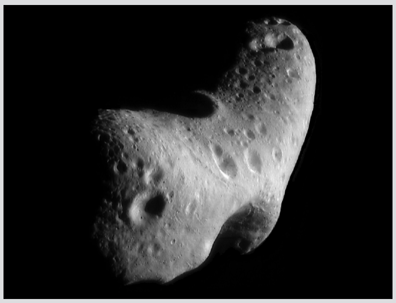
James Webb Space Telescope:
Asteroids & Near-Earth Objects

JWST will enable asteroid observations at key infrared wavelengths that are impossible to access from the ground, and with a combination of sensitivity and wavelength coverage vastly superior to previous space based observatories and complementary to SOFIA and future ground-based observatories. JWST also fills a unique niche in NASA Planetary Science Division assets by obtaining critical supporting data for NASA mission targets as well as affording the opportunity to make observations of members of the asteroid population for which spacecraft visits are prohibitively difficult.



Near-Earth object (433) Eros.
(NASA/JPL/JHUAPL)

- **Surface composition**
  Spectroscopy and numerous filters spanning 0.6 – 28.8 μm will enable characterization of absorption and emission features (including the critical 3 μm spectral region) on even small asteroids.
- **Imaging**
  Near-IR spatial resolution rivaling that of HST at V-band will enable unprecedented study of surface compositional heterogeneity and support continued study of asteroid shapes, dust, outgassing, and multiplicity.
- **Thermal Properties**
  Imaging and spectroscopy from 5 – 28.8 μm will enable detailed study of albedos, sizes, surface roughness, and thermal inertia.

