NANODIAMOND OF METEORITES: CORRECTION RESULTS OF ISOTOPIC COMPOSITIONS OF XENON COMPONENTS. A.V. Fisenko, L.F. Semjonova, T.A. Pavlova T.A. Vernadsky Institute of Geochemistry and Analytical Chemistry RAS, Kosygin Street 19, Moscow, Russia (anat@chge-net.ru)

Introduction: The increased concentrations of heavy xenon isotopes in the isotopically-anomalous Xe-HL and Xe-P6e components, identified in [1], could be the result of implantation of xenon isotopes formed during a short time (about 2 hours) of the decay of their radioactive precursors [2]. The source of the latter is the classical r-process of nucleosynthesis, for example, in a type II supernova explosion. However, the short decay time does not correspond to the ratio of the excess content of $^{132}$Xe/$^{136}$Xe.

To increase the degree of this accordance, we were corrected the isotopic compositions of the Xe-P3 and Xe-P6e components identified in [1]. In this work we present the results of such a correction and the calculated contents of the obtained potentially primary xenon components in the enriched in nanodiamond fractions (ENF) of such meteorites as Orgueil (CI), Allende (CV3), and Indarch (EH3,4).

Correction of the isotopic compositions of the xenon components: The correction was carried out under the assumption of the following:

1. Nanodiamond grains and their diamond-like surface border contain an almost isotopically-normal xenon component, designated below as Xe-P3C.

2. The isotopically anomalous component Xe-P6e, identified using the high-temperature data for xenon during the pyrolysis of ENF in [1], is also enriched in Xe-S in an amount of 3%.

3. The Xe-P6e component without this enrichment is designated below as Xe-P6e-C. The calculated excess abundances of xenon isotopes in the Xe-HL and Xe-P6e-C components normalized to $^{136}$Xe at the Xe-P3 component relative to the Xe-P3C component. This enrichment is assumed by us to be about 3% from the relative content of $^{136}$Xe.

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pr1C and Xe-pr2C component release, confirm the above assumption that the Xe-pr1C and Xe-pr2C components are contained in different carrier-phases. Note that during metamorphism under oxidizing conditions, SiC grains are less stable than nanodiamond grains. In this case, it is confirmed by the fact that the Xe-pr2C/Xe-pr1C ratio for the Orgueil (C1) and Allende (CV3) meteorites, which suffered thermal metamorphism under oxidizing conditions, is significantly lower than for the Indarch meteorite (EH3,4), that suffered this metamorphism under reducing conditions - (0.33(12), 0.37(12), 0.347(24), versus 0.73(10), respectively).

Table 2. Contents of xenon components (10^4 cm³/g) in ENF of meteorites

<table>
<thead>
<tr>
<th>Compartment</th>
<th>Xe/P3C</th>
<th>Xe-pr1C</th>
<th>Xe-pr2C</th>
<th>Xe-S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orgueil (C1), 100°C</td>
<td>49.8</td>
<td>49.548(41)</td>
<td>0.100 (10)</td>
<td>0.033 (12)</td>
</tr>
<tr>
<td>Allende (CV3), 600°C</td>
<td>25.11</td>
<td>24.813(40)</td>
<td>0.147 (14)</td>
<td>0.055 (17)</td>
</tr>
<tr>
<td>Allv</td>
<td>600°C</td>
<td>23.89</td>
<td>23.595(12)</td>
<td>0.1432(69)</td>
</tr>
<tr>
<td>Indarch (EH3,4), 630°C</td>
<td>30.91</td>
<td>30.354(35)</td>
<td>0.141 (10)</td>
<td>0.102 (12)</td>
</tr>
</tbody>
</table>

1 Measured total content of **134**Xe [5]. **2 Temperature of metamorphosis** [6].

2. The Xe-pr2C/Xe-S ratio values lie in the following row: 0.25(10); 0.32(44); 0.477(43); 0.58(22) for Orgueil (C1), Indarch (EH3,4), Allv, Allende (CV3) meteorites, respectively. The increased ratio for the Allende (CV3) meteorite is consistent with the following conclusion: SiC nanograins are less destroyed during high-temperature metamorphism under oxidizing conditions than larger SiC grains formed, for example, in AGB stars [3]. We emphasize that both types of SiC grains are contained in ENF released from the colloidal-like solutions of meteorites. The noted difference in the Xe-pr2C/Xe-S ratios could arise if, for example, SiC nanograins were more effectively shielded by the primary matrix material from the effects of oxidative "reagents" during metamorphism.

3. Based on the calculated deviations of the **128**Xe/**132**Xe ratios from the measured ones in [1], it follows that, only at the initial stages of pyrolysis (≤1000°C) for each ENF of meteorites, the negative deviations of the calculated **128**Xe/**132**Xe ratio from the measured one (-18.3(2.9)%e, -50.2(10.2)%e and -78.1(2.4)%e for Orgueil (C1), Indarch (EH3,4) and Allende (CV3), DM fraction, respectively) are observed. These deviations show that in our calculations we did not take into account the additional content of the **129**Xe isotope due to some factor(s). One of these factors can be, for example, the implantation of low-energy ions of the radioactive isotope **129**I into diamond nanograins and into SiC at the last stages of molecular cloud evolution. It is noteworthy that for the ENF of the Indarch (EH3,4) and Allende (CV3) (DM fraction) meteorites, which practically do not contain low-temperature (i.e., from the borders) Xe-P3, the **129**Xe/**132**Xe deviation is also accompanied by a negative deviation of the calculated **128**Xe/**132**Xe ratio from the measured one in [1]. Whether this is due to the conversion of a certain fraction of **127**I into **129**Xe as a result of irradiation with thermal neutrons is currently an open question.

Conclusion: The Xe-P3 and Xe-P6e components identified in [1] were corrected for a large short duration (about 2 hours) of the formation of excess heavy xenon isotopes as a result of the decay of their radioactive precursors according to the Ott hypothesis [1] with an excess ratio of **128**Xe/**132**Xe. As a result of the corrections made, new compositions of isotopically anomalous components were obtained, designated as Xe-pr1C and Xe-pr2C. In these components, which consist mainly of 134Xe and 136Xe isotopes, the value of the 132Xe/136Xe ratio is close to its value at a short duration of xenon formation of these components (2.58 and 2.27), respectively.

In the comparison of the calculated contents of the Xe-pr1C, Xe-pr2C, and also Xe-S components and the almost isotopically normal Xe-P3C component in the ENF of the Orgueil (C1), Allende (CV3) and Indarch (EH3,4) meteorites, the following is assumed:

a) The carrier phase for the Xe-pr1C component is diamond nanograins, while for the Xe-pr2C components are both nanodiamond grains and SiC-X grains. Consequently, the ENF of meteorites contains two types of SiC grains whose genesis is linked with a type II supernova and, for example, with the AGB stars. The Xe-pr1C and Xe-pr2C components differing in carrier phases and compositions were probably formed in different turbulent zones of mixing of fragments of the outer and inner shells during a type II supernova explosion. In this case, the necessary duration of the decay of the radioactive precursors of xenon isotopes to form the Xe-pr1C and Xe-pr2C components, (equal to 2.58 and 2.27 hours, respectively) to limits the "life" duration of their turbulent zones.

b) The content of the Xe-P3C, Xe-pr1C, and Xe-pr2C components in the ENF of various meteorites can be successfully calculated based on the measured xenon isotopic compositions. This allows these components to be considered as potentially primary components of xenon at the present moment in the study of meteorite matter.

References:

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