

A SEARCH FOR FURTHER CONCENTRATIONS OF ORGANIC MATERIALS IN EET A79001; C.Douglas, I.P.Wright, and C.T.Pillinger, Planetary Sciences Unit, The Open University, Walton Hall, Milton Keynes, MK7 6AA, England. M.M.Grady, The Natural History Museum, Cromwell Road, London SW7 5BD, England.

EET A79001, an SNC meteorite believed to be of martian origin, is an unusual sample containing an igneous contact between two distinct lithologies: both are maskelynite-bearing feldspathic pyroxenites, one medium grained (lithology A) and the other coarser grained (lithology B). A third material is also present, generally referred to as lithology C [1], which consists of vugs and shock-melted glassy veins and is found throughout the meteorite. EET A79001 also contains numerous salts such as carbonates [1], sulphates and phosphates [2] and possibly nitrates [3]. The origin of these materials is the subject of continued research. Previous studies have also suggested an association of these salts with carbonaceous material burning at low temperatures presumed to be organic in nature [4, 5]. Herein we report further data concerning the lithology C assemblages.

Wright *et al.* [4] reported the presence of what were believed to be organic materials in EET A79001, sub-sample 239 (hereinafter 239). This material accompanied the calcium carbonate component known as "white druse" [1] found at a lithology A/C contact. Using stepped combustion, Wright *et al.* [5] found that 4682 ppm carbon was released from 239 between 200-700°C. The isotopic composition rose from $\delta^{13}\text{C}$ ca. -26.6‰ at 200°C to +8.9‰ at 600°C, before decreasing again to lighter values at higher temperatures. The profile was interpreted as a mixing of two components: (i) an isotopically light component (870-1540 ppm; $\delta^{13}\text{C}$ ~-30‰), combusting between 200 and 650°C; this temperature interval is consistent with the identification of organic materials and (ii) a carbonate ($\delta^{13}\text{C}$ ~+12‰) which decrepitated between 450 and 700°C. Since 239 was taken from deep within the meteorite, it is reasonable to assume minimal levels of terrestrial biogenic contamination. Indeed compared to 239, a sample from the surrounding lithology A was found to release more than an order of magnitude less carbon during combustion at temperatures up to 650°C. Furthermore, a sample of band-saw fines also from EET A79001, which has obviously suffered from extreme levels of contamination, contained only 1000 ppm carbon [6]. Nevertheless, the isotopic composition of the low temperature carbonaceous material in 239 is consistent with that of terrestrial organics, therefore a pre-terrestrial origin cannot be guaranteed.

Unfortunately, further analyses of 239 were not possible since the entire sample (5.35mg) was consumed [5]. Subsequently, more druse materials have been discovered in EET A79001 as pockets within lithology A. One such sample, EET A79001,323 (hereinafter 323), a whole-rock chip from lithology A which has been analysed by high resolution stepped combustion in

the current study. The sample 323 was found to have a total carbon concentration of 1888 ppm, with an average $\delta^{13}\text{C}$ of -12.4‰ . The analysis revealed that 323, like 239, contained a large proportion of carbon that combusted at a low temperature ($<650^\circ\text{C}$). Unlike 239, the two isotopically distinct components were partially resolved, as a result of the smaller temperature increments utilised in the experiment. Carbonate accounted for 850 ppm of the total carbon released, and reached a maximum $\delta^{13}\text{C}$ of $+7.2\text{‰}$ at $550\text{-}575^\circ\text{C}$. As this value was not maintained across several temperature steps, it can be assumed that the true isotopic composition of the carbonate is actually higher. The lower temperature component ($T < 550^\circ\text{C}$) accounted for ~ 990 ppm calculated using an end-member $\delta^{13}\text{C}$ *ca.* -28.6‰ . There are two possibilities for the nature and origin of the low temperature component: (i) Either the carbon is preterrestrial in origin or (ii) the carbon is a mixture of weathering products and organic contamination which has found its way deep within the sample along microfractures and between grains. The salt deposits do not appear to be distributed in boundary sites. An argument for the carbon components of 239 and 323 being of terrestrial origin is that both samples contained a highly labile $\delta^{13}\text{C}$ -enriched component, released below 200°C . This accounted for 10-15 ppm carbon in 323 and 60-70 ppm in 239, assuming a $\delta^{13}\text{C}$ of between 0 and -5‰ . Components of this nature have appeared before in the analysis of many Antarctic meteorites. Another sample which contains large amounts of carbon released at low temperature is LEW 88516, which has three low temperature carbon components [7], one of which looks identical to the very low temperature carbon released during the analysis of 323. From isotopic considerations, the very low temperature carbon cannot be simply adsorbed air

If the carbonaceous components in 239 and 323 are truly martian organics, the implications for our understanding of Mars are immense. They may enable us to learn a great deal about the processes on Mars, both past and present, and perhaps even give clues to the origin of life. In order to ascertain that these materials are indeed martian organics further analysis is required, for example ^{14}C content would help to discriminate between terrestrial and preterrestrial organics. One such measurement of ^{14}C in salts from EET A79001 already exists, but the material analysed was collected from both the surface and the interior of the meteorite [8]. Weathering on the exterior of the sample may have produced terrestrial salts, which have a demonstrably different origin from the salts deep within the meteorite. Gas-chromatography-mass spectrometry techniques might be used to identify any organic compounds present in the samples and help discriminate between terrestrial contamination and other organic materials.

References: [1] Martinez R. and Gooding J.L. (1986), *Antarctic Meteorite Newsletter*, 9, 23-29; [2] Gooding J.L. *et al.* (1988), *Geochim. Cosmochim. Acta* 52, 909-915; [3] Grady M.M. *et al.* (1993) *Lunar Planet. Sci.* XXIV, 553-554; [4] Wright I.P. *et al.* (1989), *Nature* 340, 220-222; [5] Wright I.P. *et al.* (1988) *Geochim. Cosmochim. Acta* 52, 917-924; [6] Wright I.P. *et al.* (1993), *J. Geophys. Res.* 98, 3477-3482; [7] Wright, I. P. *et al.* (1993) *LPSC XXIV* 1541-1542; [8] Jull A.J.T. *et al.* (1992), *Lunar Planet. Sci.* XXIII, 641-642.