DISCOVERY OF BIOLOGICAL STRUCTURES IN THE TISSINT MARS METEORITE

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Summary. Preliminary SEM/EDAX studies of the Tissint meteorite shows projections of interior spherical globules rich in C and O. Such concentrations of carbonaceous material in a matrix of mineral grains poses a mystery if biological processes are excluded. They are consistent with remnants of biological structures, thus supporting earlier similar claims for the Mars meteorite ALH84001..

Key Words: Meteorites, Mars meteorite, panspermia, exobiology

The Tissint meteorite, identified as a meteorite from Mars, fell onto the Morrocan desert some 30 miles south of the village of Tissint on June 18, 2011. Shattered pieces of the meteorite were recovered in October 2011, and is only just coming to be analysed and studied. A thick fusion crust that surrounds the meteorite fragments give confidence in the assertion that the interior material is pristine and uncontaminated. Its mineralogic characterisation as olivine-phyric shergottite of Martian origin appears to be well accepted, with a most likely origin in a relatively young lava regolith that solidified 400-500 million years ago. The meteorite has been found to contain pockets of Martian atmosphere which also confirms its Martian origin.

Martian meteorites that were discovered and collected so swiftly after their fall are relatively rare, and their importance lies in the fact that they are uncontaminated. The ingress of terrestrial bacterial material through the glassy fusion crust appears to be effectively ruled out, so the search for indigenous biological structures or bio-signatures becomes all the more important.

The search for extant microbial life on Mars has continued over many years without a decisive result being obtained. The Viking lander projects of 1976 produced a strikingly positive outcome for the Labelled Gas Release experiment under the guidance of Principal Investigator Gil Levin (Levin and Straat, 1976). However, a negative result in a mass spectroscopy experiment to search for complex organics at the landing site confounded the issue, and the agreed position of NASA was that no life was detected. Gil Levin differed from this consensus, however, and continued to maintain that the 1976 experiments did in fact indicate the presence of microbial life. A recent re-examination of the Viking results appears to further vindicate the position originally held by Levin (Bianchiardi et al, 2012). The implication is that microbial life does exist currently in viable form, and indeed the high levels of methane that have been detected in the Martian atmosphere further corroborate this conclusion.

The possibility of past life on Mars came to the fore with investigations of the Alan Hills Mars meteorite ALH84001 by McKay et al in 1996 (McKay et al, 1996). These authors discovered sub-micron sized carbonate globules with surrounding layers of complex organic molecules (PAHs) of presumed biologic origin – similar to degraded biofilm. In addition, McKay et al found ovoid shaped nanometre sized particles in chains, including magnetite crystals that are laid down by some types of terrestrial iron-oxidising bacteria. An identification with nanobacteria was proposed that has been criticised on the grounds that such small micro-organisms cannot and do not exist in autonomous form. The debate relating to ALH84001 still continues without a satisfactory resolution in sight.

With this background of claims and counter-claims about extant life as well as past life on Mars, we decided to secure a sample of the new Tissint meteorite and subject it to close scrutiny. This meteorite was ejected by an impact on the Martian surface that took place some millions of years ago. If viable microbial life existed anywhere on Mars at the time, dust storms would have carried living cells even to arid and inhospitable regions, perhaps similar to the location from which the Tissant meteorite originated.

We obtained certified samples of this meteorite from a supplier known to one of us (B. Di Gregorio). SEM studies were carried out on freshly cleaved fractures of the meteorite using a Oxford Instruments LX-40 environmental scanning electron microscopy machine. To our surprise we discovered many C, O rich disc-shaped structures typically 20 microns in radius embedded in the mineral matrix.

Figures 1(a)-(d) show examples of SEM images of such structures showing them to be embedded in a mineral matrix. Figures 1(e), (f) show the same structure as in Figure 1(d) under gold coating at different magnifications. The cracking shown in 1(d) can be interpreted as implying an initially hollow carbonaceous structure. Figures 2(a)-(f) display EDAX data on elemental abundances for the structures in Figure 1, compared to abundance data external to these structures in the rock matrix. The formation of nearly spherical C-O rich spheres (discs are probably sections of spheres) within the mineral matrix is not easy to explain by any non-biological processes. Biology, on the other hand, can provide an elegant explanation of these structures. The original identification by McKay et al (1996) of structures in the Mars meteorite ALH84001 with biology would appear to be corroborated by the present studies of Tissant. Further work including Raman spectroscopy is in progress.

