SPALLOGENIC CHROMIUM IN THE SOLAR WIND. R. H. Nichols Jr.[1], K. Kitts[1] and F. A. Podosek[1], [1]Dept. Earth Planet. Sci., Washington University, St. Louis MO USA.

Recent measurements of Cr isotopes in the outer 0.3 μm, the solar wind (SW) implantation zone, of lunar grains unexpectedly display $\delta^{53}Cr \sim 5$ and $\delta^{54}Cr \sim 10$, relative to normal and to grain interiors [1]. This composition can be produced quite well by mixing terrestrial Cr with 25 ppm of a *primary proton-only* spallation Cr composition computed from the reaction cross-sections $^{56}Fe(p,x)^{50,52,53,54}Cr$ and $^{56}Fe(p,x)^{50,52,53,54}Mn$ (E_p~150-600 MeV/nuc) [2-4] and normalized to terrestrial $^{50}Cr/^{52}Cr$ (to account for "apparent" instrumental discrimination [see e.g. 5]): $\delta^{53}Cr=4\pm1$ and $\delta^{54}Cr=10\pm3$. In what locale might this mechanism be viable?

Solar cosmic ray (SCR) and galactic cosmic ray (GCR) spallation in the top few cm/m, respectively, of the *lunar regolith* will, in general, produce a volume-correlated component if the target atoms are distributed uniformly throughout the grains. The lunar plagioclase grains [1], however, have low [Cr] and [Fe], 15 ppm and 0.15 wt%, respectively, relative to the abundances in the SW zone, which will approach solar, ~2500 ppm and ~20 wt%, in a time short compared to regolith exposure (~200 Ma). Primary proton-only production rates are insufficient to produce the measured effect in reasonable times, and also neglect the effect of secondary reactions. The Cr production rate and composition from primaries and secondaries are not well known, but a rate estimate of $(1\text{-}2)\times10^{12}$ atoms Cr/g Fe/Ma (computed using $\sim3\times10^{11}$ atoms ^{53}Cr/g Fe/Ma [cf. 6] and scaling to the cross-sections [2-4]) yields $[Cr]_{Spall}/[Cr]_{Solar} \sim 5$ ppm in the SW zone in a ~200 Ma. However, estimates for the Cr GCR spallation composition (50:52:53:54=0.2:1:1:1) [cf. 6] yield a composition inconsistent with [1]: $\delta^{53}Cr:\delta^{54}Cr \sim 1:5$, at best.

Spallation in the *solar atmosphere* has recently been revisited to explain enrichments in ^{6}Li, ^{10}Be and ^{14}C in lunar soils [7-10]. The cross-sections above [2-4], an H flux (E>10 MeV) $\sim 3\times10^{6}$ H/cm^2/s and the solar [Fe/H] abundance yield a production rate of 1.5×10^{-23} atoms Cr per column density of H per sec, comparable to those needed for Li, Be and C: 5.8, 0.3 and 0.6×10^{-23}, respectively. Assuming a column density of 10^{24} H/cm^2 [e.g. 10], exposure in and above the photosphere of ~25 ka is required to obtain a steady state mix $[Cr]_{Spall}/[Cr]_{Solar} \sim 25$ ppm. Although this exposure is 100-200× longer than that required for Li, Be and C, it may be reasonable, given that ions are effectively trapped in flare loops [e.g. 11]. Larger reaction cross-sections at lower energies (<150 MeV) will reduce this time by a factor of 10-100, but could change the spallation composition. In contrast to the lunar locale, neglecting secondary neutron reactions may be warranted in solar atmosphere if the neutrons are effectively moderated by the H-rich environment.

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