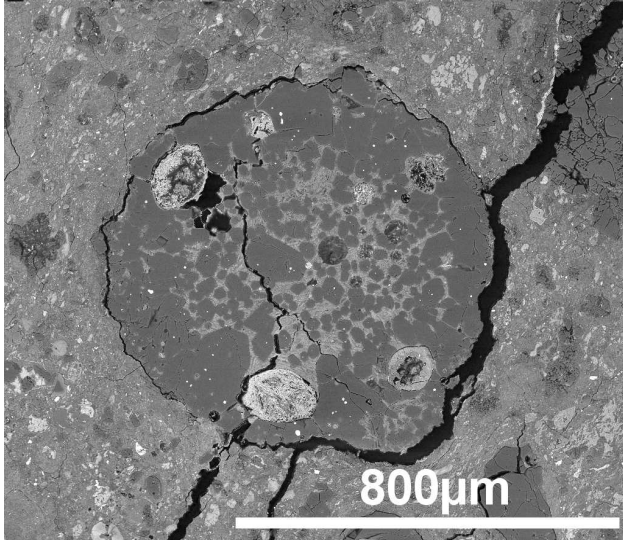
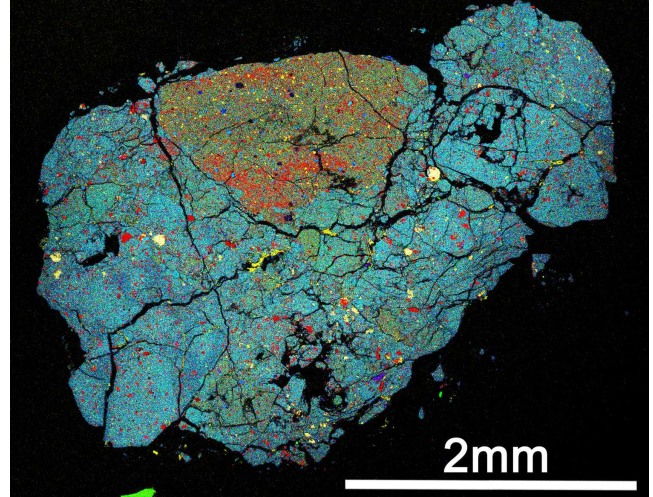


Chondrites

Chondrites are the most common type of meteorite. They characteristically contain grains called chondrules. Chondrules were molten droplets which were produced during the formation of the solar system and then accreted to form asteroids and the planets.



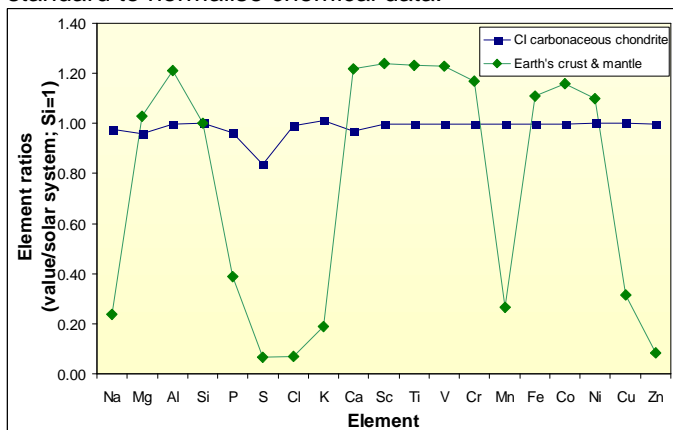
Chondrule in a carbonaceous chondrite (Murray)



X-ray image of a carbonaceous chondrite. Yellow=calcium, red=iron, green=silicon, blue=magnesium. This shows the differences in composition between the clasts.

What are carbonaceous chondrites?

Carbonaceous chondrites are a subcategory of chondrites, and are among the rarest types of meteorites. They are distinct in their chemical composition. It is the most primitive of any rock in the solar system, closely matching the composition of the Sun (and therefore the overall solar system as the Sun contains the majority of its mass). Consequently carbonaceous chondrites are used as an international standard to normalise chemical data.



The graph shows the variation in compositions of a CI chondrite and the crust and mantle of the Earth from the overall solar system.

However carbonaceous chondrites do not have a primitive appearance. They have been significantly altered by water, with many of the original materials being replaced. This has caused speculation as to how the alteration took place. Liquid water usually moves through rocks along veins and there is evidence in carbonaceous chondrites that this occurred. However, flowing water should have changed the concentrations of elements by leaching out some while leaving others, which is not observed (see graph above). There is currently no agreement about how carbonaceous chondrites can have retained their original chemistries.

On the larger scale, carbonaceous chondrites are made up of clasts from different sources. These clasts accumulated together in a similar manner to sedimentary rocks by processes occurring on the surface of the source asteroid. This causes the distribution of elements within a meteorite to be uneven on the millimetre scale.

Where do they come from?

Carbonaceous chondrites are believed to come from C-type asteroids. Asteroids are categorised by the wavelengths of light they reflect which reveals their surface composition. C-type asteroids are dark in colour, and their spectral signatures are similar to carbonaceous chondrites. They are commonplace in the outer asteroid belt between Mars and Jupiter. For volatile elements to be preserved in carbonaceous chondrites and C-type asteroids they cannot have been exposed to extreme heat. However beyond this distance from the Sun these elements remain.

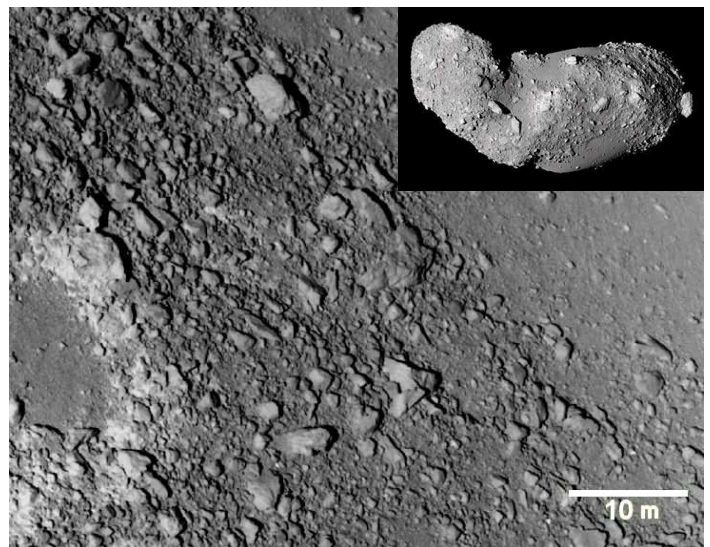


Image of the rubble surface of asteroid Itokawa (inset). Photograph taken by a Japanese satellite. Image obtained from <http://www.jaxa.jp/>

Subcategories of carbonaceous chondrites

Carbonaceous chondrites are further categorised by their individual structures and compositions. There are a number of groups, some less well-established than others. The main groups are: CI, CM, CV, CO, CR, CK