It may seem ironical that the tipping point for a long-resisted paradigm shift turns on a relatively trivial observation. But similar situations are well documented in the history of science. Evidence accumulates against a reigning paradigm without effect until a single new observation turns the tide. Sooner or later facts prevail over prejudice. In the present case our studies of the new Mars meteorite Tissant may finally declare that Mars is not a dead planet.

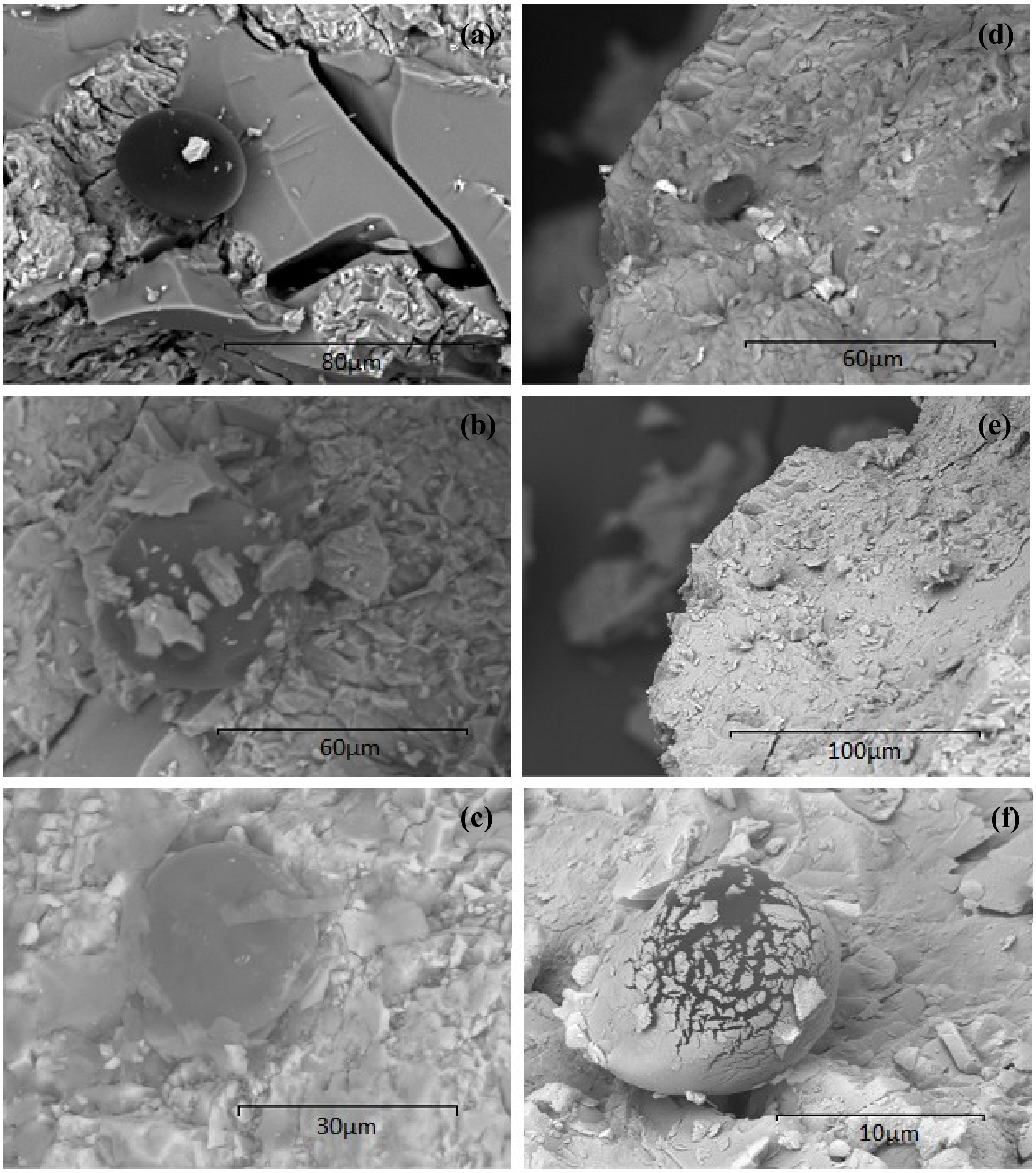

Fig. 1. Scanning electron microscopy images of the Tissint meteorite. (a) An image of a spherical structure found on the first fresh fracture, (b) a similar structure found in a second fresh fracture and on the surface (c). Images (d) – (f) depict a similar structure under different conditions: (d) uncoated, and (e) and (f) show same structure under gold coating. Cracking seen in (f) probably indicates an original C,O rich structure that is hollow.

