COMPARISON OF CARBONATE TEXTURAL FEATURES IN ALH84001 AND MICROBIALLY INDUCED TEXTURES IN ORTHOPYROXENE. L. L. Robbins , K. Van Cleave, and J. Ryan Department of Geology, University of South Florida, 4202 East Fowler Ave., Tampa, FL 33620. (robbins@chuma1.cas.usf.edu)

Introduction: The Martian meteorite ALH84001 is composed primarily of orthopyroxene, and includes unusual carbonate mineral assemblages which have been proposed to be associated with ancient Martian microbial activity [1]. While terrestrial mafic/ ultramafic rock/carbonate assemblages have been used as analogues to evaluate the origin of carbonates in ALH84001[2], little is known about whether these types of carbonates and their associated structures can be microbially produced in terrestrial orthopyroxenites. In our ongoing research, we are comparing compositional and textural data from the carbonate-rich thin section ALH84001- 323 with data obtained from microbial precipitation experiments on terrestrial orthopyroxenes, using sulfate reducing bacteria and thermophilic bacteria.

Samples and Methods: The thin section ALH84001 (,323) has been studied using polarized light microscopy to document the texture and stucture of carbonate minerals.

Orthopyroxenite samples, obtained from the Frank ultramafic body (Avery County NC) were broken into approximately <5 gram chips, slightly fractured, and cleaned using HCl and exhaustive distilled water rinses to remove organic contaminants. Samples were placed in flasks containing a synthetic Australian groundwater solution and inoculated with *Desulfovibrio* spp. culture (SRB), and incubated anaerobically for 30 days at 33°C; or with a thermophilic culture (from Champagne Pools, Rotorua, NZ) and incubated similarly at 60°C. Controls without microbes were run simultaneously. Samples and controls were removed and prepared for examination using a Philips 515 scanning electron microscope (SEM) and electron diffraction (EDAX).

ALH84001, 323: Point counting of this thin section indicates that it has approximately 9% carbonate, most of which is associated with the crush zone (Figure 1). Carbonates show the globular, vein/fracture filling and interstitial textures reported by [3] with some distinctive variations. Fibrous and granular carbonate is observed in a number of places growing into void spaces (Figure 2). Carbonate is observed in association with maskelynite (first noted by [4]), but here it forms tubular to globular shapes within the feldspathic glass; in some cases, isolated globules appear to be the ends of tubes (Figure 3). Carbonate globules/tubes show subparallel alignment in the glass. Zoned and unzoned carbonate globules were also observed, with and without distinct centers. Carbonates which appear as rosettes, with radiating carbonate crystals (av. 6.8μm in diameter) and distinct rounded centers, (av. 1.8μm in diameter); and sometimes with a void as a center, were found primarily in the crush zone (Figure 2).

Microbial experiments:. Orthopyroxene samples incubated with SRB demonstrated extensive biofilm development and the precipitation of a brown calcium-rich phase containing phosphate (Figure 4). Additionally, etching of the surface occurred on the orthopyroxene chips (Figure 5) as compared to the angular, ridged appearance in the controls. The crystalline structure of the orthopyroxene was modified into a hummocky morphology that closely resembles the weathering textures that Wentworth et al. [5] described from ALH84001. Ongoing experiments using thermophiles also demonstrate significant alteration of orthopyroxene surfaces and mineral precipitates with high concentrations of iron. (Figure 5)

References: [1] McKay D.S. et al. (1996) *Science* **273**, 924. [2] Treiman, A.H et al. (1998) *LPS XXIX*. A1630. [3] McKay, G. et al. (1997) *MAPS* **32**, A87; Scott E. R. D. and Krot, A.N. (1998) *LPS XXIX*. A1786. [4] Scott, E.R.D, et al. (1997) *Nature* **387**, 366. [5] Wentworth et al. (1998) *LPS XXIX, 1793.*

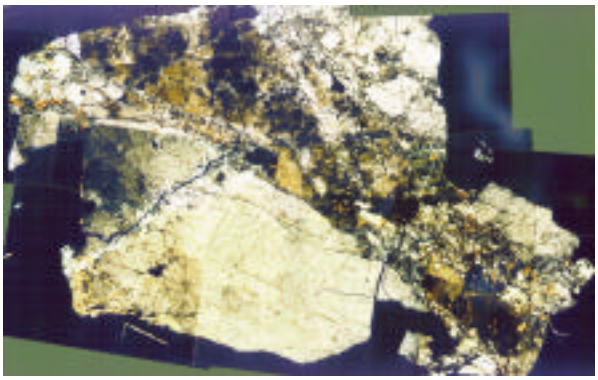

Figure 1: Photomosaic of ALH84001 (323), under crossed nicols. Sample is 7.3 mm in longest dimension.

