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THE REALITY OF THE SECULAR CHANGE IN SOLAR WIND NITROGEN ISOTOPES

J.F.Kerridge, Institute of Geophysics, UCLA, California 90024

Evidence concerning the isotopic composition of N in the early solar system currently seems to favor a picture of isotopic inhomogeneity [1] rather than of a unique primordial composition modified by local processes. Certainly the range of $^{15}N/^{14}N$ ratios found in meteorites points to the existence of more than one nucleogenetic N component, though mass-dependent modification of them is not ruled out. A two-component model has also been advanced to explain the isotopic variation observed for N in the lunar regolith [1,2]. ~~Here we address the~~ observational evidence is addressed which can be used to discriminate between such a model and one invoking a secular change in the composition of the solar wind [3].

The two components hypothesised to account for the lunar data are: solar wind N (SWN) with a constant $\delta^{15}N$ value of about +120‰ relative to terrestrial air; and a hypothetical light "planetary" N (LPN) component with $\delta^{15}N \leq -230$‰, the lowest value yet measured in ancient lunar breccias [4]. LPN is inferred to have outgassed from the lunar interior, its proportion relative to SWN decreasing with time as its internal reservoir became exhausted.

Three tests of this model have been considered so far, starting with a search for LPN surviving in lunar igneous rocks [2]. Results so far are negative: lunar rocks give $\delta^{15}N$ values close to 0 [5]. The other two tests depend on the fact that, because ^{14}N is so much more abundant than ^{15}N, a variation in LPN-content sufficient to produce the observed change in $\delta^{15}N$ also has significant effect on total N content. In the lunar regolith, such an effect would be manifested by a systematic perturbation in the relationship between N content and duration of exposure of samples to the solar wind. Such a perturbation may be revealed in two ways, both of which utilise a couple of independent measures of surface exposure: content of solar wind-implanted ^{36}Ar; and the fraction of indigenous Fe^{++} reduced to Fe^{0} by solar wind-implanted H and impact-induced melting [6].

In one approach, the relative contributions due to SWN and LPN may be calculated for each sample analysed. The calculated SWN contents correlate less well with each surface exposure parameter than do total N contents [1].

The other approach is the inverse calculation; LPN should show up as a systematic deviation from the trend-line between total N content and duration of surface exposure, and the deviation should correlate with departures of $\delta^{15}N$ from the SWN value. In fact, no deviation and no correlation may be seen [7].

The results of these tests may not eliminate the two-component model for regolith N but they seriously weaken it. The alternate view, involving a secular change in SWN composition [3], has its problems [1] but continues to survive by default [8].

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