Abstract

Title: Constraints on the Nucleosynthesis of Refractory Nuclides in Galactic Cosmic Rays

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Abundances of essentially all isotopes of the elements in the cosmic rays arriving near Earth have been measured using data from the Cosmic-Ray Isotope Spectrometer (CRIS) on the Advanced Composition Explorer (ACE). The abundances are attributable, in general, to a mix of primary nuclides synthesized in stars and secondaries produced by nuclear fragmentation in passing through the interstellar medium. For those nuclides which are dominantly primary, we have used a model of interstellar propagation to correct for the secondary contributions to the observed abundances and derive the source abundances in the material from which the cosmic rays were accelerated. In this investigation, we consider the relative source including Na, Mg, Al, Si, Ca, Fe, Co, Ni, and Cu. This data set, which includes 22 isotopes with significant primary contributions, has been used to investigate the nucleosynthetic origins of cosmic-ray material. For all of these isotopes, the cosmic-ray source abundances are found to be consistent with solar system values to within a factor of 2, and generally within <20%. We have compared the derived cosmic-ray source composition with recent numerical calculations of isotopic abundances expected to be ejected from type II supernovae over a wide range of stellar masses as well as from type Ia supernovae. Based on this comparison, we discuss limits on the relative contributions of these possible sources to the cosmic-ray material. These comparisons allow one to assess the likelihood that primary cosmic rays represent a sample of the present-day interstellar medium and also to investigate the possibility of additional contributions from special sources such as the winds of Wolf-Rayet stars.

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