SODIUM-22 PRODUCTION IN SUPERNOVAE.

Sachiko Amari[1] and Marco Pignatari[2], [1]McDonnell Center for the Space Sciences and Physics Department, Washington University, St. Louis, MO 63130, USA (sa@physics.wustl.edu), [2]E.A. Milne Centre for Astrophysics, School of Mathematics and Physical Sciences, University of Hull, HU6 7RX, United Kingdom.

Presolar grains are stardust that formed in stellar outflow or stellar ejecta, and were contained in extraterrestrial materials. The study of presolar grains in the laboratory has yielded a wealth of information about nucleosynthesis in stars, mixing in stellar ejecta and the Galactic chemical evolution [e.g., 1]. Mineral types of presolar grains include diamonds [2], SiC [3, 4], graphite [5], oxides [6, 7], and silicates [8-11]. Presolar graphite is the carrier of an exotic ^{22}Ne-rich component, Ne-E(L) [5]. Bulk (= aggregates of grains) noble gas analysis has shown that Ne-E(L) mostly consists of ^{22}Ne from ^{22}Na ($T_{1/2}$ = 2.6 a) with a small amount of ^{22}Ne from asymptotic giant branch stars [12]. Sodium-22 was traditionally attributed to novae because ONe novae produce ^{22}Na along with ^{26}Al [e.g., 13].

Many SN grains, mostly populated in low-density fractions, show Si isotopic anomalies (mostly ^{28}Si excesses, but, in a few cases, ^{29,30}Si excesses), the initial presence of ^{44}Ti, and high ^{26}Al/^{27}Al ratios [14, 15]. Helium and Ne analyses of individual graphite grains have shown that a few SN grains contain ^{22}Ne from ^{22}Na [16-19].

Isotopic abundances of SN models give us a diagnostic tool to probe stellar physics and nuclear physics uncertainties affecting the simulations. The radioactive isotope ^{22}Na, in a 15M_{sun} model (s15a28c) by Rauscher et al. [20], is produced in the O/Ne zone during hydrostatic burning with the maximum yield of 2.2×10^{-6} by mass fraction. It is hard, if not impossible, to explain ^{22}Ne-rich SN graphite grains by ^{22}Na from the O/Ne zone because 1) ^{22}Na is produced in the inner O-rich zone where the C abundance is very low ($< 1 \times 10^{-2}$), and 2) the abundance of ^{22}Na is only at a few ppm level. Recently, Pignatari et al. [21] have proposed supernova models including the effect of high shock velocities, and the H injection in the He/C zone. In these models explosive H burning produces large abundances of ^{22}Na. The largest production obtained is in the model 25T-H, with a mass fraction of $\sim 5 \times 10^{-2}$ in the O/nova zone, which is adjacent to the C-rich He/C zone. These models produce a significant amount of ^{22}Na by the explosive H burning in the outer zone of supernovae. Therefore, it would be much easier to explain the trapping of ^{22}Na into graphite grains.

Explosive H burning in supernovae [21] has been invoked to explain the isotopic signatures of ^{15}N-rich SiC A+B grains [22] and those of a few ^{14}N-rich A+B grains [23]. A+B grains comprise a few percent of the total SiC grains [24]. It is estimated that 27% of the total graphite grains originated from supernovae [15]. There are uncertainties in the estimation for the fraction of ^{22}Ne-rich grains among SN graphite grains because the detection of the noble gases depends on the conditions of the analyses prior to noble gas analysis [19]. However, if we take the number of ^{22}Ne-rich grains (86%) obtained from one of the Orgueil mounts [19], it is concluded that many SN graphite grains contain ^{22}Ne from ^{22}Na. Considering that many presolar grains show signatures of explosive H burning, a significant portion of the SN population may explosive H burning.

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