CARBON-14 AND STABLE-ISOTOPIC COMPOSITION OF ORGANIC MATERIAL AND CARBONATES FROM SOME SNC METEORITES. A. J. T. Jull1,2, S. Cloudt1 C. Courtney1, and C. J. Eastoe2, 1 NSF Arizona AMS Facility, University of Arizona, Tucson AZ 85721, USA, 2 Department of Geosciences, University of Arizona, Tucson AZ 85721, USA.

Among the many interesting properties of the SNC meteorites [1] is that they contain minerals such as carbonates that result from aqueous alteration [2]. Additionally, McKay et al [3] have reported on evidence of possible biological fossils associated with carbonates from Allan Hills 84001. The isotopic composition of C and O is important not only to understanding the origin of the carbonates, but potentially can give information about martian H2O and CO2 isotopic compositions, as well as indications of biological activity. We use 14C as a label to identify extraterrestrial carbonate phases, as they will have a low 14C/12C ratio <4% modern terrestrial carbon [see refs 4,5 for discussion], compared to higher values from terrestrial sources. We can make similar arguments for organic materials if the meteorites were irradiated as small objects in space. Terrestrial weathering products or organic materials introduced after the meteorite fall would lead to higher levels of 14C. Carbon and o-isotope abundances may also be affected by later isotopic exchange and the values that arise from weathering of meteorites are known [1,2,6].

We have previously reported measurements of the 813C, 818O and 14C composition of CO2 released from acid-etching experiments of the SNC meteorites, Allan Hills 84001 [4,5], Nakhla [4,5,7], Zagami [7] and Lafayette [8]. Measurements for ALH 84001 and Nakhla showed high 13C values up to +45‰ which correlate inversely with low 14C indicating an extraterrestrial carbonate; low values of 813C (<+5‰) show approximately modern terrestrial 14C and imply a terrestrial source. We assigned the high 813C values of carbonate observed in Allan Hills 84001 and other SNC meteorites to a fractionated source compared with the originally light carbon. A likely origin for this 13C-enriched component is an isotopically heavy martian atmosphere, however, given the possibility of biological activity involving Allan Hills carbonates, we cannot exclude this as a source of the isotopic fractionation. In contrast, Zagami carbonates show CO2 released with the lowest values of 14C having the lowest 13C of -20‰. We suggest Zagami carbonate samples a different carbon reservoir such as a magmatic source.

Previous isotopic results on carbonate from EETA 79001 [9] showed a large amount of 14C in carbonates of 813C of +3 to +8‰, indicating some exchange with terrestrial CO2. Organic phases present in SNC meteorites form part of the debate on the question of whether there is evidence for life in these rocks. Wright et al (10) studied stepped combustions of EETA 79001. We have begun some preliminary studies of 813C and 14C measurements on CO2 released by combustion in oxygen. Results are shown in the table. These results suggest that the organic phases combusting at temperatures of 200°–400°C are light with 13C of -27.7‰, typical of terrestrial organics and contain ~58% modern C. This is equivalent to a radiocarbon age of about 4300 yr. The second step (400°–600°C) contained carbon which presumably is a mixture of the +3–8‰ carbon and -27.7‰ per mil organics, but similar 13C. The higher-temperature fraction up to 830°C had some spallogenic 14C (from the silicate) released in this step. We will report further studies on SNC meteorite step-combustions and the implications of these results at the Conference.


TABLE 1. Isotopic composition of combustion of EETA 79001 in oxygen at various temperatures.

<table>
<thead>
<tr>
<th>Temp. range</th>
<th>C (µg)</th>
<th>C (ppm)</th>
<th>813C</th>
<th>Fm 14C</th>
<th>14C age (yr BP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200°–400°C</td>
<td>79</td>
<td>197</td>
<td>-27.77 ± 0.01</td>
<td>0.583 ± 0.031</td>
<td>4335 ± 430</td>
</tr>
<tr>
<td>400°–600°C</td>
<td>15</td>
<td>37</td>
<td>-2.96 ± 0.03</td>
<td>0.444 ± 0.074</td>
<td>6625 ± 1340</td>
</tr>
<tr>
<td>600°–830°C</td>
<td>30</td>
<td>74</td>
<td>-17.62 ± 0.08</td>
<td>1.66 ± 0.13</td>
<td>----a</td>
</tr>
</tbody>
</table>

a - contains spallogenic 14C released >750°C