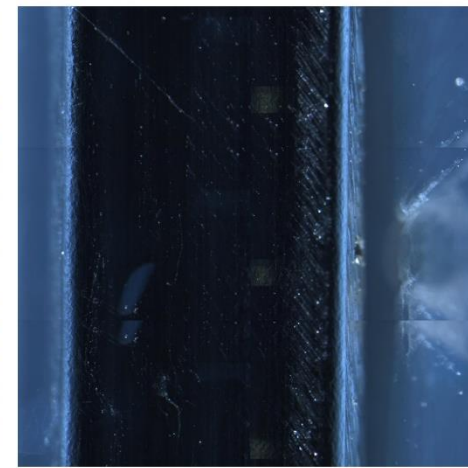
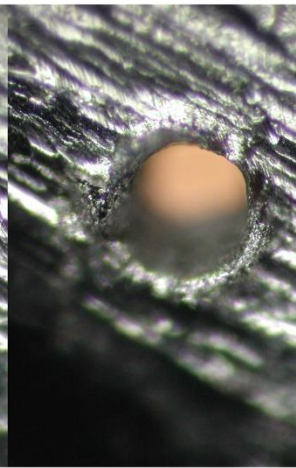
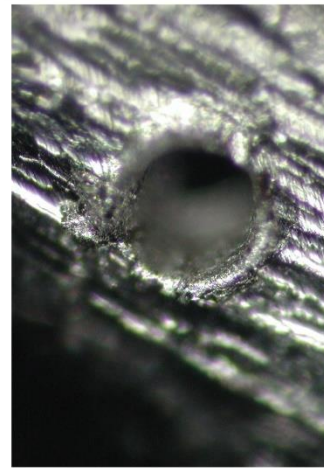
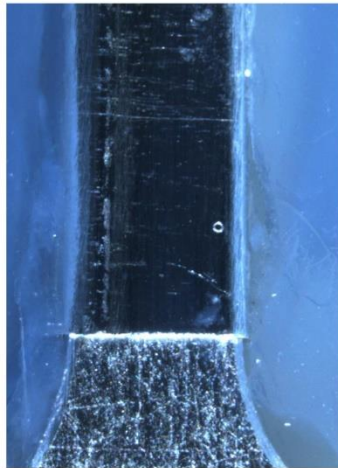
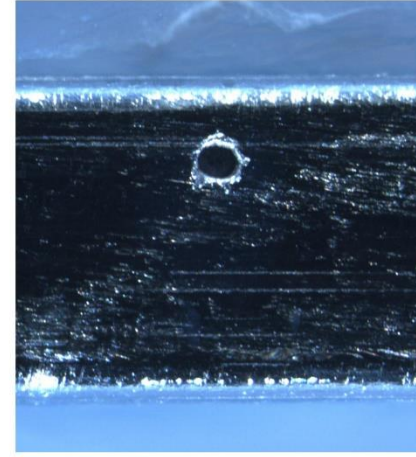
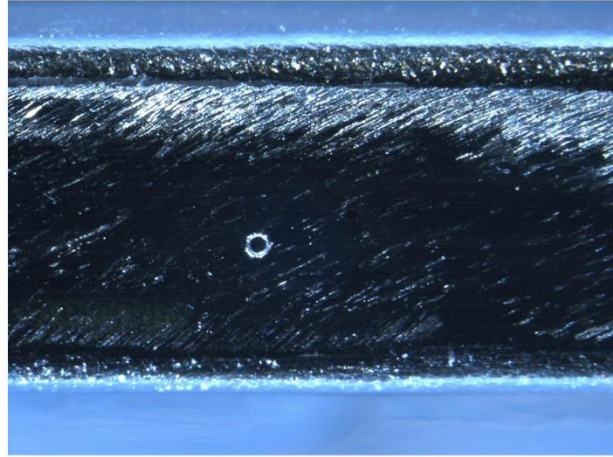
PHOTO MOSAICS OF FOUR AEROGEL TILES