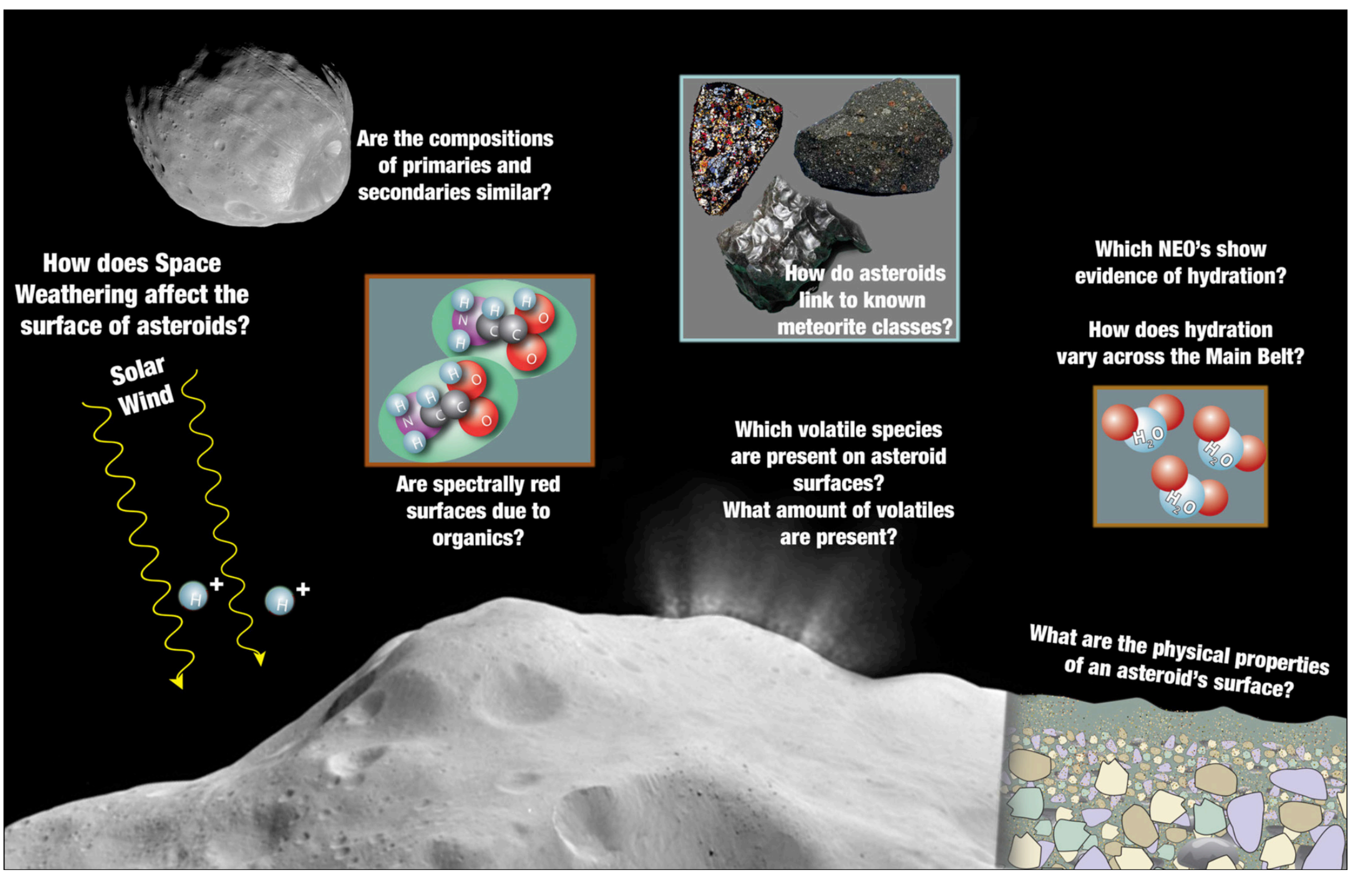


Image produced by GSFC Visualization Lab

Asteroids

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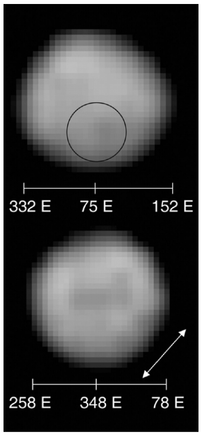


JWST will have spatial resolution comparable to Hubble and the IFU spectrometers provide spectral information at each pixel in order to decipher compositional variation (e.g. craters denoted by black circle). HST image of Pallas from Schmidt et al. (2009, Science, 326, 275).

JWST will provide the opportunity for ground-breaking observations of asteroids in three major ways:

High Spatial Resolution in the near-IR

- JWST can resolve asteroids as small as 80 km at 2.8 AU.

Broad Wavelength Coverage

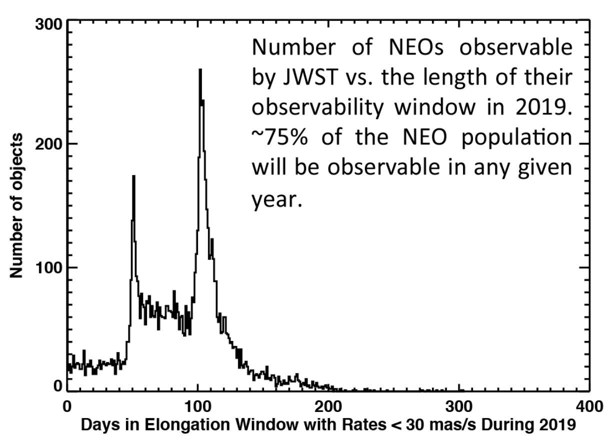
- Broad wavelength coverage will improve our understanding of how space weathering affects asteroid spectra.
- Measurements of hydroxyl and organic fundamental absorptions in the near-IR and thermal emission in the mid-IR.
- Observations in wavelength regions that are challenging or impossible from the ground, and with only limited asteroidal data from spacecraft.

Exceptional Sensitivity

- Thermal wavelength photometry will enable derivation of albedos and diameters for smaller objects than previously observable.
- NIRSpec can observe nearly every object from the main belt through the Trojan clouds with S/N > 10 in 1000 s across the entire 0.6–5 μm range.

	Composition	Surface Features	Size/Brightness Limits
Asteroids	Expanded wavelength coverage will further our understanding of asteroid compositions for all asteroid populations.	Dozens of main-belt asteroids large enough to be compositionally mapped by NIRCam and/or NIRSpec.	MIRI saturates on many asteroids, depending on fraction of pixel filled and temperature.
NEOs	Comparisons between NEOs and their Main Belt source regions will enable study of how the near-Earth environment impacts volatile content of NEOs.	NEOs will not be resolved, but the high sensitivity of the instruments will enable studies of rotational variation.	Saturation possible for the brightest objects. Photometry is possible for objects down to diameters of a few meters

The relative proximity of Near-Earth Objects (NEOs) to JWST and the unprecedented sensitivity of the instruments will enable scientific investigations of objects as small as a few meters in diameter.



JWST allows for non-sidereal tracking of objects with rates < 30 mas/s within the 85-135°Solar-elongation window.

Near-Earth Objects

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JWST observations of NEOs will further our understanding of:

- The size frequency distribution of the smallest NEOs.
- Enable precise investigations of individual objects such as spacecraft targets.
- Enable spectral characterization of the majority of known NEOs.
- Permit spectral comparisons of NEOs to their Main Belt source regions.

Link to arXiv manuscript

See more at jwst.stsci.edu and jwst-docs.stsci.edu