A SURPRISING REAPPRAISAL OF THE DISTRIBUTION OF HEAVY NOBLE GASES IN A "GIANT" UNMELTED MICROMETEORITE FROM GREENLAND.

M.Maurette1 and Ph.Sarda 2. 1CSNSM, Bat.104, 91405 Orsay-Campus, France. E-mail: maurette@csnsm.in2p3.fr. 2Dept. Earth’s Sciences, Bat.505, 91405 Orsay-Campus, France

Different SW irradiation histories of micrometeorites and lunar dust grains:

Lunar dust grains were exposed for about $T_{\text{exp}} \sim 5,000$-$10,000$ yr in SW ions and Solar Cosmic Rays (SCRs). They are still loaded with SW species because they have not been severely eroded by the SW. But micrometeorites (MMs) had much longer $T_{\text{exp}} \sim 200,000$ yr, and they were flaked off about 60 times through SW-He bursting (see ref. 1, p.169), thus keeping a much smaller residual amount of SW gases relatively to the more deeply implanted SCRs gases. In 1991, Sarda et al [2] reported on the "complete rare gas study" of a 230 µg fragment (BLII) of the largest (~0.8 mm) unmelted chondritic MMs ever collected by us. BLII might help detecting the dominant type of SCRs during this $T_{\text{exp}} \sim 200,000$ yr, which integrates about 20,000 solar cycles.

Concentrations of heavy noble gases in BLII. The SCRs gases would be mostly trapped in the unknown fraction of the top external 10µm-thick layer of BLII, which was exposed to SCRs. We could only rank their concentrations relatively to that of $^{20}$Ne. Moreover, the gases released at 750°C and 1100°C still look contaminated by terrestrial noble gases. Just for a try, we considered the 1500°C gas release, which represent about 50% of the total gas release. When the concentrations in cc STP/g are converted into g/g, BLII yields the following scaling: $^{20}$Ne/$^{36}$Ar~ 0.5; $^{20}$Ne/$^{84}$Kr~ 12.2; $^{20}$Ne/$^{132}$Xe~ 5.2 (i.e., a component much "heavier" than that expected from the SW). We next coupled this BLII relative concentrations to the absolute average concentrations of $^{20}$Ne (~ 1.5 x 10$^{-5}$ cc STP/g) measured in the dominant mass fraction of the micrometeorite mass flux (found in the 100-200 µm size range). This allows estimating the absolute concentration, $A$(wt.%), of all noble gases in this dominant mass fraction.

A big surprise! Next, the accretion equation (see ref. 1, p. 96) deduced from our scenario EMMA [3] yielded the total amounts (in g) of nobles gases in the atmosphere, which can be compared to the measured values (reported in the adjacent parenthesis): $-^{20}$Ne: 11.2 x 10$^{16}$g (5.8 x 10$^{16}$g); $-^{40}$Ar: 4 x 10$^{15}$g (2.2 x 10$^{15}$g); $-^{84}$Kr: 9 x 10$^{15}$g (9.7 x 10$^{15}$g); $-^{132}$Xe: 2.2 x 10$^{15}$g (5.4 x 10$^{15}$g). Unexpectedly, EMMA would well predict the total amounts of all heavy noble gases in the atmosphere, with the exception of the still "missing" xenon. It might be that the dominant SCRs are produced by impulsive flares that are rooted well below the solar chromosphere. They thus sample isotopically heavier material from the Sun interior, before it gets enriched in light elements and/or isotopes during its diffusion to the Sun's surface, where it feeds the "lighter" SW [4]. If this view is correct, then the average $^{20}$Ne/$^{22}$Ne ratio of ~11.8 measured for the 100-200 µm size micrometeorites would reflect the Sun interior value, and not that of a mixture of SW and hypothetical "SEPs" component.