

All About Asteroids

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South pole of Moon with Asteroid Ida
Credit: Peter van der Haar



What are Asteroids?

Mathilde



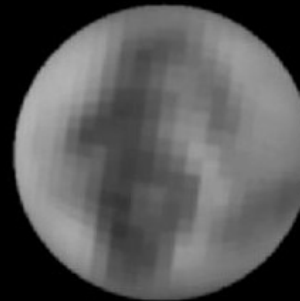
Lutetia



Vesta



Ceres



Pluto



4 Vesta



21 Lutetia



253 Mathilde



243 Ida / 1 Dactyl



433 Eros

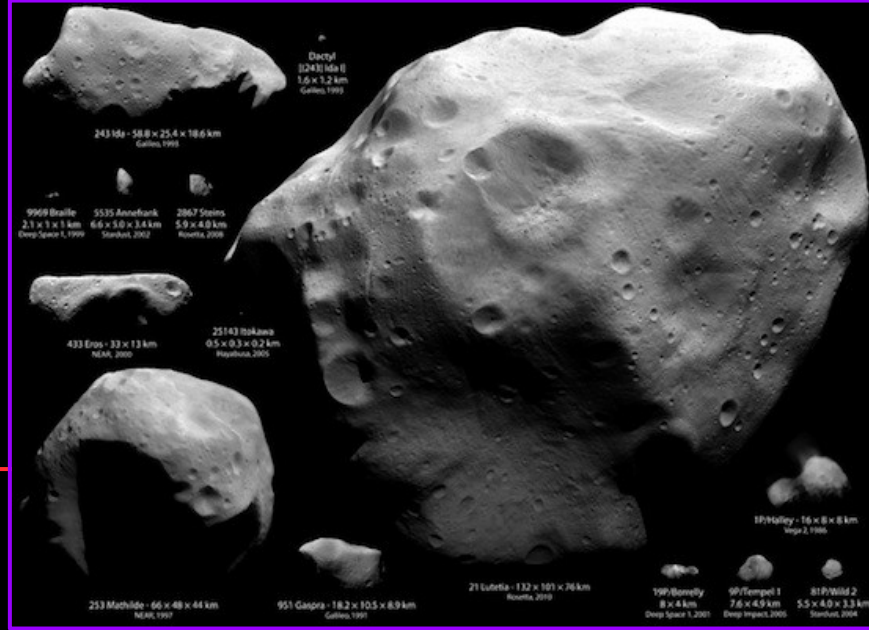


951 Gaspra

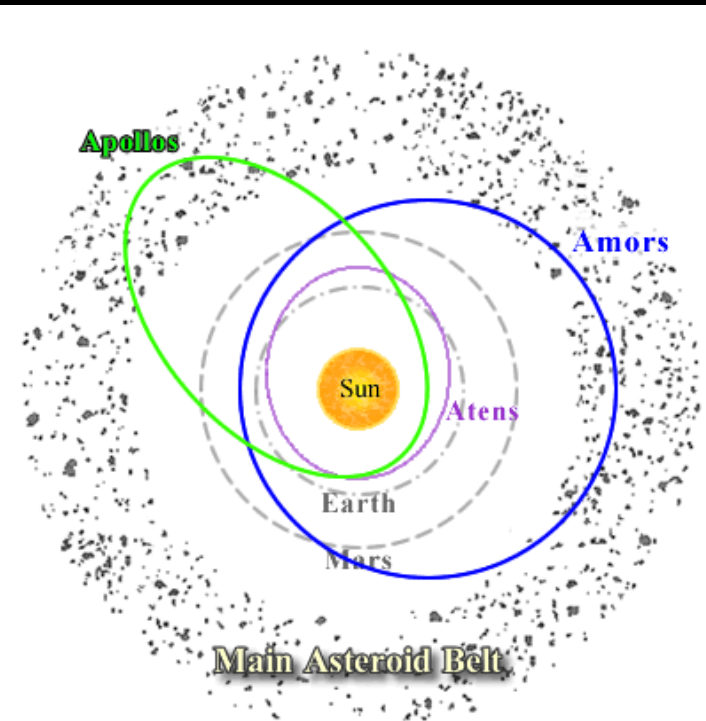
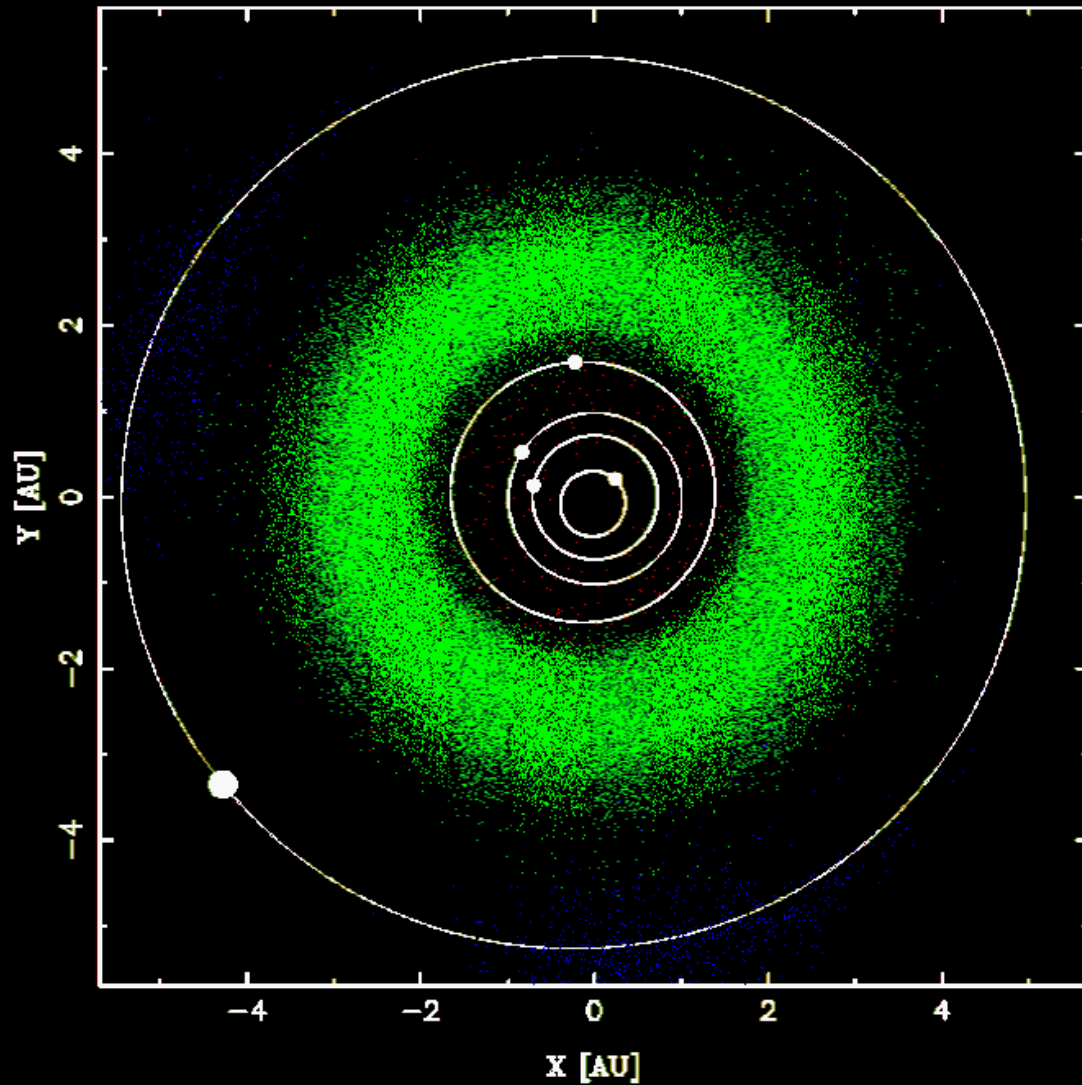
2867 Šteins

5535 Annefrank

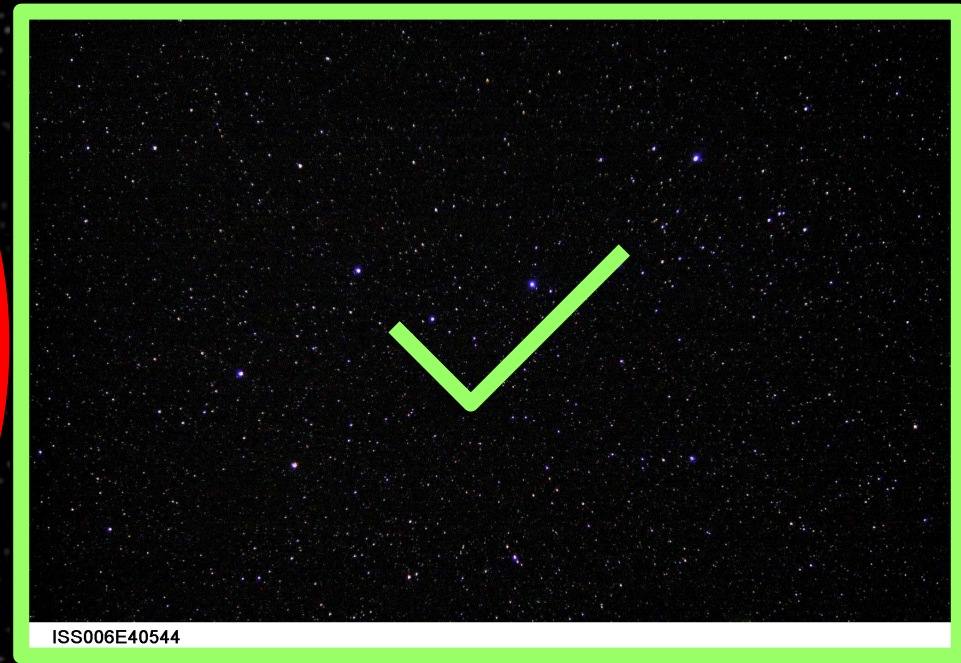
25143 Itokawa



Where are Asteroids?



