EVIDENCE FOR LARGE-SCALE DUST MIGRATION IN THE MILKY WAY FROM PRESOLAR GRAINS

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Introduction: As do all natural phenomena, stars and galaxies evolve with time. Understanding the temporal evolution of dust in the local stellar environment from which the Solar System (SS) formed cannot be decoupled from the galactic history that preceded it. Dust produced by stars from inner regions of the Milky Way will move radially outward [1], thus peppering the interstellar medium (ISM) from which new star-forming regions emerge. While ultraviolet and infrared spectroscopy have given insight into the distribution of dust in the galaxy [2], it may be possible to use presolar grains [3] as a complementary source of information for signs of large scale dust migration. Presolar grains, in particular SiC, have largely escaped the isotopic equilibration of the early SS and are predicted to survive for 0.5 - 1.5 Gyr in the ISM [4]. This makes them excellent candidates for studies of dust survivability, dust migration, and the chemical evolution of the galaxy as a function of time.

Experimental Details: Large ($\gtrsim$ 5um) SiC grains from the LS+LU residues [5] were analyzed in multi-collection for C and Si isotopes with the Washington University NanoSIMS by a Cs^+ primary beam. Lithium and B isotopes were simultaneously analyzed with an O^- primary beam in a separate session. A subset of these grains was subsequently measured for their isotopic compositions of several heavy elements by SHRIMP II and SHRIMP-RG at The Australian National University, using the methods described in [6].

Results and Discussion: Galactic cosmic ray (GCR) exposure ages of individual SiC grains range from <50 Myr to >2 Gyr, as derived from measurements of cosmogenic Li, He, or Ne isotopes [7-9]. While these ages have large uncertainties due to model predictions and analytical difficulties, some of the grains must have spent >500 Myr in the ISM. The astrophysical implication of such long ages is that at least some grains have radially migrated from an inner galactic region and have been incorporated into the local ISM during its rotation around the galactic center. This presents a scientific Catch-22: if the grains formed in a more active star-forming region, thereby experiencing a greater *local* CR flux than that from which the SS formed, then the ages determined from GCR irradiation are themselves suspect. While the true ages of the grains must come from absolute age dating, comparison among cosmogenic chronometer systems will be necessary to deconvolve the relative contributions of the primordial CR flux the grains were exposed to and the GCR flux 4.5 Ga.

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