CARBON IN ALLAN HILLS 84001 CARBONATE AND RIM. G. J. Flynn[1], L. P. Keller[2], C. Jacobsen[3], and S. Wirick[3], [1]Department of Physics, State University of New York–Plattsburgh, Plattsburgh NY 12901, USA, [2]MVA, Inc., 5500 Oakbrook Parkway, Norcross GA 30093, USA, [3]Department of Physics, State University of New York–Stony Brook, Stony Brook NY 11794, USA.

We have previously reported Scanning Transmission X-Ray Microscope (STXM) C mapping and X-ray Absorption Near Edge Structure (XANES) spectroscopic measurements on carbonate globule and opaque "rim material" from the ALH 84001 meteorite [1]. Percent-level organic carbon was found associated with both the carbonate globule and the "rim material" dominated by feldspathic glass, appearing opaque mainly because of the presence of chromites, and containing only minor amounts of the carbonate, magnetite, and sulfide which are major components in the rims described by McKay et al. [2]. Further, the organic compound in the globule was different from that in the opaque material [1].

To follow-up on those measurements, a carbonate globule with attached rim material was extracted from a freshly broken surface of a chip of ALH 84001 (ALH 84001,255). This sample was embedded in elemental S, a series of ultramicrotome thin sections were prepared and deposited on an SiO substrate. Several sections included a small (~2 × 2 µm) area of rim material attached to an ~8-µm globule fragment, preserving the spatial associations between the rim and the globule.

Transmission Electron Microscope examination of the section analyzed indicates it contains three distinct regions. Fine-grained rim material consisting of carbonate, magnetite, and rare sulfides, and coarse-grained carbonate in the globule interior are separated by a region containing coarse-grained, porous carbonate and sparse, fine-grained magnetite.

The rim material showed four strong π^* peaks. Three peaks, at 285 eV, 286.2 eV, and 288 eV, are similar to the peaks, at 284.8 eV, 286.5 eV, and 288.2 eV, detected in the carbonate globule from ALH 84001 examined previously [1]. Those peaks were associated with organic C by Fourier Transform Infrared spectroscopic examination of that globule [1]. The fourth peak, at 290 eV, is indicative of carbonate. In each C-XANES spectrum we can measure the ratio of the absorption at 290 eV to that at 288 eV to monitor the ratio of carbonate to organic C. A comparison of the average C-XANES spectrum over the carbonate globule with the average over the rim indicates that the rim has a higher ratio of organic C to carbonate than does the globule. We were unable to isolate regions in the rim which showed only the organic or only the carbonate absorption feature(s), suggesting that organic C is intimately mixed with the carbonate on the scale of ~100 nm.

The same three organic absorption peaks occur with roughly the same peak height ratios in both the rim and the globule. This indicates that, in this sample, the rim and the globule contain the same type(s) of organic compound(s). Analyses of individual carbonates within the globule showed weak, but distinct, organic absorptions accompanying the strong carbonate absorption, indicating the presence of the organic component either within or associated with the large carbonates. The porous carbonate beneath the rim exhibits the same four C-XANES absorptions, and the average spectrum of the porous carbonate is indistinguishable from that of the core carbonate.

These new measurements confirm our earlier results indicating that relatively high concentrations (percent level) of organic C are spatially associated, at the 100-nm scale, with the carbonates in ALH 84001. They differ from the earlier results in that this sample of rim material, consisting of fine-grained carbonate, magnetite, and sulfides, contains an organic component that is identical in its C-XANES spectrum to that of the carbonate globule to which it is attached. The earlier opaque sample, dominated by feldspathic glass and chromite, has a C-XANES spectrum which differs in absorption peak energies and structure from these rim and globule samples.

References: [1] Flynn G. J. et al. (1998) *LPS XXIX*. [2] McKay D. S. et al. (1996) *Science, 273,* 924–927.