

POROSITY OF CHONDRITES: SOME REGULARITIES. *V.A.Alexeev and N.S.Kuyunko.* V.I.Vernadsky Inst. of Geochem. and Analyt. Chem., Russian Academy of Sciences, Moscow, Russia.

Porosity depends on processes of formation and evolutionary history of composite materials of chondrites. The same processes may stipulate, in particular, the content of radiogenic ^4He and ^{40}Ar in the meteorites. We have analysed the distribution of porosity of H and L chondrites depending on ratio of T_4/T_{40} (where T_4 and T_{40} are U, Th-He and K-Ar gas-retention ages, respectively) for determination of possible interrelation between these features of meteorites.

The porosity values were taken from [1-4]. Gas-retention ages were calculated according to contents of radiogenic ^4He and ^{40}Ar . The noble gas data were taken from [5]. We corrected the ^4He contents for cosmogenic ^4He by the commonly followed algorithm; the ^4He production rate is taken to be 5 times greater than that of ^3He [6]. All ^{40}Ar was taken as radiogenic. The mean concentrations for U, Th and K were used: 12 ng/g, 42 ng/g and 780 $\mu\text{g/g}$, respectively, in the H-group and 13 ng/g, 43 ng/g and 860 $\mu\text{g/g}$ in L-group [6,7]. The isotopic constants were taken from [8].

All meteorites with known values of porosity, T_4 and T_{40} are given in Table. The shock stage data are given according to classifications of Stöffler et al., S1-S6 shock stages [9] or Dodd and Jarosewich, a-f shock facies [10]. Distribution of the porosity values vs. ratio of T_4/T_{40} is shown in Fig.1. On the basis of these data we can do next conclusions:

1. All points are placed in the sector. The divergence angle for H chondrite sector is less than for L chondrite one.
2. The lower porosity the wider range of T_4/T_{40} values.
3. Strongly shocked meteorites have mainly low porosity. So, among of 6 shock classified chondrites with porosity of $\rho > 10\%$ we have not strongly shocked chondrites ($>S3$ or $>c$) but among of 9 shock classified chondrites with $\rho < 10\%$ we have 6 such meteorites (67%).

We could not find any regularity in the distribution of porosity vs. ratio of cosmic-ray exposure ages of t_3/t_{21} (where t_3 and t_{21} are ^3He and ^{21}Ne exposure ages, respectively).

The obtained data may apparently be explained by decreasing the porosity and increasing the diffusion losses of radiogenic ^4He (in comparison to those of ^{40}Ar) owing to collisions of parent bodies of meteorites.

Porosity may also be stipulated by the metamorphic temperatures. If the degree of the consolidation increases with the maximum temperature which the chondrites have experienced, that is, the sintering temperature, the porosity is expected to decrease with the petrologic type [11] and may be a good measure of a consolidation of composite materials of chondrites. For H chondrites it was found a rough trend that porosity decreases with increase in petrologic type number [1]. For L chondrites, however, there was no any clear correlation between the physical properties and the petrologic types.

The change of porosity depending on petrologic type may be obscured by change of porosity after shocks. This obscure we may try to weaken by selection of meteorites with high ratios of T_4/T_{40} (for example >0.75 , see Fig. 1). Such meteorites were, apparently, not essential change by shocks, and variations of porosity in them may correlate with change of petrologic type if such correlation is real. Distribution of porosity of different petrologic type chondrites with $T_4/T_{40} > 0.75$ is shown in Fig.2. Here we can see the porosity of not only H but also L chondrites decreases with

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increase of petrologic type. Of course, the data for more number of meteorites help to do more reliable conclusions.