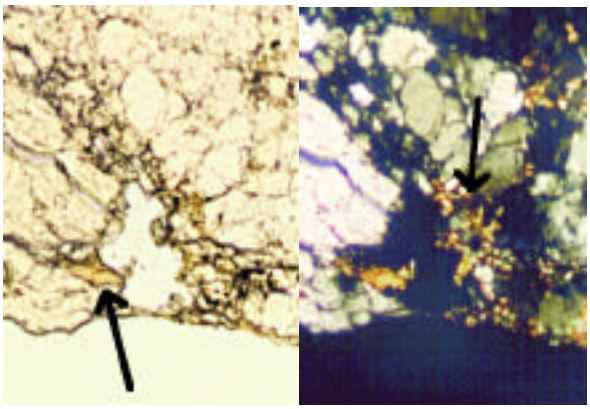

Figure 2: Close-up of cavity along lower-right edge of ALH 84001, in PPL and XPL, showing carbonate grain growing into cavity (left) and radiating carbonate texture (right). Width of picture: 240 µm.

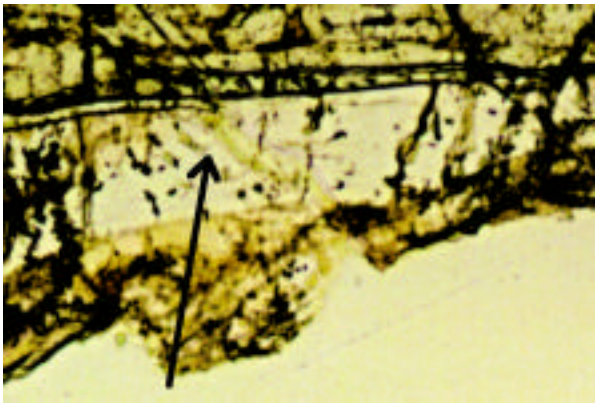

Figure 3: PPL close-up image of maskelynite grain from lower left edge of thin section, showing tubular carbonate crystals within maskelynite. Width of picture: 288 µm.

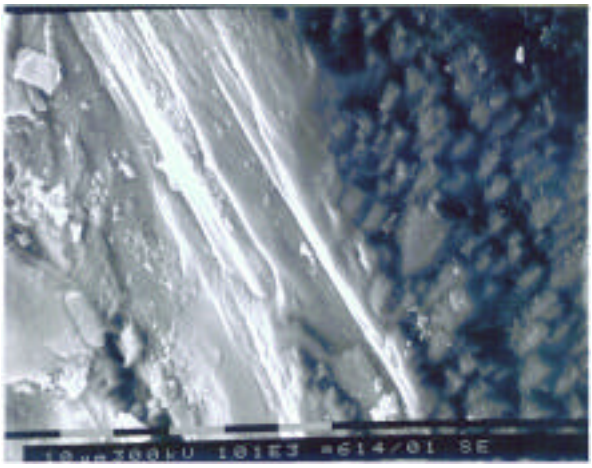

Figure 4: SEM photograph of terrestrial orthopyroxene after interaction with *Desulfovibrio spp.* culture. OPX cleavages evident on left are extensively etched by the bacteria, producing a hummocky morphology.

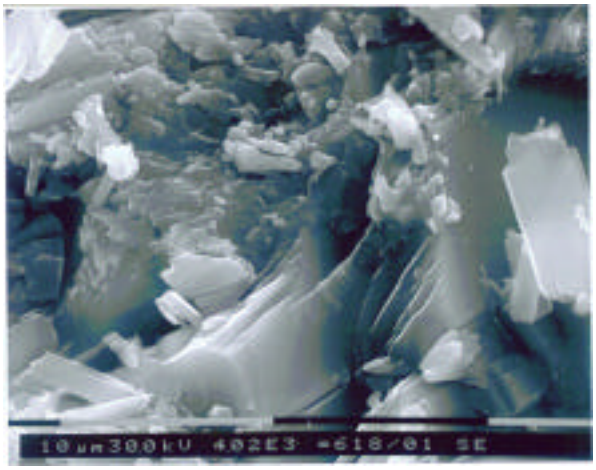

Figure 5: SEM photograph of terrestrial rthopyroxene after interaction with thermophilic bacteria culture. OPX cleavages are obscured by bacterial mat development and etching near the center of the image, and randomely oriented, precipitated crystals are evident.