ONCE AGAIN ABOUT ^{129}Xe* IN METEORITIC NANODIAMONDS. L.F. Semjonova and A.V. Fisenko, Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, Moscow 119991 Russia; e-mail: anat@chgnet.ru

Introduction. The nanodiamond in meteorites is the most abundant relict of the protonebula in comparison with other relicts (e.g., SiC, graphite). It also is most mysterious both by mechanism of formation, and by origin of chemical elements which are anomalous on isotopic composition. One of such problem is the localization in diamond grains of ^{129}I which decay has led to the excess of ^{129}Xe (^{129}Xe*). At present there are following assumptions. (1) ^{129}I has been implanted into diamond grains simultaneously with P3 noble-gas component [1, 2]. (2) ^{129}I has been adsorbed by a surface of the diamond grains and this process proceeded irrespective of capture P3 component [3]. In last model has disappeared necessity to assume big losses of P3 noble-gas component from all meteoritic nanodiamonds, even CI and CM chondrites. Within the limits of model in [1, 2] degassing events should occur over a time span of some 50 Ma, with respect to diamonds in the CO3 chondrite ALHA 77307, which were least affected and thus have the earliest closure time.

Here we give the results of additional analysis of ^{129}Xe* contents in meteoritic nanodiamonds and their correlations with ^{132}Xe-P3 and ^{132}Xe-HL.

Results and discussion. The excess ^{129}Xe concentrations (^{129}Xe*) in nanodiamonds were calculated as follows:

$$^{129}Xe^* = {}^{132}Xe_m \times (^{129}Xe/^{132}Xe)_m - {}^{132}Xe_{P3} \times (^{129}Xe/^{132}Xe)_{P3} - {}^{132}Xe_{HL} \times (^{129}Xe/^{132}Xe)_{HL} - {}^{132}Xe_{P6} \times (^{129}Xe/^{132}Xe)_{P6} - {}^{132}Xe_{Air} \times (^{129}Xe/^{132}Xe)_{Air} - {}^{132}Xe_S \times (^{129}Xe/^{132}Xe)_S,$$

where $^{132}Xe_m$ and $(^{129}Xe/^{132}Xe)_m$ are the measured ^{132}Xe concentrations and ^{129}Xe/^{132}Xe ratios for the diamond separates; subscripts "P3", "HL", "P6", "Air" and "S" define various xenon components; $^{132}Xe_{P3}$, $^{132}Xe_{HL}$, $^{132}Xe_{P6}$, $^{132}Xe_{Air}$ and $^{132}Xe_S$ are the concentrations of the Xe components. For these calculations we used the "normal" P6 component [4]. The ^{129}Xe/^{132}Xe ratios for various Xe components were taken from [2, 4], the values for $^{132}Xe_m$, $(^{129}Xe/^{132}Xe)_m$ and the concentrations of Xe components from [5, 6].

Values ^{129}Xe* on Fig. 1a have been calculated at $(^{129}Xe/^{132}Xe)_{P3} = 1.042\pm0.002$ [4], whereas on the rest figures at $(^{129}Xe/^{132}Xe)_{P3} = 1.02\pm0.01$ [2]. On Fig. 1a and 1c can see, that various values of the $(^{129}Xe/^{132}Xe)_{P3}$ ratio have not led to change of pattern of dependence ^{129}Xe* vs. ^{132}Xe-P3. Nevertheless, in the further we use the contents ^{129}Xe* calculated at $(^{129}Xe/^{132}Xe)_{P3}$ equal to 1.02±0.01.

On the Fig. 1a and 1c there are the group of meteorites, data for which can approximate by linear dependence in half-logarithmic scale. This dependence can to result from, e.g., increases in time of closing I-Xe system or reduction of iodine retain in the diamond grains with increase a thermal metamorphism degree. The data deviation for diamonds of other meteorites can explain as follows. The Allende CV3 and Indarch E,H3-4 diamonds have the least contents of ^{129}Xe* and of Xe-P3 (Fig. 1a, c). Most possibly, these meteorites have been experienced strong thermal metamorphism after decay of the basic quantity of ^{129}I. On the content of ^{129}Xe* the diamonds of Mezö Madaras and Kainsaz meteorites is identical with Allende and Indarch diamonds, but differs from theirs on contents of P3 component. Such distinction is caused, possibly, by identical both the time of closing I-Xe system and losses of iodine, but different a thermal metamorphism degree. The last condition especially evidently is visible on plot ^{129}Xe* vs. ^{132}Xe-HL (Fig. 1b). Two these conditions could be executed if the speed of cooling of parent body of Allende and Indarch was more than in case of Mezö Madaras and Kainsaz.

The highest ^{129}Xe* concentration is observed in the unique CO3 meteorite ALHA 77307 (Fig. 1). It is possible that alteration of protonebular matter in the parent body of this meteorite resulting from thermal or hydrothermal metamorphism was rather small [7]. At the same time, the concentration of P3 for nanodiamonds in ALHA 77307 is lower than that for nanodiamonds in CI and CM meteorites (Fig.1a, b). One can assume, therefore, that losses of Xe-P3 from nanodiamonds of ALHA 77307 occurred outside of the parent body, i.e. before accretion. Such correlation of ^{129}Xe* and P3 contents is in a complicated manner to explain within the limits of Gilmour's model [1, 2] and it finds a simple explanation at surface sorption of iodine by diamond grains [3].

