Why do we study Astromaterials?

- Ancient bodies of frozen ice and dust that formed beyond the orbit of the most distant planet.
- Expected to contain the original building blocks of the Solar System.
- The Earth accretes ~40,000 tons of cosmic dust /year originating mainly from the disintegration of comets & collisions among asteroids **Love and Brownlee (1993)**

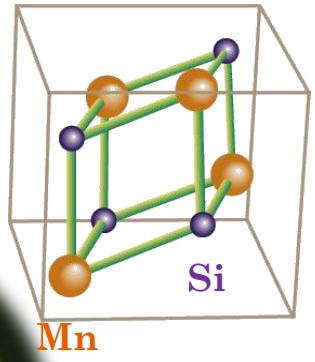
Comet McNaught /Jan.2007

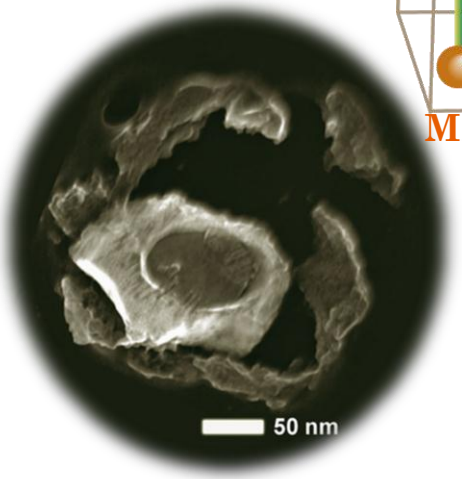
New Mineral Discoveries from Astromaterials

Brownleeite: MnSi

from a cometary dust

Crystal system: Cubic
Space Group: $P2_13$,
Cell volume: 94.63 Å^3, Z=4
Density: 2.913 g/cm^3





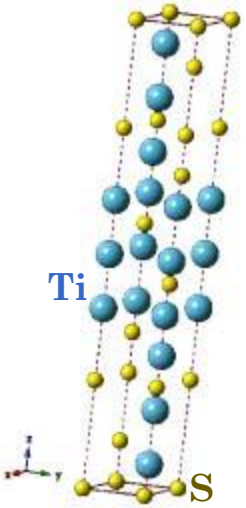
Nakamura-Messenger et al. (2009)

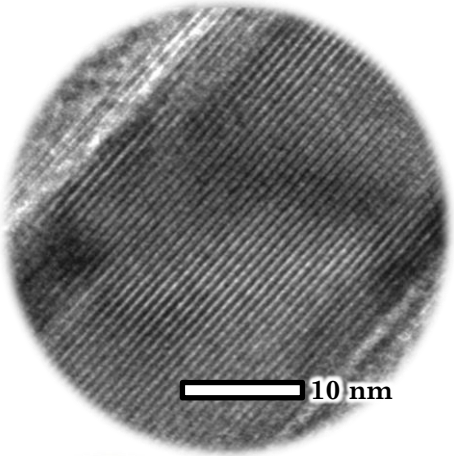
Prof. Don Brownlee
Univ. of Washington

Wassonite: TiIS1

from Y691 meteorite

Crystal system: Rhombohedral
Space Group: R3m
Cell volume: 268.42 Å^3, Z=4,
Density: 4.45 g/cm^3





Nakamura-Messenger et al. (2012)

Prof. John Wasson
UCLA

NASA/JSC Astromaterials Research & Exploration Science Directorate

Astromaterial Curation & Science Since 1969

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				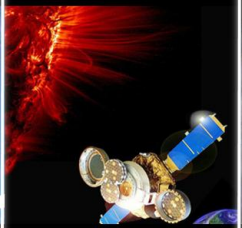	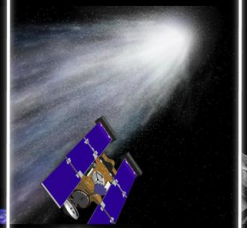		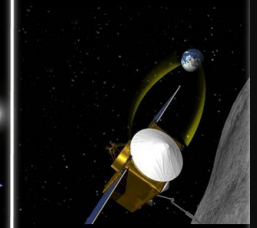
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			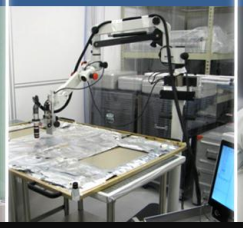		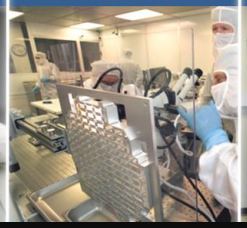		