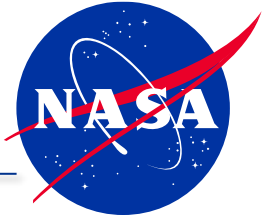
OTHER CRATERS IN THE AL FOILS



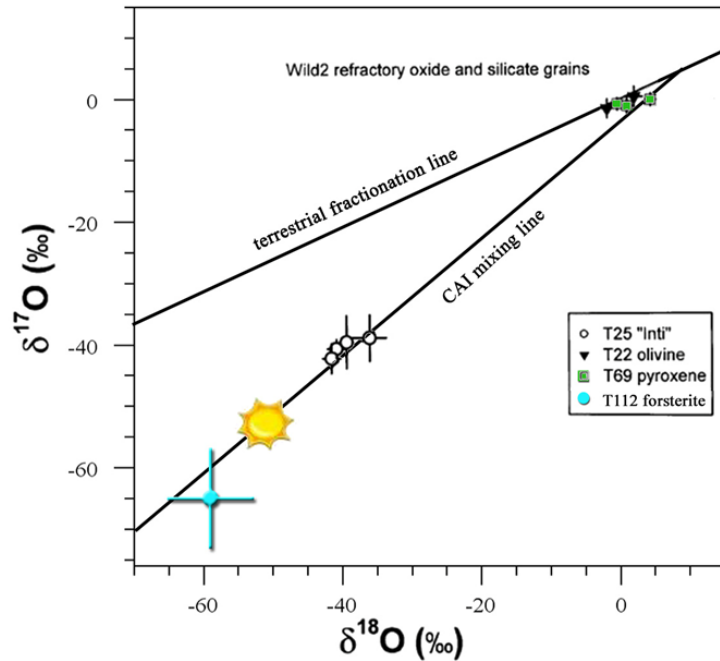
(each foil is ~3 mm wide)



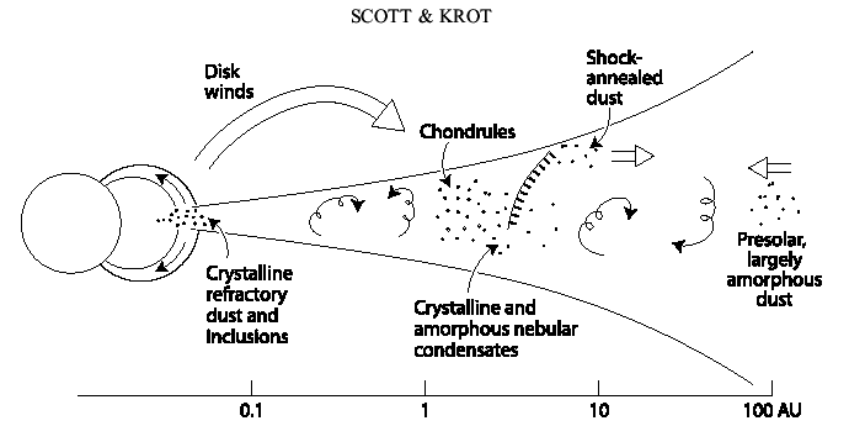
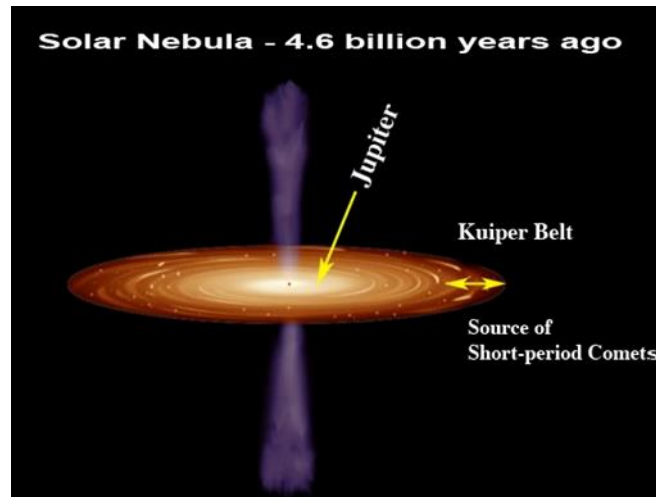
SCIENCE RESULTS



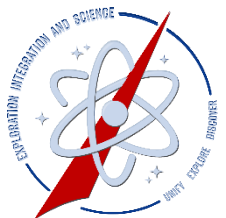
- See great review papers e.g. Brownlee (Ann. Rev. Earth & Planet Sci., 2014), Westphal et al. (MAPS, 2017) and Ogliore (Geochemistry, 2023) see great review papers e.g. Brownlee (Ann. Rev. Earth & Planet Sci., 2014), Westphal et al. (MAPS, 2017) and Ogliore (Geochemistry, 2023)



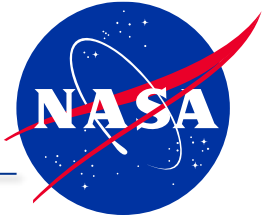
The O isotopic composition of the track 112 olivine suggest the O isotopic composition to be close to that of the Sun (Genesis sample - McKeegan *et al.* 2008).



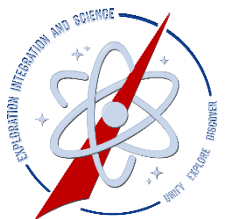
The cartoons above summarize the structure of the solar nebula and the processes that formed and transported minerals 4.6 billion years ago. Data suggest that track 112 formed near the Sun and was some how transported to the outer solar system where comet Wild-2 formed.



