Analysis of the release kinetics of Xe-HL and Xe-P6 during pyrolysis of the meteoritic nanodiamonds. A. V. Fisenko and L. F. Semjonova, Vernadsky Institute of Geochemistry and Analytical Chemistry Russian Academy of Sciences, Kosygina 19, Moscow, 119991 Russia, e-mail: anat@chgnet.ru

Introduction: Position of noble gases of P3, HL and P6 components in meteoritic nanodiamonds and processes of their capture are debatable questions till now. Therefore the analysis of these components remains one of the basic directions of nanodiamonds research. Here we give the analysis of results of release kinetics of Xe-HL and Xe-P6 during pyrolysis of meteoritic nanodiamonds according to data in [1].

Results and discussion: Analysis of the release kinetics of Xe-HL and Xe-P6 during pyrolysis of nanodiamonds of various meteorites was performed using differential curves of xenon release. They have been calculated on the basis of data [1] which were approximated by curves of normal distribution. For nanodiamond of each meteorite the differential curve of Xe-HL release as well as Xe-P6 should satisfy to following conditions. (A) The integral area is equal to the content of total released xenon of each component. (B) Relative yield of the xenon components at any step of the heating, calculated on a differential curve, is equal to those according to [1]. Differential curves for nanodiamonds of some meteorites are shown on Fig. 1.

Analysis of Xe-HL and Xe-P6 release kinetics on the basis of differential curves has shown the following. Alterations of release temperatures of almost total Xe-HL and Xe-P6 depending on a degree thermal metamorphism of meteorites are similar (Fig. 2). As an indicator of the degree of thermal metamorphism we used the sum of (Xe-P3 + Kr-P3) [1] normalized to those for Orgueil. On Fig. 2 are also shown the median values of temperatures for Xe-HL according to [1]. One can see, the distinctions between these values and calculated by us do not exceed 3%.

It is supposed that decrease of Xe-HL median temperature for Orgueil and Semarkona diamonds relatively thermal metamorphized meteorites is caused by labile subcomponents HL [1]. At the same time, for Orgueil and Semarkona diamonds the decrease of Xe-P6 release temperature is also observed relative to the meteorite Leoville (Fig. 2). This indicates that decrease of destruction temperatures of meteoritic nanodiamonds during pyrolysis can be also caused by his modifying as a result of oxidizing processes in parental bodies of meteorites. Possibly, as a result of these processes the defectiveness of diamond grains is increased that lead to decrease of their temperature of destruction.

Temperatures of the 90% Xe-HL and Xe-P6 release are greatest for nanodiamonds of meteorite Leoville (Fig. 2), which is least thermal metamorphized from CV reduced group. For more thermal metamorphized meteorites the temperature of HL and P6 xenon release is decreased (Fig. 2). It is possibly that these reductions are caused by modifying of the host-phases of HL and P6 components during metamorphism under various reducing-oxidizing conditions.

The initial host-phases of HL and P6 components possibly were not less thermal stability than in Leoville, and their thermostability was affected as a result of intensive aqueous alternation or thermal metamorphism. At the same time the initial ratio of the host-phases of HL and P6 components was most probable similarly to those in meteorite Orgueil.

According to data on Fig. 2, the character of alteration of Xe-HL and Xe-P6 contents depending on a degree thermal metamorphism of meteorites is distinguished. Hence, the host-phases of HL and P6 components differ by modifying and safeties during metamorphism. For example, this can be result from different position of Xe-HL and Xe-P6 in diamond grains. It is probably that the Xe-HL in grains of diamond due to implantation [2, 3] is distributed more or less uniformly whereas Xe-P6 is basically concentrated in the central zone of large grains. Such localization of Xe-P6 could be result of the formation of large grains in two stages, which have been proceeded at various times and, probably, in different astrophysical places. After formation of diamonds on first stage, the grains adsorbed noble gases of P6 component. After adsorption of gases the second stage of growth of these grains could occur in the environment having, for example, another isotopic composition of carbon.

