Dating of samples using radioactive decay

(1) Rubidium - Strontium method

$^{87}Rb \xrightarrow{\beta} {}^{87}Sr$ $t_{1/2} = 48.8 \times 10^{9}$ yrs

$\lambda = \ln 2 / t_{1/2}$

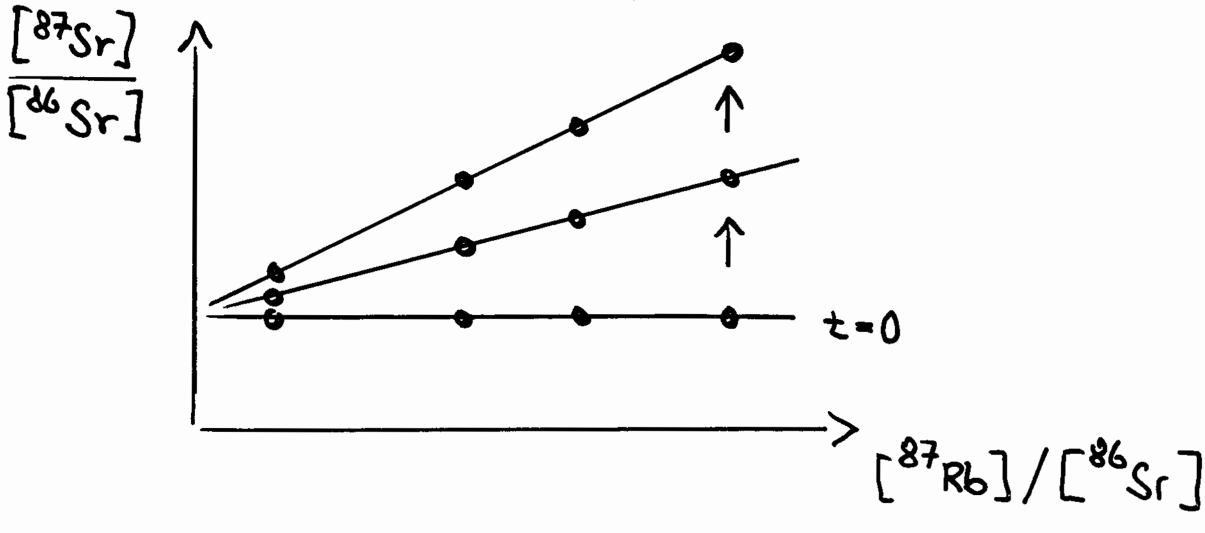
$$[^{87}Rb]_t = [^{87}Rb]_0 \cdot e^{-\lambda t}$$

$$[^{87}Sr]_t = [^{87}Sr]_0 + [^{87}Rb]_0 (1 - e^{-\lambda t})$$

$$= [^{87}Sr]_0 + [^{87}Rb]_t \cdot (e^{\lambda t} - 1)$$

Reference isotope ^{86}Sr

$$\frac{[^{87}Sr]}{[^{86}Sr]}(t) = \frac{[^{87}Sr]}{[^{86}Sr]}(0) + \frac{[^{87}Rb]}{[^{86}Sr]}(t) \times (e^{\lambda t} - 1)$$



