ROCK-MAGNETIC AND REMANENCE PROPERTIES OF YAMATO 980459 (Y-980459). D. Shah[1], S, Brachfeld[1], E. First[2], J. Hammer[2] [1]Department of Earth and Environmental Studies, Montclair State University, Montclair, NJ 07043, [2]Department of Geology and Geophysics, University of Hawai'i, Honolulu, HI 96822.

Introduction: This study examines the magnetic recording assemblage and remanence properties of the SNC meteorite Yamato-980459 (hereafter Y-980459), a primitive member of the shergottite group of Martian meteorites. This study is in conjunction with a petrographic study of Y-980459 [1-2], with the combined goal of better understanding the origin, intensity, and long-term stability of the Mars crustal anomalies detected during the Mars Global Surveyor mission [3]. This work is integrated with previous studies using synthetic analogs of the Mars crust in which we examined the petrographic and magnetic properties of iron-rich and iron poor basalts [4-7]. Our synthetic iron-rich basalt had an Fe/Al ratio comparable to that of SNC meteorites, but was richer in Si and poorer in Mg relative to shergottite group. Here we examine samples of Y-980459 to gain a more representative picture of the magnetic and remanence carrying abilities of the Mars crust.

Methods: One thin section and four chips of Y-980459 ranging from 3.5 to 9.0 mg were provided by the NIPR Research Program for Antarctic Meteorites. Compositional analyses were performed using a JEOL JXA-8500F Field Emission Hyperprobe at the University of Hawai'i at Mānoa, and are described in [1-2]. Magnetic susceptibility, natural remanent magnetization (NRM), anhysteretic remanent magnetization (ARM), and hysteresis parameters were measured at Montclair State University.

Results and Discussion: Y-980459 is composed of large olivine phenocrysts and Ca-clinopyroxene encased in a fine-grained and glassy groundmass of Fe-rich olivine, chromite, dendritic olivine, chain-like augite, and sulfide grains. Y-980459 lacks plagioclase and maskelynite [1-2, 8-9].

Preliminary electron microprobe analyses indicate an average chromite composition of $Cr_{1.66}Fe_{0.65}Mg_{0.39}Al_{0.27}Ti_{0.01}O_4$. Some of the chromites contain slightly more Ti and slightly less Cr. The average composition of iron sulfides has 57.61 wt% Fe and 37.83 wt% S. The iron sulfides also contain 0.61 to 6.94 wt% Ni [2].

The four Y-980459 chips are weakly magnetic with susceptibility values of $5.14*10^{-7}$ to $6.34*10^{-7}$ m^3/kg. We measured NRM values of $4.62*10^{-6}$ to $4.80*10^{-5}$ m^3/kg, which are comparable to the range of NRM values reported in [10]. ARM values range from $2.47*10^{-6}$ to $2.20*10^{-4}$ m^3/kg. The susceptibility, NRM, and ARM values of Y-980459 are similar to a set of set of synthetic Mars analogs synthesized under iron-wustite fO_2 conditions [5].

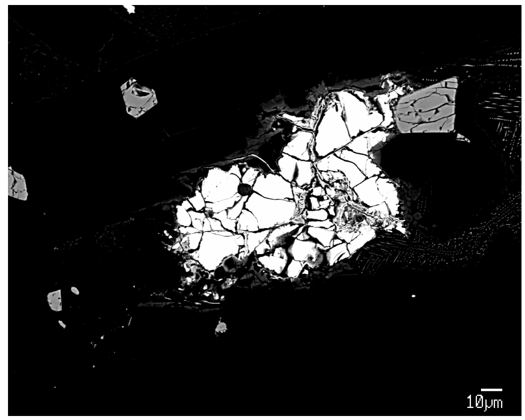
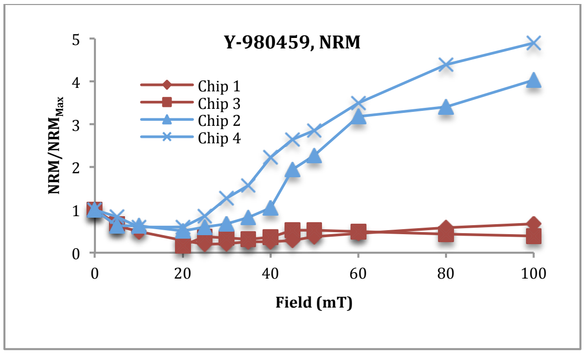


Figure 1: Backscatter electron image of an iron sulfide grain in Y-980459 [2].