Conclusions: Thermostability of the meteoritic nanodiamonds depends on a degree thermal metamorphism and reducing-oxidizing properties of their parental bodies. These factors in a different degree alternated the host-phases of HL and P6 components. It is probably that during strong thermal metamorphism in reducing environment the layer-by-layer graphitization of diamond grains have been occurred. In this case the high content of Xe-P6 relatively Xe-HL in the Indarch nanodiamonds could be caused by localization of the Xe-P6 in central part of the large nanodiamond grains.

References: [1] Huss G. R. and Lewis R. S. (1994) *Meteoritics, 29*, 791–810. [2] Verchovsky A. B. et al. (1998) *Science, 281*, 1165-1168. [3] Huss G.R. et al. (2008) *Met. Plan. Sci., 43*, 1811-1826.

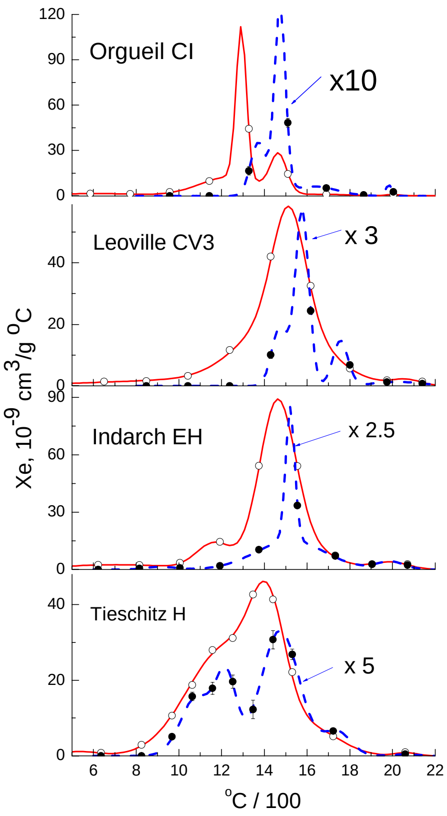

Figure 1. Differential curves of the Xe-HL release (solid red lines) and the Xe-P6 (dash blue lines). The open and filled points - differential yield of Xe-HL and Xe-P6 according to [1].

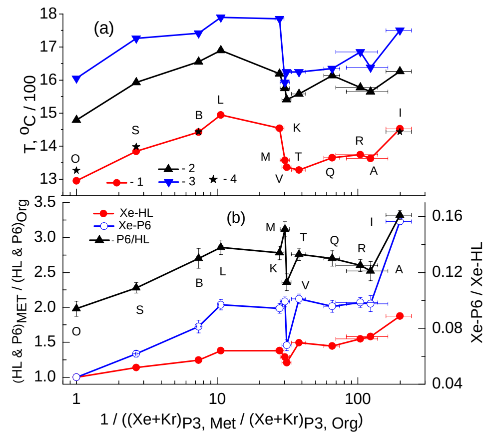

Figure 2. (a) Temperature of the Xe-HL and Xe-P6 release during pyrolysis of nanodiamonds depending on the degree thermal metamorphism of meteorites. 1 - Median temperature, 2 and 3 - 90% yield of Xe-HL and Xe-P6, accordingly, 4 – median temperature according to [1]. Designations: O - Orgueil CI, S – Semarkona LL3.0, B – Bishunpur LL3.1, L – Leoville CV3, K – Kainsaz CO3, M – Mezo Madaras L3.5, V – Vigarano CV3, T – Tieschitz H3.6, Q – Qingzhen EH3, R – Ragland LL3.5, A – Allende CV3, I – Indarch EH4.

(b) Alteration of contents of Xe-HL and Xe-P6, and P6/HL ratio for nanodiamonds depending on a degree of thermal metamorphism of the meteorites.