Inhomogeneous argon distribution in shocked chondorites and 40Ar/39Ar ages

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40Ar/39Ar age studies of shocked meteorites require 40Ar/36Ar ratios. Isochron plot and/or inverse isochron plot have been used to obtain the ratios. We propose a new type of analysis called Age-Initial Ratio (AIR) line when isochron cannot be defined. The 40Ar/36Ar age equation can be modified as

(40Ar/36Ar)i = (J(40Ar)m-(39Ar)(exp(lamda.t)-1))/J(36Ar),

where 40Ar/36Ar ratio is expressed as a function of possible age (Figure). One AIRlines corresponds to one data point. If data points have the same ages and initial ratios they go through the same single coordinate. Normally a group of crossing point is formed since data includes some errors.

We carried out laser probe 40Ar/36Ar spot analyses and Cathodoluminescence (CL) measurement on a 5 x 5 mm2 thin section of L6 chondrite, Y75097. Inverse isochron analysis yielded an impact age and 40Ar/36Ar initial ratio of 330 Ma and 185, respectively. However, it was difficult to define an isochron for data obtained from 1.5 mm apart from the shock vein because of small amount of 36Ar (i.e. large errors).

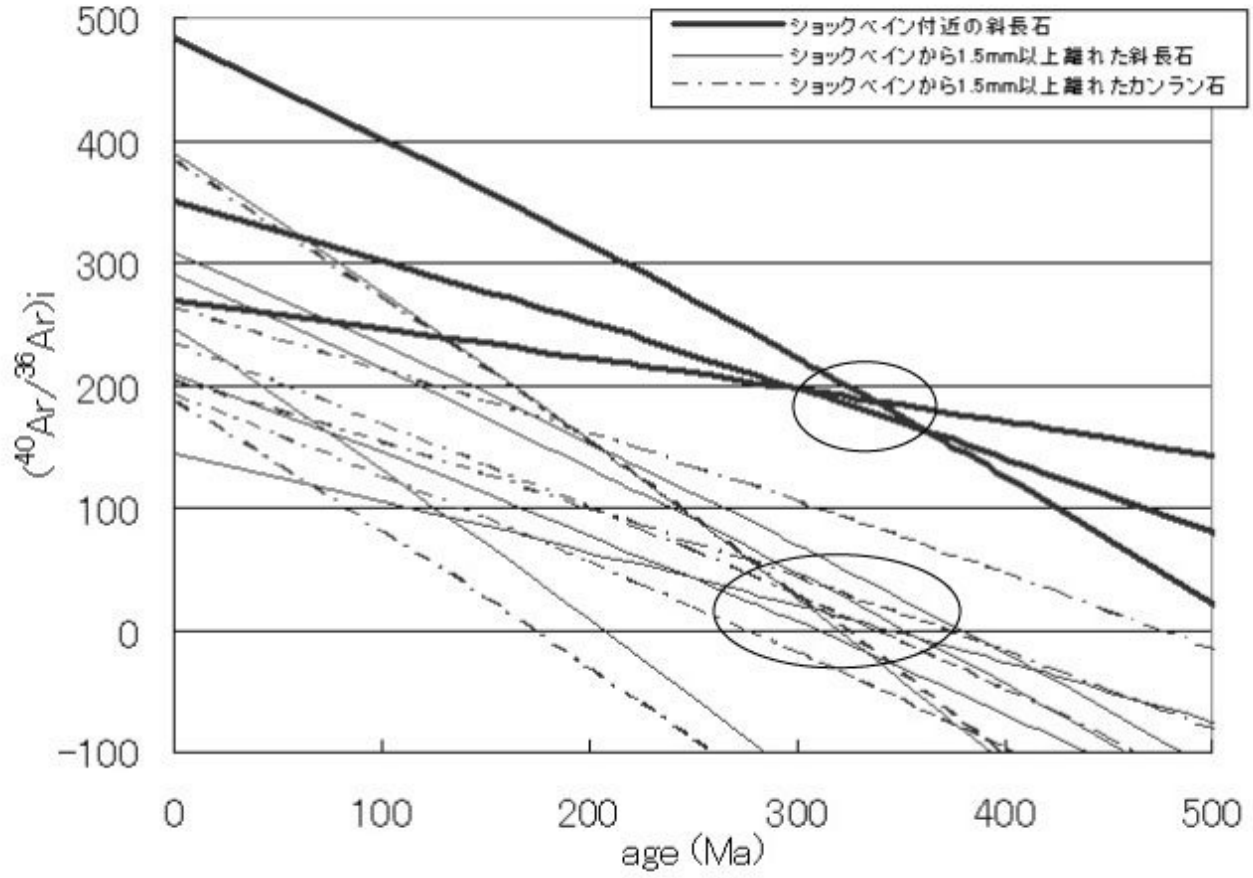
We applied AIRline analysis on the data set, and obtained two groups of crossing points as shown in the figure. The three lines from plagioclase near shock vein gave the same results as the inverse isochron analysis. Data from plagioclases and olivines more than 1.5 mm apart from the vein made a loose group of the same age but different 40Ar/36Ar ratio of nearly 0. This illustrates that the chondrite has two different 40Ar/36Ar ratios in a small area within a few millimeters. AIRline analysis provides a new approach to visualize the group of different 40Ar/36Ar ratios when isochron analyses are not difficult.

40Ar enrichment in the shock veins have been reported previously (e.g., McConville et al. 1988). Kaneoka et al. (1988) have carried out bulk 40Ar/39Ar age analysis and obtained an age of 490Ma. This might represent an apparent 40Ar enrichment due to a use of single 40Ar/36Ar ratio. In a review by Bogard (1995), many data sets gave impact ages of approximately 500Ma. However, most of the data are from bulk analyses. They need to reviewed in detail using microanalyses.

BOGARD D. D. (1995) Impact ages of meteorites: A synthesis. Meteoritecs 30, 244-268.

KANEOKA I.,TAKAOKA N. and YANAI K. (1988) 40Ar-39Ar analyses of Yamato-75097 (L6) chondrite from Antarctica. Proc. NIPR Symp. Antarct. Meteorites 1st, 206-214.

McCONVILLE P., KELLEY S.and TURNER G. (1988) Laser probe 40Ar-39Ar studies of the Peace River shocked L6 chondrite. Geochim. Cosmochim. Acta 52, 2487-2499.


ショックベイン付近の斜長石
ショックベインから1.5mm以上離れた斜長石
ショックベインから1.5mm以上離れたカンラン石
500
400
300
200
100
0
−100
0
100
200
300
400
500
age (Ma)
$(^{40}Ar/^{36}Ar)i$