Table

Meteorite	Porosity,	T_4 , Gy	T_{40} , Gy	T_4/T_{40}	Shock stage, facies
ALH 77288 H6	2.1	3.53	4.63	0.76	-
ALH 77294 H5	13.8	3.62	4.53	0.80	-
Forest Vale H4	18.1	4.30	4.63	0.93	S2
Gilgoin H5	5.2	2.05	3.11	0.67	S4
Kernouve H6	9	4.26	4.64	0.92	S1
Monroe H4	5.8	1.21	2.21	0.55	bc
Mount Browne H6	6.8	3.43	4.11	0.83	S3
Wellman (a) H5	6.3	2.72	3.54	0.77	-
Zhovtnevyi H5	13.1	3.89	4.29	0.91	S3
ALH 76009 L6	7.8	1.96	4.31	0.45	-
Arapahoe L5	2.5	0.40	2.78	0.14	e
Barratta L4	0.7	0.40	0.98	0.41	S4
Bjurböle L4	16.7	3.84	4.25	0.90	S1
Bruderheim L6	8.1	0.93	2.06	0.45	S4
Elenovka L5	10.5	3.47	4.11	0.84	S2
Kunashak L6	5	0.45	0.64	0.70	e
Leedey L6	10.5	1.92	4.12	0.47	S3
New Concord L6	9.2	0.74	1.70	0.44	d
Saratov L4	18.3	3.78	4.52	0.84	S2
Y 74191 L3	10.3	1.57	3.48	0.45	-
Y 75097 L6	10.1	0.46	0.52	0.88	-

References: [1] Yomogida K., Matsui T. Mem. Natl Ins. Polar Res., 1981, No.20, 384. [2] Homano Y., Yomogida K. Ibid., 1982, No.25, 281. [3] Britt D.T. et al. LPS XXVI, 1995, 177. [4] Schmitt R.T., Stöffler D. Meteoritics, 1995, v.30, 574. [5] Schultz L., Kruse H. Meteoritics, 1989, v. 24, 155; Schultz L. Private communication. [6] Wasson J.T., Wang S. Meteoritics, 1991, v.26, 161. [7] Kallemeyn G.W., Rubin A.E., Wang D., Wasson J.T. GCA, 1988, v.53, 2747. [8] Steiger R.H., Jäger E. EPSL, 1977, v.36, 359. [9] Stöffler D., Keil K., Scott E.R.D. GCA, 1991, v.55, 3845. [10] Dodd R.T., Jarosewich E. EPSL, 1979, v.44, 335. [11] Yomogida K., Matsui T. LPS XII, 1981, 1227.

Notes to Table: T_4 and T_{40} are U,Th-He and K-Ar ages, respectively. An uncertainty of age values is about 10%.

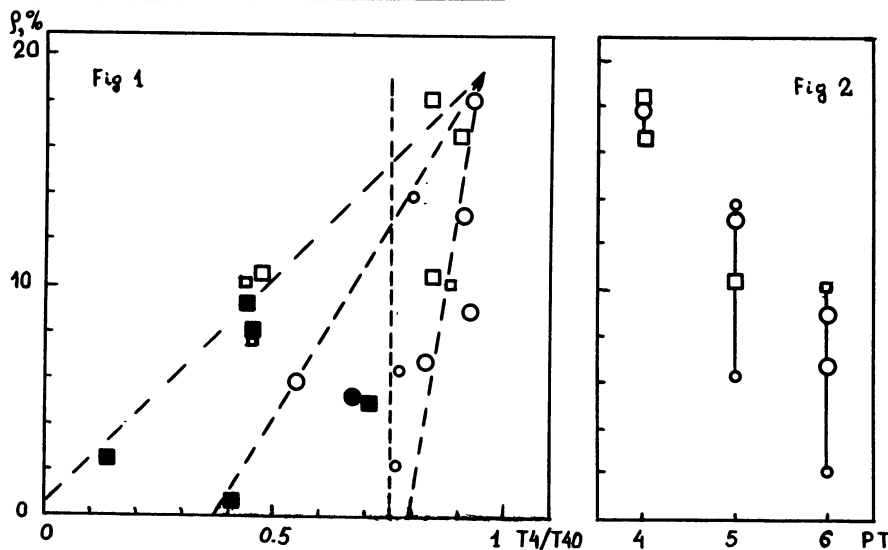


Fig. 1. Porosity (p) vs. ratio of gas-retention ages (T_4/T_{40}). Circles are H chondrites, squares are L chondrites. Big symbols are for shock classified meteorites (opened: $< S3$ or $< c$; filled: $> S3$ or $> c$). Small symbols - shock data is not available.

Fig.2. Porosity vs. petrologic type of chondrites with $T_4/T_{40} > 0.75$. Designation see in Fig.1.