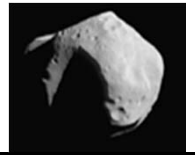
What have we learned from space missions to asteroids?

Marcello FULCHIGNONI

Paris Observatory/Univ. Paris 7, France

Asteroid (Type)	Gaspra (S)	Mathilde (C)	Ida (S)	Eros (S)	Itokawa (S)	Steins (E)	Lutetia (M? C?)
							
Diameter	12 km	53 km	31 km	17 km	0.35 km	6.7 x 5.9 x 4.3 km	121 x 112 x 87 km
Period	7.09 hr	17.406 d	4.634 hr	5.267 hr	12.132 hr	6.047 hr	8.168 hr
Age	200 My	2-4.5 Gy	1 Gy	2 Gy	1-100 My	100-150 My	0.07-3,5 Gy
Density	2.7g/cm^3 (b)	1.3 g/cm^3 (a)	2.6 g/cm^3 (b)	2.67 g/cm^3 (b)	1.95 g/cm^3 (b)	? (c)	3,5-3.9 g/cm^3
Porosity	?	55 – 63 %	18 – 24 %	16 – 21 %	39 – 43 %	?	?
Meteorite	ordinary chondrite	carbonaceous chondrite	ordinary chondrite	ordinary chondrite	ordinary chondrite	aubrite	? CR/CO/CV or Enstatite condrite?
Objective	Fly-By Galileo (1991) Res=54m/px	Fly-by NEAR (1997) Res=180m/px	Fly-by Galileo (1993) Res=25m/px	1 year-RD NEAR (2000) Res=cm/px	Hovering Hayabusa (2005) Res<1cm/px	Fly-by Rosetta (2008) Res<80 m/px	Fly-by Rosetta (2010) Res >60 m/px
	-First asteroid with young age (200 Myr) -Absence of large craters	-First asteroid with low density - Large craters (5 with D> 5 km) suggest porous bodies have much higher impact strength than expected	- First discovery of a satellite (Dactyl) - Age estimate (1 Byr) - First estimate of density of S-type - First constraints on mechanical properties	- Larger amount of boulders than expected - Lack of very small craters - First evidence of thick regolith	- First evidence of rubble-pile structure - First S-type with low bulk density - Large boulders - Lack of small craters (<10 m) requires unknown process	-- First chunk of e highly differentiated object --First visit to a body shaped by the YORP effect?	--Larger, older explored asteroid --high density -- heterogeneity -- Very large craters (D>40 km) -- Landslides --Fields of large boulders (> 60 m)

(a) Average densities of meteorites for C type asteroids: **2.9 – 3.5 g/cm3**
(b) Average densities of meteorites for S type asteroids: **3.19 – 3.40 g/cm3**
(c) Average densities of aubrites **2.97 – 3.27 g/cm3**