Explanation of low ^{129}Xe* contents in diamonds of CI and CM meteorites, and also in Acfer, which contain the greatest content of P3 (Fig. 1a, c) is one of the basic criteria of a reality of models of iodine association with nanodiamonds. According to Gilmour's model it is necessary, that after decay of the basic quantity of iodine the formed ^{129}Xe* in the CI, CM diamonds have been lost during thermal metamorphism together with some amount of P3 [1, 2]. At the same time, CI and CM meteorites have been experienced heating not above 140°C [8, 9]. It is unlikely, that heating up to such temperature could

lead to significant losses of ^{129}Xe*, with regard to, e.g., the temperature of the beginning of its releasing at pyrolysis Orgueil nanodiamonds (≥300°C). In model of surface-connected iodine [3] the low contents of ^{129}Xe* in the meteorites which have been experienced significant aqueous alterations (e.g., Orgueil CI, Murchison CM2 and Murray CM2) are explained by loss of iodine as a result of leaching. It is obvious, that this process did not affected the noble gases.

On the plot ^{129}Xe*/^{132}Xe-HL vs. ^{132}Xe-P3 the data for most of meteoritic nanodiamonds also can approximate by linear dependence in half-logarithmic scale (Fig. 1d). Possibly, without revealing the reason of occurrence of such dependence to do a conclusion about almost constant of ^{129}Xe*/^{132}Xe-HL ratio among the least degassed nanodiamond separates [2] is represented insufficiently unreasonable.

Conclusion. The analysis of relations of ^{129}Xe* and P3 and HL contents in meteoritic nanodiamonds has shown that the model of surface-connected iodine in diamond grains is more preferable than model of simultaneously capture of iodine and P3 gases as a result of the implantation.

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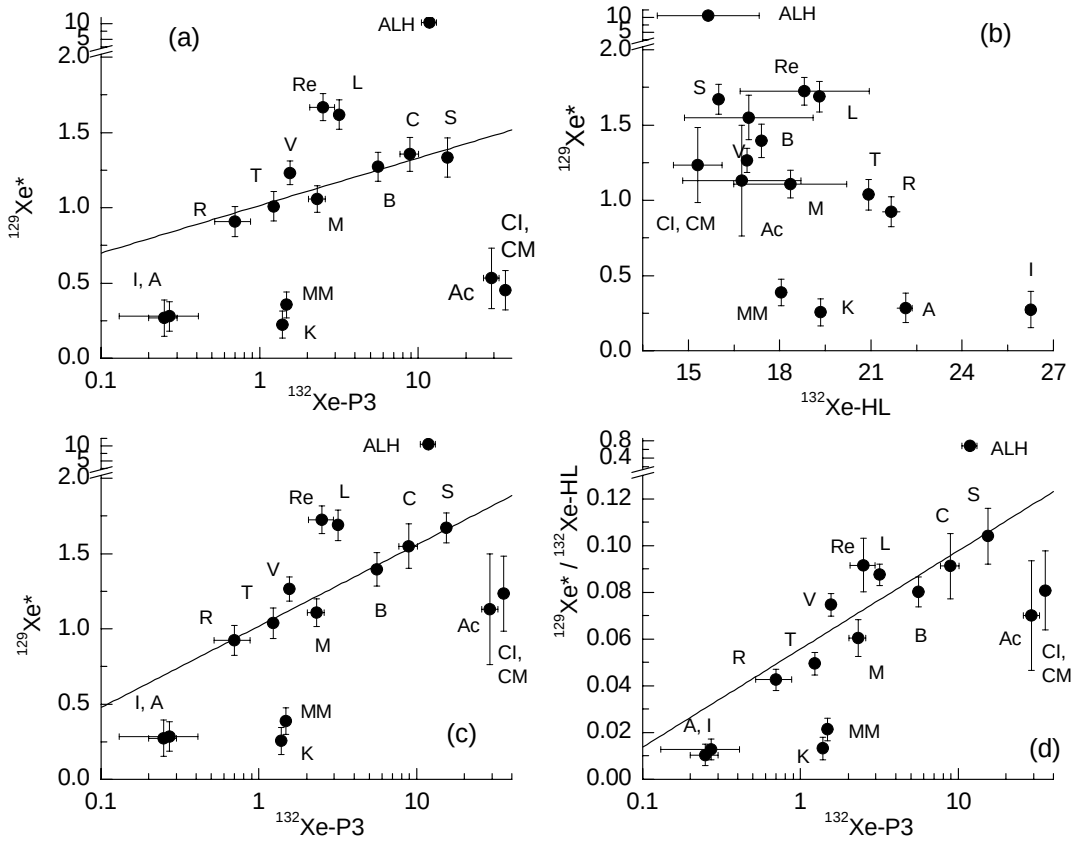

Figure 1. Relations between the contents of ^{129}Xe* and ^{132}Xe–P3, ^{132}Xe–HL in meteoritic nanodiamonds. The uncertainties of data are ±1σ. All Xe amounts in 10^{-8} cc/g. Designations: A–Allende CV3, Ac—Acfer 214 CH, ALH—ALHA 77307 CO3, B—Bishunpur LL3.1, C— Colony CO3, I–Indarch E,H3-4, K—Kainsaz CO3.2, L—Leoville CV3, M—Mokoia CV3, MM—Mezö Madaras L3.5, S—Semarkona LL3.0, T—Tieschitz H3.6, R- Ragland LL3.5, Re–Renazzo CR2, V—Vigarano CV3; CI, CM – the average data for Orgueil CI, Murchison CM2, and Murray CM2.