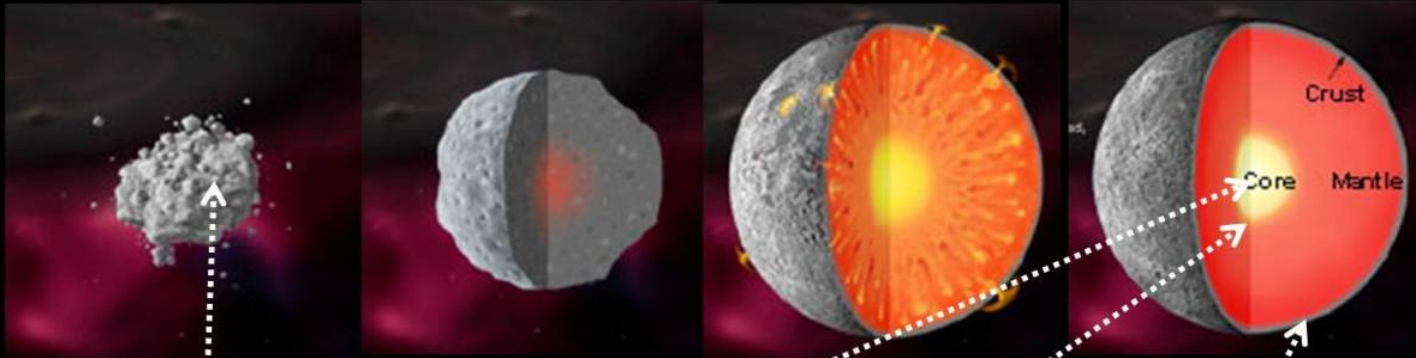
Where are Asteroids?



Types of Asteroids

Different Asteroid & Meteorite Types

Source: Smithsonian Museum of Natural History http://www.mnh.si.edu/earth/text/5_1_4_0.html



Chondritic Stony
Meteorite

Asteroid Type C



Iron
Meteorite

Asteroid Type M



Pallasite
Meteorite



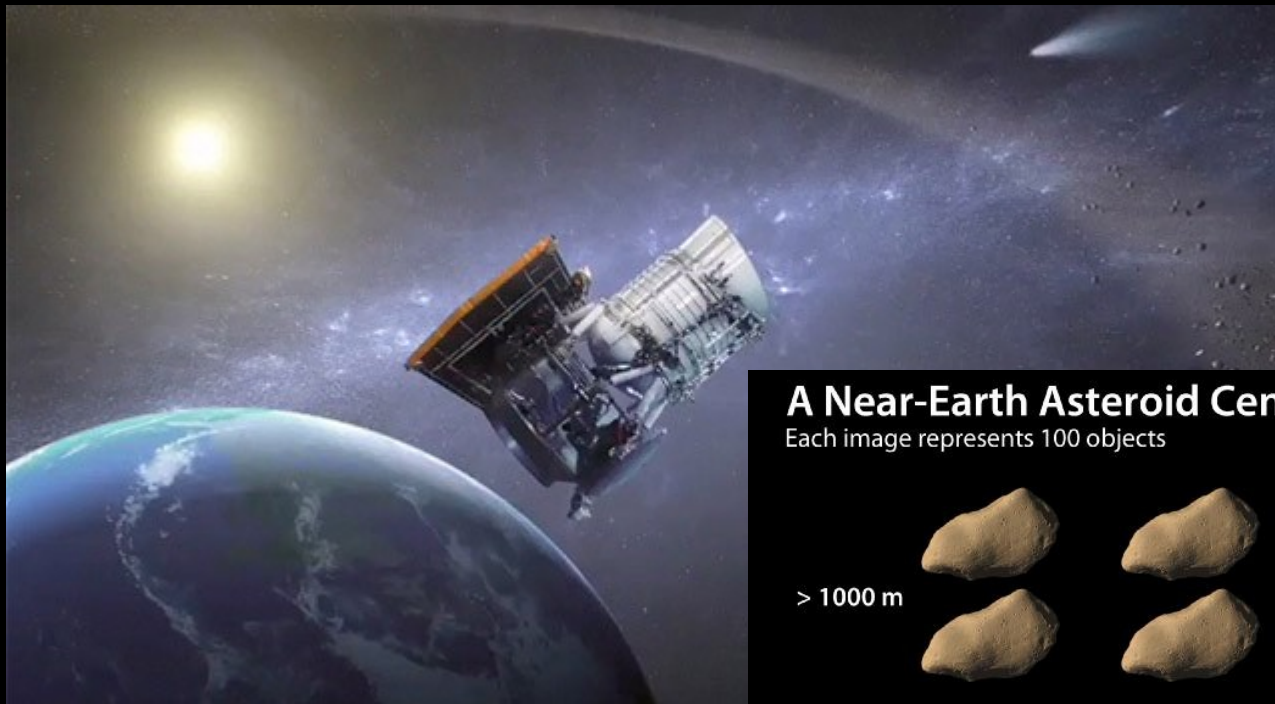
Achondritic Stony
Meteorite

Asteroid Type S

License: Wikimedia Creative Commons

How Did We Get This Info?

