INVESTIGATION ON ISOTOPIC COMPOSITION OF NOBLE GASES IN THE TSAREV METEORITE. Y.A.Shukolyukov, Dang Vu Minh, V.I. Simonovsky, M.M. Fugzan, L.F. Migdisova, N.I. Zaslavskay. Vernadsky Institute of Geochemistry and Analythical Chemistry USSR Acad. Sci., Moscow.

In 1976 in the Tsarev village (Volgograd region) 28 fragments weighing 1100 kg of L5 chondrite were found. It is the largest stone meteorite found in the USSR and the third largest in the world. We present the first results on isotopic composition of noble gases in the Tsarev meteorite and compare it with that of solar wind. Isotopic analysis was carried out on mass spectrometer MI-1201 operating in quasi-static mode. New system was used for complete automation of measurement and calculation procedures, including scaning magentic field, registration and treatment of mass spectrum. Blank of system at 1700°C: ^{136}Xe-5.10^{-13}, ^{86}Kr-2.10^{-12}, ^{40}Ar-3.10^{-8}, ^{20}Ne-1.10^{-9}cm^{3}STP. Mass discrimination was less than 0,5%per m.u. and a correction was made for all data.

Isotopic composition of Xe. The isotopic composition of Xe in bulk rock samples of the Tsarev meteorite differs from that of carbonaceous chondrites, solar wind and terrestrial atmosphere.

A great excess of radiogenic ^{129}Xe was found in comparison with AVCC. It is obvious even from the results of isotopic analysis of Xe in the bulk rock samples. The meteorite is considerably enriched in ^{129}Xe in comparison with solar wind, terrestrial atmosphere and many ordinary chondrites of various classes. A ^{129}Xe concentration in the Tsarev chondrite is of 1.8.10^{-10}cm^3/g and corresponds to the formation interval 100 My.

At stepwise heating it became clear that there exist two mineral phases-carrier of ^{129}Xe (Fig. 1). The isotopic ratios, especially the $^{129}Xe/^{130}Xe$ ratio and gas concentration in the same sample varied from one subsample to another. This fact indicates that gas concentration is not homogenous in all parts of meteorite. A possible error on determination of Xe amount is excluded because the variations on Xe concentration are accompanied by great variations on Xe isotopic composition measured with high precision. Perhaps, in the past the Tsarev meteorite has undergone heating and lost low-temperature fraction of gases. There exist considerable differences on Xe distribution in the structure of various fragments (Fig. 2). Probably, at the impact losses of gases in various parts of the meteorite occurred at different degrees depending on the depth from the meteorite surface and caused the inhomogenity on concentration of gases remained in the structure of the meteorite. The variations on the $^{129}Xe/^{130}Xe$ ratio due to inhomogenous distribution of ^{129}I, an progenitor of ^{129}Xe in mineral phases which can retain Xe at different degree at the impact interaction.

Other isotopic ratios demonstrated multicomponent composition of Xe in the Tsarev meteorite. On the three-isotope diagram the experimental points don't lie on the straight line, that would be in the case of two-component mixture (Fig. 3).

One of the Xe component in the Tsarev meteorite is atmospheric-like Xe, another is radiogenic ^{129}Xe, the third Xe component is solar Xe. It is impossible to consider the first Xe component as consequence of admixture of atmospheric Xe during experiment because: 1) the blank of system is about 100 times less than measured amount of Xe, 2) all isotopic ratios of "atmospheric-like" Xe considerably differ from those of Xe in the terrestrial atmosphere.

In the bulk samples of the Tsarev meteorite we don't find obvious signs of ^{244}Pu fission Xe which is usually observed in chondrites.

Isotopic composition of Kr. The isotopic composition of Kr in the Tsarev meteorite is more like that solar wind than that of carbonaceous chondrites and terrestrial atmosphere. It is especially clear in the abundance of ^{78}Kr and ^{80}Kr isotopes. There exist correlations between the Kr isotopic ratios indicating great role of mass fractionation process in formation of the isotopic composition of Kr in the Tsarev meteorite (Fig. 4).

Isotopic composition of Ne and Ar. In the isotopic composition of Ne and Ar in the Tsario meteorite the obvious signs of spallogenic component were found. The gas is enriched in ^{21}Ne and ^{22}Ne relative ^{20}Ne. The $^{20}Ne/^{22}Ne$ ratio is 3.5, the $^{21}Ne/^{22}Ne$ ratio is 0.92. Contribution of spallogenic Ar is considerable too. The $^{38}Ar/^{36}Ar$ ratio is 0.344. The concentration of ^{40}Ar is remarkable and ranged from 9.10^{-6} to 28.10^{-6}cm^3/g. The minimum K-Ar age of crystallization is 2.6 My. The cosmic age calculated from the concentration of spallogenic isotopes $^{21}Ne_c$ and $^{38}Ar_c$ is 2.6 - 0.4 My.