Detection sensitivity & analytical precision

Sample size & mass required for analysis


La Paz Blue Ice Field


La Paz Ice Field Camp Site


1430 meteorites collected
in this season

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				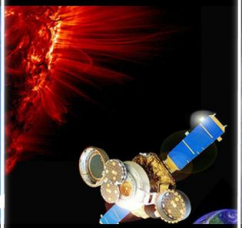	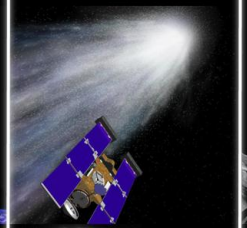		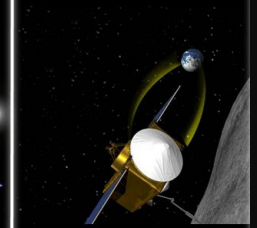
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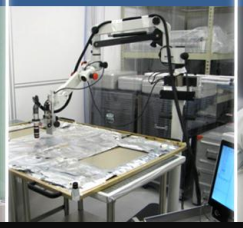
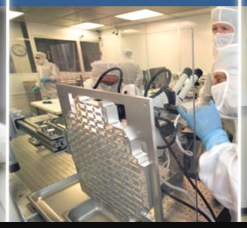
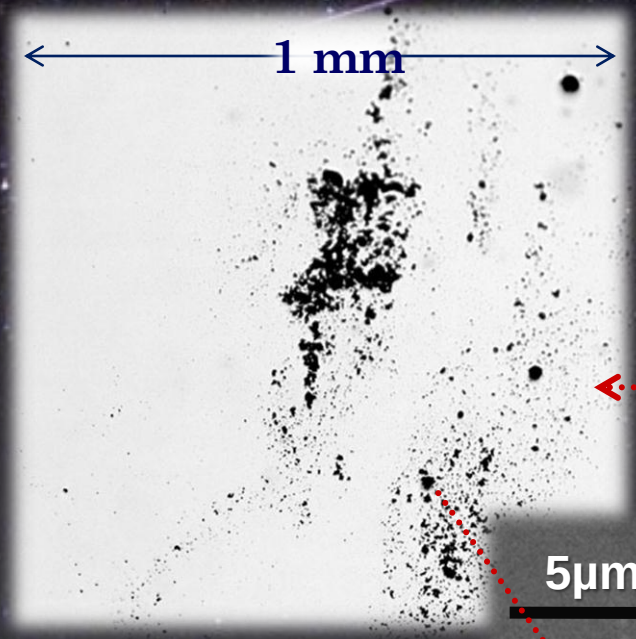
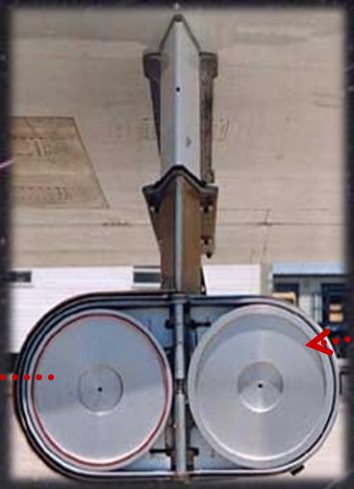
							

Detection sensitivity & analytical precision

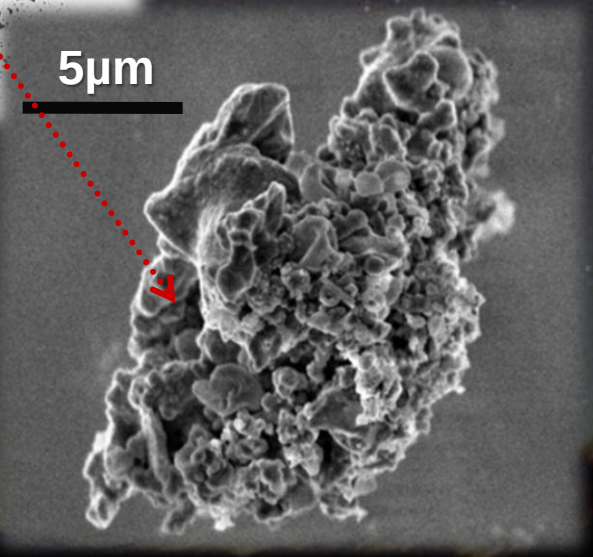
Sample size & mass required for analysis

