



OSIRIS-REX
ASTEROID SAMPLE RETURN MISSION



Why Bennu and Asteroids Like it Have Surprisingly Rugged Surfaces?

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Delbo, Avdellidou (OCA, CNRS), Poggiali, Deshapriya,
Brucato (INAF), Bottke, Walsh (SwRI), Ballouz, Ryan,
Asphaug, Lauretta, DellaGiustina (UA), Emery (NAU),
and many others ...



A Rocky Start

We expected fine-grained materials



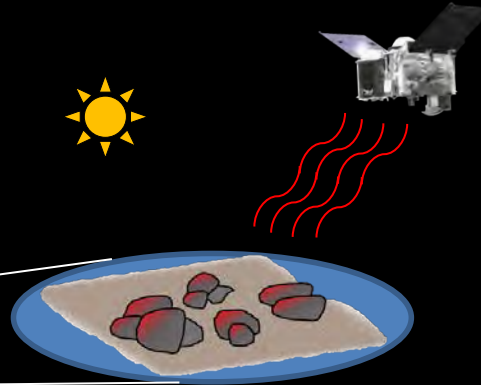
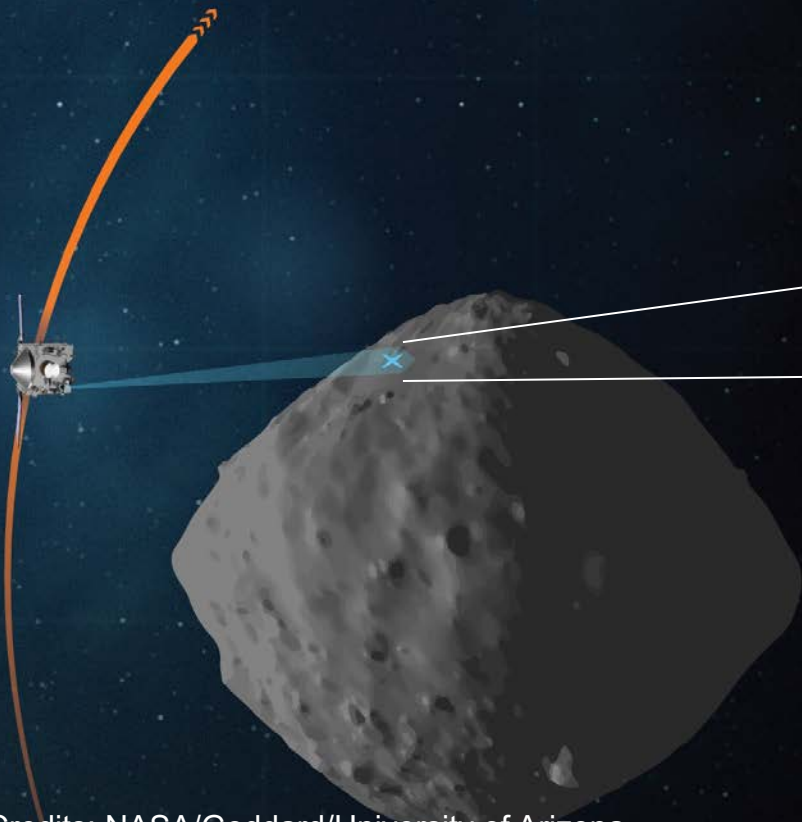
We found big rocks



Where are the fine-grained materials?