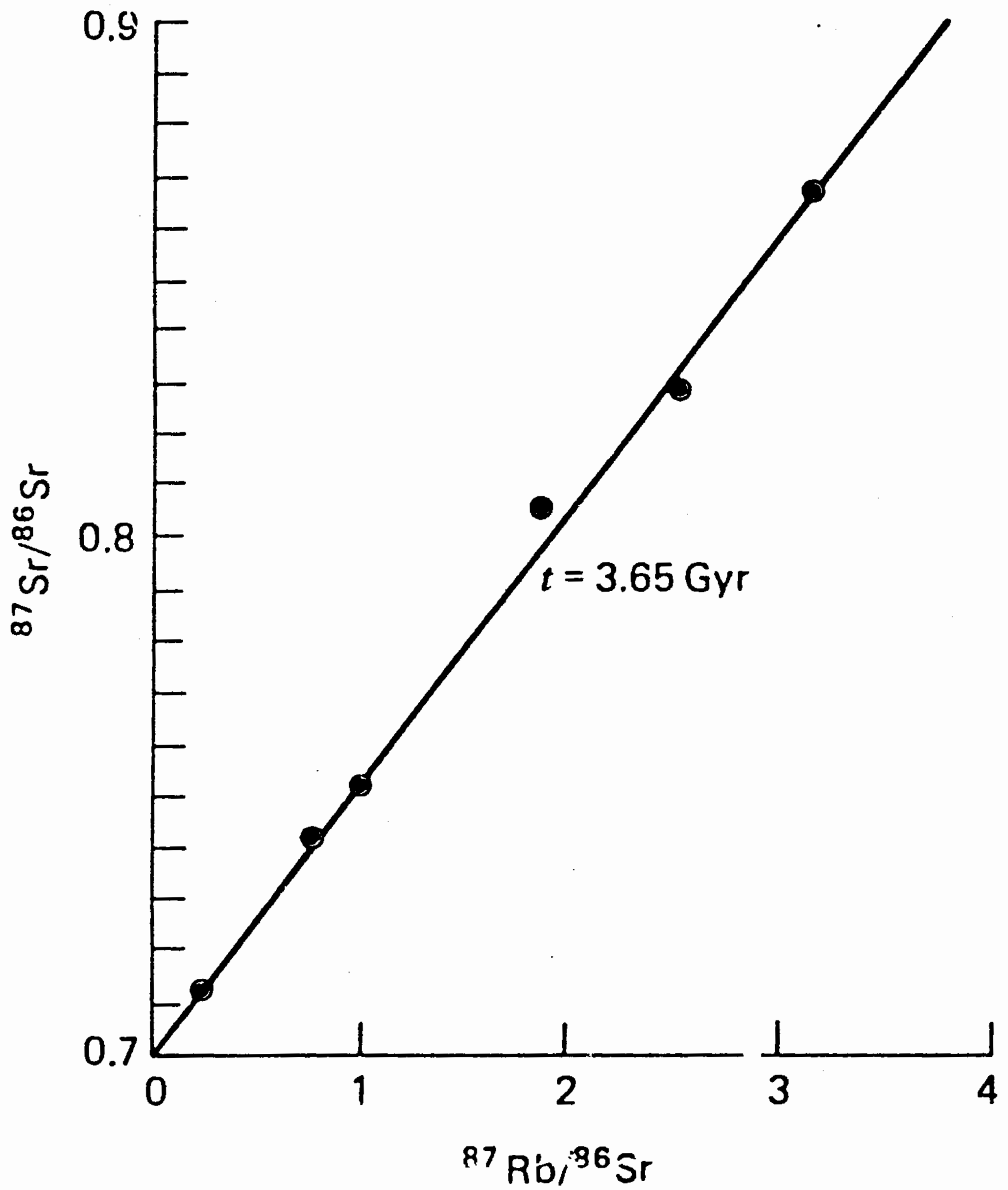


Figure 1-14 Isochron for the Amitsoq gneiss from the Godthaab district of southwestern Greenland. This is one of the oldest terrestrial rocks. Data from S. Moorbath, R. K. O'Nions, R. J. Pankhurst, N. H. Gale, and V. R. McGregor, Further rubidium strontium age determination on very early Precambrian rocks of the Godthaab district, West Greenland, Nature Physical Sciences, **240,** 78–82 (1972).

(2) Lead - lead method

$^{238}U \rightarrow {}^{206}Pb \qquad t_{1/2} = 4.46 \times 10^{9}$ yrs

$^{235}U \rightarrow {}^{207}Pb \qquad t_{1/2} = 0.704 \times 10^{9}$ yrs

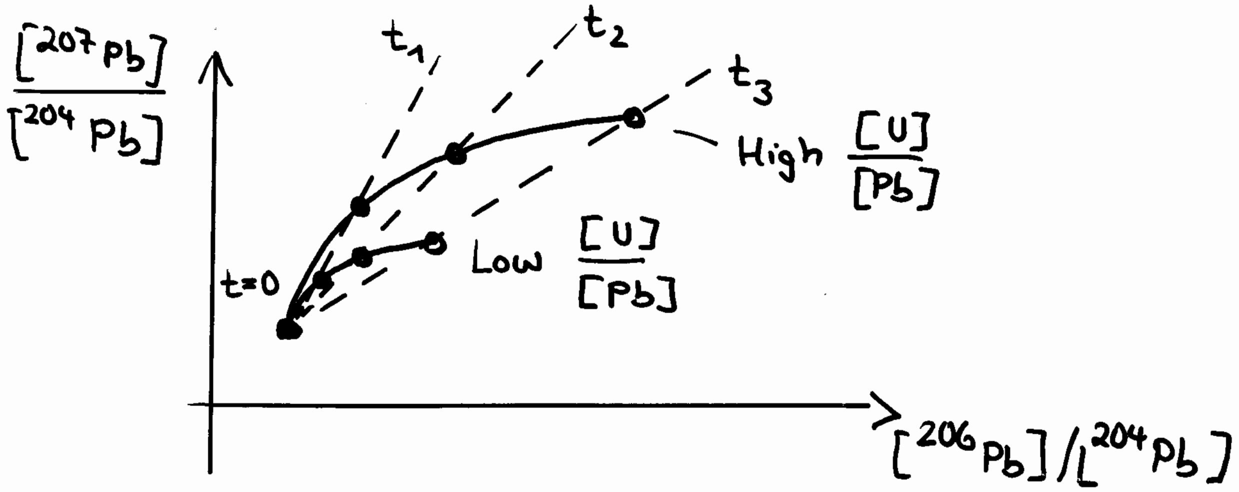
Reference isotope ^{204}Pb

$$\frac{[207/204]_t - [207/204]_0}{[206/204]_t - [206/204]_0} = \frac{[^{235}U]}{[^{238}U]}(t) \cdot \frac{e^{\lambda_{235} \cdot t} - 1}{e^{\lambda_{238} \cdot t} - 1}$$

$$R = \frac{1}{137.9} \qquad f(t)$$

$$[207/204]_t = [207/204]_0 + [206/204]_t \cdot R \cdot f - [206/204]_0 \cdot R \cdot f$$

