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IN SITU ISOTOPE ANALYSES OF ORGANIC CARBON FROM THE TISSINT MARTIAN METEORITE: EVIDENCE FOR A BIOGENETIC ORIGIN
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Introduction: Exploration for paleoenvironment and possible existence of life on Mars are the main goals of Mars missions. Martian meteorites, the only available rocks from Mars, supply us with a unique chance to study these issues using various sophisticated instruments. Tissint is a new witnessed Martian meteorite fall. The unique fresh samples of Tissint are criti-cally important for study of organic compounds in Martian meteorites, since terrestrial contami-nation is a very serious issue. Tissint is an olivine-phyric shergottite, consisting mainly of olivine phenocrysts, maskelynite (shocked glass of plagioclase) and pyroxenes with minor chromite, il-menite, sulfide and apatite [1,2]. The meteorite has been heavily shocked, as indicated by pres-ence of shock-melt veins and pockets, maskelynite and various high-pressure assemblages [2,3]. At least 3 shock events were recognized in Tissint [3]. Here we report discovery of organic car-bon in this meteorite and the in situ element and isotope analyses. Our observations favor for a biogenic origin.

Results: The organic carbon has two petrographic settings, most fully filling fractures and cleavages in olivine and pyroxenes and a few enclosed in the shock-melt veins. Laser micro-Raman analysis shows that the organic carbon is similar to kerogen. Furthermore, a sharp peak at 1327 cm-1 was detected in some organic carbon inclusions in the shock-melt veins, indicative of formation of diamond by a shock event. The organic carbon of both petrographic settings has been analyzed with the Cameca NanoSIMS 50L. The elemental ratios of H, N, O, S, P and Cl to C of the organic carbon are comparable with the working reference of coal, but distinctly higher than the graphite standards, confirming that the organic carbon is a kerogen-like matter. Except for 4 grains with normal H isotopes, all other 9 analyses are highly D-enriched (deltaD= 324˜1183 permil). The organic carbon is characteristic of light C isotopes, with delta13C values of -13.0 ˜ -33.3 permil. The N isotopes are normal within the analytical uncertainty.

Discussion and Conclusions: The presence in the shock-melt veins and the D-enrichment of the organic carbon demonstrate a Martian origin. Furthermore, the clear petrographic settings of the organic carbon evidently indicate depositing from organic fluids, after eruption of Tissint basalt and the following shock event that produced abundant fractures. The organic carbon can-not be magmatic in origin claimed by previous work, which was based on its presence in mis-described ”magmatic inclusions” [4]. The organic carbon is either unlikely derived from chon-dritic debris that impacted on Mars, because kerogen is an insoluble organic matter. The signifi-cantly light C isotopes of the organic carbon suggest a biogenic origin. Our observations are the currently available evidence for possible biotic activity on Mars.

References: [1] Aoudjehane H. C., et al. 2012. Science 338: 785-788. [2] Lin Y. T., et al. 2012. Meteoritics & Planetary Science 75: 5131. [3] El Goresy A., et al. 2013. Lunar and Planetary Science Conference XXXXIV: #1037. [4] Steele A., et al. 2012. Science 337: 212-215.

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