Stratospheric Cosmic Dust Collection



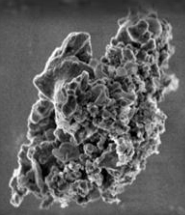


NASA ER-2 high altitude aircraft



Great Leonids Meteor Storm 2001 ©T. Kusano

My hair as a Scale



Comet Dust

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				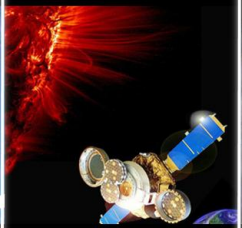	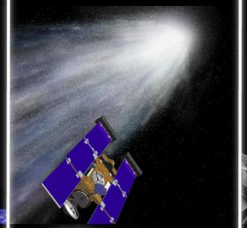		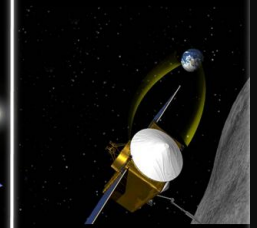
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			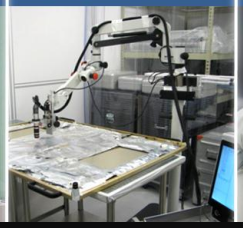		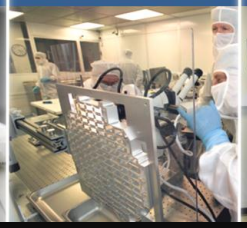		

Detection sensitivity & analytical precision

Sample size & mass required for analysis

What is OSIRIS-REx

- **OSIRIS-REx is a sample return mission** that returns at least 60 g (and as much as 2 kg) of **pristine carbonaceous regolith** from asteroid 1999 RQ36

- **OSIRIS REx is an acronym**
  - **Origins**
    - provide pristine sample to reveal the origin of volatiles and organics that led to life on Earth
  - **Spectral Interpretation**
    - provide ground truth for ground-based and space based spectral observations of B-type carbonaceous asteroids
  - **Resource Identification**
    - identify carbonaceous asteroid resources that we might use in human exploration
  - **Security**
    - quantify the Yarkovsky Effect on a potentially hazardous asteroid, thus providing a tool to aid in securing the Earth from future asteroid impacts
  - **Regolith Explorer**
    - Explore the regolith at the sampling site *in situ* at scales down to sub-millimeter

OSIRIS-REx Mission Timeline/Milestone Overview

2012	
2013	
2014	
2015	
2016	Launch
2017	
2018	RQ 36 Rendezvous
2019	1st Sample Attempt
2020	
2021	RQ36 Departure
2022	
2023	Return to Earth
2024	
2025	EOM But curation efforts continue…!

- Encounter asteroid **1999 RQ36** in 2018
- Study 1999 RQ36 for up to 505 days, globally mapping the surface from a distance of 5 km to 0.7 km
- Obtain at least 60 g of pristine regolith and a surface material sample
- Return to Earth in 2023 in a Stardust-heritage Sample Return Capsule
- Deliver samples to JSC curation facility for world-wide distribution

