

Rosetta and the study of asteroids

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Rosetta Steins fly-by Press Conference
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Why study asteroids?

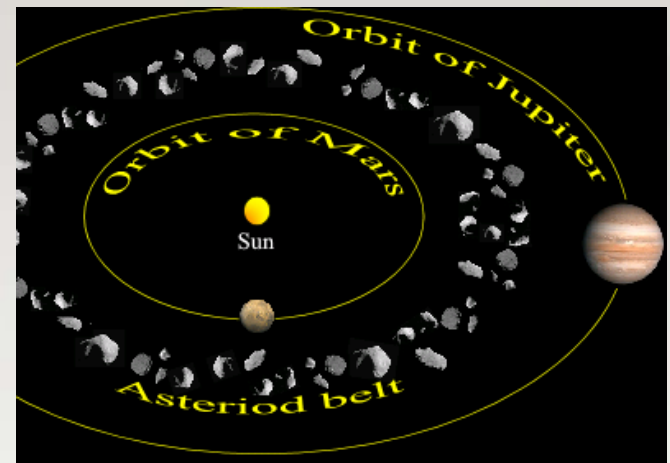
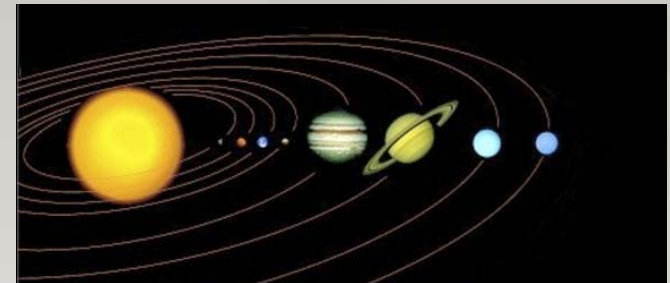
The history of our solar system has been locked into its various members

The various stages of its formation and evolution can be unlocked by investigating the solar system bodies – particularly minor bodies as they have not been altered by internal heating

In the early solar system the first planetesimals (formed by dust accretion) accumulated into planetary embryos to eventually form our planets

In the asteroid belt this process was stopped when Jupiter formed

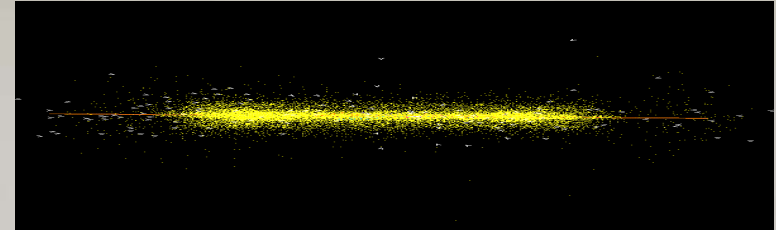
→ **Asteroids keep a memory of that part of solar system formation, like a piece of solar system DNA**



Theresa Knott

Why study asteroids?

The main asteroid belt, between Mars and Jupiter, is rather crowded



Collisions play a significant role in defining asteroid compositions and internal structures

(Larger) asteroids have been destroyed by collisions.
→ different asteroid families

Collisions may result in many fragments that can re-accumulate to form new asteroids.

All asteroids are different as they have their own collisional history!
(therefore **we have to visit as many as possible**)

Asteroid Encounters – historical overview

Galileo

(951) Gaspra, 29 Oct 1991 (1600 km at 8 km/s, S-type: 18.2 x 10.5 x 8.9 km)

(243) Ida, 28 Aug 1993 (2391 km at 12.38 km/s, S-type: 56 x 24 x 21 km)

(and its satellite Dactyl: 1.6 x 1.4 x 1.2 km)

NEAR Shoemaker

(253) Mathilde, 27 June 1997 (1212 km at 9.93 km/s, C-type: d = 60 km)

(433) Eros, arrival 23 Dec 1999, touch down 12 Feb 2001 (S-type: 33 x 13 x 13 km)

Deep Space 1

(9986) Braille, 29 July 1999 (13,500 km, 15.5 km/s, V-type: 2.1 x 1 x 1 km)

Stardust

(5535) Annefrank, 2 Nov 2002 (3100 km at 7.4 km/s, S-type: 6.6 x 5.0 x 3.4 km)

