OB ASSOCIATIONS AND PROTOSOLAR ABUNDANCES; D.N. Schramm and D.L. Tubbs, Univ. of Chicago, Chicago, IL 60637.

It is shown that the elemental and isotopic composition of a protosolar cloud forming in a young star forming region (i.e., an OB association) may be be significantly different from the "average" interstellar medium. As Reeves (6) has previously discussed, several supernovae may have contributed to the composition of the protosolar cloud prior to its initial collapse. In this talk a quantitative description will be presented of the evolution with time of the abundances in an OB association. Some discussion will also be presented on mixing scales. Of particular interest with regard to isotopic anomalies is that because of early supernovae, the composition of the gas in the OB association will be initially enriched in the products of explosive nucleosynthesis and the r-process relative to the s-process. In addition to the isotopic anomalies in meteorites, another useful probe which seems to support these ideas is the r/s ratio in the galactic cosmic rays.

Observations with the HEAO-C and UK-6 satellite of the ratio of r-process to s-process nuclei in cosmic rays may indeed be a useful probe of nucleosynthesis occurring in stellar OB associations. Within the limits imposed by assumptions about the nucleosynthetic sites, elemental mixing in the interstellar medium (ISM), and cosmic-ray (CR) acceleration mechanisms, the average r/s composition of the OB association and the CRs produced therein is estimated as a function of time and predictions are made.

Specific assumptions are as follows. 1) Nucleosynthesis of r-process nuclei occurs when massive ($M_1 \lesssim M \lesssim M_2$) stars go supernova (SN). The mass limits are varied about the values of $M_1 \sim 8M_\odot$ and $M_2 \sim 70M_\odot$ (1). The r-process yield -- mass fraction of r-nuclei ejected as a function of stellar mass -- is given several analytic forms that bracket possible r-process sources. Nucleosynthesis of s-process nuclei occurs in low to intermediate mass ($M \lesssim 9M_\odot$) stars (2,3), and the yield is also given analytic forms to cover possible production sites. The r and s source functions are normalized such that the amounts of r and s nuclei ejected and mixed, averaged over all stars of the association are equal.

2) The mixing of the SN ejecta with the ISM of the association is complete within a volume, centered on the SN, whose boundary expands in a specified way. The evolution of this mixing front is given several histories, in order to bracket possible mixing rates. The most rapid mixing is determined by the expansion of the SN remnant, while the slowest mixing is diffusive. Pre-SN injection of s-nuclei into the ISM occurs via the stellar wind and mass loss from red giant envelopes.

3) The CRs are produced by SN events. Ambient nuclei are accelerated by SN shocks on timescales defined by the possible acceleration mechanisms (4,5).

As each star of the association evolves on a timescale determined by its mass, the ejection and mixing of r- and s-nuclei are followed, and the ratio of average r to average s compositions is estimated. It is likely that the average r/s ratio in the cosmic rays will exceed unity, and the amount may set constraints on one or more of the assumed physical processes discussed above.

If, as preliminary indications show, the r-process isotopes are enriched in the cosmic rays, then one would have reason to believe that this may be related to the r-like enrichment shown in certain Allende inclusions.

References

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