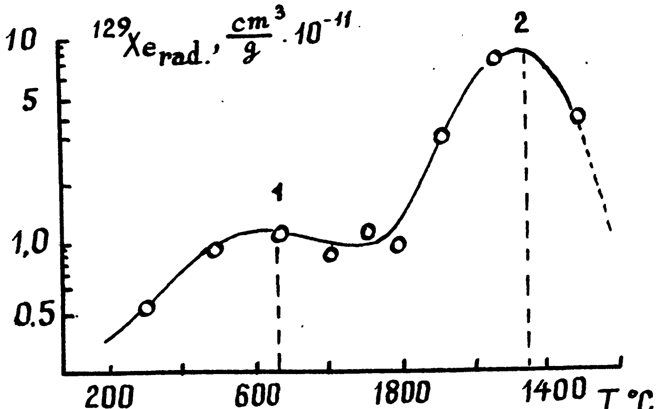

Fig. 1

Fig. 1 Release pattern of radiogenic ^{129}Xe from the Tsarev chondrite: 1-sulphite phase (?), 2-high-temperature condensate.

NOBLE GASES IN TSAREV METEORITE

Shukolyukov Yu.A. et al.

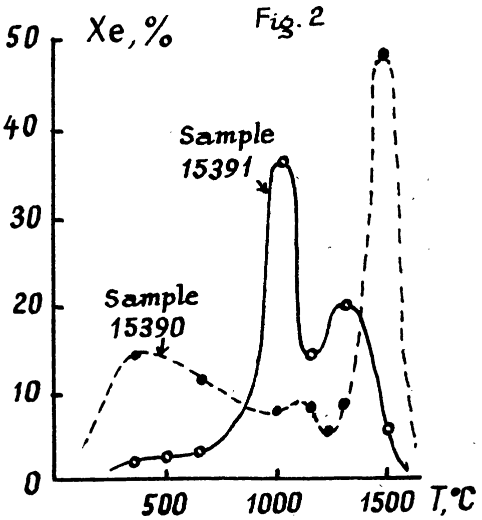

Fig. 2 Xe release curve of two fragments of the Tsarev meteorite.

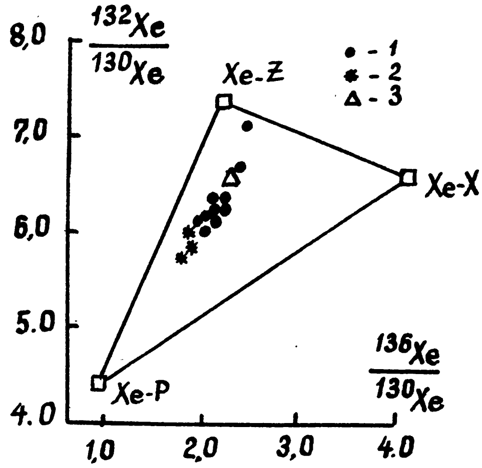

Fig. 3

Fig. 3 Variations on the isotopic ratios of Xe in the Tsarev meteorite. 1-bulk-rock samples, 2-solar Xe, 3-atmospheric Xe,X,P,Z-components of the primordial Xe.

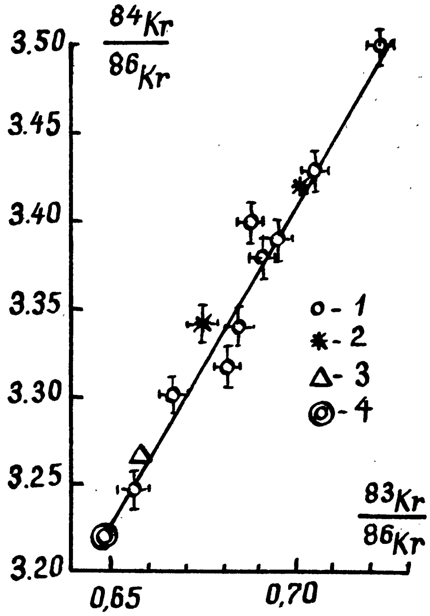

Fig. 4

Fig. 4 Kr isotopic correlation in the Tsarev meteorite (1), solar (2), atmospheric Kr (3), AVCC (4).