FURTHER EVIDENCE FOR A MARTIAN REGOLITH COMPONENT IN SHERGOTTITES

M. N. Rao[1], L. E. Nyquist[2], D. D. Bogard[2], D. H. Garrison[1], S. R. Sutton[3] and R. C. Reedy[4] [1]Jacobs-ESCG, NASA Johnson Space Center, Houston.TX. [2]ARES(KR), NASA Johnson Space Center, Houston.TX. [3]Dept. of Geological Sciences, Univ. of Chicago, Chicago. IL. [4]Planetary Science Institute, Los Alamos. NM.

Introduction: In the shergottites EET79001, Shergotty, and Zagami, there are gas-rich impact-melt (GRIM) glasses (,8 ,27, 104, and Sherg-B), where one finds ^{80}Kr excesses produced by thermal neutron irradiation (fluence: 0.7- 1.2 x 10^{15} n/cm^2) of Br [1]. The same GRIM glasses also show ^{149}Sm isotopic deficits produced by thermal neutron capture on ^{149}Sm yielding a fluence of 1.0 ± 0.4 x 10^{15} n/cm^2 [2]. Recently, [3] measured the isotopic shifts in ^{150}Sm/^{149}Sm and ^{158}Gd/^{157}Gd ratios in the phosphate-leachates from bulk EET79001 and Zagami and calculated a fluence of 1.2 – 3.4 x 10^{15} n/cm^2 for the thermal neutron irradiation of these samples in the Martian regolith. These results show that the mineral components comprising the precursor materials of these glasses were subjected to thermal neutron irradiation (fluence: ~10^{15} n/cm^2) when they were lying buried in the Martian regolith near the shergottite-source regions on Mars.

In the Martian regolith, at sites where thermal neutrons occur, fast neutrons also are expected to occur there because thermal neutrons are generated by the slowing-down (moderation by H_2O) of fast neutrons arising from the high energy cosmic ray interactions with atomic nuclei in the regolith materials. Here, we examine the implications of this proposition for ^{83}Kr and ^{84}Kr abundances in GRIM glasses.

Results: To study the composition of the Kr isotopes produced by fast neutron interactions with the target elements Rb and Sr occurring in the GRIM glasses, we plot ^{83}Kr/^{86}Kr vs.^{84}Kr/^{86}Kr ratios determined in these samples. The data points of the glasses (,27 and ,8) belonging to olivine phyric type shergottites plot on a tie-line joining Kr-1 (Mars atmosphere) with Cosmo-I composition (produced by GCR+SCR+ fast neutron (n, xp yn) interactions) having a ^{83}Kr/^{84}Kr ratio of 0.35. Further, the basaltic shergottite type glasses (,104 and Sherg-B) plot on a different tie-line joining Kr-1 with Cosmo-II (^{83}Kr/^{84}Kr = 0.77). Using the ^{83}Kr and ^{84}Kr isotopic excesses obtained after correcting the measured abundances for Kr-1 and GCR+SCR contributions and using Rb and Sr abundances determined by isotope-dilution [4] in these glasses and applying the fast neutron production cross sections for Rb & Sr (n, xp yn) ^{83}Kr & ^{84}Kr reactions from [5], we calculate integrated fast neutron fluences (range: 0.4 – 1.8 x 10^{15} n/cm^2) to which the GRIM glass mineral constituents were exposed in the Martian regolith prior to meteorite compaction. We find that the thermal and fast neutron fluences calculated for these glasses agree with one another suggesting that the glass-precursor regolith materials received neutron irradiation at intermediate depths (in the top few meters) in the Martian regolith. The implications of these results for the subsurface water-ice in the regolith near the shergottite source regions on Mars will be discussed.

References: [1] Rao M. N. et al. 2009. Abstract#1361, 40th Lunar & Planetary Science Conference. [2] Rao M. N. et al. 2002, *Icarus*, 156, 352-372. [3] Hidaka H. S. et al. 2009. Earth Planet. Sci. Lett. 288, 564-571. [4] Wooden J. L. 1982. 13th Lunar & Planetary Science Conference, 879-880. [5] Gilabert E. et al. 2002. Meteorit. Planet. Sci. 37, 951- 976.