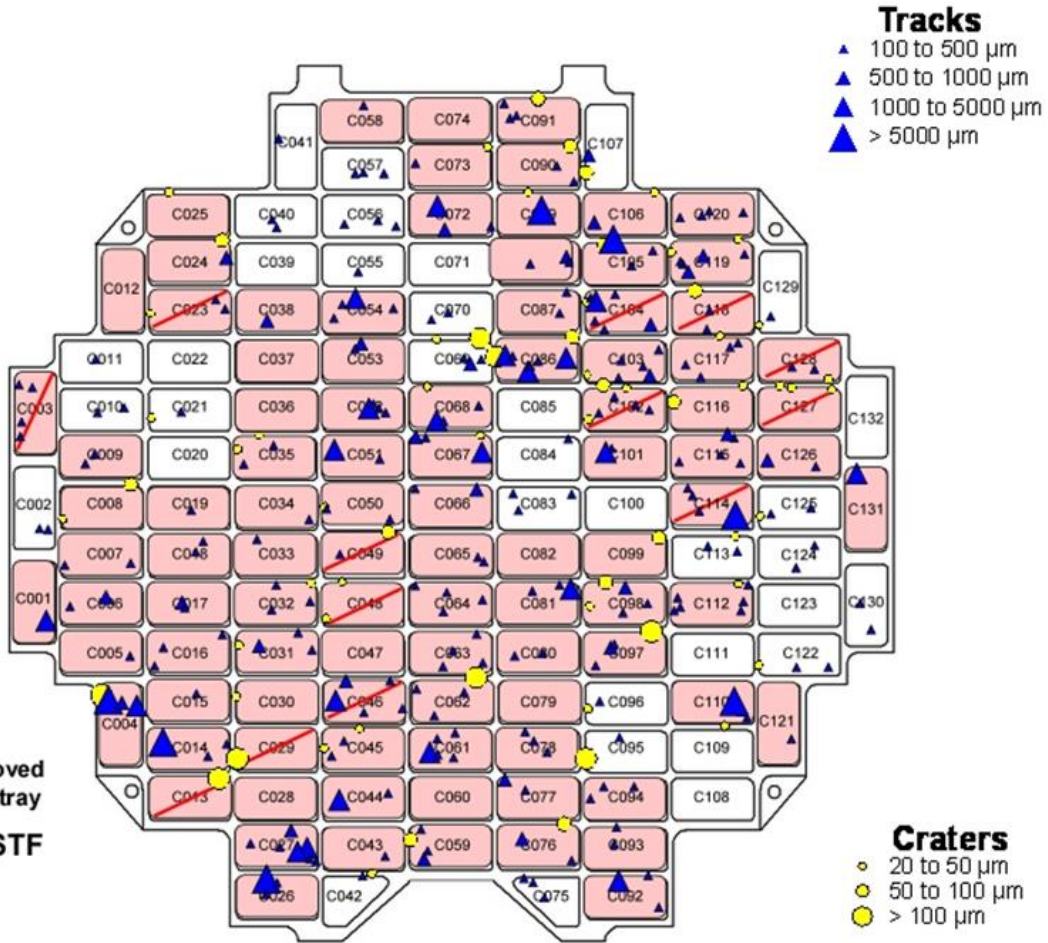
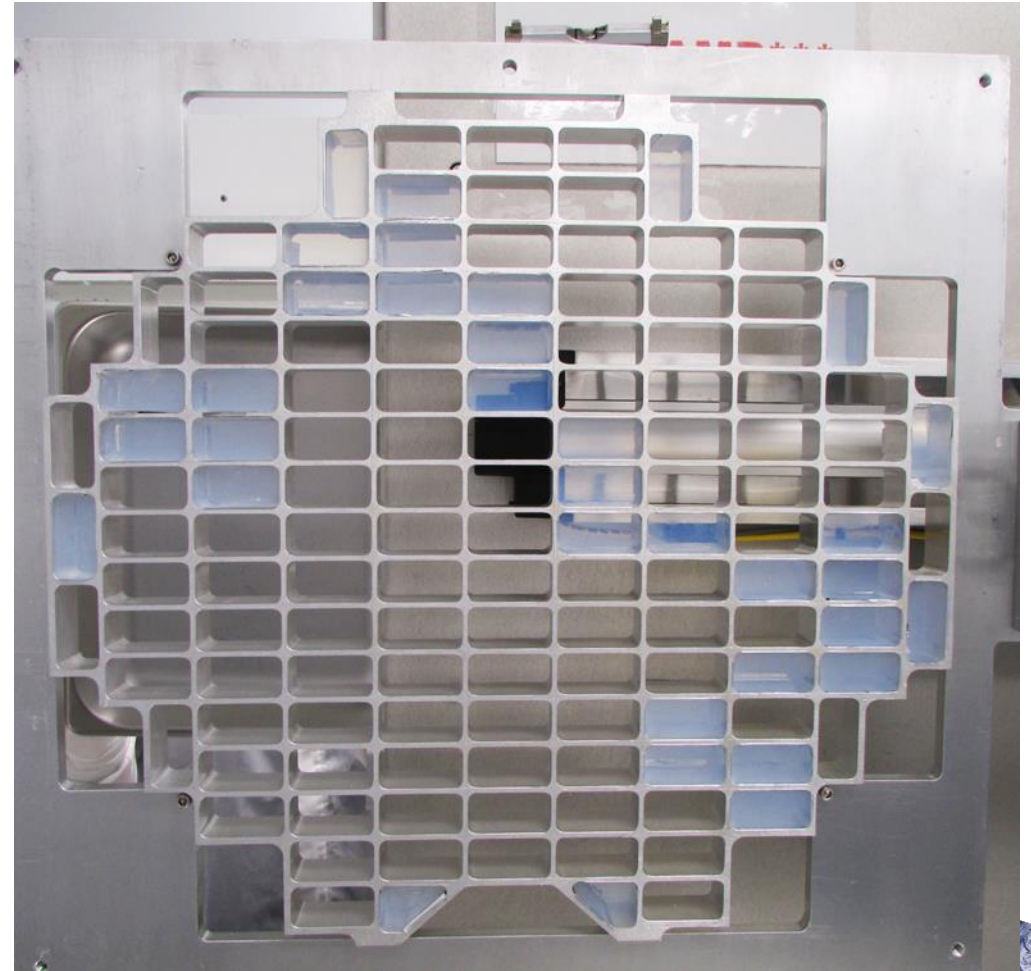
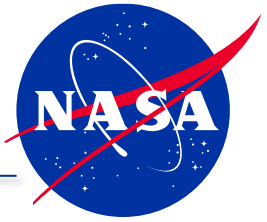
CURRENT STATE OF COMETARY TRAY