$$y = y_0 + x \cdot a - x_0 \cdot a$$



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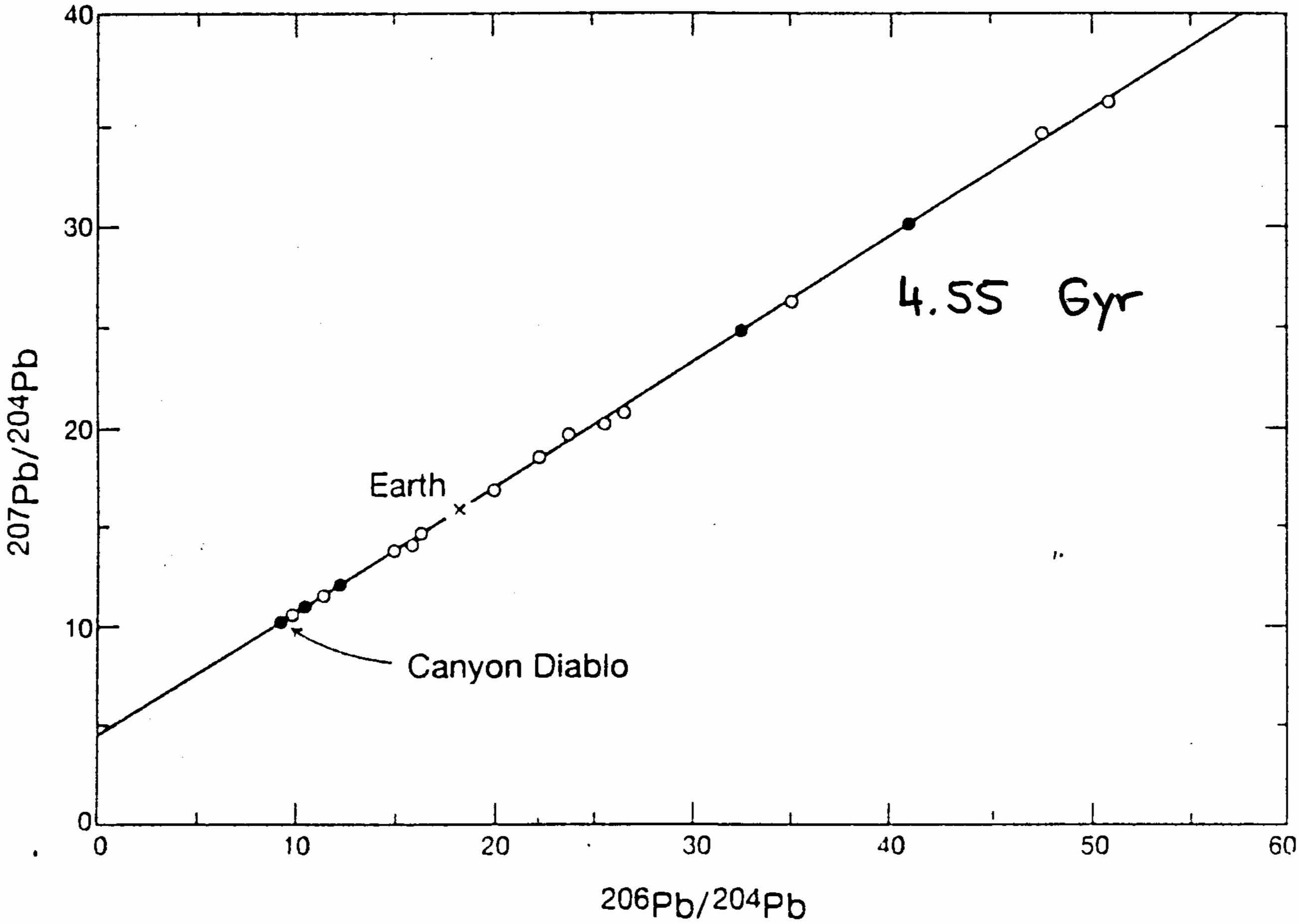
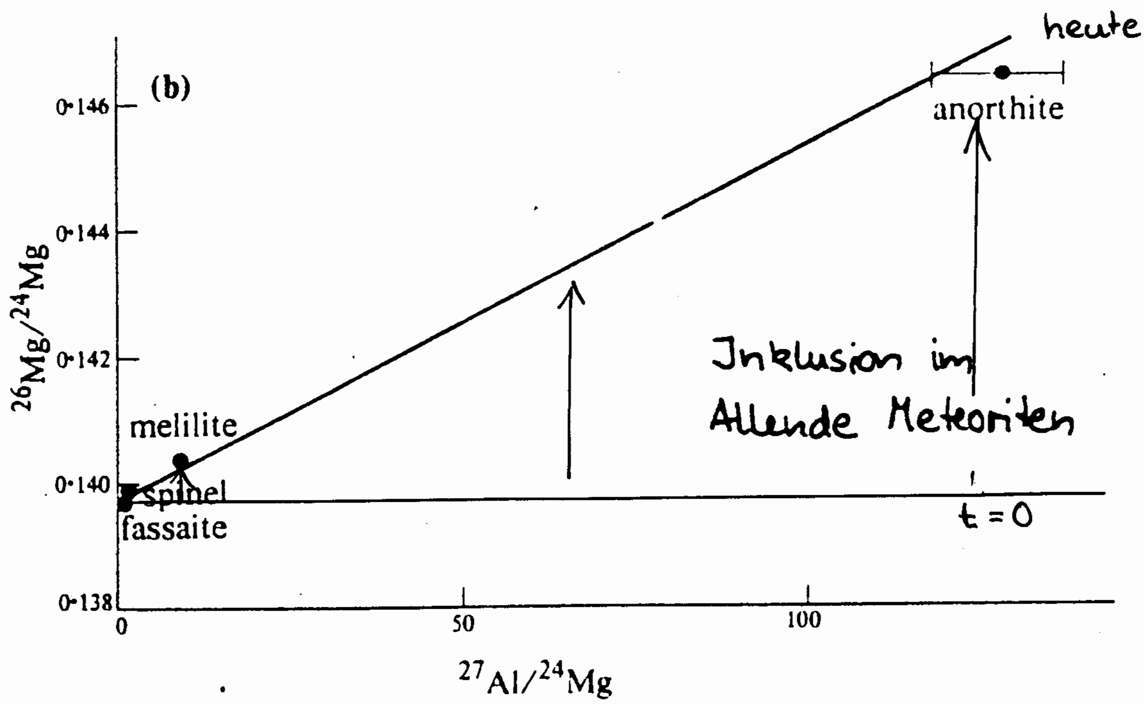
