TERRESTRIAL AGES OF ANTARCTIC METEORITES: IMPLICATIONS FOR CONCENTRATION MECHANISMS. Ludolf Schultz, Max-Planck-Institut für Chemie, 65 Mainz, FRG.

Antarctic meteorites differ from meteorites fallen in other places in their mean terrestrial ages. BOECKL (1) estimated the terrestrial "half-life" for the disintegration of stone meteorites by weathering under the climatic conditions of the Western United States of America to about 3600 years. Antarctic meteorites, however, have terrestrial ages up to $7 \cdot 10^5$ yrs, indicating larger weathering half-lifes.

The terrestrial ages of meteorites are determined by their concentration of cosmic-ray-produced radionuclides with suitable half-lives. ^{14}C, ^{26}Al and ^{36}Cl have yielded reliable ages of Antarctic meteorites. A summary of the results is given by NISHIIZUMI (2). Because of the long half-life of ^{26}Al ($t_{1/2} = 7 \cdot 10^5$ yrs) this isotope is only useful for terrestrial ages greater than about $3 \cdot 10^5$yrs. On the other hand, ^{14}C-terrestrial- ages can only be measured when the age is less than about $4 \cdot 10^4$ yrs. The gap between these limits is partly closed by measurements of ^{36}Cl. This isotope must be measured in the metal phase of meteorites because the production of cosmogenic ^{36}Cl in silicate phases is highly variable. To determine also terrestrial ages of achondrites, which do not contain any metal phase, we have used ^{81}Kr ($t_{1/2} = 2 \cdot 10^5$ yrs) combined with cosmogenic ^{38}Ar (3-5). A summary of these results is given in Tab. 1.

From these measurements and also from mineralogical investigations (6) it became clear that many Antarctic achondrite specimens are paired or even multiple falls. Most of the Yamato polymict eucrites belong to two falls only; the same is true for the Elephant Moraine eucrites. Also all investigated Allan Hills polymict eucrites are parts of one fall. Therefore, from 17 meteorites investigated only ten individual terrestrial ages are obtained.

Fig. 1 shows the distribution of terrestrial ages of Allan Hills and Yamato meteorites. To discuss the distribution of terrestrial ages of Allan Hills meteorites the following assumptions are made:

- Since more than $7 \cdot 10^5$ yrs a "steady-state" situation is present concerning ice movement. ablation, meteorite infall rate etc.
- The sink for meteorites is physical weathering. Weathering (= destruction) takes place only for meteorites sitting on the surface of the ice. The destruction is proportional to the number of meteorites exposed. The removal of meteorites by strong winds or meteorite hunters is not important for this discussion.
- Allan Hills meteorites are direct falls and meteorites transported within the ice to their place of recovery.
- Meteorites with terrestrial ages less than 10^5 yrs are direct falls.

Fig. 2 shows the expected distribution of terrestrial ages which was constructed with a destruction half-life of $1.6 \cdot 10^5$ yrs and a transport time of the meteorites within the ice (without weathering) of $1.5 \cdot 10^5$ yrs. The ratio of local falls to transported meteorites is 1:1 which is anticipated by transport models (7). The agreement between the calculated distribution of terrestrial ages and observation is reasonably good, although the number of dated meteorites is still rather small.

Schultz, L.

Most of the Yamato meteorites have shorter terrestrial ages than the Allan Hills meteorites (see Fig. 1). This difference has been noted earlier by HONDA (8), NISHIIZUMI et al. (9), FIREMAN (10), and JULL et al. (11). If these meteorites are direct falls only the weathering half-life must be greater compared to Allan Hills conditions. This, however, seems not to be likely. JULL et al. (11) explain the absence of Yamato meteorites with greater terrestrial ages by the removal of these stones by ice flow through the blocking system of the Yamato Mountain barrier. However, it seems to be also possible that the Yamato ice field is not stagnant for a sufficient long time. Direct falls dominate the Yamato meteorites; accumulation took place not long enough to build-up the pattern of weathering in the distribution of terrestrial ages. This model implies that the Yamato ice field has an age of less than 10^5 yrs and that the concentration mechanism by ice movement plays only a minor role. Absolute ages of ice could help to clarify this problem.

References: (1) Boeckl R. (1972) Nature, 236, p. 25-26. (2) Nishiizumi K. (1984) In: Field and Laboratory Investigations of Meteorites from Victoria Land (eds. Marvin U.B. and B. Mason), Smithsonian Contr. Earth Sci., 26, p. 105-109. (3) Freundel M., J. Crabb, and L. Schultz (1983) Meteoritics, 18, p. 299-300. (4) Schultz, L. and M. Freundel (1984) Meteoritics, 19, p. 310. (5) Schultz L. (1985) Abstracts 10th Symp. Antarctic Meteorites, Tokyo, p. 158-159. (6) Delaney J.S., H. Takeda and M. Prinz (1983) Proc. Eights Symp. Antarctic Meteorites, Mem. Natl. Inst. Polar Res., Spec. Issue 30, p. 206 - 223. (7) Whillans I.M. and W.A. Cassidy (1983) Science, 222, p. 55-57. (8) Honda M. (1981) Geochem. J., 15, p. 163-181. (9) Nishiizumi K., J.R. Arnold, D. Elmore, X. Ma, D. Newman, and H.E. Grove (1983) Earth Planet. Sci. Lett., 62. p. 246-250. (10) Fireman E.L. (1983) Proc. Eights Symp. Antarctic Meteorites, Mem. Natl. Inst. Polar Res., Spec. Issue 30, p. 246-250. (11) Jull A.J.T., D.J.Donahue, T.H. Zabel, and E.L. Fireman (1984) Proc. Lunar Planet. Sci. Conf. 15th, in J. Geophys. Res. 89, p. C329-C335.

