NOBLE GAS COMPONENTS IN THE LUNAR METEORITE NORTHWEST AFRICA 10203

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Introduction: Northwest Africa (NWA) 10203 is a feldspathic regolith breccia with numerous fragmental light and dark clasts with mineral fragments connected through a glassy matrix. We expect the presence of trapped solar noble gases in this meteorite, in addition to cosmogenic gases. Helium, neon and argon were measured in clast and matrix samples of this meteorite with two key objectives. First to characterize trapped solar gases and second to estimate the cosmic ray exposure age of the meteorite.

Experimental Procedures: We have extracted He, Ne and Ar from two clast and three matrix samples from a slice of NWA 10203 by stepwise heating using a CO_2 laser, to characterize the gas release properties of different clast and matrix components. Laser power was increased in steps such as 10, 20, 40, 65 (in %), until complete gas extraction. Extracted gases were purified and processed following standard procedures as detailed in [1].

Results and discussions: Measured He is a mixture of cosmogenic, radiogenic and trapped components with $^{4}He/^{3}He$ varying from ~ 8-20. This shows severe He loss in NWA 10203 compared to most of lunar meteorites [2]. Neon and Ar were resolved into cosmogenic and trapped components. Based on a Ne-three isotope diagram, trapped Ne is fractionated solar wind (SW) with an inferred $^{20}Ne/^{22}Ne$ ratio of 12.17±0.16. Cosmogenic $^{22}Ne/^{21}Ne$ is in the range ~ 1.4-1.7, consistent with the feldspathic composition, based on the recent Lunar meteorite data compilation [2]. Measured $^{40}Ar/^{36}Ar$ is in the range 1.9-6.0 and $^{36}Ar/^{38}Ar$ is ~5.2, mostly representing trapped Ar as in most lunar meteorites. The elemental ratio of trapped $^{20}Ne/^{36}Ar$ is in the range ~ 0.02 to 0.16, which is even lower than the terrestrial atmospheric value, indicating diffusive gas loss. The $^{40}Ar/^{36}Ar$ ratios are higher for low-T steps than for high- T steps. This indicates that Ar from the first releases is from K-rich mineral like plagioclase.

Trapped gas release: Trapped Ne and Ar are clearly observed in all the clast and matrix samples. For example, in one clast sample, at 10% laser power, trapped ^{20}Ne ($^{20}Ne_{trap}$) represents only 1.4% of the total ^{20}Ne of this step whereas cosmogenic Ne ($^{21}Ne_{cos}$) represents 52% of the total ^{21}Ne of this step. At a higher laser power of 40%, $^{20}Ne_{trap}$ is 50% whereas $^{21}Ne_{cos}$ is only 19%. This trend is observed in all the samples. Therefore, cosmogenic Ne tends to be released earlier than trapped SW-Ne. As the SW is surface sited, one would expect the release of SW components to occur earlier than that of the volume sited cosmogenic gases. This may indicate that all the trapped gases in low retentive mineral like plagioclase may have been lost due to the brecciation process, but cosmogenic gases are still present and got released at lower temperature. Like Ne, trapped Ar was also released at high temperature, possibly from the highly retentive minerals. In addition, release patterns of both cosmogenic and trapped Ar are similar. This could be due to trapped solar gases originally surface correlated having migrated to grain volumes later. This may also indicate the regolith reworking due to brecciation or micrometeorite bombardment.

Cosmogenic components: Cosmogenic light noble gases ^{3}He, ^{21}Ne, ^{38}Ar are used to derive cosmic ray exposure ages (CREAs) T_3, T_{21} and T_{38} respectively. This CREA represents combined irradiation record on the lunar surface and during Moon–Earth transit. Production rates of ^{3}He, ^{21}Ne and ^{38}Ar are estimated based on [3] and [4]. The CREAs for two clast samples are estimated as $T_{3\,=}$(9-14 Ma), $T_{21\,=}$(23-29 Ma) and $T_{38\,=}$ (66-70 Ma). T_3 and T_{21} are clearly lower than $T_{38,}$ which indicates depletion in lighter noble gases He and Ne. This may be caused due to degassing activated by the ejection processes from the Moon. Reults from more clast samples from NWA 10203 will be presented during the meeting.

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