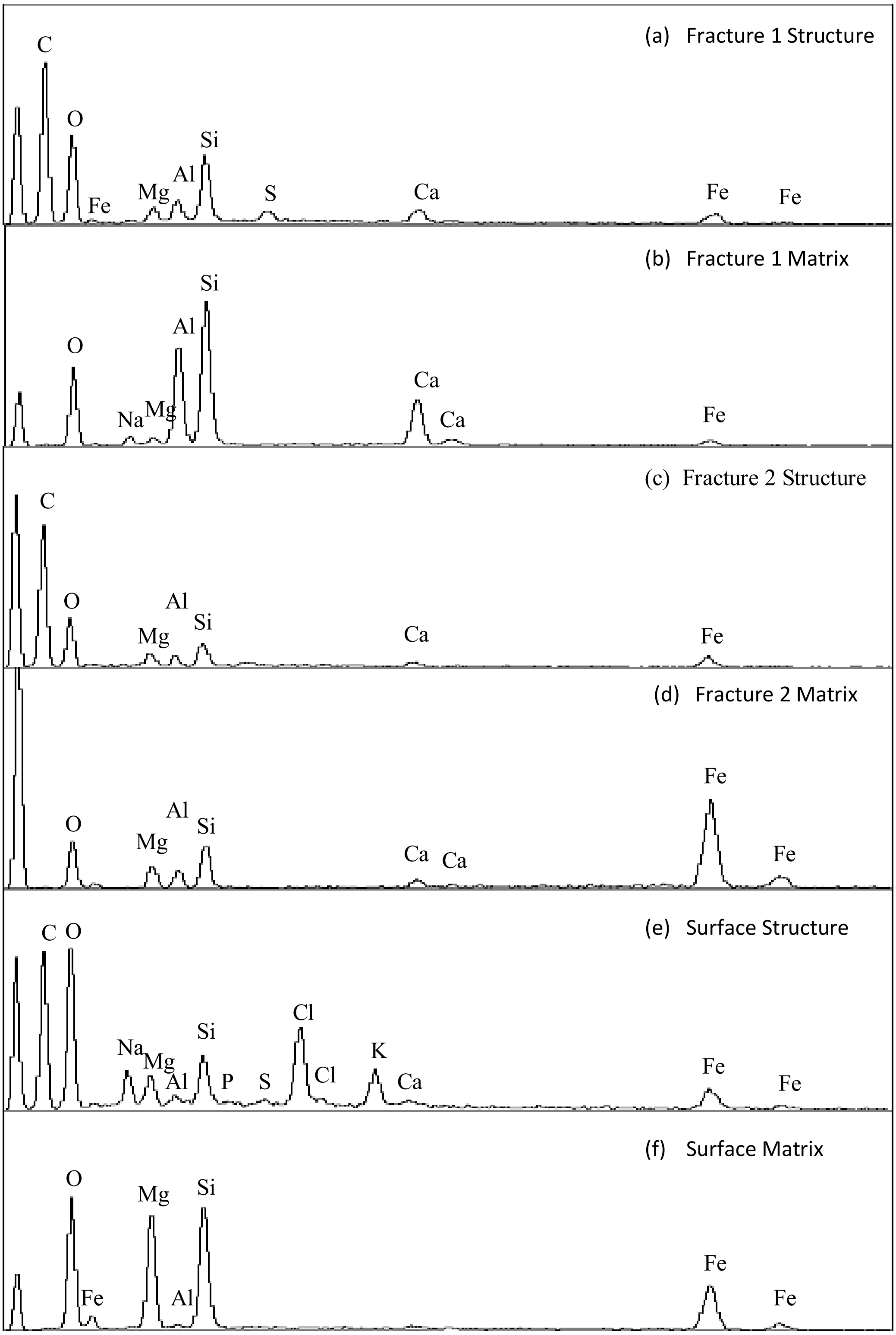

Fig. 2. X-ray spectra of the chemical elements found in the Tissint meteorite. Spectra's (a), (c) and (e) correlate to the structures shown in Fig's 1 (a)-(c) respectively with respective rock matrix spectra sown in (b), (d) and (f).

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