Research gives new insights into 4 billion year-old meteorites

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Carbonaceous Chondrites were formed in the solar nebula before planets like Earth existed.

(PhysOrg.com) -- Scientists have gained new insight into the makeup of ancient meteorites called Carbonaceous Chondrites, in research published in the October edition of the journal *Earth Science and Planetary Letters*.

Carbonaceous Chondrites are made up of the dust that formed the solar nebula, which is the cloud of dust and gas that made up our early solar system before rocky planets such as Earth and Mars were formed. The asteroids are 'chemically primitive', which means that none of the chemical elements of which they are composed have been moved around, taken out or added since they formed 4.56 billion years ago.

This makes Carbonaceous Chondrites valuable for understanding what conditions were like in the early solar system.

In the new study, Imperial College London researchers reveal that the particles which make up Carbonaceous Chondrites are much finer than previously thought - each being approximately 10 to 100 nanometers in size. These tiny grains severely restricted the flow of water through the rock.

This explains why soluble elements such as sodium and chlorine are still present in Carbonaceous Chondrites that have fallen to Earth, in spite of the presence of water. Water would normally be expected to dissolve soluble elements and transport them out of the rock.

Dr Phil Bland, the lead author of the research, from the Department of Earth Science and Engineering at Imperial, explains:

“We couldn’t understand why Carbonaceous Chondrites didn’t seem to follow the same geological rules as other rocks in space and on Earth. In previous studies, computer models predicted that water should have dissolved and transported the soluble material, and yet the geological evidence clearly showed that this was not the case.”

The new research shows that the dust particles which made up the Carbonaceous Chondrites were so small that water particles clung to them and could not move. This prevented the soluble material from being transported and deposited elsewhere.

Dr Bland says: “When you pour water through fine sand particles it gets trapped. The same thing happened inside Carbonaceous Chondrites, where the particles were so fine that the water was bound to it. We calculated that water particles could have flowed less than a millimetre every one million years.

“Studying the geology of Carbonaceous Chondrites is helping us to see what conditions were like in the early solar system. We think the fine-grain particles that make up Carbonaceous Chondrites were some of the last remnants of the original cloud of dust and gas in the solar nebula. We believe that ice formed around each tiny grain before they all clumped together to make rocks that eventually turned into carbonaceous chondrite asteroids,” adds Dr Bland.

The researchers came to their conclusions by studying the size of grains in Carbonaceous Chondrite fragments using powerful microscopes. The resulting data was input into computer models to determine how the water particles would have flowed through Carbonaceous Chondrite rock.

More information: Earth and Planetary Science Letters

Provided by Imperial College London (news : web)