Bennu's temperature



Surface
temperature
data

Both rocks and fine-grained
materials are on the surface

Machine learning distinguishes
their contributions to temperature

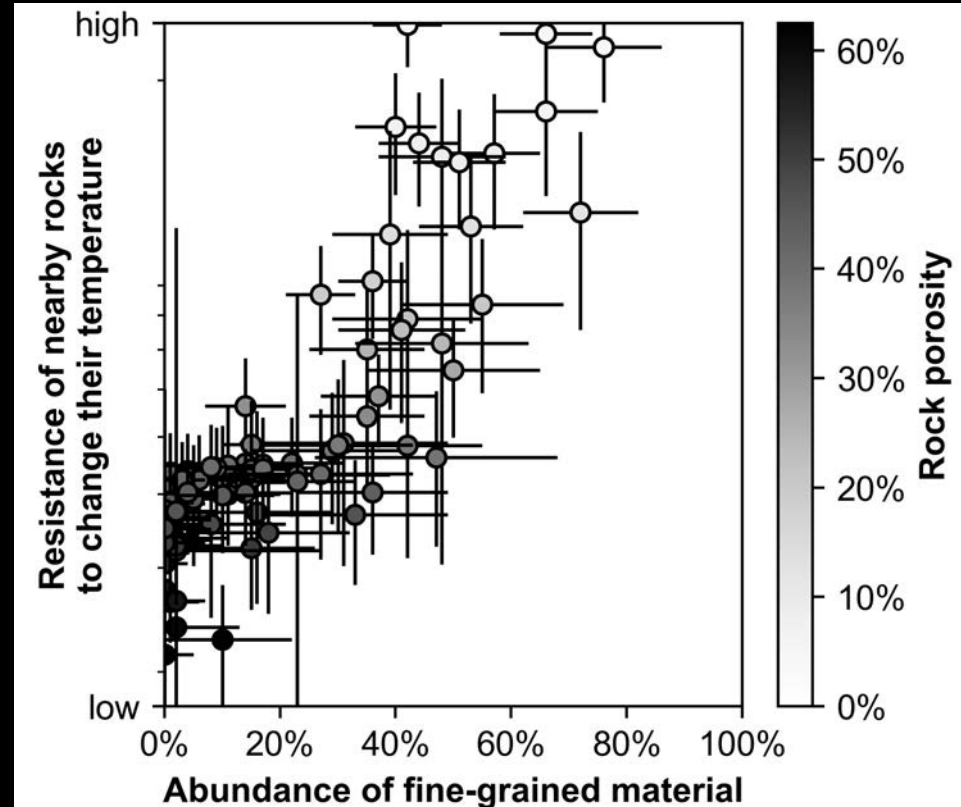


A Surprising Correlation

Resistance of rocks to change temperature derived from data

This resistance decreases with increasing volume of voids (porosity)

