ARE SHERGOTTITES SULFIDE SATURATED?

K. Righter[1] and L. R. Danielson[2]. [1]Mailcode KT, NASA-JSC, 2101 NASA Pkwy., Houston, TX 77058 E-mail: Kevin.righter-1@nasa.gov. [2]Mailcode KR, NASA-JSC, 2101 NASA Pkwy., Houston, TX 77058.

Introduction: Shergottites have high S contents (1300 to 4600 ppm; [1]), but it is unclear if they are sulfide saturated or under-saturated. Resolution of sulfide saturation depends upon temperature, pressure, oxygen fugacity (FeO), and magma composition [2]. Expressions derived from experimental studies allow prediction of S contents, though so far they are not calibrated for shergottitic liquids [3-5]. We have initiated an experimental study to test current S saturation models for shergottitic liquids, and to make new calibrations if necessary. This issue has fundamental implications for determining the long term S budget of the martian surface and atmosphere (from mantle degassing), as well as evolution of the highly siderophile elements (HSE) Au, Pd, Pt, Re, Rh, Ru, Ir, and Os, since concentrations of the latter are controlled by sulfide stability.

Experiments: Mixtures of shergottitic bulk compositions and FeS in alumina capsules, with an oxygen buffer in a separate alumina capsule, are sealed into silica tubes and equilibrated in Deltech furnaces for 48-72 hrs [6]. These experiments are quenched and sectioned for analysis by electron microprobe for major elements and S. Two shergottite compositions – one evolved and a second more primitive - are currently being studied so that effects of melt compositional variation can be evaluated.

Calculations: The S content of a silicate melt in equilibrium with sulfide liquid is known to be a function of T, P, fO_2, and bulk composition [2]. Recent calibrations have included the effects of all of these variables. We use several recent studies [3-5] to compare predicted S contents to those measured in our shergottitic quench glass. Initial comparisons are good, with expressions recovering S contents of FeO-rich liquids at the IW buffer. More experiments are required to explore melt compositional ranges in Al_2O_3, FeO and MgO appropriate to shergottites.

Conclusions: Preliminary assessments indicate that most shergottites may be sulfide under-saturated, whereas a few appear to be sulfide saturated. The two groups also have distinctly different HSE absolute concentrations, showing that sulfide-saturated shergottites contain much lower HSE contents than the S saturated. Because shergottite parent melts are likely generated at higher pressures [7,8], and sulfide saturation has a negative pressure dependence, melts from the martian mantle may initially be saturated, become under-saturated during ascent, and then become saturated again upon subsequent differentiation in the crust. The importance of olivine, chromite, and sulfide fractionation, as well as the stabilization and de-stabilization of sulfide during fractionation, will be emphasized with various shergottite [9,10] and terrestrial examples.

References: [1] Meyer, C. Jr., 2008. website: http://curator.jsc.nasa.gov/antmet/mmc/index.cfm; [2] Wallace, P.J. and Carmichael, I.S.E. 1992. *Geochim. Cosmochim. Acta* 56: 1863-1874; [3] Li, C. and Ripley, E.M. 2005. *Mineralium Deposita* 40: 218-230; [4] Liu, Y. et al. 2007. *Geochim. Cosmochim. Acta*, 71: 1783-1799; [5] Holzheid, A. and Grove, T.L. 2002. *Amer. Mineral.* 87: 227-237; [6] Righter, K. et al. 2006. *Chem. Geol.* 227: 1-25; [7] Monders, A.G. 2007. *Met. Planet. Sci.* 42, 131-148; [8] Musselwhite, D.S. et al. 2006. *Met. Planet. Sci.* 41: 1271-1290; [9] Puchtel, I. et al. 2008. *Lunar Planet Sci.* XXXIX, #1650; [10] Jones, J.H. et al. 2003. *Chem. Geol.* 196:21-41.