My Tasks on OSIRIS-REx Mission

2012
2013
2014
2015
2016 **Launch**
2017
2018 **RQ 36 Rendezvous**
2019 **1st Sample Attempt**
2020
2021 **RQ36 Departure**
2022
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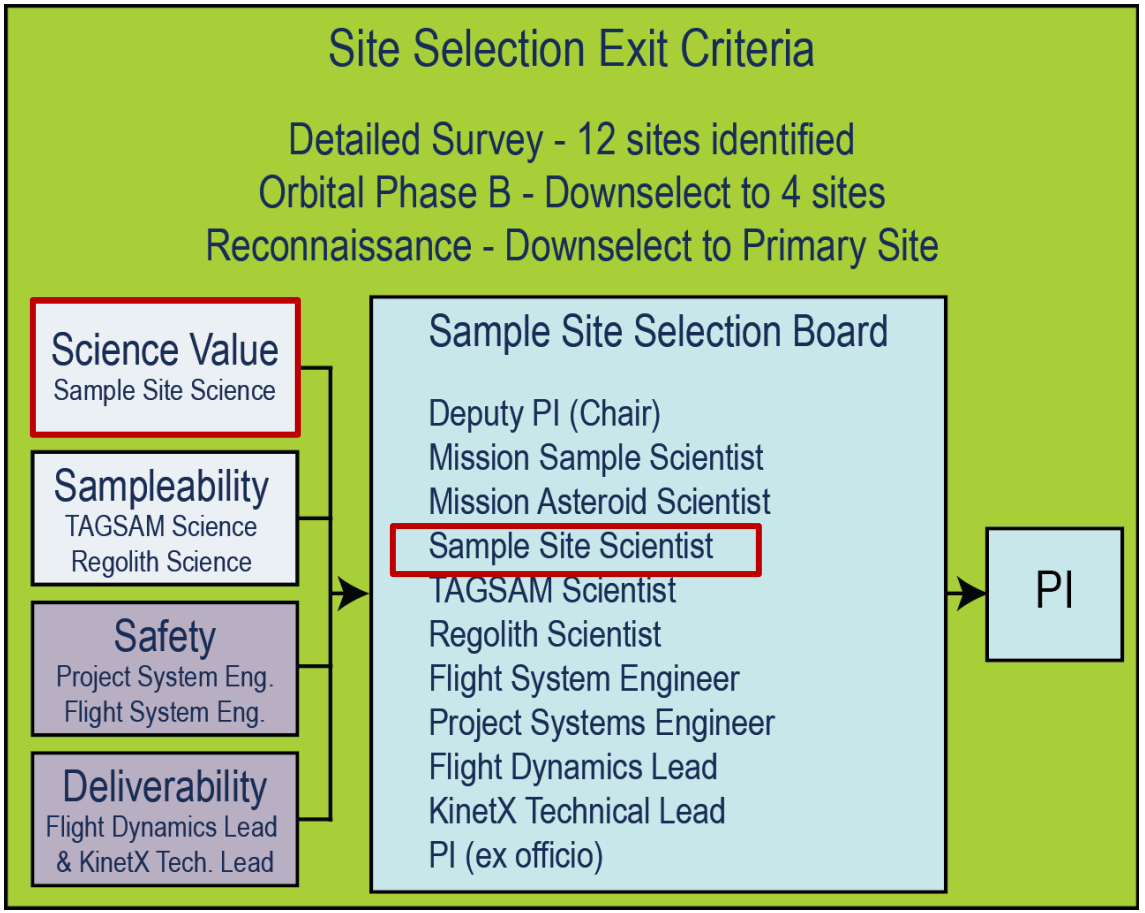
2025 **EOM**
But curation efforts continue…!



My Tasks on OSIRIS-REx Mission

Sample Site Scientist

The primary responsibility of Sample Site Scientist is to define the strategy for selecting and characterizing the primary sample site on RQ36 based on production and interpretation of science value maps. She needs to explicitly define the data acquisition strategy, processing methodology, and data products required to meet science objective.

Outgassing Activity	Albedo	Organic Chemistry	Adsorbed Molecules
Active Outgassing	extremely dark ≤ 0.03	Reduced Hydrocarbons (heterocycles, amino acids	Small organics (Formaldehyde, Cyanide,
Less Active/ Diffuse Outgassing	0.03 ≤dark ≤ 0.05*	Oxidized Hydrocarbons (alcohols, acids, hydroxy	Ammonia
Ancent outgassing site		Unfunctionalized Hydrocarbons	Water
		Insoluble Organic Matter (humic acid, coal, tholin etc)	

Sample Site Science Value

Mineralogy	Grain Size	Sample Freshness	Geology
			Lobate material at Plume Outskirt
	Sub-mm grain size (primitive CC components)		Flow
Hydrated minerals phyllocilicates/hydroxides	1-2 cm aggregates of sub-mm sized grains	Spectral Reddening Free Area	Freshly open trench bottom
Carbonates	Large chondrules & CAIs size sub-mm ≤ Grain ≤ cm	Less than Average RQ36 reddening	Recent Crater Rim Crater Ray/Lobate
Salfates	1- 2 cm small meteorite size grain	Average RQ36 reddening area	smooth plain

