Solar wind implantation of radionuclides

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Measurements of decay products of extinct radionuclides indicate their presence in the early solar system. Among those hypothesized to be present at the time of CAI includsion are ^{10}Be, ^{26}Al, ^{36}Cl, ^{41}Ca, and ^{53}Mn. The provenance of these radionuclides has been a topic of considerable debate. Potential sources are stellar sources and energetic particle interations. Be-10 is noteworthy among these radionuclides since it is not formed through stellar nucleosynthesis [1].

Nishiizumi and Caffee [2] demonstrated the presence in lunar surface materials of live ^{10}Be, unequivocally associated with the surface layers in grains. This ^{10}Be, produced by energetic protons from O in the solar atmosphere, is entrained in the solar wind and implanted on the surfaces of exposed mineral grains.

Based on these observations on the lunar surface Bricker and Caffee [3] proposed that ^{10}Be entrained in the solar wind could likewise be incorporated into calcium-aluminum inclusions at the time of their formation. To test the viability of this model Bricker and Caffee used the ^{10}Be data of McKeegan *et al*. [4], who measured the ^{10}Be/^{9}Be ratio in CAIs, using ^{10}B as a proxy for ^{10}Be. Using ^{10}Be fluxes and mass inflow rates considered reasonable for the early solar system Bricker and Caffee [3] were able to produce ^{10}Be/^{9}Be ratios similar to those measured by McKeegan *et al* [4].

We have now extended this model to other radionuclides known to be present in the early solar system. Our model is broadly consistent with measurements of ^{7}Be, ^{41}Ca, and ^{53}Mn. Our model cannot account for the ^{26}Al found in the early solar system. This model makes specific predictions about radionuclide production and mass inflow rates. The model, the correspondence with measurements, and the specific requirements needed for this model will be discussed.

[1] Marhas and Goswami (2004) *New Astron. Rev.* **48**, 139-144 [2] Nishiizumi and Caffee (2001) *Science* **294,** 352-354 [3] Bricker and Caffee (2010) *Astro. J.* **725**, 443-449 [4] McKeegan *et al* (2000) *Science*, **2898**, 1334-1337