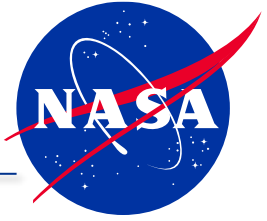
- Cometary Tile Removal
- The Curation staff continues the effort to remove all the aerogel tiles remaining in the cometary tray
- There are now 32 cells left in the cometary tray



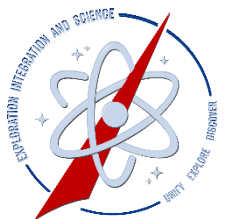
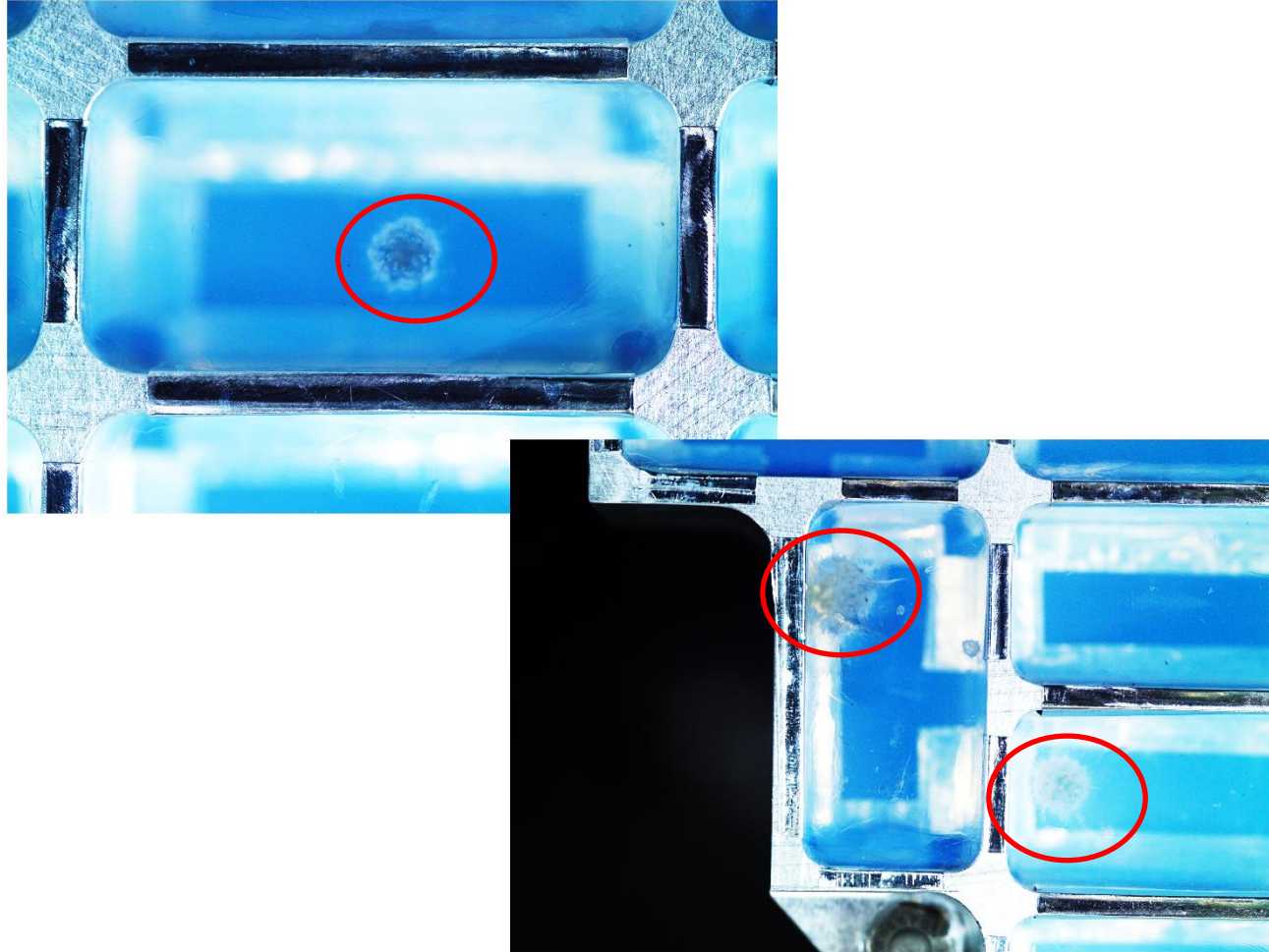
CURRENT STATE OF COMETARY TRAY



