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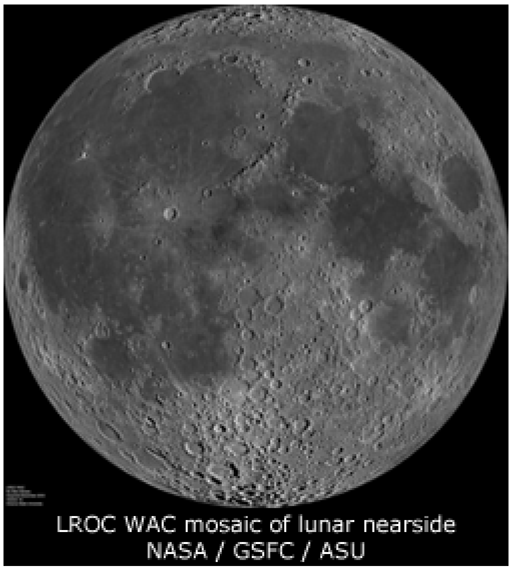
Flux of O^+ Ions from Earth to the Moon



Each orbit of the Moon swings it through Earth's ***magnetosphere*** for five days. Those hours are a boon to spacecraft orbiting the Moon and collecting vital data on both planetary bodies (for one example of the use of ***magnetometer*** data from an orbiting spacecraft, see **PSRD** article: ***The Moon at its Core***).

During a crossing of Earth's ***plasma sheet*** by the Japan Aerospace Exploration Agency (JAXA) Kaguya (***SELENE***) spacecraft, in orbit around the Moon from 2007-2009, the onboard ion sensors detected something extraordinary. Terrestrial O^+ ions (originating in the ***ionosphere***) escape to the Moon when Earth's magnetosphere blocks the Moon from the ***solar wind***, according to new analyses by Kentaro Terada (Osaka University) and colleagues from JAXA and Nagoya University.

Most of the time the solar wind bathes the Moon with ***plasma***. But when the Moon swings through Earth's magnetosphere, the solar wind drapes around the magnetosphere's boundary, giving rise to the favorable conditions for relatively high-energy O^+ ions (1–10***keV***) in the plasma sheet to escape and bombard the lunar surface.

What does this mean for the lunar surface regolith? Terada and coauthors report that the transport of biogenic oxygen from Earth to the Moon, calculated from Kaguya data, is $\geq 2.6 \times 10^4$ ions per square centimeter per second, which is consistent with previous GEOTAIL (JAXA-NASA) satellite ion-flux observations in the distant tail of Earth's nightside magnetosphere. Terada and colleagues hypothesize that this flux is not only happening now, but has been happening since Earth's ***Great Oxygenation Event***, 2.4 billion years ago. This detection of a flux of O^+ ions from Earth to the Moon is an elegant detail added to what planetary scientists have learned about oxygen and the mix of ***oxygen isotopes*** in the lunar regolith from laboratory analyses. The work by Terada and colleagues bolsters the idea that the oxygen isotopic composition of lunar regolith can be explained by a terrestrial upper-atmosphere source as well as by bombardment of solar wind, interplanetary dust or cometary ice particles (for example, see the 2009 work by Hashizume and Chaussidon).

See Reference:
· Terada, K., Yokota, S., Saito, Y., Kitamura, N., Asamura, K., and Nishino, M. N. (2017) Biogenic Oxygen from Earth Transported to the Moon by a Wind of Magnetospheric Ions, *Nature Astronomy,* v. 1, 0026, doi: 10.1038/s41550-016-0026. [***view abstract***]

See also:
· Hashizume, K. and Chaussidon, M. (2009) Two Oxygen Isotopic Components with Extra-Selenial Origins Observed among Lunar Metallic Grains—In Search for the Solar Wind Component, *Geochimica et Cosmochimica Acta,* v. 73, p. 3038-3054, doi: 10.1016/j.gca.2009.02.024. [***view abstract***]
· Ozima M., Yin Q.-Z., Podosek, F. A., and Miura, Y. N. (2008) Toward Understanding Early Earth Evolution: Prescription for Approach from Terrestrial Noble Gas and Light Element Records in Lunar Soils, *PNAS,* v. 105, p. 17654-17658, doi: 10.1073/pnas.0806596105. [***view abstract***]

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