NEOWISE and other Earth-based search programs



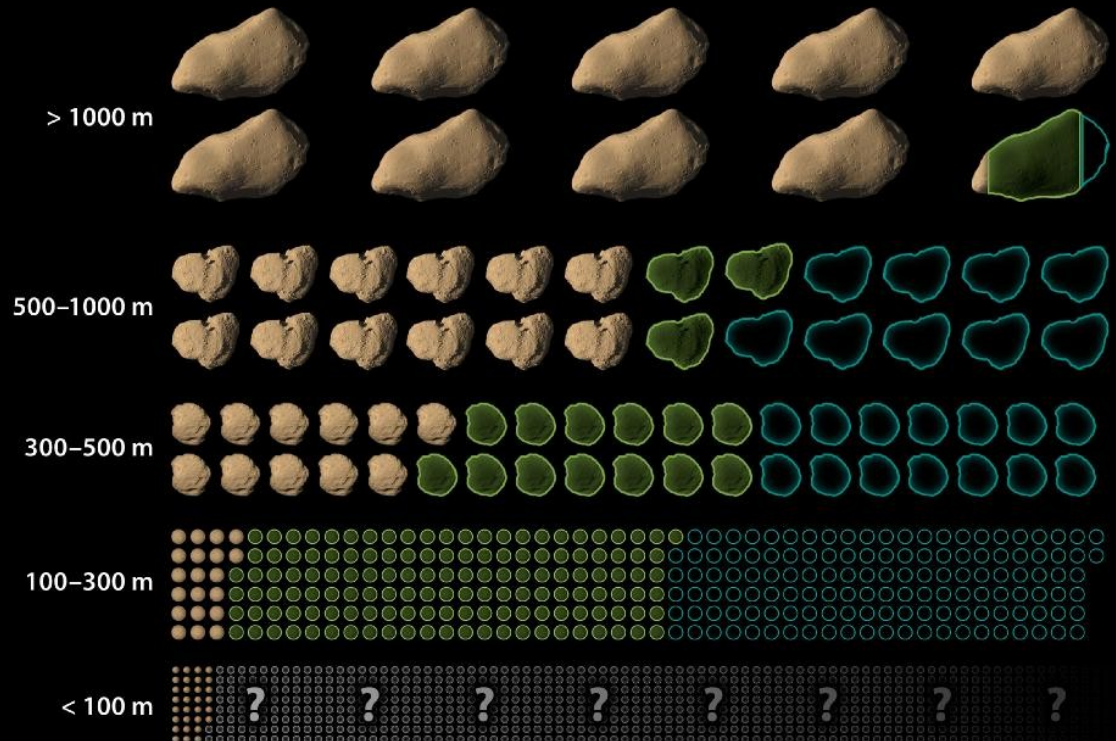
A Near-Earth Asteroid Census

Each image represents 100 objects

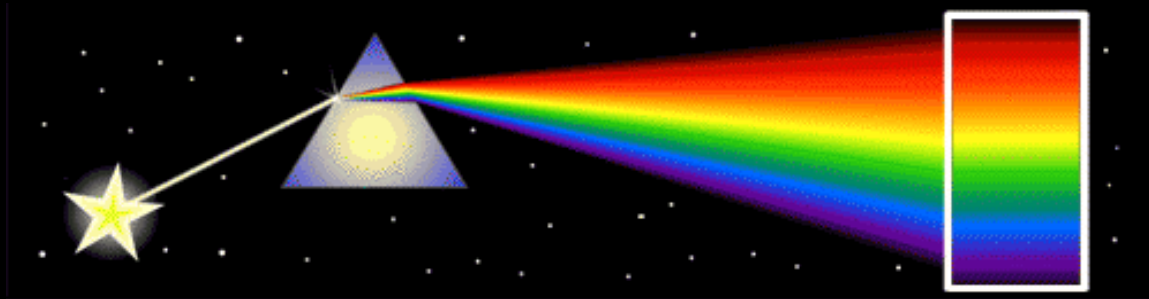
Known Asteroids ●