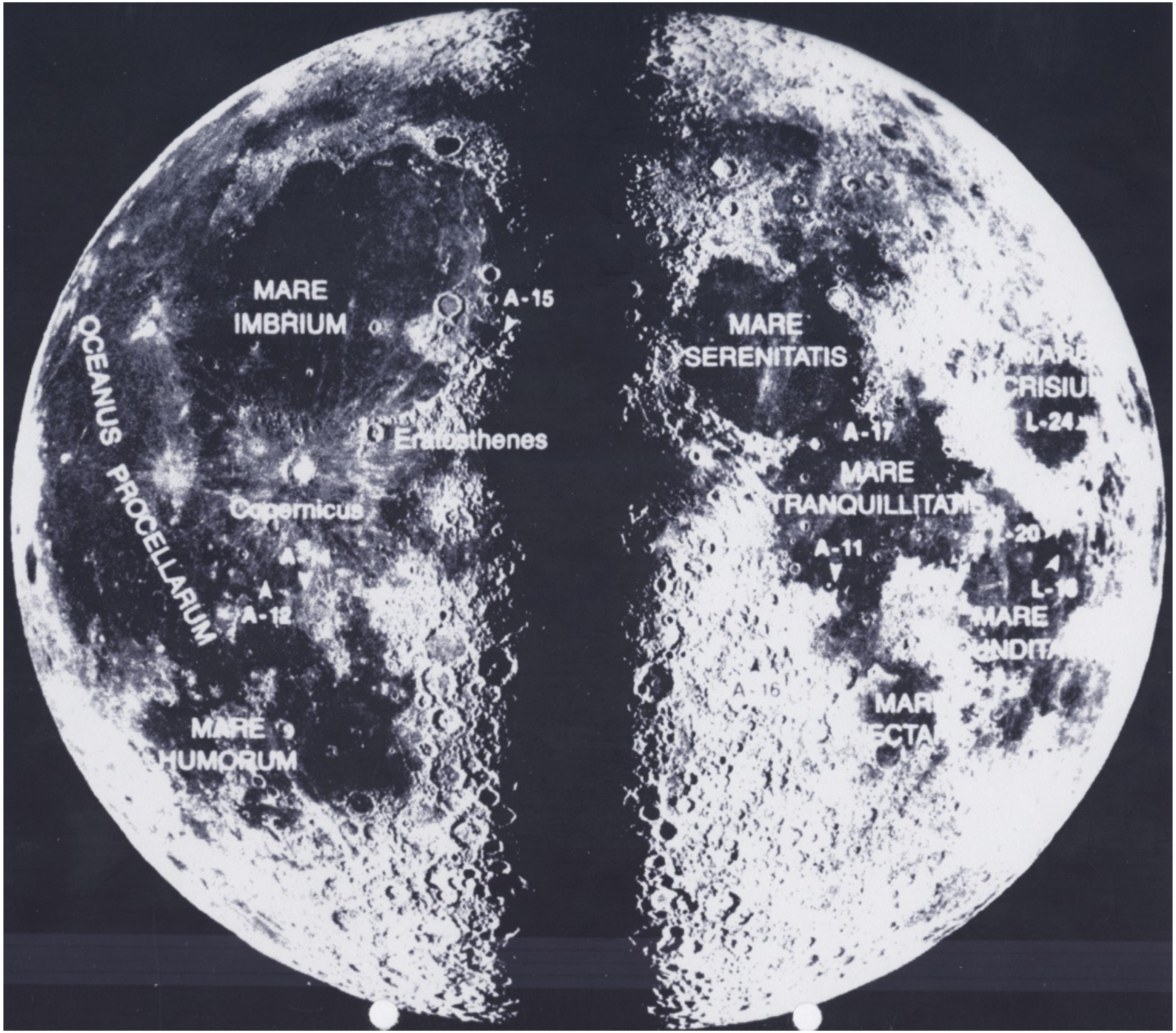
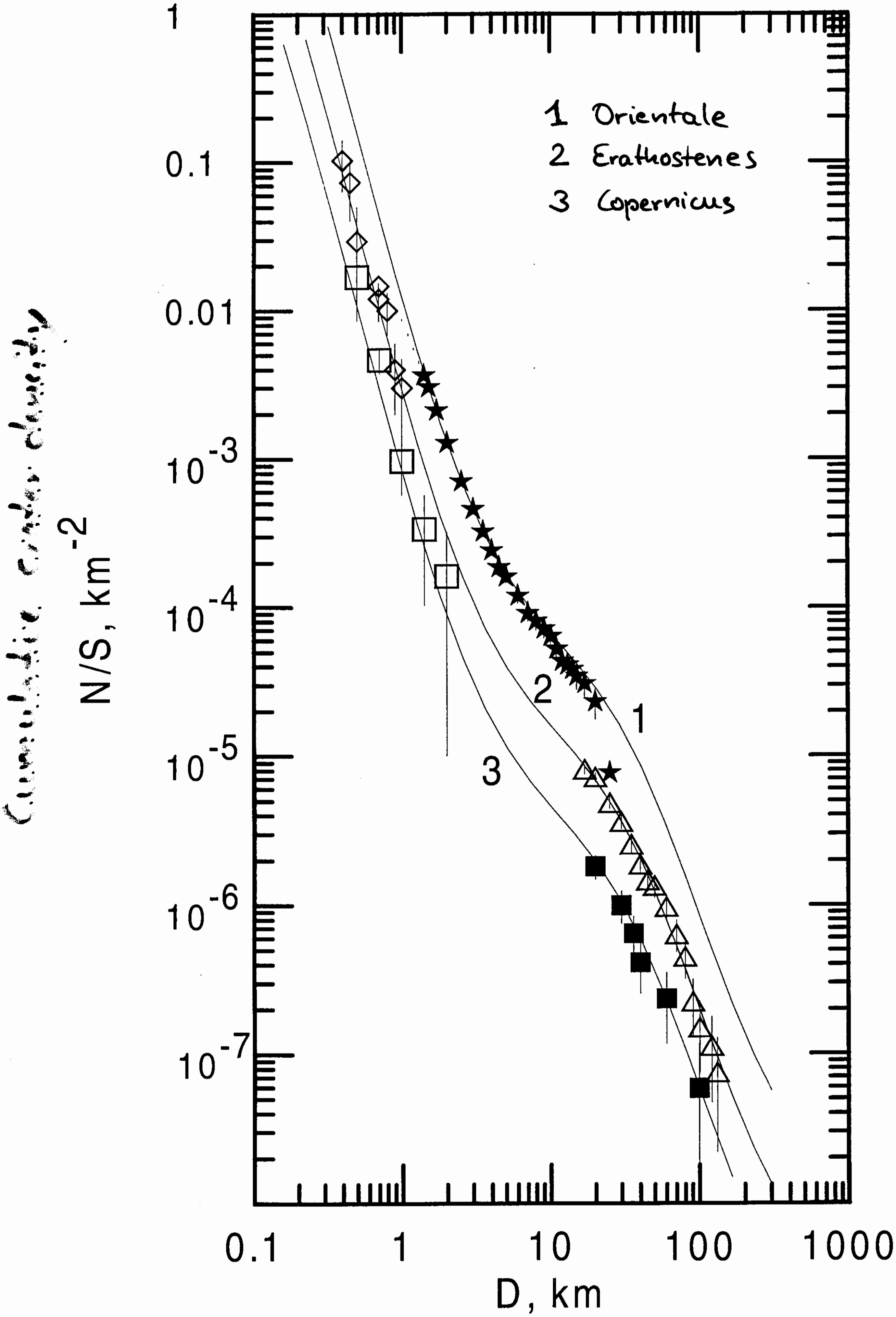