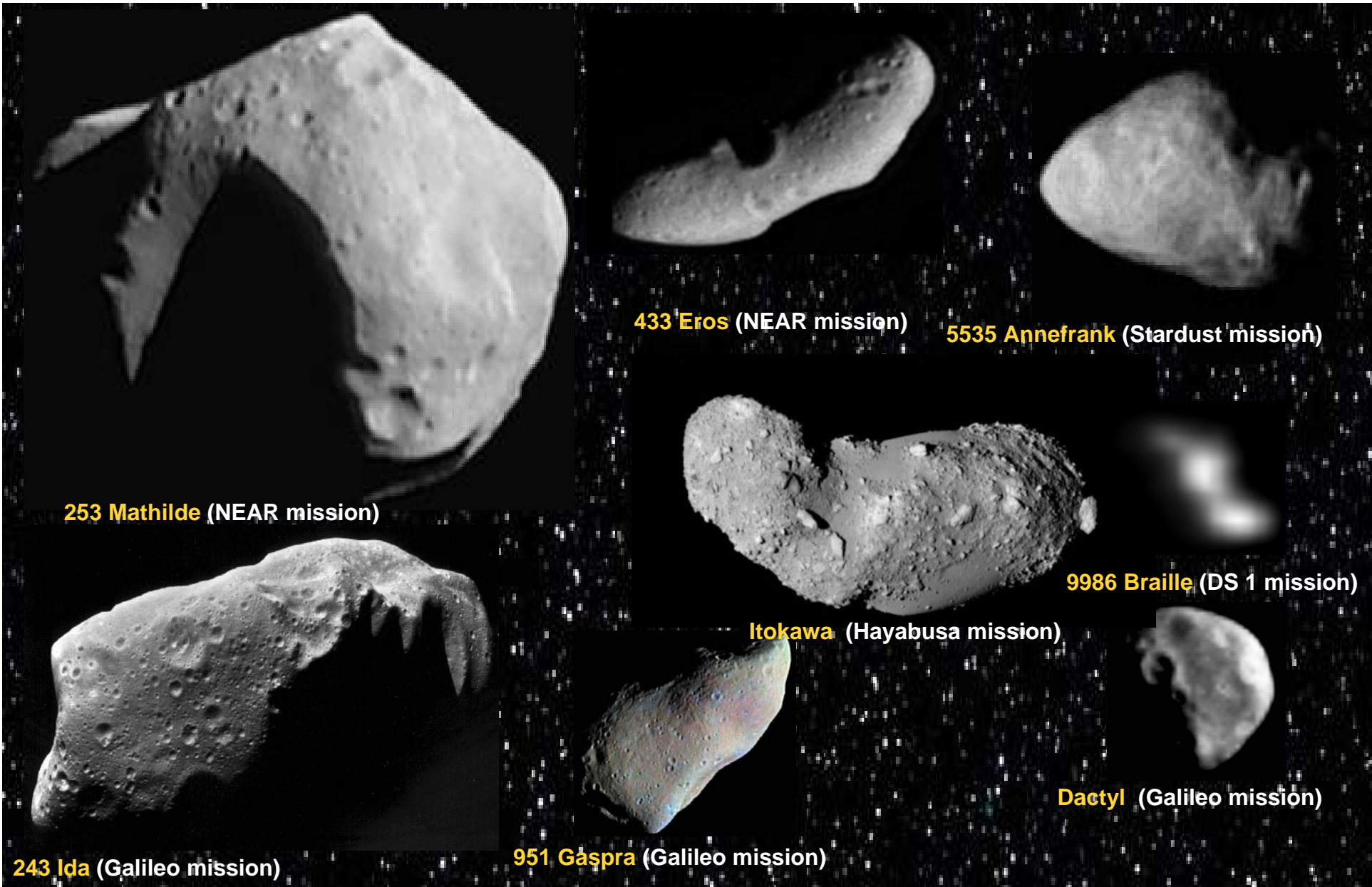
Hayabusa

(25143) Itokawa, 12 Nov 2005 (Touch down for sampling, S-type: 540 x 180m)

Rosetta

(2867) Steins 5 Sep 2008 (~800 km at 8.62 km/s, E-type: d ≈ 4.6 km)

(21) Lutetia 10 July 2010 (~3000 km at 15 km/s, C-type (M?): d ≈ 95 km)



253 Mathilde (NEAR mission)

433 Eros (NEAR mission)

5535 Annefrank (Stardust mission)

243 Ida (Galileo mission)

Itokawa (Hayabusa mission)

9986 Braille (DS 1 mission)

951 Gaspra (Galileo mission)

Dactyl (Galileo mission)



(2867) Steins – why is it interesting?

Discovery: 4 Nov 1969

'Home': main asteroid belt

Diameter: 4.6 km, irregular shape

Orbit around the Sun: almost circular,
inclined $\sim 10^\circ$ above the ecliptic

Diffuse reflection (albedo): 0.45 ± 0.1

Rotational Period: 6.052 ± 0.007 hrs

Type: E (very rare, iron-poor or
iron-free silicates)



Rosetta's measurements at (2867) Steins

- Accurate size, shape, volume, rotation rate and diffuse reflection (albedo)
- Multi-color imaging of the surface
- Multi-wavelengths spectral mapping
- **Clues on surface morphology and composition**
 - Volume & morphology of craters (collisional history, material strength)
 - Nature of the regolith presence or absence, thickness, down-slope movement
- Mass and density determination
- In-situ studies of the asteroid environment
 - (Satellites?), dust, gas, plasma, radiation, magnetic field & interactions with interplanetary magnetic field and solar wind



Instruments working at Steins

15 instruments are switched on during the fly-by (14+1):

- 4 remote sensing instruments for imaging and/or spectrometry:
ALICE, OSIRIS, VIRTIS, MIRO (ultraviolet, visible, infrared, sub-mm)
- 7 instruments investigating the charged-particle, magnetic and radiation environment near the asteroid:
Plasma Consortium instrument (IES, ICA, LAP, MIP, MAG), ROMAP, SREM
- 3 in-situ instruments for the search of gas & dust particles around the asteroid:
GIADA, ROSINA, COSIMA
- 1 Radio Science experiment:
RSI



