THE SOURCE OF ORGANIC SPECTRAL FEATURES IN ALH84001: LAB CONTAMINATION, TERRESTRIAL OR EXTRA-TERRESTRIAL?

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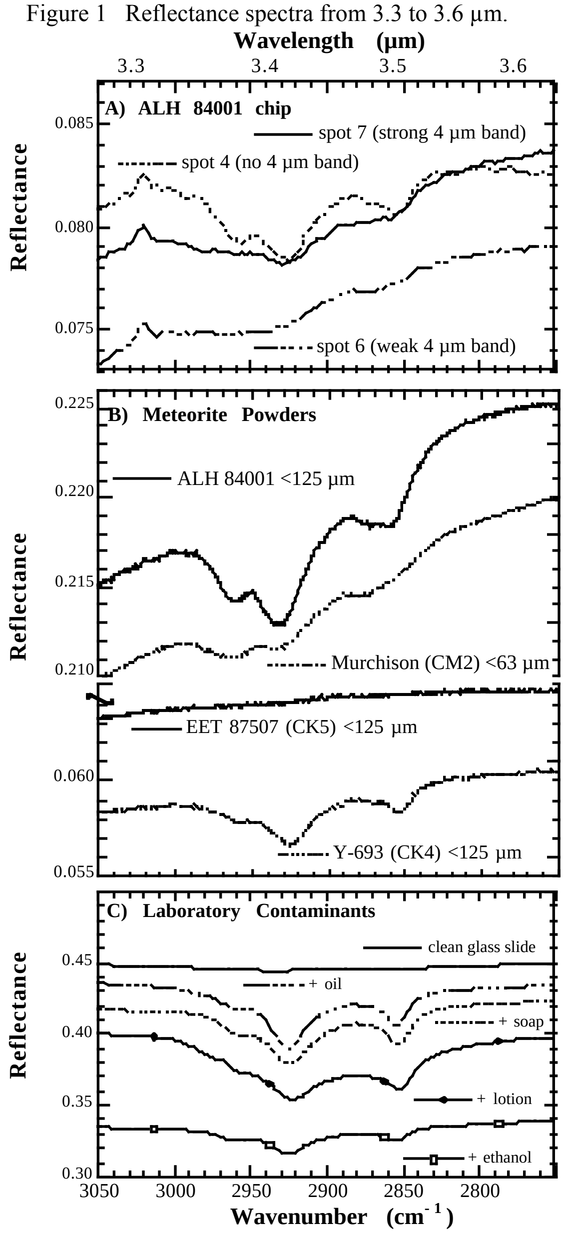
This study involves characterization of the organic features observed in spectra of ALH84001. In order to determine the likelihood and extent of laboratory contamination contributing to these features, we have measured infrared spectra of several potential organic contaminants. For comparison we have measured spectra in our lab of the carbonaceous meteorites: Murchison (CM2), EET87507 (CK5) and Y-693 (CK4).

Figure 1 Reflectance spectra from 3.3 to 3.6 µm.



Background. The organic matter in Murchison includes both abiogenic amino acids and other compounds [1]. Infrared analyses of an extract of Murchison indicate that branched cycloalkanes are the most abundant hydrocarbons present [2]. Infrared spectra of an acid-treated Murchison sample exhibit a weak aromatic CH feature near 3050 cm^{-1} (assigned to PAHs) and a strong aliphatic CH triplet at 2960, 2926 and 2870 cm^{-1} [3].

Methods. Reflectance spectra were measured of a chip and powder of ALH84001 as described in [4]. Spectral measurements of other meteorite powders were performed similarly. The contaminant samples were prepared by coating clean glass slides with ethanol, oil from human skin, soap and lotion.

Results. Reflectance spectra are shown in Figure 1 for A) 3 spots on our ALH84001 chip, B) ALH84001, Murchison, EET87507 and Y-693 powders, C) laboratory contaminants. (Spectra of Murchison and Y-693 are offset for clarity.) Weak features in the range 3.3-3.5 µm for ALH84001 have been assigned to superimposed features of organics and carbonates [4]. The organic features in ALH84001 spectra are distinctly different from those of the 4 contaminants tested. Features are observed near 2960, 2930 and 2860 cm^{-1} (~3.38, 3.41 and 3.50 µm) that are assigned to aliphatic CH stretching [5] and are similar to those observed in the spectrum of Murchison.

Additional features at 2340, ~1310, ~810 cm^{-1} (~4.27, 7.6 and 12.3 µm) in spectra of ALH84001 may be due to organic components as well. A feature at 4.27 µm is observed for EET87507 and Y693, but not for Murchison. A carbonate feature is observed near 3.97 µm in the ALH84001 and Murchison spectra. The combined organic and carbonate features in the ALH84001 chip spectra suggest the presence of calcite, magnesite and siderite.

Applications to Mars. These measurements indicate that lab contamination does not contribute to the ALH84001 spectral features. Although the aliphatic CH bands shown here for ALH84001 are similar to those of the non-terrestrial aliphatic hydrocarbon component of Murchison, this alone cannot determine whether the organics in ALH84001 are terrestrial or extra-terrestrial. Spectroscopic identification of minor organic components in ALH84001 suggests that detection of minor organics (if present) in the Martian regolith would be possible using multi-spectral imaging.

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