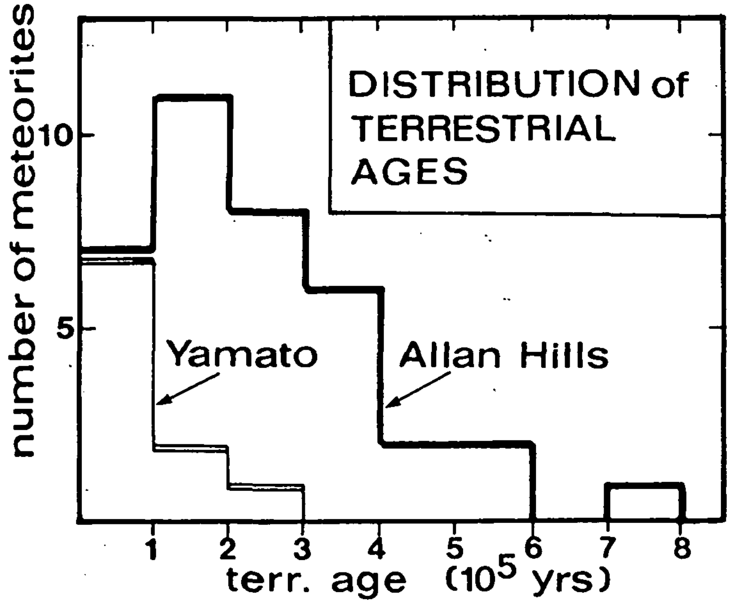

Fig.1: Distribution of terrestrial ages of Allan Hills and Yamato meteorites (2,11,Tab.1). Possible paired falls are counted only once.

Schultz, L.

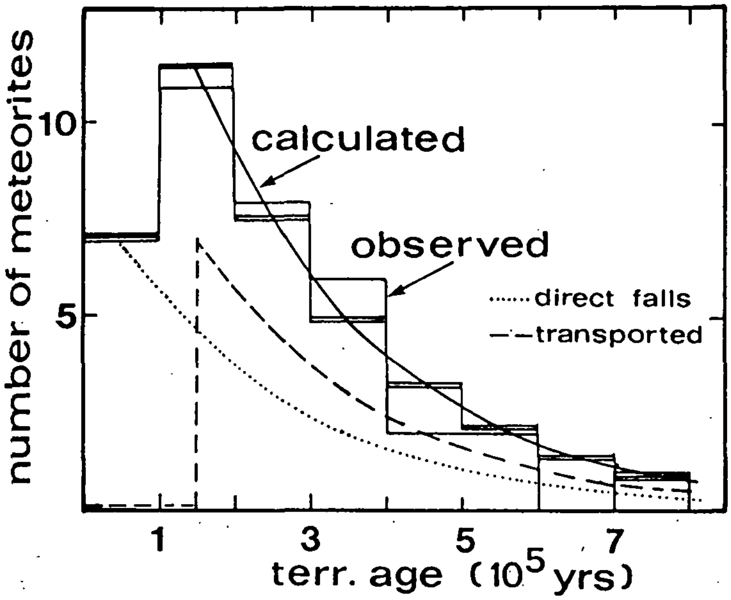

Fig.2: For Allan Hills meteorites the distribution of terrestrial ages is calculated from direct falls and transported meteorites. The "weathering" half-life on the surface of the ice is $1.6 \cdot 10^5$yrs and the transport time within the ice is about $1.5 \cdot 10^5$ yrs.

Tab. 1: Terrestrial ^{81}Kr and exposure ages of Antarctic achondrites. Brackets indicate paired falls.

Sample	Class	Terrestrial age (10^3yrs)	Exposure age (10^6yrs)
ALH 78132	Euc	121 ± 52	16.1 ± 1.2 ⎤
ALH 79017	Euc	117 ± 51	15.5 ± 1.7 ⎥
ALH 81009	Euc	115 ± 92	14.5 ± 1.6 ⎦
ALH 77005	She	190 ± 70	3.6 ± .4
EET 79004	Euc	250 ± 23	21.6 ± 2.1
EET 79005	Euc	185 ± 41	27.6 ± 1.7 ⎤
EET 79006	Euc	190 ± 39	26.2 ± 1.6 ⎥
EET 82600	Euc	173 ± 29	26.3 ± 1.9 ⎦
TIL 82403	Euc	≦32	28.5 ± 1.8
PCA 82502	Euc	309 ± 31	21.9 ± 1.5
Y 74450	Euc	≦44	73.3 ± 6.5 ⎤
Y 790007	Euc	≦34	73.5 ± 7.2 ⎦
Y 790122	Euc	111 ± 31	24.4 ± 1.8 ⎤
Y 790260	Euc	140 ± 32	21.6 ± 1.7 ⎥
Y 790266	Euc	150 ± 33	22.0 ± 2.0 ⎦
Y 75032	Dio	22 ± 56	17.2 ± 1.6
Y 790727	How	225 ± 58	12.7 ± 1.2