Less fine-grained materials where rocks are more porous

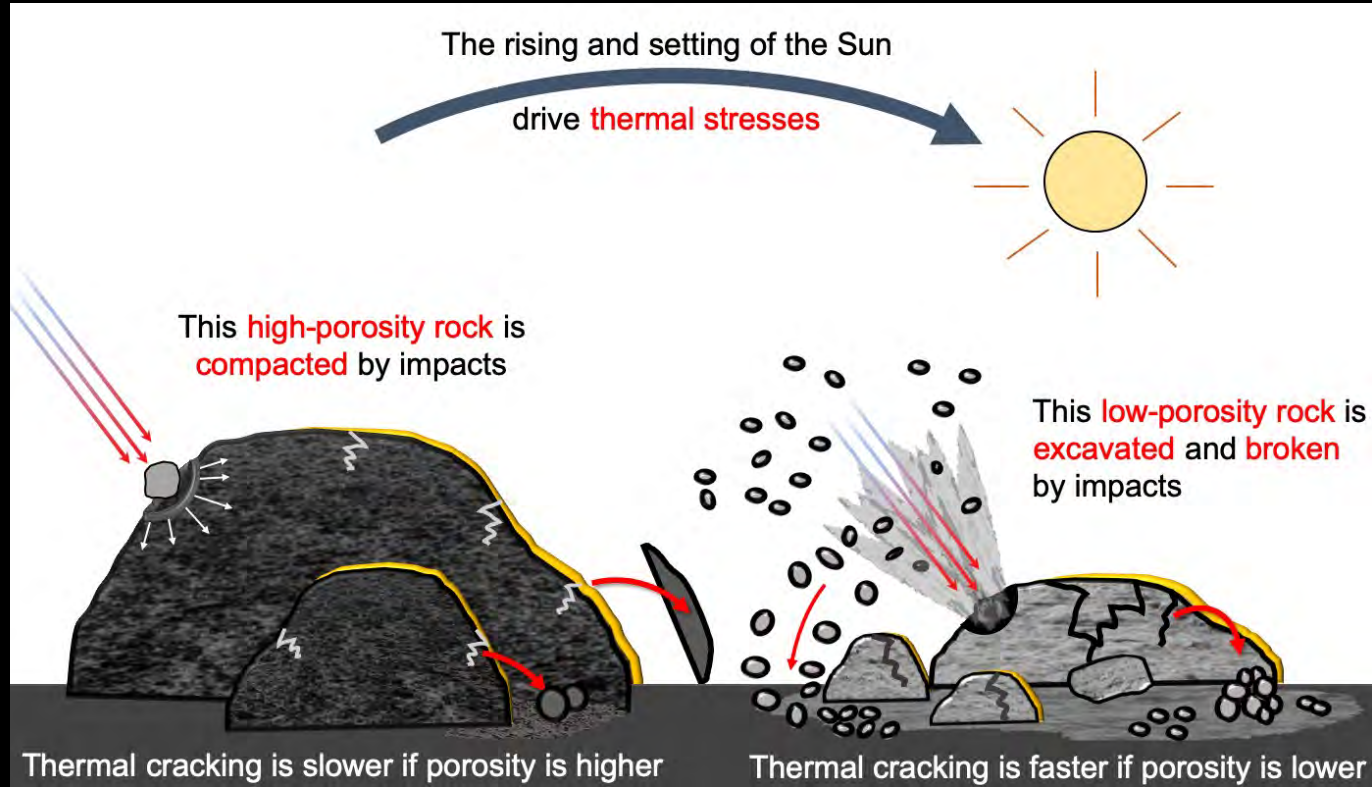




Porosity & rock break-up

Fine-grained materials produced in rock fragmentation

- ↑ Rock porosity
- ↓ Fragmentation
- ↓ Fine-grained materials



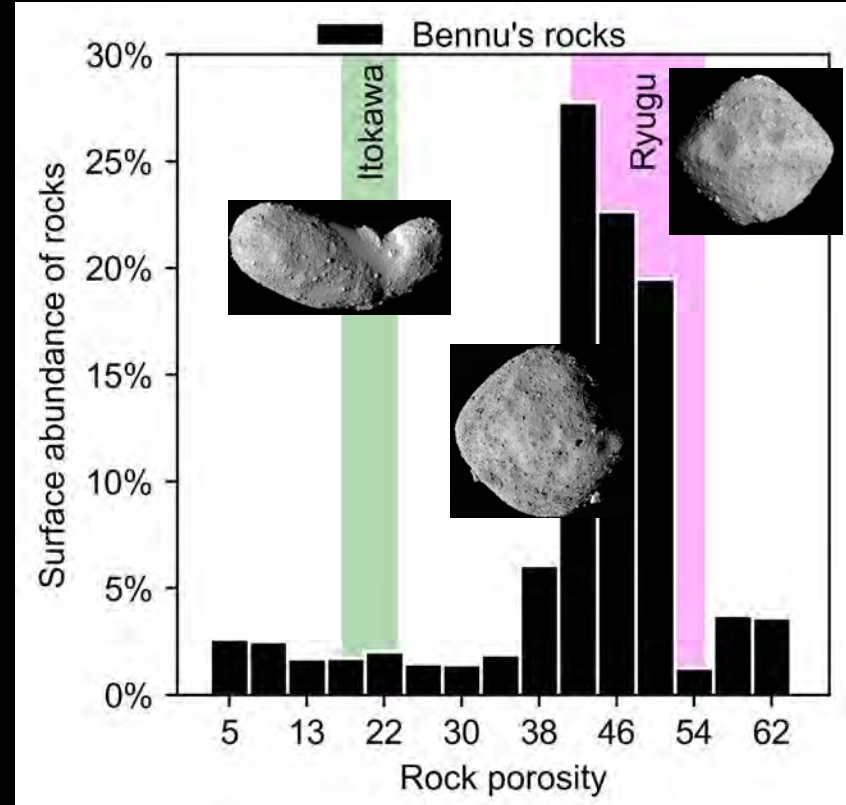


Bennu & Other Asteroids

Bennu lacks fine-grained materials because its rocks are highly porous

Asteroid **Ryugu**: high-porosity rocks & little fine-grained materials

Asteroid **Itokawa**: low-porosity rocks & abundant fine-grained materials





A General Phenomenon



Itokawa

Eros

**S-type
asteroids**

have low porosity
rocks and... have
abundant fine-grained
materials

Others



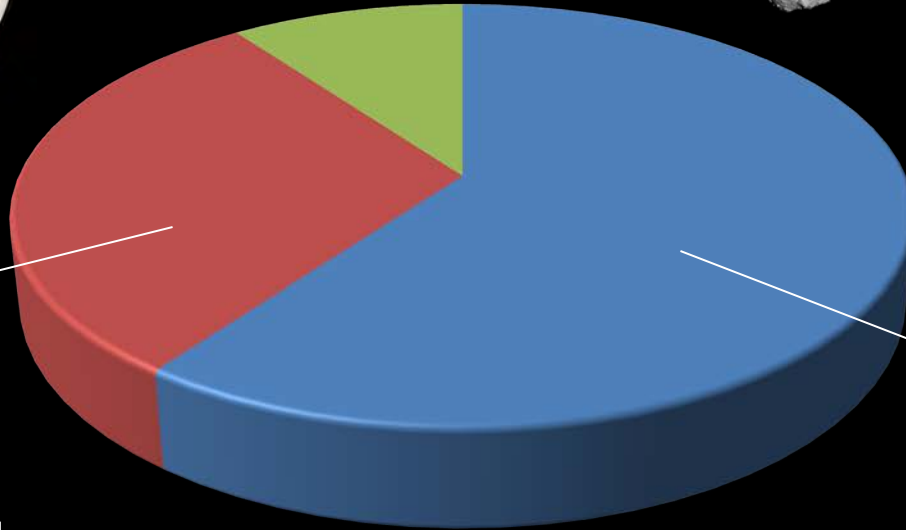
Bennu



Ryugu

**Carbonaceous
asteroids**

