GYPSUM AND JAROSITE IN ROBERTS MASSIF 04262: ANTARCTIC(?) WEATHERING AS A PROXY FOR MARTIAN WEATHERING. J. P. Greenwood, Dept. of Earth & Environmental Sciences, Wesleyan University, Middletown, CT 06459 USA (jgreenwood@wesleyan.edu).

Introduction: Gypsum has been identified on Mars by MEX OMEGA [1] and jarosite identified via MER-B lander [2] and both minerals are examples of the importance of calcium and iron sulfates in Martian weathering processes. The weathering of Martian basalt to form Ca and iron sulfates should be an important process on Mars. Martian jarosite has been identified in MIL 03346 [3] and Ca-sulfate has been identified in EETA 79001 [4], but both phases have yet to be identified in the same Martian sample.

Sample and Methods: RBT 04262, 40 thin-section was examined using transmitted and reflected light microscopy and with the Wesleyan JEOL JSM-6390LV/LGS SEM w/ BSE and EDAX Genesis w/ spectral mapping which stores full EDS spectra for each pixel for later analysis.

Results:

Gypsum. A calcium-sulfate phase is seen as veins in Cl-apatite in Figure 1. The calcium-sulfate vein is seen extending from a heavily altered iron-sulfide (pyrrohotite) suggesting the source of calcium and sulfur were the Martian calcium-phosphate and iron-sulfide, respectively. This calcium-sulfate phase vein is also seen cross-cutting maskelynite (not shown), suggesting that the weathering occurred after maskelynite formation. Unless multiple shock events occurred to the protolith of RBT 04262, this weathering must be considered to have occurred after the shock event that launched the rock from Mars (Antarctic weathering). The apatite is heavily fractured in RBT 04262, 40, appearing visually more fractured than apatite in Shergotty. Calcium-sulfate is seen filling cleavage-related fractures in other apatites in RBT 04262, 40.

Using the standardless 'quantitative' EDAX software, the calcium-sulfate phase is well-matched to a known gypsum from St. Lucia, suggesting the calcium-sulfate phase is gypsum.

In a second area of RBT 04262, 40 the calcium-sulfate phase is seen abutting another altered pyrrhotite grain (Figure 2).

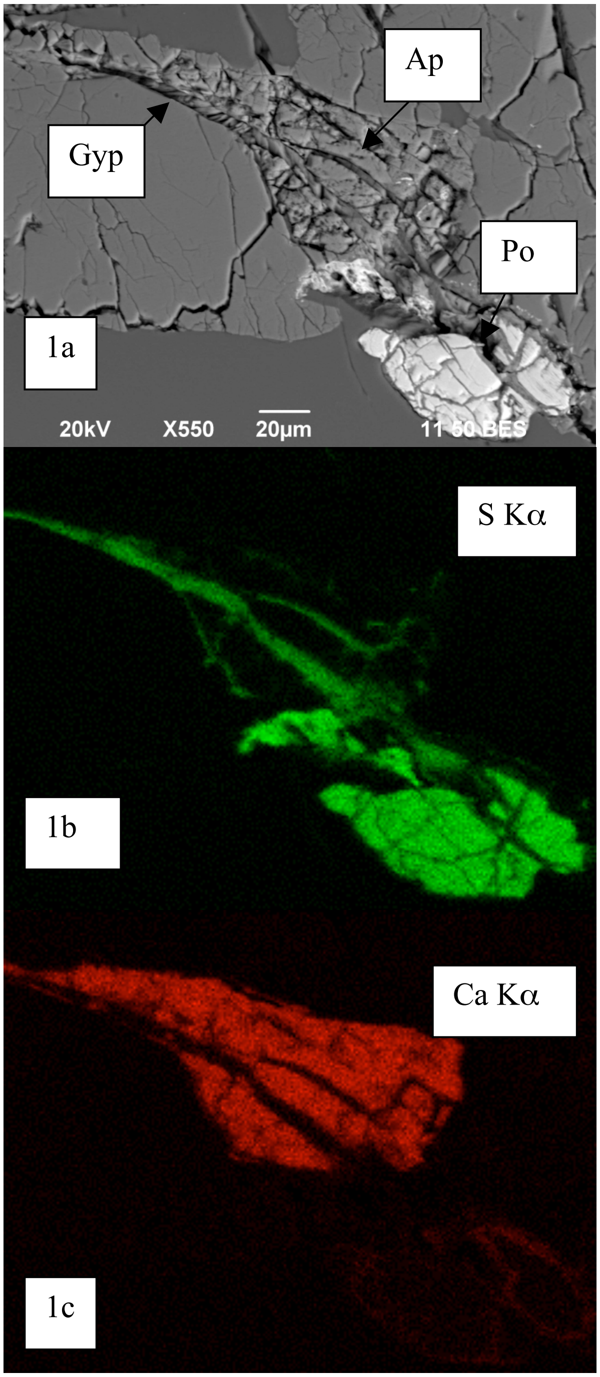
Jarosite. The pyrrohotite grain in Figure 2 is seen to be veined by a chemically complex assemblage. Parts of the alteration vein are rich in K, Fe, and S. Using standardless 'quantitative' EDAX software, the K-,Fe-,sulfate is well matched with a terrestrial K-jarosite, with possibly a natrojarosite component.

Iron-phosphate. Figure 2d shows a P Kα image which shows enhanced phosphorus in the veins in pyrrhotite. Spectral analysis suggests that the phosphorus is contained in an Fe-phosphate phase, but the iron-phosphate appears to be sub-micron in size and is difficult to resolve.

