BARIUM FROM A MINI r-PROCESS IN SUPERNOVAE, D. Heymann, Dept. of Geology, Dept. of Space Physics and Astronomy, Rice University, Houston, TX 77001.

Isotopic anomalies of Ba in the Allende meteorite suggest the addition of r-process Ba to normal Ba of the solar system (1, 2). The deduced Ba-137/Ba-135 yield ratio of about unity is consistent with the "classical" variant of the r-process, but also with the postulated mini r-process in the zone of explosive Ne- and C-burning of a supernova (3). The major difficulty of the second process is that it, seemingly, overproduces Ba-138 by far too much.

Table 1 shows my calculated yields of the Ba isotopes A = 134-138 as function of neutron dose, normalized to Ba-138 ≡ 1.00. Temperature is assumed to be $T_9$ = 2.00. There are two conditions for which the Ba-137/Ba-136 yield ratio is about unity. One occurs for neutron dose about 1.5[-7] mole s/cc; the other for >1[-6] mole s/cc (numbers in brackets are exponents of ten). For the smaller value of neutron dose, the Ba-138/Ba-137 yield ratio is in the range 1-3, which implies that the Ba-138 addition is from 0.1-0.5 that of the Ba-137 addition, that is to say a predicted Ba-138 anomaly in the range 0.1-0.6‰. The Ba-134/Ba-137 yield ratio is in the range 1[-2] to 6[-4], which implies a Ba-134 anomaly in the range 0.1-0.006‰. The Ba-136/Ba-137 yield ratio is in the range 3[-1] to 1[-1], which implies a Ba-136 anomaly in the range 6-1‰. The additions of the comparatively small amounts of Ba-136 and Ba-138 for neutron doses in the range 1-2[-7] mole s/cc can be easily accommodated by renormalization of the data. The bulk of Ba-135 comes via Xe-135; the bulk of Ba-137 is directly produced from s-Ba. Consequently, if the Ba addition comes from a mini r-process in supernovae, the neutron dose of that process must be on the order [-7] mole s/cc.

TABLE 1

Calculated yields of Ba isotopes A = 134-137, normalized to Ba-138 ≡ 1.00, for neutron capture in an s-seed of Ba (4) at $T_9$ = 2.00. Assumption: the neutron capture-chain in Ba is arrested at Ba-138. Yields are cumulative for isobars of Ba, Cs, Xe, and I. Numbers in brackets are exponents of ten.

| A = | 134 | 135 | 136 | 137 |
|---|---|---|---|---|
| Neutron Dose mole s/cc | | | | |
| 2[-8] | 1.4[ 0] | 1.4[ 0] | 5.1[ 0] | 5.4[ 0] |
| 4[-8] | 3.1[-1] | 6.1[-1] | 2.0[ 0] | 2.7[ 0] |
| 6[-8] | 9.6[-2] | 4.8[-1] | 1.0[ 0] | 1.9[ 0] |
| 8[-8] | 3.2[-2] | 5.2[-1] | 6.1[-1] | 1.3[ 0] |
| 1[-7] | 1.3[-2] | 5.7[-1] | 3.5[-1] | 1.0[ 0] |
| 2[-7] | 2.0[-4] | 8.1[-1] | 3.4[-2] | 3.4[-1] |
| 3[-7] | 4.9[-6] | 7.7[-1] | 4.7[-3] | 1.6[-1] |
| 4[-7] | 1.4[-7] | 5.9[-1] | 1.7[-5] | 9.1[-2] |
| 6[-7] | < [-10] | 2.6[-1] | 1.6[-5] | 5.9[-2] |
| 8[-7] | < [-10] | 1.2[-7] | 4.4[-7] | 5.5[-2] |
| 1[-6] | < [-10] | 7.7[-2] | 1.1[-8] | 5.4[-2] |

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(3) Lee T., Schramm D. N., Wefel J. P., and Blake J. B. (1979) Ap. J. 217, 213.

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