Biotic Earth Wind (EW) as the origin of oxygen isotope anomalies in contemporary lunar regolith

Minoru Ozima[1]

[1] NONE

What is the mean isotopic composition of oxygen in the solar system is one of the most important problems in modern cosmochemistry. However, this important parameter is not known precisely enough to determine how the planetary systems evolved from the bulk reservoir. There are now three end member predictions for the Suns oxygen isotope composition, with D17O value (defined as the deviation from the mass dependent terrestrial fractionation line) range from 20permil [1-4], 0 permil [5], and +20 permil [6].

(a) Based on statistical arguments and the current prevailing planet formation theory from the solar nebula disk, Ozima et al [5] suggested that the average solar nebula composition should be close to D17O = 0 permil and most closely represented by the Earth composition;

(b) Hashizume and Chaussidon [2] have measured oxygen isotopes in iron and iron-nickel grains recovered from lunar soil that were exposed to solar wind between 1-2Ga ago. Hashizume and Chaussidon [2] attributed the extremely light component (D17O = -20 permil) to SEP (solar energetic particle, [7]), assuming that SEP better represents indigenous solar component. However, the reality of SEP is now seriously questioned by Grimberg et al [8] on the basis of recent computer simulation of ion implantation in matter.

(c) Ireland et al. [6], who have also measured implanted oxygen isotope composition in the lunar metal grains concluded that the indigenous solar wind oxygen had significantly positive D17O values up to about +20 permil. Their metal grains were recovered in lunar soils only recently exposed to the solar wind. We note that the implanted oxygen observed by Ireland et al. [6] almost perfectly overlap with oxygen isotopic composition in the earth ozone layer [9]. This coincidence leads us to examine the possibility of whether or not the implanted oxygen came from the Earth ozone layer.

Recently, Ozima et al. [10] showed that a detectable amount of N and light noble gases could be transported from an abiotic Earth with putative primordial CO2 atmosphere, if the Earth had no magnetic field. On the basis of recent spacecraft observations, Seki et al. [11] estimated the O+ flux escaping from the Earth to be 4 x 10^4 ions cm^{-2} s^{-1} at the Moon orbit, of which about 10% (i.e. 4 x 10^3 ions cm^{-2} s^{-1} hits the Moon surface (about 0.1% if there is no geomagnetic field [10]). This further supports the possibility of the terrestrial origin of the anomalous oxygen in the lunar metal particles. To examine further this hypothesis, we discuss here the following problems.

#1. What is the amount of the Solar Wind oxygen implanted in a lunar metal particle?

#2. How much is the flux of the Solar Wind, which can account for the implanted amount (#1)?

#3. Does the Earth-escaping oxygen have the same isotopic composition as the oxygen in the Ozone layer?

Conclusions: We conclude that the anomalous oxygen found in metal particles in lunar soils can be reasonably attributed to oxygen generated in the Ozone layer and transported to the Moon from a biotic Earth (with the present N-O atmosphere). This further implies that the anomalous oxygen with positive D17O permil values identified in lunar metals does not contradict with a recent statistical conclusion that the solar oxygen isotopic composition is the same as those in planets [5].

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