"NORMAL PLANETARY" Ne-Q IN CHELYABINSK AND MARS. L. E. Nyquist[1], J. Park[2,3], K. Nagao[4], M. K. Haba[5], T. Mikouchi[6], M. Kusakabe[7], C.-Y. Shih[8], and G. F. Herzog[2] [1]XI/NASA Johnson Space Center, Houston, TX 77058, USA. E-mail: laurence.e.nyquist@nasa.gov. [2]Dept. Chemistry & Chem. Biology, Rutgers U., Piscataway, NJ 08854, USA. [3]Kingsborough Community College, Brooklyn, NY 11235, USA. [4]Korea Polar Research Institute, Yeonsu-gu, Incheon 406-840, Korea. [5] IGP, ETH Zürich 8092 Zürich, Switzerland. [6]Dept. Earth and Planet. Science, Graduate School of Science, U. Tokyo, Hongo, Tokyo 113-0033, Japan. [7]Dept. Environment. Biology and Chemistry, U. Toyama, 3190 Gofu-ku, Toyama 930-8555, Japan. [8]Jacobs, NASA/JSC, Houston, TX 77058, USA.

Introduction: Noble gas analyses of the LL5 chondrite Chelyabinsk identify "Q"-noble gases in those samples with the lowest cosmogenic and radiogenic noble gas abundances. Analyses of impact melted pyroxenes from the heavily shocked Martian shergottite Dhofar 378 identify a trapped component with ^{20}Ne/^{22}Ne = 7.3±0.3 that Park and Nagao [1] identified as trapped Martian atmosphere. This ^{20}Ne/^{22}Ne ratio can be derived from juvenile Ne with ^{20}Ne/^{22}Ne = 10.67 as in Q-Ne [2] via fractionation by the solar wind induced sputtering mechanism [3].

Chelyabinsk: "Q" noble gases in LL-chondrites remain after cosmogenic and radiogenic components are removed [4]. These gases are negligible in the most heavily shielded sample of Chelyabinsk, which contains ^{3}He = 4x10^{-11} ccSTP/g and ^{4}He = 2.5 x 10^{-8} ccSTP/g. Solar-normalized abundances of ^{4}He, ^{20}Ne, ^{36}Ar, ^{84}Kr, and ^{132}Xe (see [2]) are just slightly below Q-values, and ^{36}Ar/^{132}Xe and ^{84}Kr/^{132}Xe are in agreement with Q-values [2,8]. ^{20}Ne/^{22}Ne and ^{21}Ne/^{22}Ne for this and another sample lie close to a mixing line between Ne-Q and cosmogenic values; data for five samples lie closer to a mixing line with the P3 component [2].

Mars (Dhofar 378): On a Ne three-isotope plot four samples of pyroxene impact melt lie on a mixing line between cosmogenic Ne and (^{20}Ne/^{22}Ne, ^{21}Ne/^{22}Ne) = (7.3±0.3, 0.03) [1]. Compiled literature data define a quadrilateral with vertices at (7.3, 0.03), (10.67, 0.03), (0.8, 0.8), and (0.8, 1.0), the latter two points being cosmogenic Ne compositions. Data for the depleted shergottite DaG 476 extrapolate to "trapped" ^{20}Ne/^{22}Ne = 10.60±0.16 [5], which we associate with the Martian mantle.

Discussion: In the solar wind induced sputtering model [3] isotopic fractionation occurs in the altitude interval Δz between the atmospheric homopause at ~125 km and the exobase at ~195 km, and is parameterized by (Δz/T) where T is temperature. Present-day T ~ 200K and (Δz/T) = 0.4 lead to a steady-state value of ^{20}Ne/^{22}Ne ~ 70% of the juvenile ^{20}Ne/^{22}Ne, or ~7.5 for juvenile Ne = Ne-Q and ~9.6 for solar ^{20}Ne/^{22}Ne = 13.75 [3,6].

Conclusion: The evidence favors "normal planetary" Q-Ne as the Martian juvenile Ne. The atmospheric ^{20}Ne/^{22}Ne could be quite variable over recent Martian history due to outgassing on a 10^{8} yr timescale [3], initial atmospheric Ne having been lost [7].

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