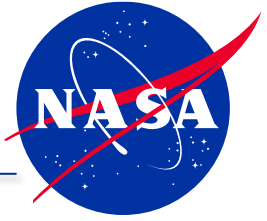
TRACK HARVESTING



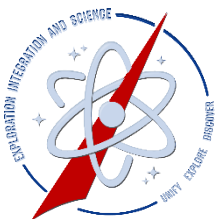
- The largest Wild 2 samples are only now being harvested and examined

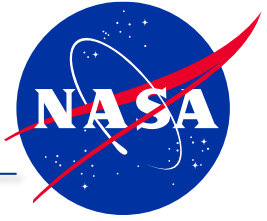


STARDUST LAB UPGRADES



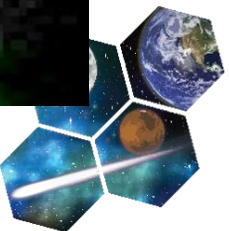
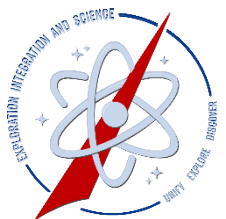
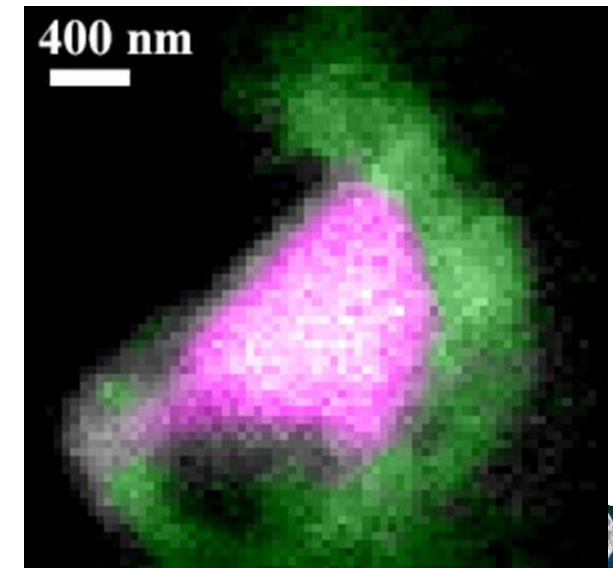
- In late February 2025 we replaced all the lab ceiling fan filter units with new, improved units
 - These units are, of course, the core of the clean lab
 - This upgrade should take us through the next 20 years
- We have recently successfully migrated the keystoning system to a new computer – the previous one was 20 years old



