SHORT COMMUNICATION

DISCOVERY OF AMINO ACIDS FROM DIDWANA-RAJOD METEORITE AND ITS IMPLICATION ON ORIGIN OF LIFE

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Aromatic amino acids Phenylalanine, Tyrosine and Tryptophan have been identified for the first time from the Didwana-Rajod meteorite which fell on Earth (most probably from asteroid belt between Mars and Jupiter in our Solar system) in 1991 near Didwana in Nagaur district of Rajasthan.

There are two broad theories of the origins of life. According to the first theory, life originated on Earth and the second suggest that life was brought to Earth from other planets and therefore, extraterrestrial. The study of amino acids (building blocks of life) in meteorites suggests that organic compounds were derived from proto planets and it was strongly supported by the occurrence of amino acids from Murchison meteorite. The Murchison meteorite (Australia) contains the amino acids, Glycine, Alanine, Valine, Proline, Aspartic acids and Glutamic acid (Oro et al. 1971). Proteins are made from amino acids and are the basic structural units of life.

The Laser Raman spectroscopic studies on the Didwana-Rajod meteorite have confirmed the presence of aromatic amino acids – Phenylalanine, Tyrosine and Tryptophan (Figs.1 to 4). Figure 2 shows the Raman shift (spectral bands) around 625, 1208, 1338 which corresponds to Phenylalanine, Tyrosine, and Tryptophan. These amino acids are extraterrestrial and any ground contamination is ruled out in the analysis. HPLC and GC-MS techniques are being used for additional recovery of amino acids from the meteorite. Laser Raman spectroscopy is a powerful tool for the study of biological (orgánic) molecules and provides direct molecular structural information on terrestrial and extraterrestrial materials. We have used Laser Raman spectroscopy for the characterisation of Lesser Himalayan microbial (stromatolitic) carbonates and Didwana-Rajod meteorite for the first time in India (Tewari et al. 2001). The Didwana-Rajod meteorite is classified as H5 Chondrite on the basis of petrography, geochemical, isotopic and electron probe micro analysis (Paliwal et al. 2001). Figure 4 shows the presence of chondrules in the petrographic thin section of the meteorite. Cosmogenic tracks, radionuclides and the isotopic composition of rare gases have also been measured from the meteorite. The classification of the meteorite is also supported by Mossbauer spectroscopy (Paliwal et al. 2001). The chondrules occur as radial and rimmed structures and generally have sharp boundaries (Fig. 4). Oxygen isotope values are found to be $\delta^{18}O=+3.8‰$ and $\delta^{17}O=+2.5‰$, confirming its H group chondrite. Nitrogen content is about 2 ppm with $\delta^{15}N \approx 3.4\%$. Didwana-Rajod meteorite has been assigned a U, Th - ^{4}He age of 4.2 Ga and K-Ar age of 4.53 Ga (Paliwal et al. 2001). Therefore, the present report of amino acids from the meteorite as old as 4.2 to 4.53 Ga is quite significant and has important implication on the origin of life in the universe.

Comets and meteorites may have been a potential source of organic compounds on the early Earth. Life must have been originated in some planet of our Solar system if not on

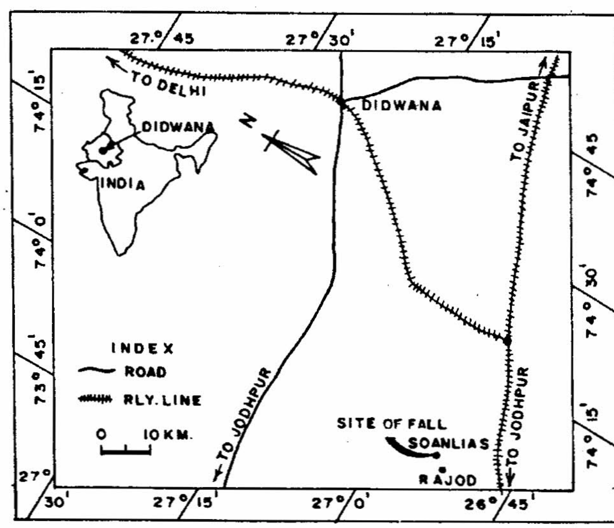

Fig.1. Location map of Didwana-Rajod meteorite fall site (*after* Paliwal et al. 2001).