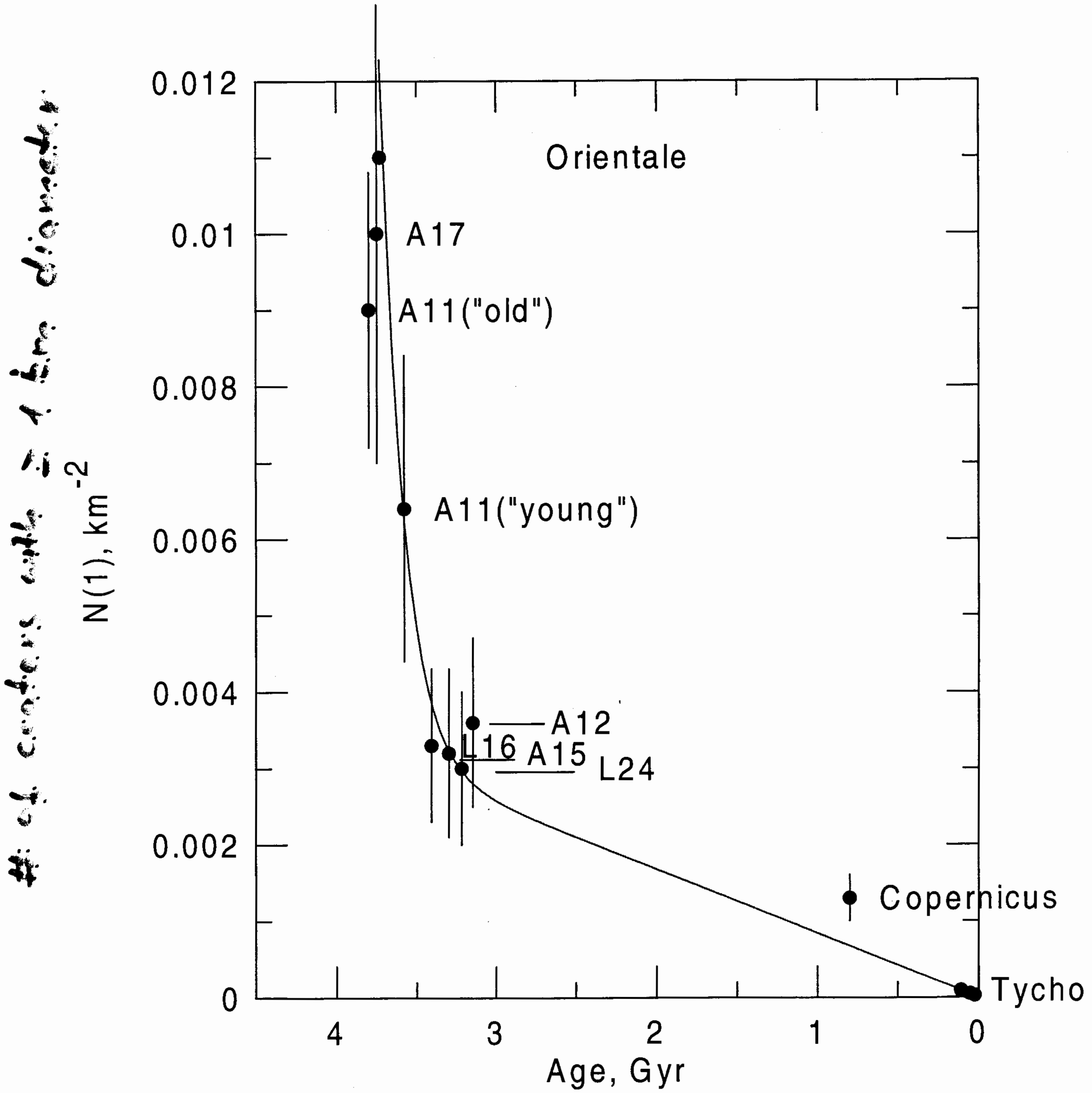
Figure 2.2. Lead-lead isochron for meteorites; a plot of data from two laboratories. The average terrestrial (marine sediment) data point of Chow and Patterson (1962) is shown as a cross. Some overlapping data points are omitted and values for highly radiogenic samples are well off the range plotted here, but all of the data were used to constrain the least-square fitted line (Eq.2.23).



