DATING LARGE LUNAR IMPACTS BY HELIUM-3 IN MARINE SEDIMENTS.

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The transfer of rocks from Mars and Moon to Earth is documented by about 40 lunar and 35 Martian meteorites, which are all unpaired. The increasing amount of those meteorites recovered from hot and cold desserts lead to a change in the opinion of the meteoritic community from: "*It is practically impossible*" to "*It is practically easy*" to eject solid matter from Moon and Mars [e.g. 1]. Recent numerical simulations of impacts on Moon showed that a given impacting projectile ejects about 1 to 5 times its mass from Moon, and even in the case of small impacting projectiles (10-30 m diameter) Moon is loosing mass [2].

Here we discuss the possibility to geochemically identify large lunar impact events in terrestrial sediments. Lunar composition does not allow tracing lunar impact layers in terrestrial sediments by conventional impact indicators such as Platin Group Element enrichments or shocked quartz. However the surface of Moon accumulated Helium-3 (^3He) over billions of years with concentrations ranging from 5 to 50 ppb [3], and represents the largest (except the sun) reservoir for ^3He in the inner solar system. Thus, a rather small amount (~40-50 t) of average lunar regolith (15 ppb)on Moon contain the current annual/global average volume of ^3He delivered by 40,000 t of IDPs to Earth [4].

The mass of lunar ejecta transferred to Earth's atmosphere can be calculated by considering that a projectile ejects about 1 to 5 times its mass from Moon [2] and ~1/3 of the escaping mass eventually hits Earth after a few million years (most arrives in $<10^4$ years) [5]. About 0.15-0.20 times the projectile mass is ejected from Moon without experiencing shock pressures in excess of 20 GPa and, thus, can retain >40% of the initial ^3He during impact ejection [6, 7] (Note that lunar meteorites appear to be exclusively weakly shocked). During the Moon-Earth transit especially the fine grained fraction accumulates additional ^3He.

Finally the ^3He-delivery through Earth atmosphere implies that the very fined grained durst enters a peak-temperatures below the ^3He release temperature. For a given particle friction heating is controlled by entry angle and velocity [8]. Thus lunar dust on geocentric orbits (11.1 km/s; entry angle mostly >45° [5)] is highly favored for delivering ^3He compared to asteroidal (12.1 km/s) or cometary dust (14.1 km/s) which enter along the full capture cross section of Earth [8]. Additionally, lunar dust on geocentric orbits which enter at gracing angels have a high probability for aero-breaking and, hence, soft deceleration. Therefore, we propose that large lunar impact events may be recorded by a pronounced ^3He-anomaly in marine sediments.

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