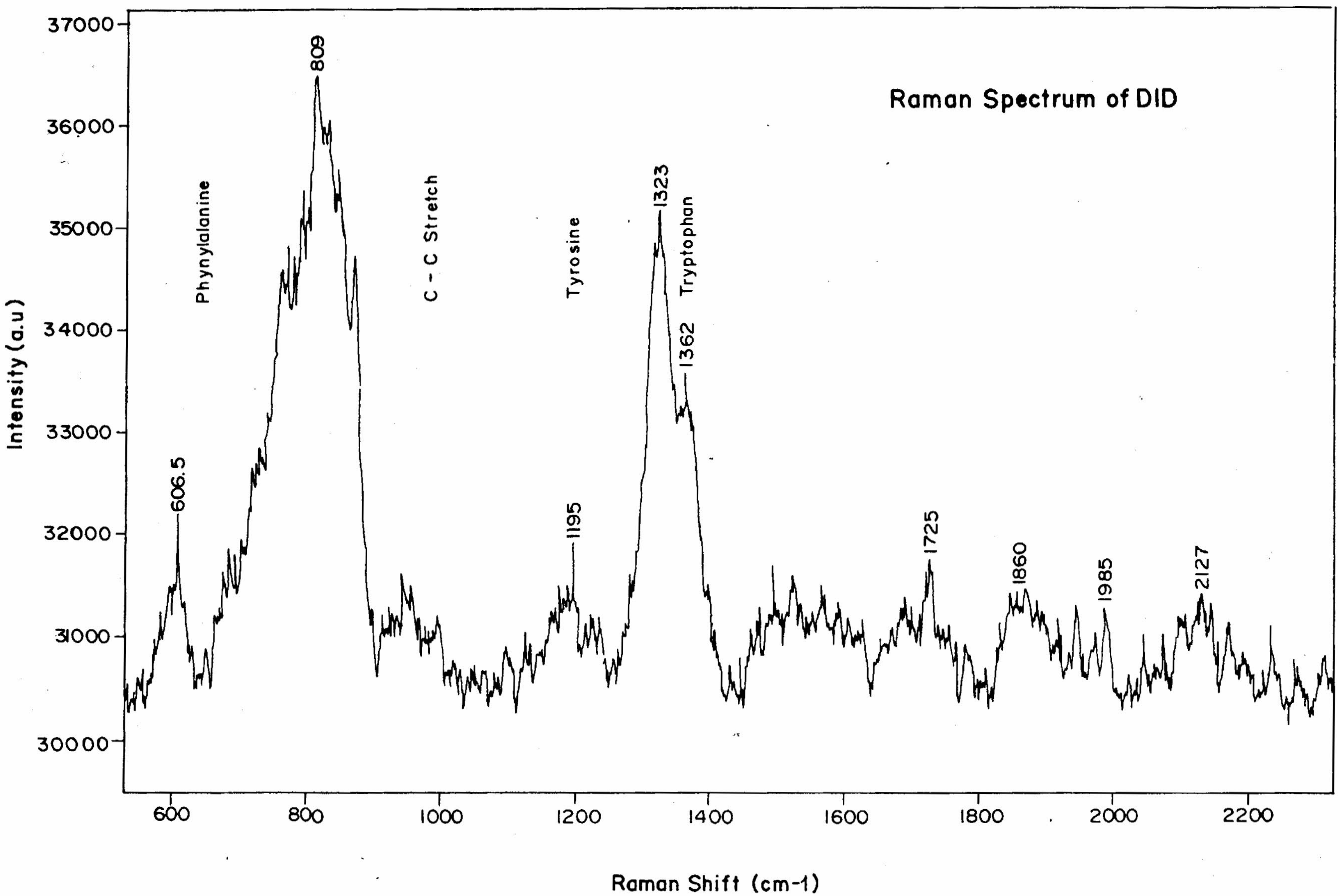

Fig.2. Laser Raman Spectrum of Didwana-Rajod meteorite showing amino acids.

