Megascale isotopic anomaly in Cr?

K. KITTS, R. H. NICHOLS JR. AND F. A. PODOSEK

Dept. Earth & Planetary Sciences and McDonnell Center for the Space Sciences, Washington University, St. Louis, MO 63130, USA (kitts@levee.wustl.edu)

Undifferentiated meteorites provide many examples of microscale (spatial scale cm and smaller) isotopic anomalies, i.e. isotopic variations indicating incomplete mixing of stellar nucleosynthetic components, reflecting preservation of presolar solids [1]. Megascale anomalies, i.e. isotopic variations among different planetary bodies (e.g. in O [2] and arguably in Cr [3,4]), are fewer and smaller, and provide different constraints on solar nebula models.

Pursuant to better understanding of possible megascale anomalies in Cr, we have recently reported isotopic data for surface-correlated (putatively solar wind) Cr in lunar soil [5], finding excess ^{54}Cr of at least 8 epsilon-units, and also excess ^{53}Cr half that big. These results are well outside the envelope anticipated beforehand.

Perhaps these data do not represent presolar anomaly, but rather nuclear reactions within the solar system. The moon itself is a possible venue for such reactions; an interesting alternative is the atmosphere of the sun [6]. These two possibilities seem at the edge of plausibility [7]: They cannot be eliminated unambiguously but neither can they be supported in quantitative detail. In this work, therefore, we pursue ramifications of the interpretation that surface-correlated lunar Cr really is isotopically anomalous.

The direct interpretation is that the sun, or at least the source region of the solar wind, has a different isotopic composition than the terrestrial planets, reflecting different admixture or presolar nucleosynthetic components. This seems outlandish, but the difference need be only of order one permil. This situation could arise if the solar system's antecedent interstellar cloud were itself spatially heterogeneous.

Alternatively, instead of solar wind Cr we may have measured meteoritic Cr. There is enough inferred meteoritic material in lunar soils to permit this interpretation, but its distribution is not known well enough for definitive evaluation. An immediate objection to this hypothesis is that known meteoritic (whole rock) Cr is not so anomalous, so a very unusual source of meteoritic material would have to be postulated. Thus, this interpretation would permit the tenet that the sun and terrestrial planets were made from the same material but at the expense of requiring that most meteoritic infall to the moon is not like known meteoritic material, e.g. is possibly from isotopically exotic comets.

References: [1] Zinner (1997) *AIP Conf. 402*, 3. [2] Clayton (1993) *Ann. Rev. EPS* **21**, 115. [3] Lugmair & Shukolyukov (1998) *GCA* **62**, 2863. [4] Podosek et al. (1999) *LPSC XXIX*, #1307. [5] Kitts et al. (2002) *LPSC XXXIII*, #1822. [6] Nishiizumi & Caffee (2001) *Science* **294**, 352. [7] Nichols et al. (2002) *MAPS*, submitted.