New Predicted Total (WISE) ○

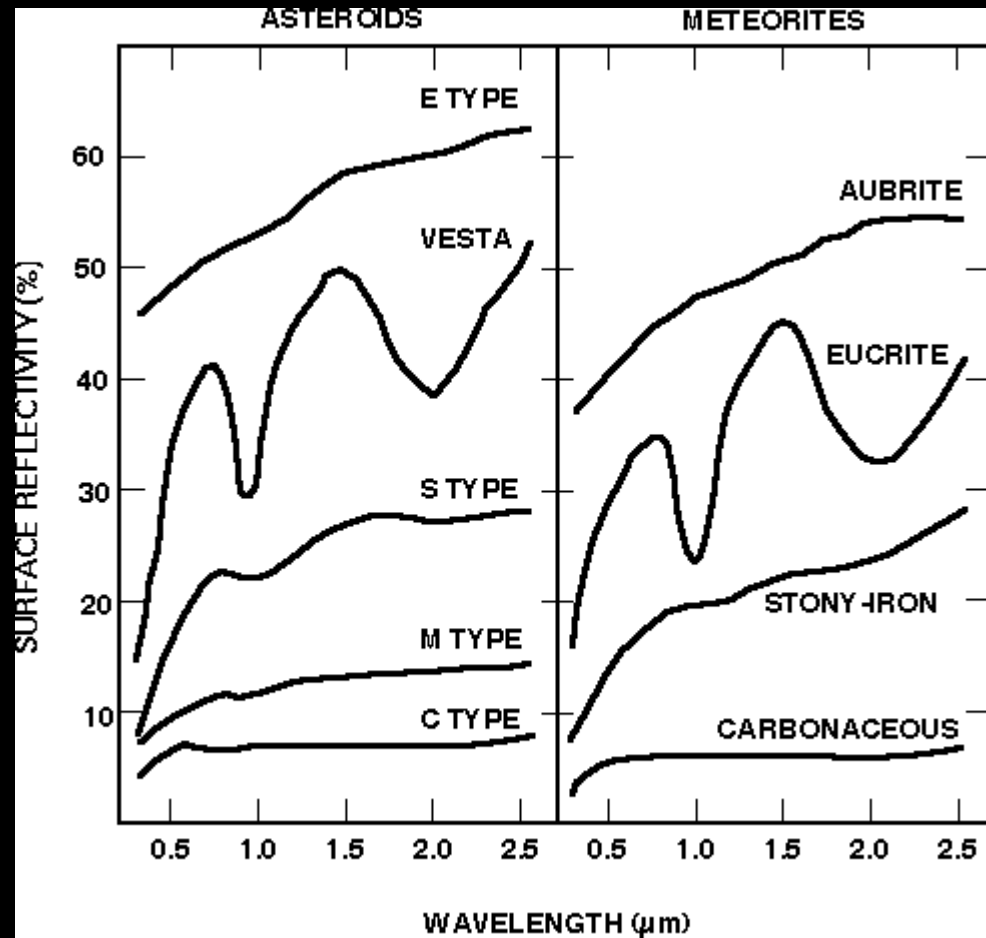
Old Predicted Total (pre-WISE) ○



How Did We Get This Info?



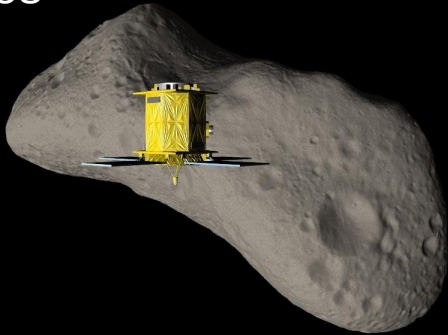
Spectrum from
Earth-based
telescopes



How Did We Get This Info?