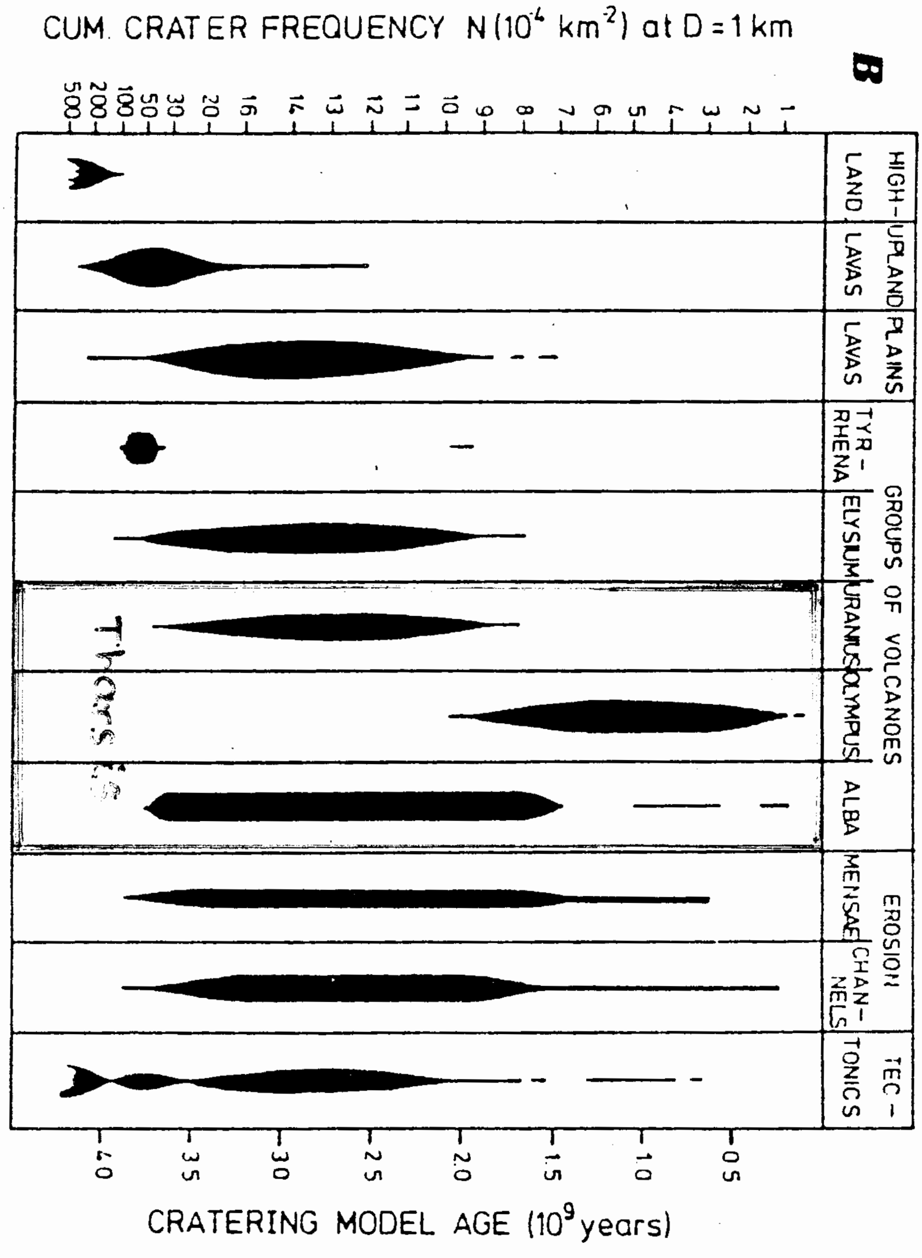

MARE
IMBRIUM
A-15
OCEANUS PROCELLARUM
Eratosthenes
Copernicus
A-12
MARE
HUMORUM
MARE
SERENITATIS
CRISIU
L-24
A-17
MARE
TRANQUILLITATI
A-11
MARE
A-16
MAR
ECTA


1 Orientale
2 Erathostenes
3 Copernicus
Cumulative crater density
N/S, km^-2
D, km
1
0.1
0.01
10^-3
10^-4
10^-5
10^-6
10^-7
0.1
1
10
100
1000
1
2
3

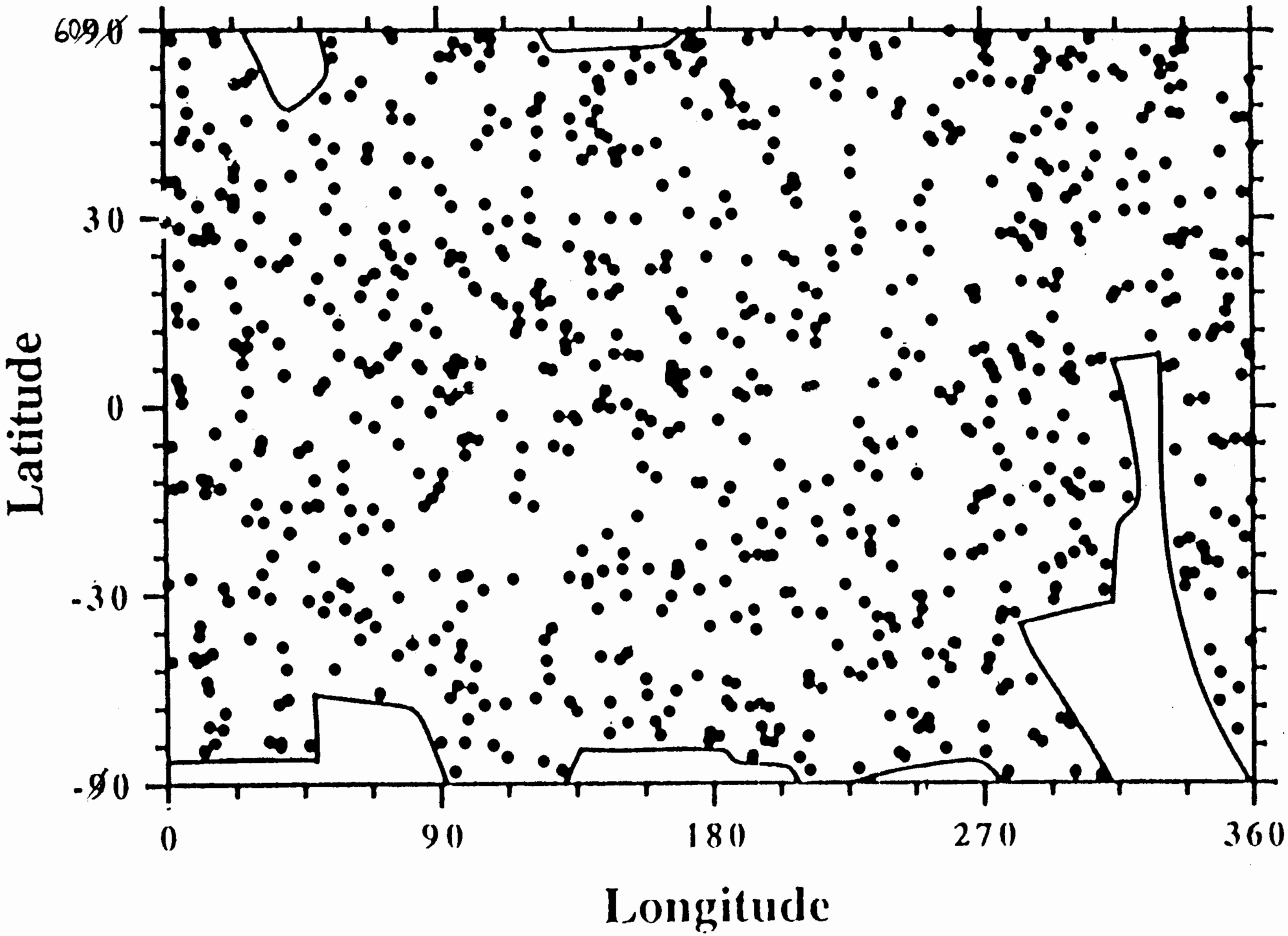
a).



