ON ORIGIN OF COSMOGENIC Ne-21 EXCESS IN SiC OF CHONDRITES;
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In the paper a possibility of production of Ne isotopes in nuclear reactions with energetic particles accelerated in the supernova explosion $4.7 \cdot 10^9$ yr ago has been considered. At that final stage of nucleosynthesis the light isotopes Li, Be and B had been produced too that allowed us using their cosmic abundances /1/ to determine the irradiation parameters. Normalizing the absolute value of proton flux in accordance with the Be-9 observed abundance and fitting the portion of α-particles in accordance with the abundances of Li isotopes lead to the best correspondance of the calculated abundances of all isotopes to the observed ones (Tabl.1) at the following values of the parameters: $I_p(>15MeV) = 1.62 \cdot 10^{19} cm^{-2}$; $I_\alpha(>15MeV/nucl.) = 1.89 \cdot 10^{17} cm^{-2}$; $\alpha/p = 1.2 \cdot 10^{-2}$; $\gamma = 2.5$ (if $F(>E_0)dE = K E^{-\gamma} dE$ is the energy spectrum form).

Table 1. Observed and calculated abundances (atoms/10^6Si) and ratios of isotopes of Li, Be and B.

Isotope	Li-6	Li-7	Be-9	B-10	B-11	Li-7/Li-6	B-11/B-10	Li/Be	B/Be
Obs./1/	4.28	52.8	0.73	4.22	16.98	12.0	4.02	61.1	30.8
Calcul.	4.00	41.1	0.73	4.70	15.40	9.3	3.00	55.7	24.8

In conformity with the energy spectrum of particles the statistically weighted cross sections of Na-22 and neon isotopes production on the main target nuclei are computed by CDC-6500 (JINR, Dubna) using mostly the experimental excitation functions /2-6/ (see Tabl.2). The Na-22 data have been used to evaluate the amounts of Ne-E(L) and Ne-E(H) in the refractory fractions of carbonaceous chondrites /7/. It is shown, e.g., that Ne-E(H) had been produced by irradiation of SiC grains with accelerated particles at the last stage of the nucleosynthesis.

Table 2. Statistically weighted production cross sections of Na-22 and Ne isotopes (mbarns)

Target(abund*/1/) \ Nuclide	Na-22	$Ne-22_d$	Ne-21	Ne-20
Na (0.0574)	62.00			
Mg (1.074)	27.96	1.42	9.73	22.70
Al (0.0849)	7.43	2.41	1.33	6.61
Si (1.0000)	2.68	0.15	1.09	2.68
S (0.515)	0.32			

* - atoms/10^6Si

The SiC grains are characterized by some excess of Ne-21 In the Murchison C2 chondrite it totals $(6-11) \cdot 10^{-8}$ ml/g (in the grains of $\gtrsim 0.2-2$ μm size) that exceeds up to 40-fold the magnitude expected from the recent cosmic ray irradiation for the exposure age of the chondrite /8/. In the SiC of carbonaceous chondrites Ne-21/Ne-E(H) $\leq$ 0.005 while in the SiC of ordinary chondrites Ne-21 - Ne-E(H) correlation is observed that is especially evident in the Tieschitz chondrite /9/: Ne-21/Ne-22 ratios are in the range of 0.07 (Inman) - 0.49 (Tieschitz).

It is natural to suppose that direct production of neon isotopes as well as Na-22 should take place in the supernova explosion $4.7 \cdot 10^{9}$ yr ago. In Table 3 the calculated amounts and ratios of the Ne isotopes in the SiC grains generated by accelerated particles during the supernova explosion are presented. It is

Table 3. Calculated amounts (10^{-8}ml/g) and ratios of Ne isotopes produced in SiC during the supernova explosion in comparison with the data /8,9/ for the Murchison (HO) & Tieschitz chondrites

Isotope / SiC	$^{22}Ne_{Na}$	$^{22}Ne_{d}$	$^{22}Ne_{Na+d}$	^{21}Ne	^{20}Ne	$^{21}Ne/^{22}Ne$	$^{20}Ne/^{22}Ne$
Murchison			2232	5.62	549	0.0025	0.246
Tieschitz						0.49	1.9
Calcul.	2422	136	2558	994	2422	0.41*	1.0*

* - $^{21,20}Ne/^{22}Ne_{Na}$

seen that the measured and calculated contents of Ne-21 in SiC of the Murchison chondrite are very different: the theoretical value is 177 times the observed one in HO-fraction. The similar differences are observed for other fractions whereas the respective values of Ne-E(H) contents in SiC are in accordance /7/. It could be due to different kinetics of Ne and Na volatilizing from SiC grains at T<1400°C corresponding to the beginning of Ne-E(H) intensive release. Such a situation could arize at the simultaneous short irradiation and heating of SiC grains of carbonaceous chondrites followed by fast cooling that promoted conservation of the radiogenic Ne-22 /10/. Just these very conditions are realized at the front of shock waves. The losses of Ne-21 have totaled 99%. If the losses of other neon isotopes from SiC of carbonaceous chondrites were similar to those, only $0.8 \cdot 10^{-8}$ ml/g of $Ne\text{-}22_{d}$ and $15 \cdot 10^{-8}$ ml/g of Ne-20 generated during the supernova explosion would remain in HO-fraction of the Murchison chondrite. Thus, the most part of Ne-20 in this fraction is of a different, very likely, planetary origin.

In the case of ordinary chondrites the calculated and observed values of the Ne-21/Ne-22 ratios are in accordance (see Tabl.3). This fact as well as the Ne-21 - Ne-22 correlation /9/ could testify that SiC grains of ordinary chondrites were irradiated by the energetic particles at the comparatively low temperatures /10/.

References

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