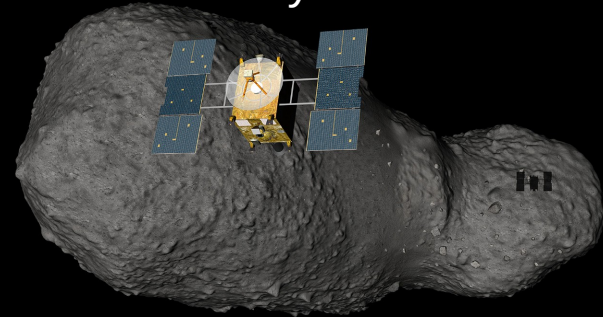
Dedicated Spacecraft missions

Near to Eros

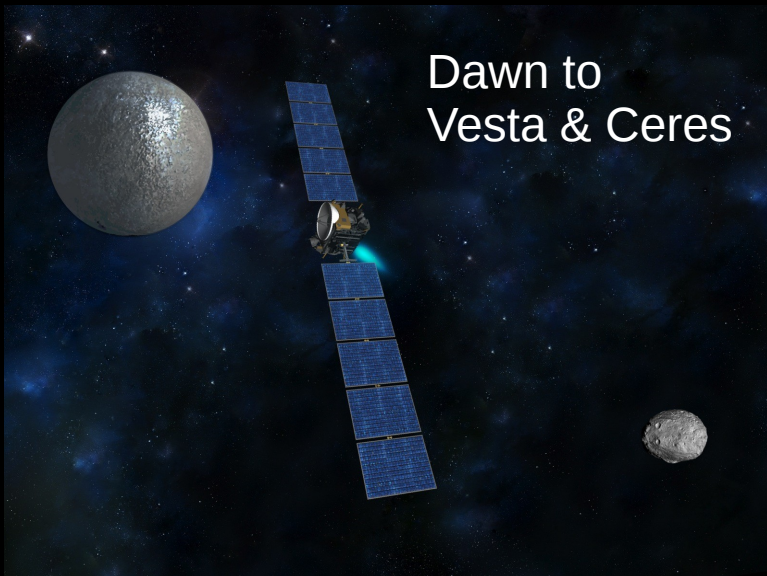


(C) NASA Visual Computing

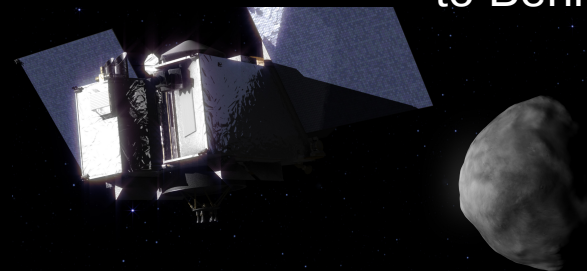
Hayabusa to Itokawa



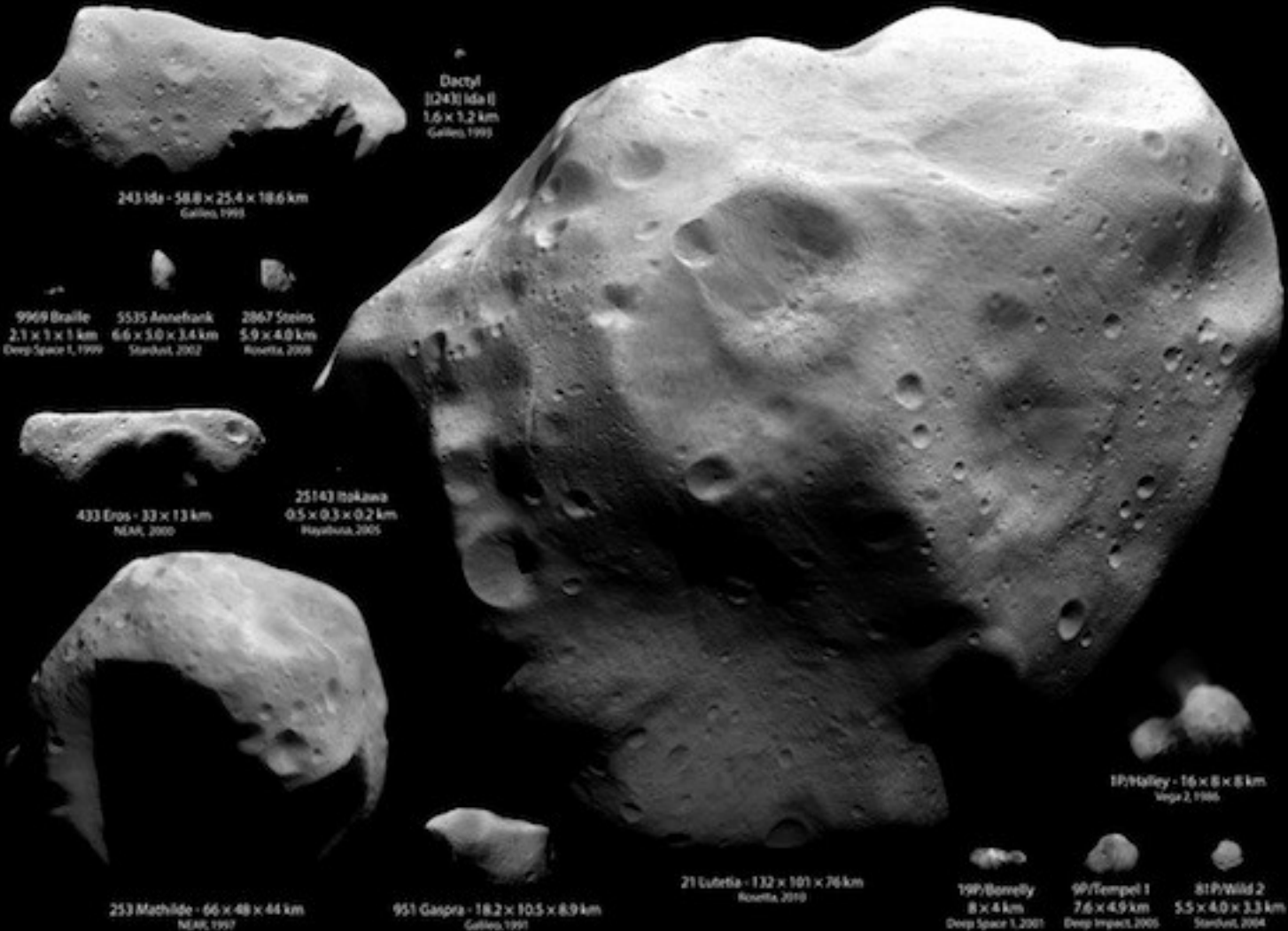
Dawn to
Vesta & Ceres



OSIRIS-REx
to Bennu



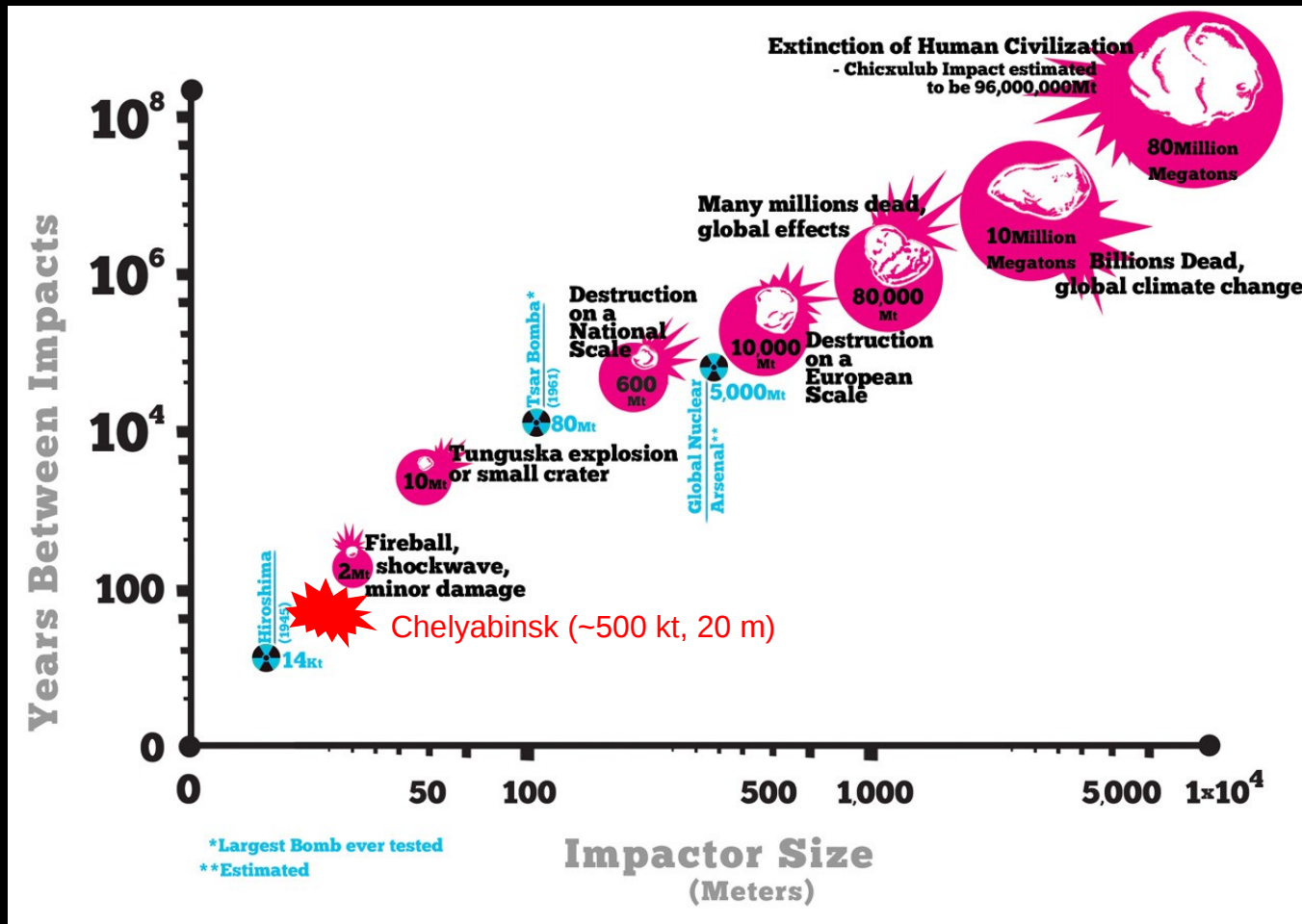
Why Study Asteroids?



Why Study Asteroids?



Impact Hazard



Why Study Asteroids?

Exploration/Mining



Why Study Asteroids?

THE SPACE ECONOMY: A MODERN DAY GOLD RUSH

Asteroid Mining Will Create A Trillion-Dollar Industry

As our **population grows** we need to find a **sustainable supply of natural resources** to fuel exploration in space and prosperity on Earth.



MORE ASTEROIDS DISCOVERED NEAR EARTH EVERYDAY



WATER-RICH ASTEROID

One water-rich asteroid could produce **enough** fuel for every rocket launched in history.

USES OF WATER IN SPACE



ROCKET FUEL



BREATHABLE AIR



DRINKABLE WATER

PLATINUM-RICH ASTEROID

Could contain more Platinum Group Metals than what's been mined on Earth in all of history

NEAR-INFINITE SUPPLY OF PRECIOUS RESOURCES

ONE SINGLE 500M water-rich asteroid



would produce over \$5 trillion worth of water for use in space.