The Primordial Biomolecules

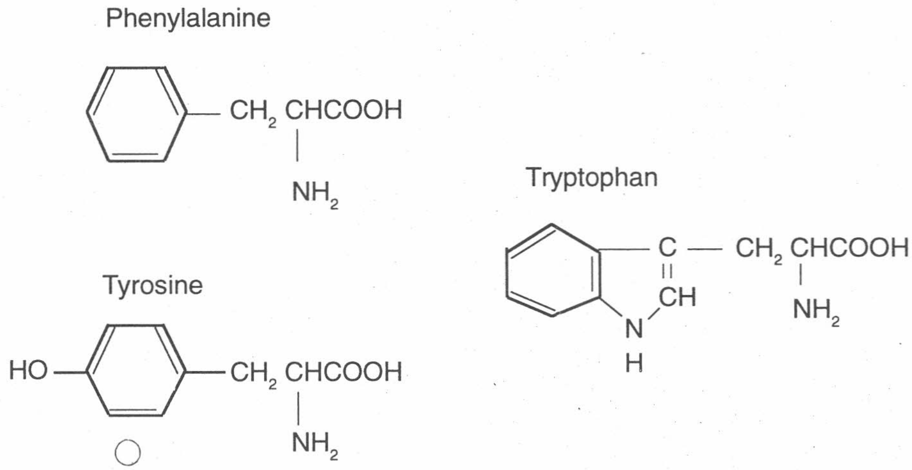

Fig.3. Molecular structure of Phenylalanine, Tyrosine and Tryptophan the basic molecules of life.

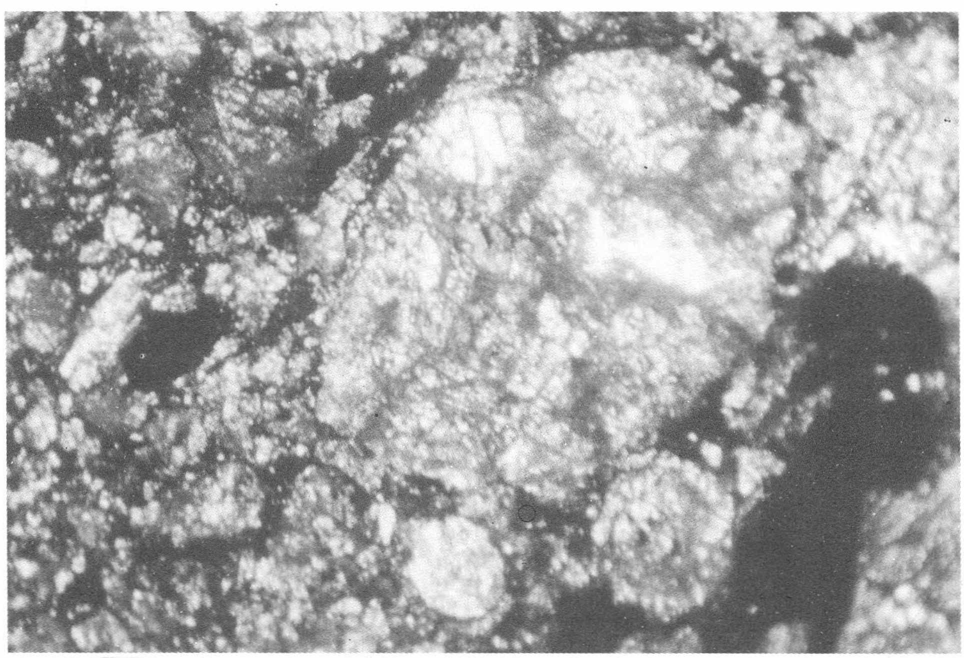

Fig.4. Microphotograph of Didwana-Rajod meteorite (H5 Chondrite) showing cluster of Chondrules.

Earth. The earliest microbes (prokaryotes) may have travelled between Earth, Mars, Venus and Mercury when the planetary system was young (Tewari, 1998, 2001). The occurrence of nannobacteria from Martian meteorite ALH 84001 supports this hypothesis (McKay et al. 1996). The amino acid carrying rocks (meteorites) blasted out of the other planets must have landed on Earth. Bada et al. (1998) consider martian amino acids as reliable biomarker, however, doubted the Antarctic ice contamination in martian meteorite ALH 84001. There is no contamination in DR meteorite. Life on Earth probably originated after the final stage of bombardment of the solar system by bolides dated at 3900-3800 Ma. The oldest record of bacterial microfossil and stromatolites on Earth are reported from 3465 Ma old Apex chert of Western Australia (Schopf, 1993). Therefore, the present discovery of amino acids from the Didwana-Rajod meteorite also supports the theory that the biomolecules and bacteria exists in outer space and the microbial life is transported to the Earth by meteorites, asteroids and comets. Further detailed studies on the meteorite are in progress.

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