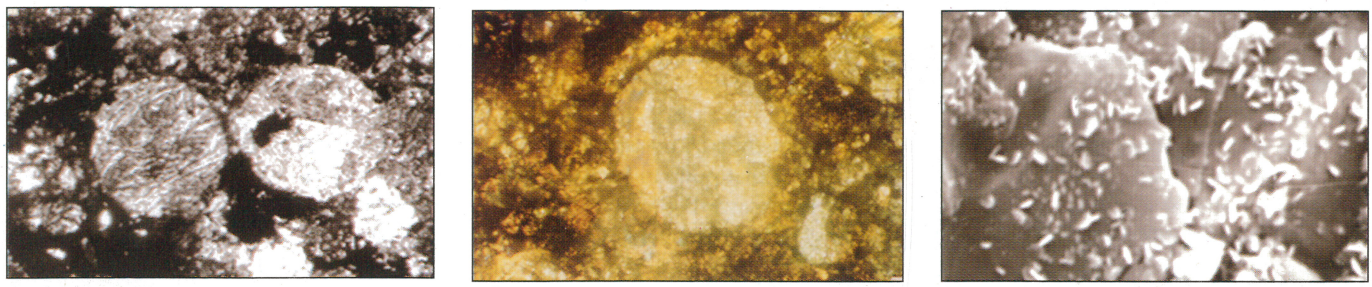
Might life on Earth have come from space?



a b c

Figure 1 Micrographs of the Didwana–Rajod meteorite (an H5 chondrite). a, A cluster of chondrules, (aggregates of minerals); b, an enlarged chondrule; c, scanning electron micrograph of the meteorite showing (possibly bacterial?) rod- and sausage-shaped structures.

Dehradun A team of geologists has obtained the first evidence from India to support the theory that life might have originated in space, before being introduced to Earth by meteorites.

Vinod Tewari of the Wadia Institute of Himalayan Geology in Dehradun and co-workers have identified the amino acids phenylalanine, tyrosine and tryptophan from a meteorite that fell near Didwana in the Nagaur district of Rajasthan in India in 1991. Amino acids are the basic building blocks of proteins.

"These amino acids are extra-terrestrial and any ground contamination is ruled out in the analysis," report the scientists[1], who include B. S. Paliwal from J. N. V. University in Jodhpur and K. Venkatakrishna from the Manipal Academy of Higher Education in Manipal.

The Didwana–Rajod meteorite probably came from an asteroid belt between Mars and Jupiter, say the researchers, who used laser Raman spectroscopy, a powerful tool for studying biological molecules, to confirm the presence of the amino acids in the meteorite samples.

Classified as an H5 chondrite, the Didwana–Rajod meteorite (Fig. 1) has been estimated to be between 4.2 billion and 4.5 billion years old. Carbonaceous chondrites are the rich in carbon, which is fundamental to life on Earth, and so are very interesting with regard to the origin of life, says Tewari.

According to recent research[2,3], comets and meteorites may have been a source of organic compounds on the early Earth. The Murchison meteorite found in Australia contains the amino acids glycine, alanine, valine, proline, aspartic acid and glutamic acid.

The most convincing evidence for the extraterrestrial delivery of two amino acids (alpha-amino isobutyric acid and racemic isovaline) comes from the Cretaceous–Tertiary section of the Stevens Klint in Denmark. These amino acids are not thought to occur naturally on Earth but are common in carbonaceous meteorites.

"The presence of polycyclic aromatic hydrocarbons in martian meteorite ALH-84001 discovered from Antarctica and interplanetary dust particles strongly supports the extraterrestrial source of organic molecules," says Tewari.

The researchers have also reported the possible presence of microbial life in the Didwana–Rajod meteorite[4]. They have found what could be bacterial structures ranging in size from 30 to 200 nm — the putative nanobacteria are found in rod, spherical and sausage shapes (Fig. 1c).

"The possible biogenic structures have been compared with biogenic structures recorded from martian meteorites" from Antarctica, Egypt and India, and detailed investigation is in progress, Tewari told *NewsIndia*.

The oldest record of life on Earth, in the form of bacterial microfossils and stromatolites, is reported from the Apex chert of Western Australia, which is 3.5 billion years old. The Earth is about 4.6 billion years old. Microfossil records reveal that unicellular prokaryotic biota lived on Earth 3.4 billion to 3.5 billion years ago. Multicellular eukaryotes evolved later in Earth's history.

The oldest known sedimentary rocks on Earth are 3.9 billion years old and belong to the Isua metaquartzite in Greenland, but no convincing microfossils have been reported from these rocks.

The scientists conclude that their discovery of amino acids and possible biogenic structures in the Didwana–Rajod meteorite supports the theory that biomolecules exist in space and that microbial life has been transported to Earth by meteorites, asteroids and comets.

1. Tewari, V. C. *et al. Journal of the Geological Society of India* **60,** 107–110 (2002).
2. Oro, J. *et al. Nature* **230,** 105–106 (1971).
3. Cooper, G. *et al. Nature* **414,** 879–883 (2001).
4. Tewari, V. C. 13th International Conference on the Origin of Life, Oxaca, Mexico, 132–133, abstract (2002).

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