Hysteresis parameters of all four chips cluster in the upper left portion of the pseudo-single-domain field of a Day Plot [11]. The remanence properties of the four chips of Y-980459 sample fall into 2 categories; Category 1 (chips 1 and 3) samples have magnetic susceptibility values of $5.14*10^{-7}$ to $5.33*10^{-7}$ m^3/kg, a normal ARM alternating field (AF) demagnetization pattern in which ARM/ARM_{Max} decays steadily with peak applied field, and samples acquire a weak signal during AF demagnetization of the NRM. Category 2 samples (chips 2 and 4) have susceptibility values of $6.22*10^{-7}$ to $6.34*10^{-7}$ m^3/kg, and acquire a strong signal during AF demagnetization of the NRM (Figure 2). The difference between the chips may be a function of heterogeneity in oxide and sulfide distribution.

The increase in intensity of NRM during AF demagnetization is likely a gyroremanent magnetization (GRM), a spurious remanence acquired perpendicular to the applied field during AF demagnetization. GRM acquisition is a common behavior in the iron sulfide greigite (Fe_3S_4) [12 and references therein]. This is consistent with the microprobe observations of sulfide grains in Y-980459, suggesting the presence of ferromagnetic iron sulfides in the sample. However, the microprobe composition is nearer to pyrrhotite than greigite.



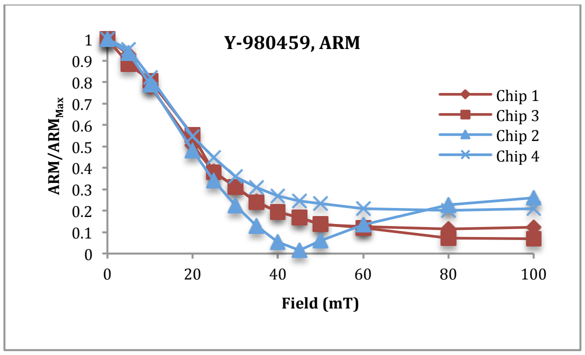


Figure 2: Normalized alternating field demagnetization curves for the NRM (top) and ARM (bottom). Category 1 chips are plotted in red. Category 2 chips are plotted in blue.

Conclusions: Four chips of Y-980459, a primitive member of the shergottite group of Martian meteorites, are being analyzed for magnetic properties to better understand the magnetic recording assemblage and remanence properties of the Martian Crust. The four chips examined have higher susceptibility values than those reported in a previous study of Y-980459 [10], but have very similar properties to synthetic Mars basalts synthesized under iron-wustite fO_2 conditions. The samples acquired a GRM during AF demagnetization, which we attribute to the presence of ferromagnetic sulfides. Thermoremanent magnetization (TRM) will be induced in the chips to assess the intensity of primary TRM that Y-980459 can acquire. However, our NRM and ARM results suggest that this basaltic shergottite is not a likely carrier of intense crustal anomalies.

References: [1] First, E., Hammer, J., (2012), *International Symposium on Crystallization in Glasses and Liquids*. [2] First, E., Hammer, J. (2012) *LPS XLIV*, this volume. [3] Acuña, M.H., et al., (1999), *Science*, *284*, 790-793. [4] Hammer, J.E. (2006) *Earth Planet. Sci. Lett.*, *248*, 618-637. [5] Brachfeld, S.A. and Hammer, J.E. (2006) *Earth Planet. Sci. Lett., 248*, 599-617. [6] Bowles, J.A., et al. (2009) *JGR, 114,* E10003. [7] Bowles, J.A. et al., (2012) *JGR*, B03202. [8] Greshake, A., et al., (2004), *Geochemica. Cosmochim. A.*, *68*, 12359-2377. [9] Usui, T., et al., (2009), *Geochim. Cosmochim. A., 72*, 1711-1730. [10] Hoffmann, V.H. et a., (2010) 73rd Meeting Meteoritical Society, Abstract #5338. [11] Day, R., et al., (1977), *Phys. Earth Planet. Int., 13*, 260-267. [12] Roberts, A.P. et al., (2011), *Rev. Geophys. 49*, 1-46.