TO QUESTION ABOUT FORMATION OF THE PALLASITE PARENT BODIES: ON THE PECULIARITIES OF TRACE ELEMENT COMPOSITION OF MINERAL COMPONENTS FROM THE OMOLON PALLASITE. Lavrentjeva Z.A., Lyul A.Yu. V.I. Vernadsky Institute RAS, Moscow (lavza@mail.ru).

Introduction: Pallasites are highly differentiated meteorites with two major phases, olivine and Fe-Ni metal [1]. Based on the chemical composition of metal and silicates pallasites are subdivided into main, main anomalous, Eagle Station, and pyroxene bearing groups [2]. The origin of pallasites is also controversial. A standard view is that pallasites originated from the core – mantle boundary in differentiated bodies [2, 3]. At the same time, pallasites could be formed not at the core–mantle boundary (most abundant opinion), but as impact–brecciated mixture of the core–mantle material. A mixing of small amounts of metal from the core with mantle olivine could be caused by catastrophic collisions between asteroids [4]. Such collisions could transform colliding objects into a series of differentiated bodies with diverse metal–silicate ratios.

This work reports new data on the trace element composition of mineral fractions of the Omolon pallasite, which are considered from the viewpoint of cosmochemical history of pallasites. The preliminary study of olivine crystals shows that the meteorite Omolon belongs to main group of pallasites with low concentration of fajalite about 12.3 % [5]. The Omolon pallasite experienced two impact deformations, which follows from data on the chemical composition of opaque minerals and petrography of this meteorite [6].

The elemental composition of fractions was analyzed at the Central Laboratory of GEOKHI RAS using optimized version of neutron–activation analysis developed for analyzing extraterrestrial material [7]. The main aim of our study is to estimate better the petrogenesis of pallasites from studying the trace element distribution in individual mineral.

Results and discussion. Under consideration are peculiarities of elemental composition of accessory minerals and fragments extracted from Omolon pallasite. The analysis of the chemical composition of the obtained data showed that:

Tridymite in Omolon pallasite (fraction M, Fig. 1) is enriched in REE with the prominent predominance of heavy REE $(Lu/La)_M/(Lu/La)_{CI}$ = 1.97 and positive Eu anomaly $(Eu/Sm)_M/(Eu/Sm)_{CI}$ = 2.37. The element distribution in the tridymite indicates that this mineral accumulates HREE. Tridymite in comparison with the clean olivine (fraction A, Fig. 1.) it is strongly enriched by rare-earth elements, Na, Ca, Sc and by siderophilic elements.

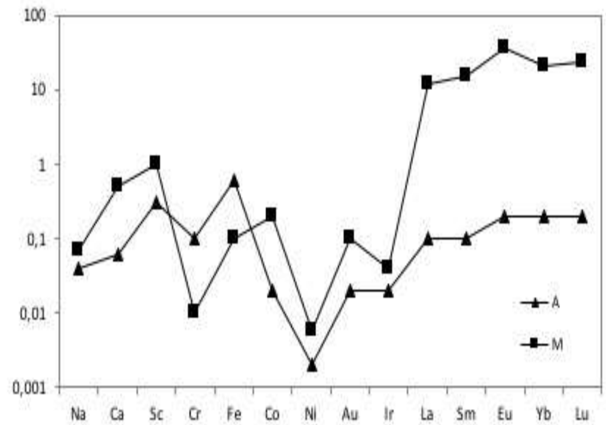

Fig.1. CI chondrite–normalized of trace element abundance patterns in accessory minerals from Omolon pallasite: 1 – fraction A (pure olivine); 2 – fraction M (trydimite).

The presence of tridymite in the olivine grains is uncommon, the phase of silica and forsterite the incompatible minerals, which are not formed in the presence of each other. In pallasite of main group Fukang, also as in Omolone, is discovered the tridymite, which, as he is presented by the authors of work, was formed after olivine. Tridymite is a SiO_2, polymorph that crystallizes within a narrow range of low-pressure, high temperature conditions. It can stably form at vacuum pressures and temperatures between 867 and 1470ºC **[**8]. It cannot with stand pressures > 0.4 GPa at any temperature, even for short durations. It is therefore as a pressure indicator in terrestrial and planetary materials **[**9].

