EXPOSURE AGES OF H CHONDRITES. V.A.Alexeev. V.I.Vernadsky Institute of Geochemistry and Analytical Chemistry, USSR Academy of Sciences, Moscow, USSR

Cosmic-ray exposure ages of meteorites can supply information on both the formation and the radiation history of these cosmic bodies (1,2). We have calculated the He-3, Ne-21, and Ar-38 exposure ages for 228 H chondrites in order to study a some regularities of the exposure age distributions. The noble gas data are from the compilation by Schultz and Kruse (3). When more than one analysis was available for a given meteorite, the average value of the exposure ages was used. The meteorites with low ratios of cosmogenic He-3 and Ne-21 ($(He\text{-}3/Ne\text{-}21)_c < 2.5$) suggest diffusion loss of rare gases, and therefore these meteorites were excluded.

For obtaining the cosmogenic component the measured concentrations were corrected for a trapped component, using a solar isotopic composition for the solar-gas bearing meteorites and atmospheric ratios for the rest of the analyses. Meteorites were considered to be solar-gas bearing if they met all of the criteria according to Wasson (4). Production rates of cosmogenic isotopes were used as a function of the shielding dependent cosmogenic ratio $(Ne\text{-}22/Ne\text{-}21)_c$ according to Eugster (5). Mean production rates (i.e. production rates corresponding to a shielding described by $(Ne\text{-}22/Ne\text{-}21)_c=1.11$) were used for all samples with $Ne\text{-}20/Ne\text{-}22 > 1.2$ (2) as well as for the samples with $(Ne\text{-}22/Ne\text{-}21)_c < 1.05$ or $(Ne\text{-}22/Ne\text{-}21)_c > 1.25$. If data in the $(He\text{-}3/Ne\text{-}21)_c$, $(Ne\text{-}22/Ne\text{-}21)_c$ diagram plot above or below the correlation line reported by Nishiizumi et al. (6) by more than 20% we used the mean production rates also. Spallation data are rejected if the uncertainties caused by the correction for trapped components exeed 20%.

The exposure age distributions are studied. We have used the following expression to calculate the average exposure age $\bar{t}$:

$$\bar{t}=\left(\sum_{i=1}^{m} t_i^3+\sum_{i=1}^{n} t_i^{21}+\sum_{i=1}^{l} t_i^{38}\right)/(m+n+l)$$

where m, n, and l are the numbers of the values of the He-3(t_i^3), Ne-21(t_i^{21}), and Ar-38(t_i^{38}) exposure ages for a given meteorite respectively. The ages t_i differed from the average age, $\bar{t}$, by more than 50% were rejected and new value of $\bar{t}$ was calculated. The results are shown in Fig.1. We can see that:

1) the shielding corrected production rates reduced by 1.4 times the scatter in exposure ages derived from cosmogenic He-3 and Ne-21 (cf. A and B, Fig.1);

2) the ages derived from cosmogenic Ar-38 concentrations are systematically lower by about 15% than He-3 and Ne-21 ages. This result agrees with conclusion obtained by Graf and Marti (2) on decreasing of the Ar-38 ages by about 10%;

3) a reduction in the proposed by Eugster (5) Ar-38 production rate by 15% allows to get the better agreement for all exposure age distributions: He-3, Ne-21, and Ar-38 (see Fig.1, C);

4) the calculated Gaussion curves showed the standard deviations (1σ) of 10%, 11%, and 16% for He-3, Ne-21, and Ar-38 exposure age distribution respectively (see Fig.1, C).

We have also studied the dispersion of the average exposure ages (t_i) relative to the average age, $\bar{t}$ (see above), for a given meteorite. We have used the expression:

$$\bar{t}_i=(t_i^3 + t_i^{21} + 1.15 \times t_i^{38})/3$$

where t_i^3, t_i^{21}, and t_i^{38} are the He-3, Ne-21, and Ar-38 exposure ages for a individual measurement of rare gas concentration in the given meteorite respectively. Summary histogram of distributions for all meteorites with multiple determinations of the rare gas contents is given in Fig.2. The Gaussian curve was calculated for this histog-

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ram. Standard deviation was found equal to ~10% (1σ). This value is indicative of good reprodusibility of the age determinations and may be used in determining the clustering of the meteorite exposure ages.

Exposure age distributions of H chondrites within the age interval of 0-10 Ma are shown in the Fig.3 with different steps of histograms (1, 0.5, and 0.2 Ma). The Gaussian curves were also calculated for these distributions. We can see in this age region only one peak at about 6-7 Ma. These distributions does not show any another reliable peaks in this age region.

References:

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(6) Nishiizumi K. et al. (1980) Earth. Planet. Sci. Letts, 50, 156-170.

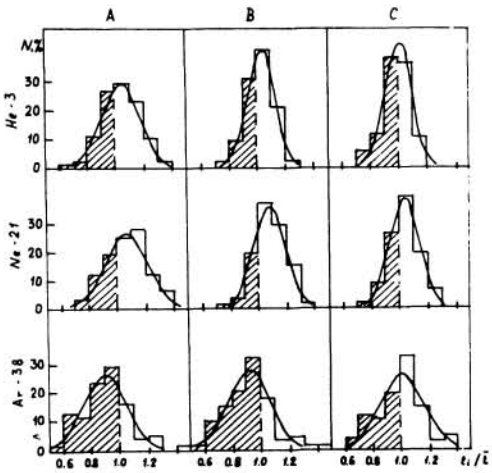

Fig. 1

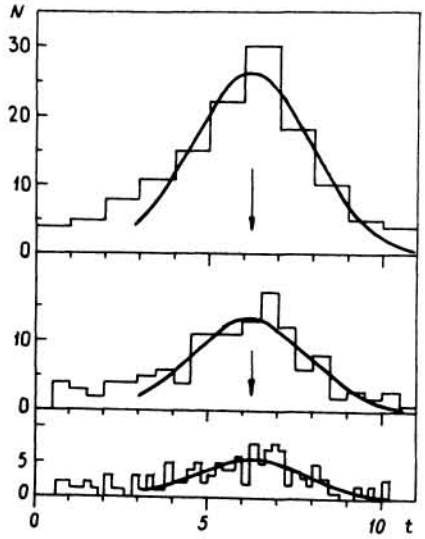

Fig. 3

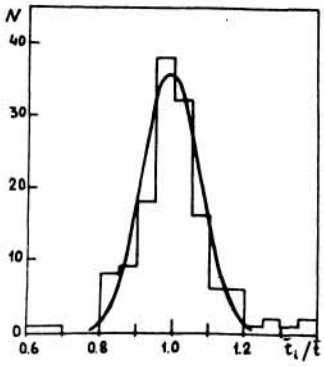

Fig. 2

Fig.1. Summary distributions of the He-3, Ne-21, and Ar-38 exposure ages (t_i) relative to average exposure age of meteorite ($\bar{t}$) without (A) and with (B) shielding corrections. C is the same as B, but the production rate of cosmogenic Ar-38 given in (5) is reduced by 15%. Hutched areas correspond to values of ages $t_i \leq \bar{t}$ ($\bar{t}$=1).

Fig.2. Dispersion of the average exposure ages ($\bar{t}_i$) in multiple determinations of the ages of a given meteorite.

Fig.3. The exposure age distributions of H chondrites within the age interval of 0-10 Ma. Steps of histogram are 1, 0.5, and 0.2 Ma.