My Tasks on OSIRIS-REx Mission

2012	
2013	
2014	
2015	
2016	Launch
2017	
2018	RQ 36 Rendezvous
2019	1st Sample Attempt
2020	
2021	RQ36 Departure
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2024	
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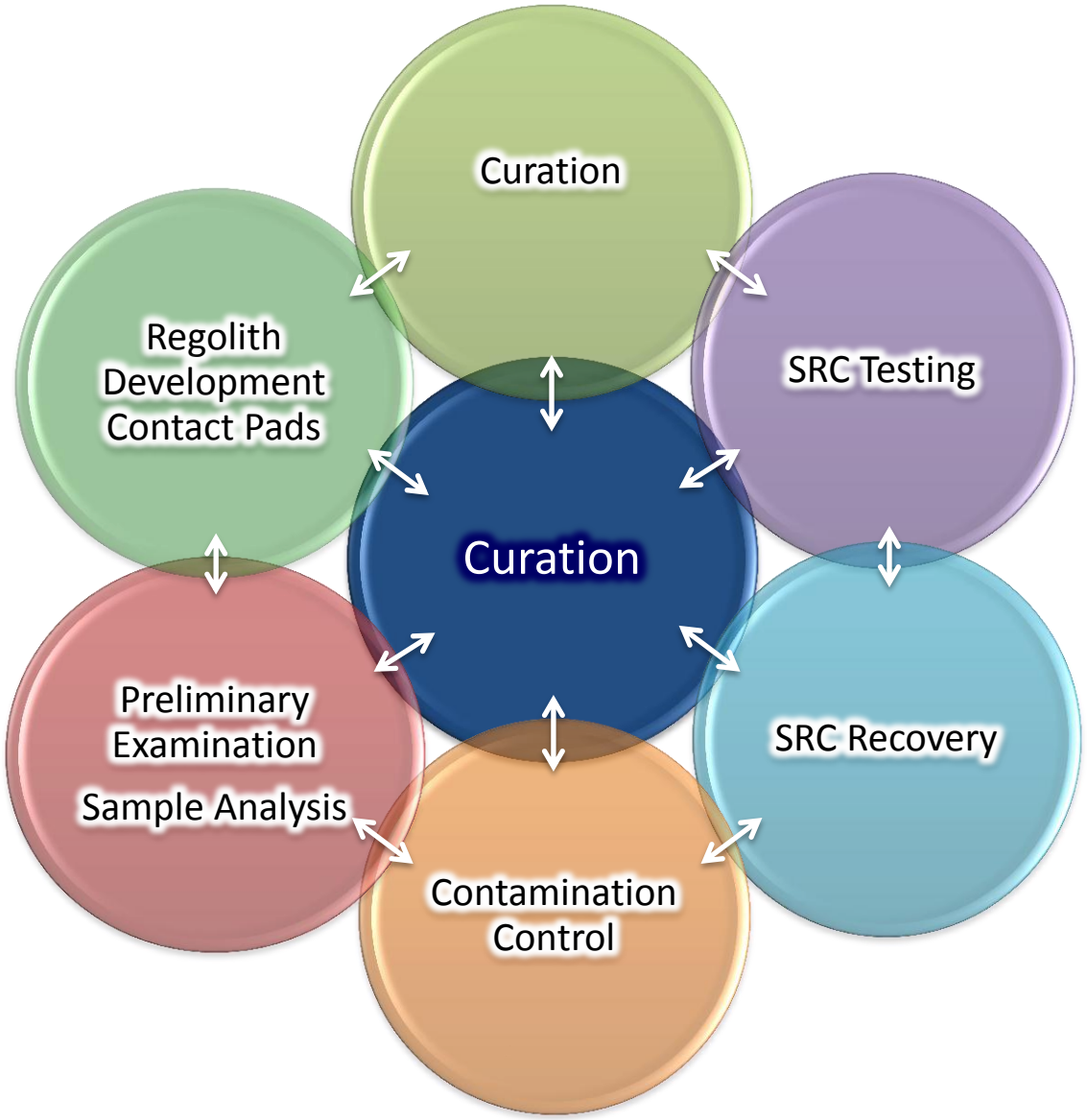
OSIRIS-REx Curation Project Deputy Lead



"2020 Vision"

Pat Rawlings

NASA/JSC Astromaterials Research & Exploration Science Directorate

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				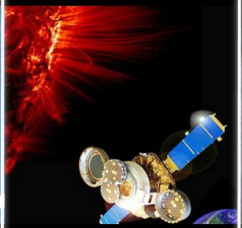	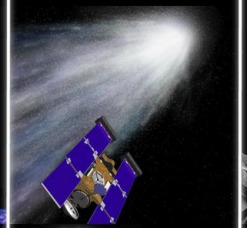		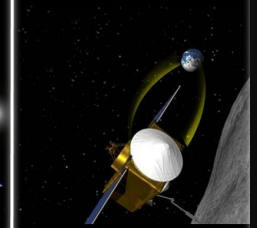
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			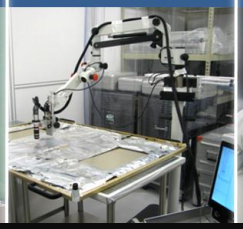		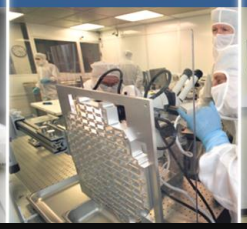		

Detection sensitivity & analytical precision

Sample size & mass required for analysis