It currently costs **\$20,000** to send a liter of water from Earth to Deep Space

USES OF PLATINUM GROUP METALS ON EARTH

REDUCE COST OF ELECTRONICS



ELECTRIFY TRANSPORTATION



DRIVE INNOVATION, AND CREATE A GREENER EARTH



ONE SINGLE 500M platinum-rich asteroid

Worth \$2.9 Trillion



more than the yearly world output of platinum

50%

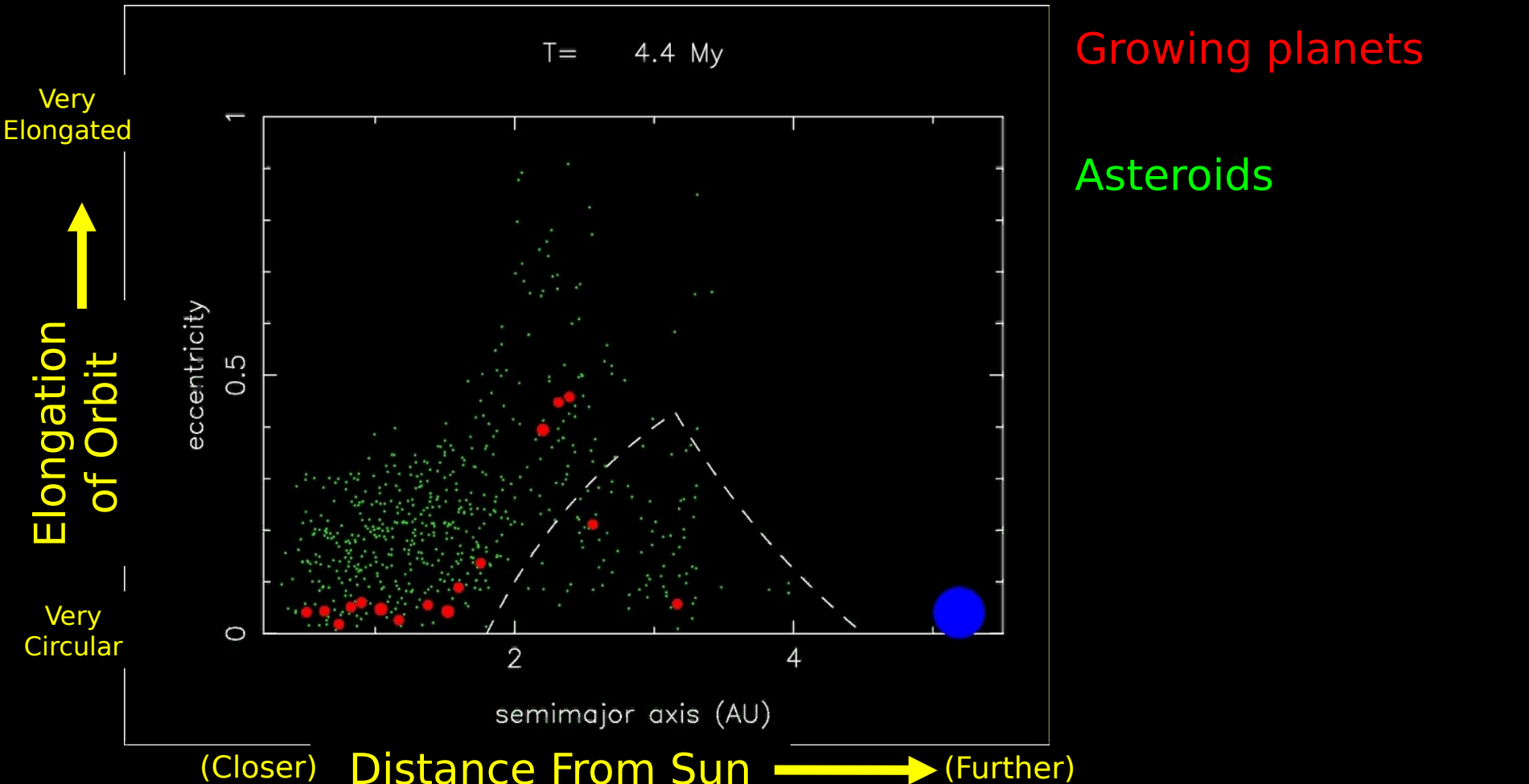
More than the known world-reserves of PGMs

At current market prices, one ounce of platinum is valued over **\$1,500**

Asteroid mining will open a trillion-dollar industry and provide a **near-infinite supply** of Platinum Group Metals and water to **support our growth** both on this planet and off.

Why Study Asteroids?

Building Blocks of Planets & Clues to Evolution



What Do We Still Need to Learn?

- Complete census of Near Earth Asteroids
- How do asteroids evolve?
- Exact compositions & how does that relate to life and planetary formation and evolution?
- ??