have high porosity
rocks and... lack fine-
grained materials



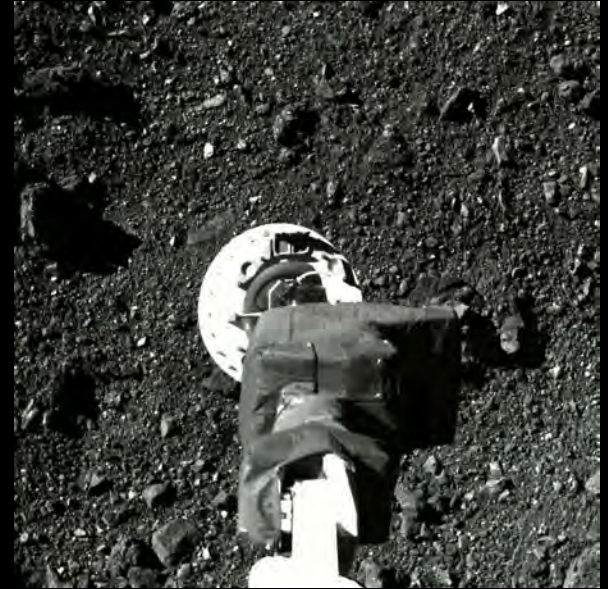
ASTEROIDS



Sample Return Missions

Despite the rugged surface, OSIRIS-REx successfully sampled Bennu

Our study will help better prepare future sample-return missions!



Credits: NASA/Goddard/University of Arizona

The diversity of asteroids tells us
how the solar system evolved



Summary

Bennu's rugged surface due to high porosity of its rocks

Like a sponge, the voids within rocks cushion the blow from incoming meteors and slows down thermal cracking

Cambioni et al. paper: "Fine-regolith production on asteroids controlled by rock porosity" published today in *Nature*

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