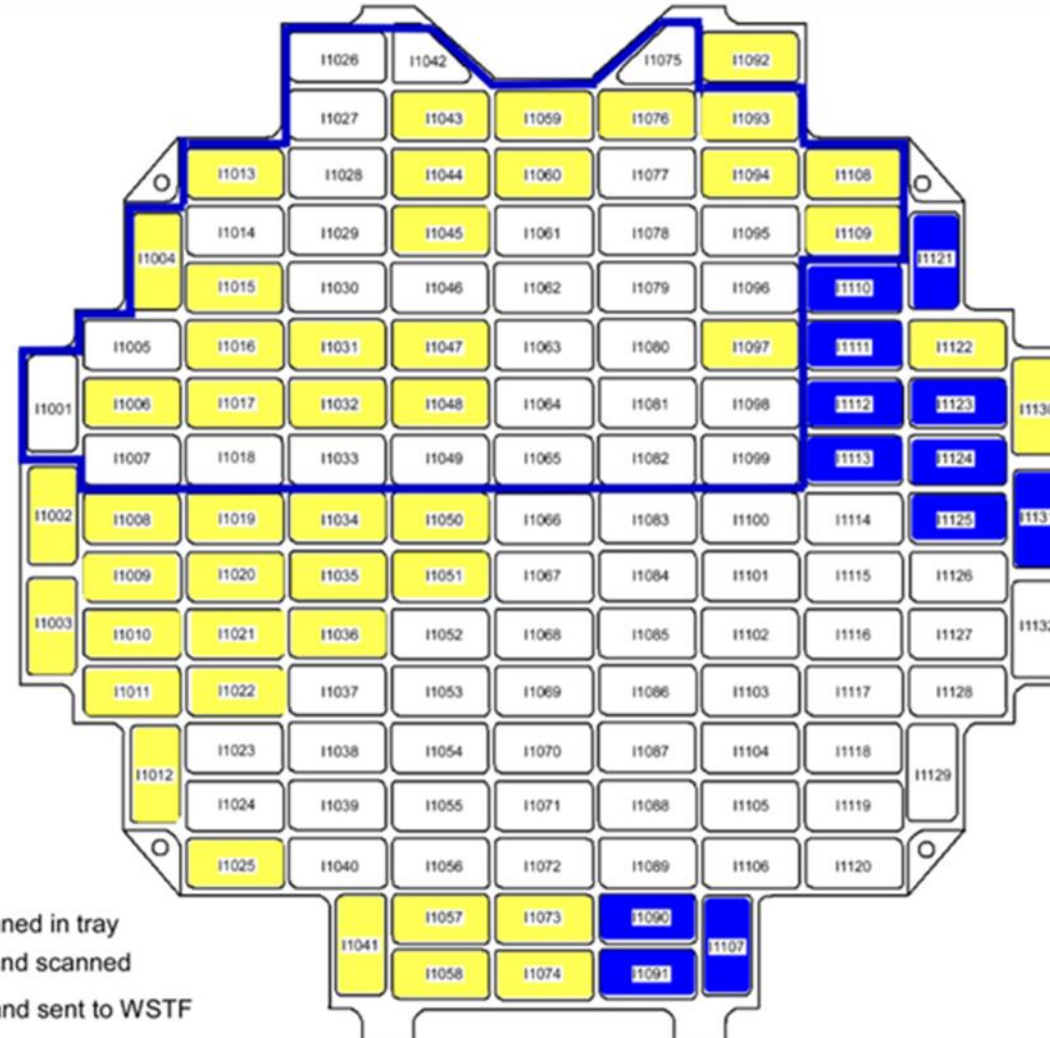
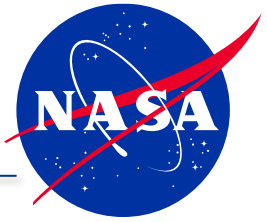


- Twice prior its encounter with Wild-2, the Stardust spacecraft raised its collector into the interstellar dust stream
- Stardust collected a few dozen “fresh” interstellar dust particles
- We have paused collection of interstellar tray imaging, in order to improve image collection processes
- We will restart this effort in the coming months

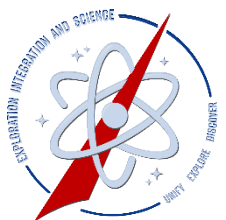
X-ray image of the interstellar grain “Hylabrook” with olivine crystals (red) surrounded by noncrystalline magnesium silicate (green). From Westphal et al. *Science* (2014)



CURRENT STATE OF STARDUST INTERSTELLAR TRAY



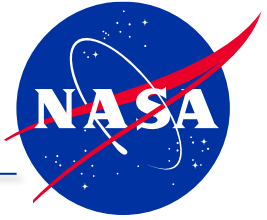
- Region scanned in tray
- Cell pulled and scanned
- Cell pulled and sent to WSTF



CURATION OF COSMIC DUST

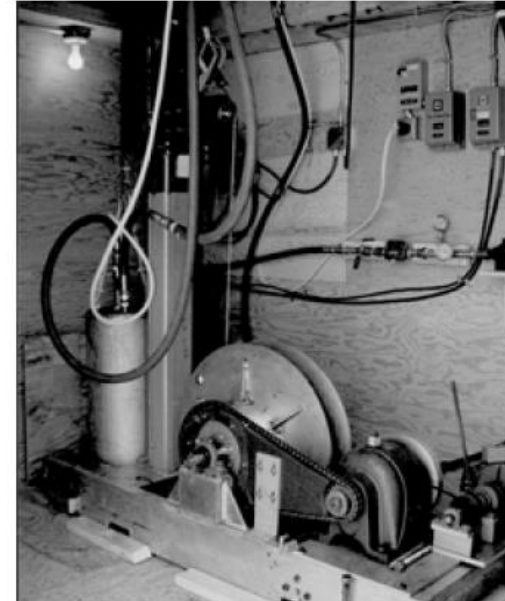


COSMIC DUST COLLECTION



- Over the past 45 years NASA has collected stratospheric dust on a variety of platforms, with the main goal being to better understand comets and asteroids