Troilite (fraction G, Fig. 2) demonstrates enrichment in Cr, Fe, Ir, and Co relative to Ni - $(Cr,Fe,Ir,Co/Ni)_G/(Cr,Fe,Ir,Co/Ni)_{CI}$ = 590.0; 301.7; 8.0, and 4.0, respectively. Such a distribution of siderophile elements in the troilite suggests that Cr, Fe, Ir and Co is more chalcophile elements than Ni. Enrichment of troilite in Cr can be related to the presence of daubreelite. In daubreelite (fraction L, Fig. 2), the abundance of iron and zinc $(Fe,Zn)_L/(Fe,Zn)_{CI}$ = 1.0 and ratio of $(Ir/Ni)_L/(Ir/Ni)_{CI}$= 1.0 correspond to CI chondrites. The abundances of volatile Zn and Na with close condensation temperatures strongly differ

$(Zn/Na)_L/(Zn/Na)_{C1}$ = 16.7 due to different geochemical properties.

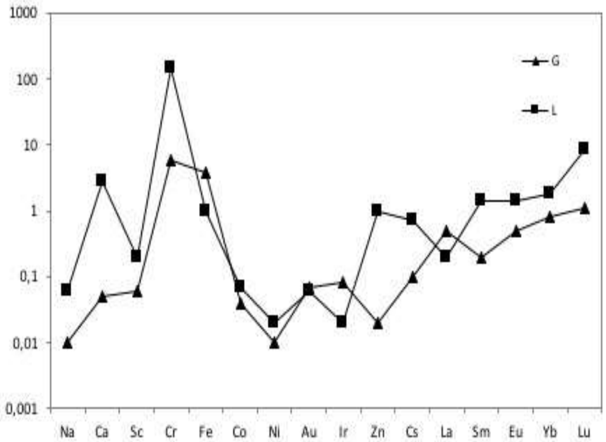

Fig.2. CI chondrite–normalized of trace element abundance patterns in accessory minerals from Omolon pallasite: 1 – fraction G (troilite); 2 – fraction L (daubreelite).

Daubreelite is enriched in Co and Au relative to Ni and Ir. The distribution of siderophile elements in the troilite and daubreelite suggests that these minerals were formed under different conditions (probably, troilite was formed at higher temperature than daubreelite).

Fragments enriched in refractory lithophile elements. The Omolon pallasite contains four fragments with high contents of refractory lithophile elements (Fig.4). All fragments enriched in LREE, Na, Ca, Sc, Cs.

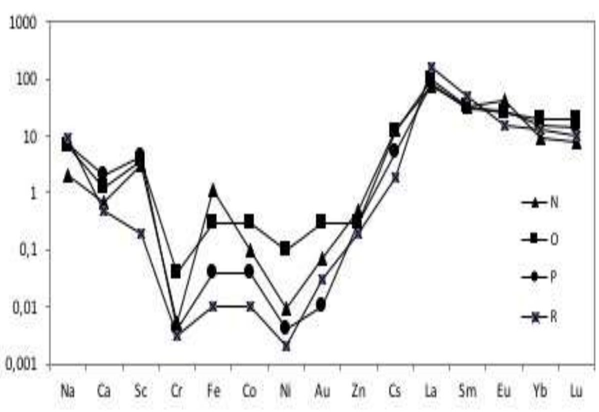

Fig.3. CI chondrite–normalized of trace element abundance patterns in fragments N, O, P, R from Omolon pallasite.

The fragments N, O, P, and R show significant fractionation between LREE and HREE $(La/Lu)_N/(La/Lu)C1 = 9.7$; $(La/Lu)_O/(La/Lu)C1 = 5.2$; $(La/Lu)_P/(La/Lu)C1 = 6.6$; $(La/Lu)_R/(La/Lu)C1 = 16.2$ with positive anomalies of Eu in the N fragment and negative, in O and R fragments. In the fragments of the Omolon pallasite, the HREE/LREE fractionation increases with increase of Na content in them. Obviously, the LREE, Na, and Th were incorporated in the same mineral. In the pallasites, the carriers of such elements as Na, K, U, and Th are phosphates [10]. The Omolon pallasite contains two phosphates [6]: stanfieldite $Ca_4 Mg_3 Fe_2 (PO_4)_6$ and whitlockite (Ca Mg $Fe^{2+})_3$ $(PO_4)_2$. Whitlockite in this case is of geochemical interest as accumulator of small amounts of alkalis available in pallasites [10]. Hence, LREE and Na in the fragments are accumulated in whitlockite.

Conclusion. Based on the study of the features of lithophile and siderophile trace element distributions in the accessory minerals and fragments from Omolon pallasite the assumption has been made that these peculiarities probably result from mixing effects of material of core and mantle olivine from different differentiated parent bodies. Such a mixture could result from a strong impact between asteroids [4].

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