GEOCHEMICAL DIFFERENCES BETWEEN SURFACE BASALTS AND MARTIAN METEORITES: THE NEED FOR MARTIAN SAMPLE RETURN. J. Filiberto, Rice Universiy Department of Earth Science, MS 126, 6100 Main Street, Houston, TX 77005 Justin.Filiberto@rice.edu.

The SNC meteorites are crystallized basaltic magmas and cumulate igneous lithologies that represent our only samples of the Martian surface. They have been extensively investigated to explore the geochemistry of the Martian interior and crust [e.g., 2]. Yet, there remain many questions about Martian petrology that cannot be answered from these meteorites alone.

The exact location of origin of the SNC meteorites on the Martian surface is unknown, which limits their utility for studying crustal mineralogy. Further, all of the basaltic SNCs are relatively young [4], which makes understanding changes in mantle and crustal composition through time difficult. Finally, most of the SNC meteorites contain cumulate phases, have experienced alteration (either on Earth or Mars), and/or show evidence for re-equilibration all of which complicate the use of these samples in producing Martian geochemical models [2, 5-6]. This work focuses on the basaltic and ol-phyric shergottites because they represent the closest to being near magma compositions.

Robotic explorations of the Martian surface have provided a wealth of new geochemical and mineralogic data that can be used to better understand the SNC meteorites, and combined with data from the meteorites to better understand the Martian igneous history. The data from the global surface and surface basalts represent a wider range in age than the SNC meteorites, which can help constrain how the geochemistry and mineralogy of the Martian crust has changed through time [e.g., 7].

The FeO content (fig 1) of the surface basalts (basalts in Gusev Crater, Bounce Rock in Meridiani Planum, and Pathfinder "dust" free rock composition [8-13]) are consistent with, but have a larger range in bulk composition than, the shergottites [14], suggesting that the shergottites do not represent the full compositional range of the Martian crust.

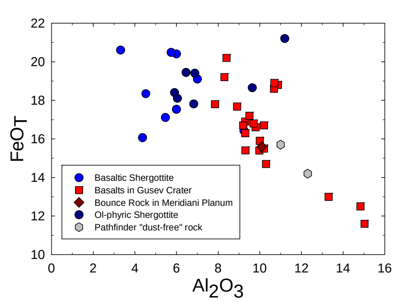

Fig 1. FeO vs Al_2O_3 bulk compositions for basalts in Gusev Crater, Bounce Rock in Meridiani Planum, Pathfinder "dust" free rock composition, and basaltic and ol-phyric shergottites

The Mg/Si vs. Al/Si ratios of surface basalts are significantly different from those of the basaltic SNC meteorites (fig 2 modified from [6]). The ~3.6 Ga basalts in Gusev Crater [15] have compositions similar to those of terrestrial basalts, while Bounce rock in Meridini planum has a composition similar to some of the shergottites.

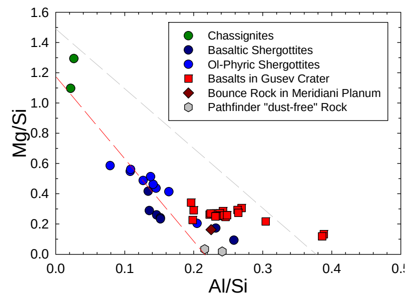

Fig 2. Mg/Si vs. Al/Si compositions for Martian basalts and the two chassignites. Data and symbols are from fig 1. Gray dashed line is terrestrial crust line [1] and the red dashed line is the Martian crust line [3].

Experimental petrology [16-17] and thermobarometer modeling [18] studies reveal significantly different temperatures and pressures of formation for the surface basalts compared to the shergottites. This suggests that the source regions for the shergottites and surface basalts are different. Hypotheses that might explalin these differences include: 1) there was a change in mantle composition through time; 2) surface basalts are more representative of average Martian basalt compositions while the shergottites are products of more localized melt; or 3) surface basalts are localized melts while the shergottites are more representative of an average Martian basalt.

Mars sample return is our best tool to resolve the differences between the SNC meteorites and surface basalts. Ideally, returned samples would represent an average Martian basalt. However, ideal samples are not the only way to resolve these differencse. A "grab and go" sample of regolith (soil and rock mixture) from a known, well studied, locale (which would be less expensive) would still help resolve a lot of these issues. A grab and go sample of the Martian regolith could be extensively studied using the same tools and techniques we already utilize for the SNC meteorites, providing more detailed information (e.g., ages, REE's, light elements, noble gases [19]) than is possible from a robotic exploration. This would bridge the gap in data between the SNC meteorites and the data from robotic explorations, and greatly help to constrain Martian geochemical and mineralogic history.

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