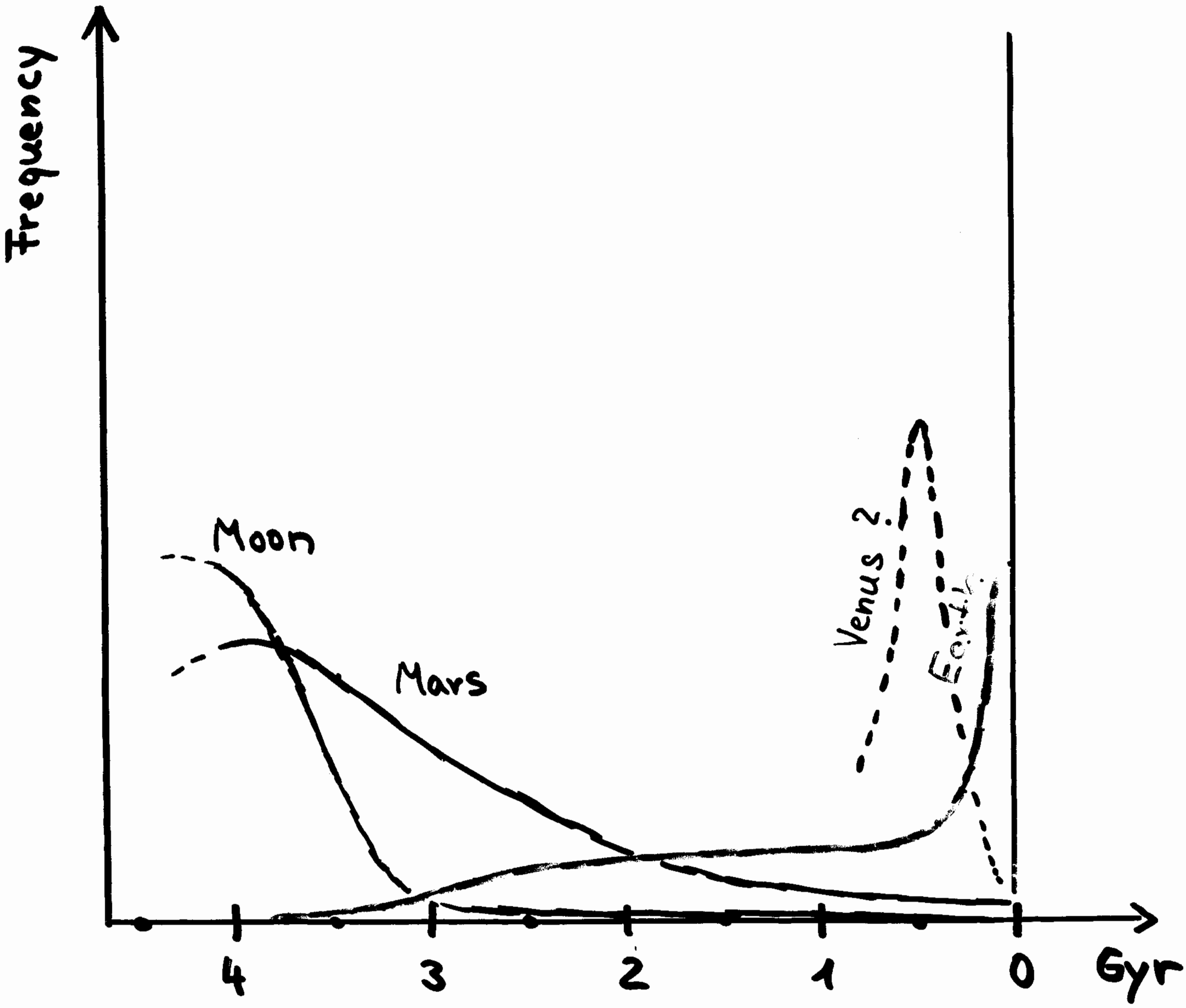
# of craters with ≥ 1 km diameter
N(1), km-2
0.012
0.01
0.008
0.006
0.004
0.002
0
Orientale
A17
A11("old")
A11("young")
A12
L16
A15
L24
Copernicus
Tycho
4
3
2
1
0
Age, Gyr


CUM. CRATER FREQUENCY N (10⁴ km⁻²) at D = 1 km
B
HIGH-LAND
UPLAND LAVAS
PLAINS LAVAS
GROUPS OF VOLCANOES
TYR-RHENA
ELYSIUM
URANIUS
OLYMPUS
ALBA
Tharsis
EROSION
MENSAE
CHAN-NELS
TEC-TONICS
CRATERING MODEL AGE (10⁹ years)

Schaber et al.: Impact Craters on Venus JGR '92



Observed Venusian impact crater distribution in simple cylindrical projection.



Frequency
Moon
Mars
Venus ?
Earth
4
3
2
1
0
Gyr