Susan Taylor's South Pole Water Well Collection



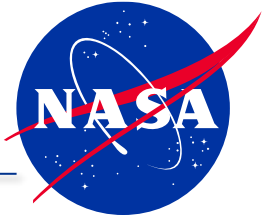
Penny Wojniakiewicz collecting airborne dust on Kwajalein



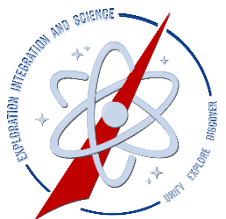
Small and Large Area Collectors have flown on NASA U-2, ER-2, and WB-57 Stratospheric Aircraft



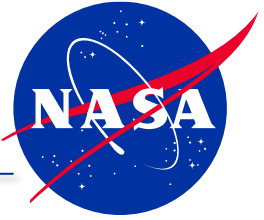
COSMIC DUST LABORATORY STATUS



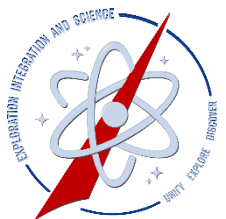
- The Cosmic Dust Lab had been closed for the latter part of 2024 for lab updates but is now back in operation and samples are being processed and allocated as in the past
- Now the lab is being prepared for possible receipt of samples from a new Balloon/Glider platform being tested this month



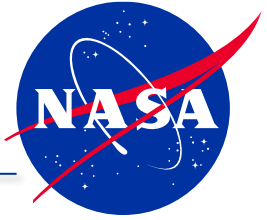
SURVEY OF CLUSTER PARTICLE REMNANTS FROM TARGETED COLLECTIONS



- The majority of the recent sample cosmic dust requests have been for grains from targeted collection flights, which potentially sample known comets
 - “meteor showers” which sample known comets
- While the majority of these samples have now been allocated, some do remain
- We have been performing a survey of those collectors to determine which materials remain for possible allocations, and images of remnants of cluster particles are being uploaded to the Cosmic Dust database

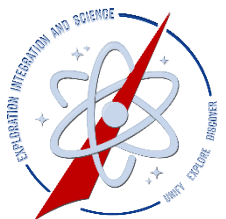


PREVIOUS TIMED COLLECTIONS OF METEOR SHOWERS

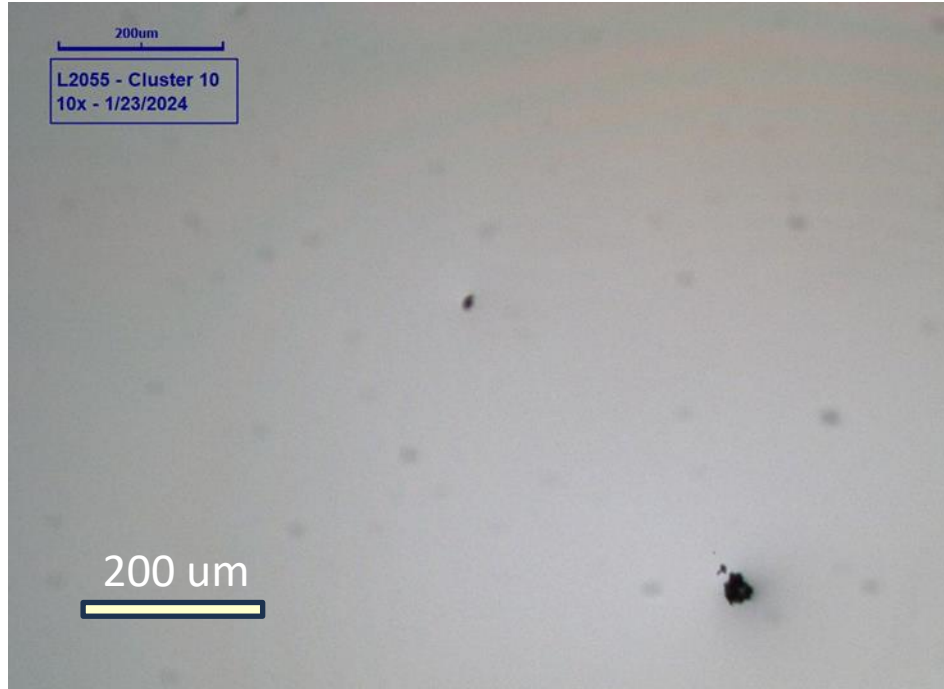
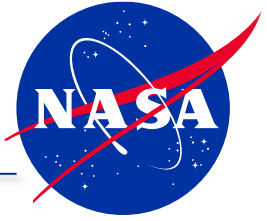