Discussion: In Roberts Massif 04262, an olivine-phyric shergottite, iron-sulfide and calcium-phosphate minerals are undergoing reaction (dissolution and reprecipitation?) to form gypsum, jarosite, and an iron-phosphate phase, presumably during the meteorite's residence in Antarctica. If true, then an acidic and oxidizing fluid was present in this meteorite, due to the formation of jarosite which requires fluid of this type to form [5]. The weathering of iron-sulfides on Earth to form acidic and oxidizing fluids is common, thus this can be reconciled with the formation of an acidic fluid in a basic rock. Presumably, under more extensive weathering of silicate minerals in Martian basalt, the pH would be raised to values where jarosite would not be stable. The weathering of apatite and iron-sulfide in Martian basalt to liberate calcium and sulfur for gypsum formation and iron and phosphorus for iron-phosphate mineralization would also seem to have importance for Mars.

Weathering implications for Mars. In RBT 04262, apatite and pyrrhotite are being weathered to form gypsum, jarosite, and an iron-phosphate mineral. During early weathering of Martian basalt, we are seeing that the calcium-phosphate and iron-sulfide minerals are most susceptible to alteration. While the weathering of RBT 04262 is likely occurring in Antarctica, a similar susceptibility of the apatite and pyrrhotite to incipient weathering on Mars may be expected. Oxidizing crustal fluids on Mars may attack iron-sulfides first in Martian basalts. The weathering of iron-sulfides leads to increasing acidity of fluids, which would enhance the dissolution of the calcium-phosphate minerals [6]. The formation of jarosite, gypsum, and iron-phosphate minerals during the early stages of weathering of Martian basalts may be an important process on Mars globally.

References: [1] Gendrin, A. et al. (2005) *Science, 307,* 1587–1591. [2] Klingelhöfer et al. (2004) *Science,* 306, 1740-1745. [3] Vicenzi E. P. et al. (2007) *LPSC XXXVIII,* Abstract #2335. [4] Gooding J. L. et al. (1988) *GCA, 52,* 909-915. [5] Greenwood J. P. et al. (2005) *LPSC XXXVI,* Abstract #2348. [6] Greenwood J. P. and Blake R. E. (2006) *Geology, 34,* 953-956.



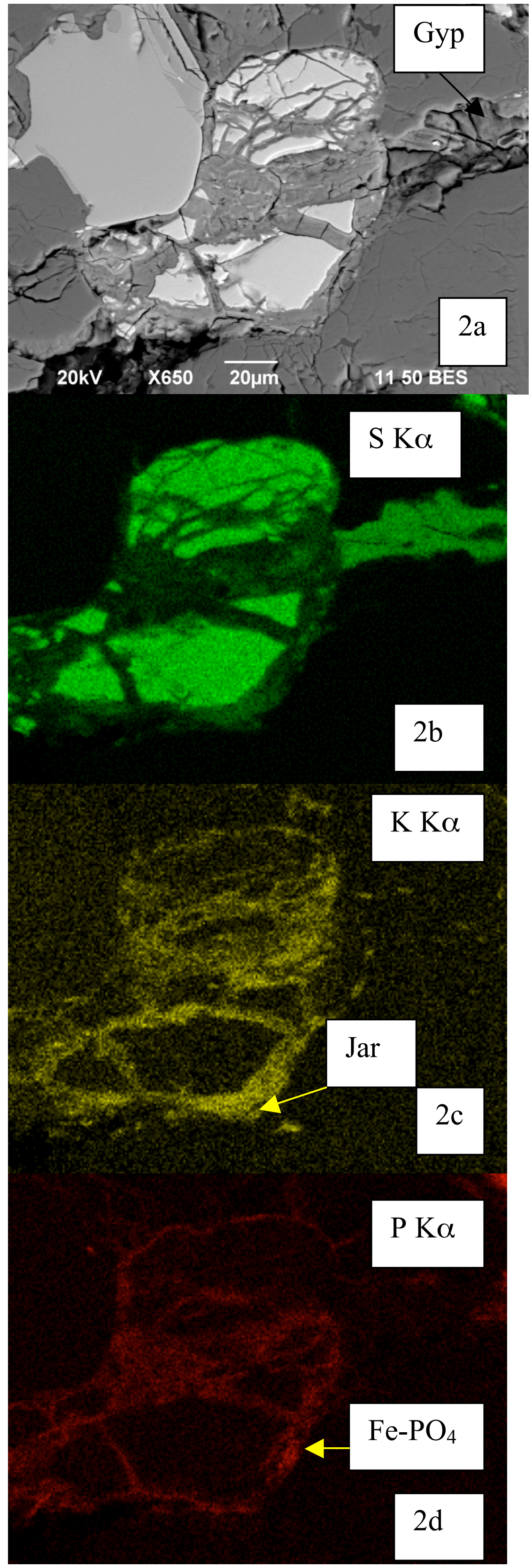


Figure 1. (a) BSE image of gypsum veins in apatite and pyrrohotite in RBT 04262, 40. Gyp: gypsum; Ap: apatite; Po: pyrrhotite. (b) S Kα image. (c) Ca Kα image.

Figure 2. (a) BSE image of pyrrhotite veined by jarosite and other phases. Gypsum vein abuts jarosite-rich veins. (b) S Kα image. (c) K Kα image. Jar: Jarosite (d) P Kα image. Fe-PO_4: iron-phosphate phase.