HELIUM LOSS AND SHOCK PRESSURE IN MARTIAN METEORITES – A RELATIONSHIP

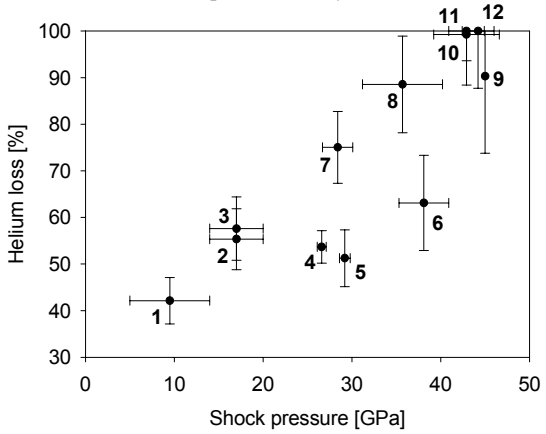
S. P. Schwenzer[1], J. Fritz[2], A. Greshake[2], S. Herrmann[1], K. P. Jochum[1], U. Ott[1], D. Stöffler[2], B. Stoll[1]

[1]Max-Planck-Institut für Chemie, J.-J. Becher Weg 27, D-55128 Mainz, Germany, schwenze@mpch-mainz.mpg.de; [2]Humboldt-Universität zu Berlin, Museum für Naturkunde, Institut für Mineralogie, D-10099 Berlin, Germany.

Introduction: Impact on a parent body causes shock effects, which have been shown to influence the inventory of noble gases and easily volatilized elements in the affected rocks [1, 2]. A well-known example is the resetting of the Ar-"clock" by a major degassing event and therefore a pronounced clustering of Ar-ages around ~0.5 Ga for the L-chondrites [2]. The influence of shock on the nobel gas content in chondrites has been demonstrated for ^{40}Ar [3] and ^{4}He [4], with a complete loss resulting from shock pressures in excess of ~35 GPa.

Methods: Here we investigate the effects on the radiogenic ^{4}He inventory of Martian meteorites. We combine data from three studies: Radiogenic ^{4}He from noble gas mass spectrometry, U and Th contents measured by SSMS [5], and peak shock pressures based on the shock induced reduction of the refractive index of plagioclase [6]. The loss of ^{4}He is inferred from the difference between the amount of ^{4}He produced by radioactive decay of U and Th since closure of the magmatic system (as deduced from ages obtained by Rb/Sr and/or Sm/Nd dating [7, 8]) and the measured ^{4}He amount.

Results: Our data show a correlation between the ^{4}He loss and the shock pressure as determined with the method of [6] in the range of ~10–45 GPa, indicating that the amount of energy deposited by shock is correlated with the loss of ^{4}He. In addition to our data it is known [9] that the heavily shocked LEW88516 (~44 GPa [6]) also suffered complete loss of ^{4}He. For ^{40}Ar the situation is more complicated, as there is both, loss and implantation of Martian atmospheric ^{40}Ar by shock.



Helium loss vs. shock pressure. 1: Lafayette, 2: Nakhla, 3: Gov. Valadares, 4: Chassigny, 5: Zagami, 6: EETA79001, 7: Shergotty, 8: ALHA84001, 9: QUE94201, 10: SaU005, 11: DaG476, 12: ALHA77005.

References: [1] Keil K et al. (1994) *Planet Space Sci, 42*: 1109–1122. [2] Bogard DD (1995) *Meteoritics, 30*: 244–268. [3] Stöffler D et al. (1991) *GCA*, 55, 3845–3867. [4] Schultz L & Stöffler D (1993) *MAPS*, 28, 432. [5] Jochum KP et al. (2001) *MAPS, 36*, A90–A91 [6] Fritz J et al. (2003) *LPSC, XXXIV,* #1335. [7] Meyer C (2001) Mars Meteorite Compendium; Houston. [8] pers. comm. E. Jagoutz, Mainz. [9] Ott U & Löhr HP (1992) *MAPS, 27,* 271.