"Timed Collection" Attempts

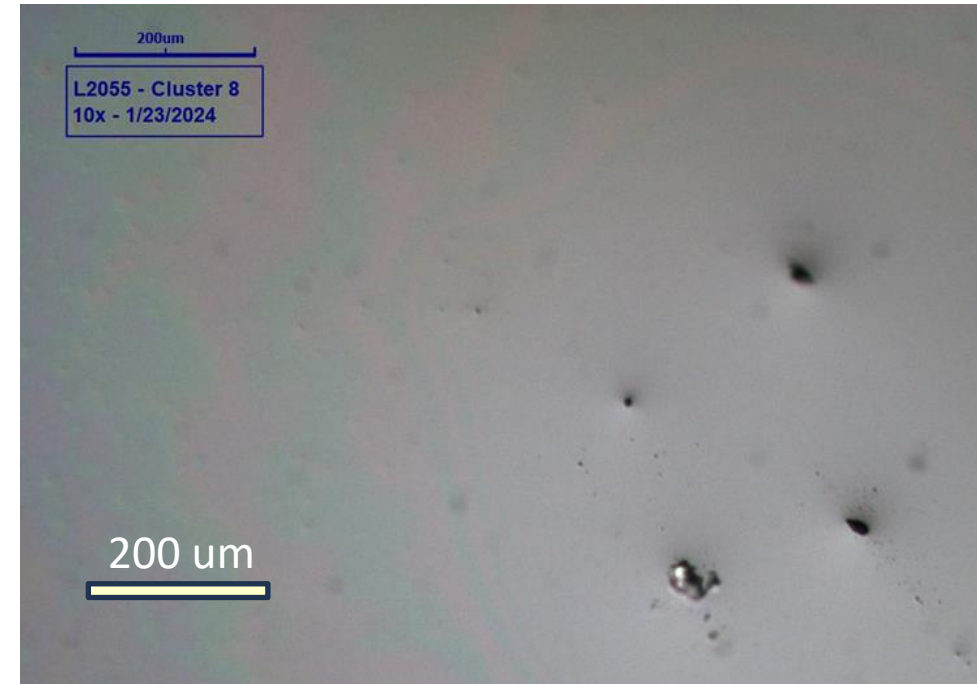
Date	Meteor Shower	Parent Body	Collectors
Dec 2020	Geminids	3200 Phaethon	W7320, W7321, W7322, W7323
Oct 2012	Draconids	21P/Giacobini-Zinner	U2153, U2154
Oct 2012	Draconids	21P/Giacobini-Zinner	L2094, L2095, L2096, L2097
Oct 2011	Draconids	21P/Giacobini-Zinner	W7303
Dec 2000	Geminids	3200 Phaethon	U2099, U2100
Dec 1999	Geminids	3200 Phaethon	L2046, L2047, L2048, L2049, L2055
Apr 1982	Pi Puppids	26P/Grigg-Skjellerup	W7304, W7305



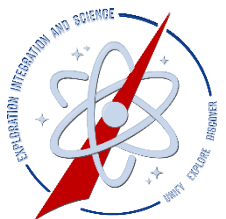
SAMPLES FROM TARGETED COLLECTIONS



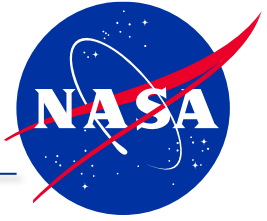
L2055 Cluster 10 – The largest particle is ~35x40 um, the others are ~20 um and ~12 um



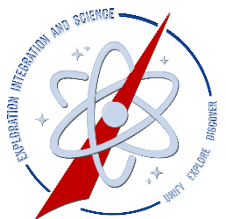
L2055 Cluster 8 – The largest particle is ~50x40 um, The next is ~30x30 um, then ~25 um and ~15 um



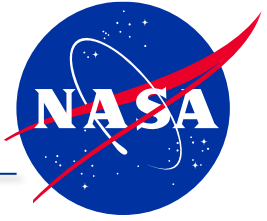
COLLECTION FLIGHTS ON NASA ER-2 AND WB-57 AIRCRAFT



- We can only fly the Large Area Cosmic Dust Collectors on the NASA ER-2 aircraft, and had to pay for those flights, so those flights have ended for now
- We will continue to fly the Small Area Cosmic Dust Collectors on the WB-57 aircraft, including attempts at dedicated flights targeting comet showers



COSMIC DUST LABORATORY UPGRADES



- We have been clearing the Lab of unused equipment, to make room for samples from the Balloon/Glider flights
- We are installing an environmental SEM in the lab to facilitate preliminary characterization of samples

