A LASER MICROPROBE - MASS SPECTROMETRIC STUDY OF AN ALTERATION PRODUCT IN THE SHERGOTTITE EETA79001. R.H. Carr and E.K. Gibson Jr., SN4 Johnson Space Center, NASA Road 1, Houston, Texas, 77058.

The possibility that the SNC meteorites (in particular the four shergottites) originated on Mars has provoked intensive study of these rare specimens during the last few years. The discovery of noble gases (1), nitrogen (2) and carbon dioxide (3), trapped in the lithology C shock-melt inclusions of EETA79001, which closely match Viking spacecraft data for the martian atmosphere, in both elemental abundance and isotopic composition, has greatly strengthened the case for a martian provenance. Indeed, the situation is such that some secondary minerals found in the meteorites may now be postulated as being martian weathering products.

Studies of EETA79001 (4) have indicated the presence of Antarctic weathering products in this, one of the most pristine SNC meteorites known; hence, identification of martian weathering products may not be straightforward. A component identified in Nahkla which had certain characteristics of a carbonate mineral also had an unusual carbon isotopic composition (3) - a martian weathering product could be present.

White crystalline material surrounding glassy inclusions in the interior of EETA79001 has been found, by energy dispersive X-ray spectrometry, to have major element abundances consistent with it being calcium carbonate (4). Whether this material is of martian or terrestrial origin has important consequences regarding our understanding of alteration processes in both environments.

As part of a detailed study of this putative calcium carbonate, we have employed a laser microprobe system to determine the nature of the gaseous species released upon volatilization of localized areas of the sample. Briefly, the analytical system comprises of an industrial-grade Nd glass laser, combined with a bench-top quadrupole mass spectrometer. Gases produced by firing the laser into the sample (contained in a vacuum chamber) pass directly into the mass spectrometer for analysis.

Figure 1a shows the total ion current (TIC) vs. time profile for the analysis of EETA79001,239 - chip F. The laser was fired four times into the sample - twice into the white putative carbonate (shots 2 and 4) and twice into the lithology A ground mass (shots 1 and 3). Peaks in the TIC profile indicate a rise in pressure in the mass spectrometer above background due to the production of gases by the laser shots - here clearly associated with the carbonate and not with lithology A. Figure 1b shows the background-corrected spectrum from the second laser shot. (The spectrum from shot 4 is essentially identical). The major peaks can be assigned as: 44 (CO₂), 28 (CO), 16 (O) and 12 (C), consistent with identification of carbonate by comparisons with analyses of mineral standards. A small increase in the m/z 18 peak (H₂O) could be determined above background after the shots into carbonate, but lack of a suitable mineral standard prevents absolute differentiation between anhydrous and hydrated mineral phases.


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Figure 1a. Total ion current (TIC) vs. time profile for laser microprobe-mass spectrometric study of EETA79001,239 (chip F). Laser shots 1 and 3 were into Lithology A ground mass and show no significant release of volatiles. Laser shots 2 and 4 were into the white putative alteration product (carbonate). Peaks in the TIC profile indicate a rise in pressure in the mass spectrometer above background due to the production of gases by the laser shots—clearly associated with the carbonate and not with the lithology A.

Figure 1b. Background-corrected spectrum from second laser shot into the alteration product of EETA79001,239. Major peaks can be assigned as: 44 (CO₂), 28 (CO), 16 (O), and 12 (C), consistent with identification of carbonate by comparisons with analyses of mineral standards.