THE KARA IMPACT STRUCTURE: IRIDIUM ABUNDANCES IN THE CRATER ROCKS

M.A.Nazarov, L.D.Barsukova, D.D.Badjukov, G.M.Kolesov, and I.V.Nizhegorodova - Vernadsky Institute of Geochemistry and Analytical Chemistry USSR Academy of Sciences, Moscow, 117975, USSR

It is suggested [1] that the Ir enrichment at the K/T boundary sediments is due to a huge crater-forming impact event. The Kara/Ust-Kara twin impact structure is supposed to associate with the K/T event [2-4]. If the suggestion is correct the Kara impactites should show Ir enchancement and the chondritic composition of the extraterrestrial component which was reported for the K/T sediments (e.g. [5]). For this reason in the present work we studied Ir abundances in the Kara and Ust-Kara crater rocks. The obtained Ir data are discussed here together with Ni and Cr concentrations in the same samples analysed earlier [3].

SAMPLES AND METHOD. Ir concentrations were measured by RNAA procedure [6]. The accuracy (1 σ) of the measurements is shown on Fig.1, if it is more than a size of a symbol. The main types of the Kara and Ust-Kara crater rocks described by [3] were analyzed. The studied collection includes 12 target rocks, 17 suevites, 14 impact melts and glasses, and 9 overlying sediments.

RESULTS. Ir concentrations in the target rocks vary from 0.025 to 1.1 ppb (Fig.1 and 2). The highest Ir contents were found in diabase rocks (up to 1.2-2.3 ppb).Some sandstones are also enriched in Ir (up to 1.1 ppb). Shales and carbonates are characterized by lower Ir abundances. They contain less than 0.3 ppb of Ir. Concentrations of Ir in suevites are not so variable (Fig. 1 and 2). At the average glass-poor and glass-rich suevites have 0.33 ppb and 0.27 ppb of Ir, respectively. The impact melts and the glasses contain mainly 0.15 ppb of Ir (Fig. 2). They are probably slightly depleted in Ir relative to suevites. However in some cases the impact melts and the glasses show high Ir concentrations (up to 1.3 ppb). High Ir contents were determined also in the overlying sediments. These rocks have from 0.1 to 0.7 ppb of Ir. One sample of a matrix material from a clastic dyke showed 20 ppb of Ir but a repeated analysis gave only 0.31 ppb.

DISCUSSION. The study supports the preliminary conclusion of [3] that Ir abundances in the Kara crater rocks are much higher than those in the upper crust. The Ir enrichment can be related to the presence of basalt or mantle components in the target rocks. In fact the Ni-Cr-Ir relationships in the Kara crater rocks are close to those in the mantle (Fig. 1). Deviations of the relationships from the mantle proportions can be due to element fractionation during formation of the target sediments. The high Ir and Cr contents found in some sandstones give evidence for the fractionation which was obviously caused by accumulation of platinid nuggets and chromite grains during sedimentation. Source regions of the basalt and ultramafic components are Polar Ural and Pai-Khoi mountains where the rocks are very abundant. The high Ir concentration in the Pai-Khoi diabase rock and petrographical observations [3] of a basalt material in the target sediments support the terrestrial origin of the Ir enrichment in the Kara structure.

The low Ir variation in the impactites is apparently due to the impact mixing of different types of the target rocks. Other elements show a similar behavior that is a typical feature of impact chemistry. Extraterrestrial Ir is not distinguishable statistically in the impactites because of the high variation of Ir concentrations in the target rocks. However Ir/Cr and Ir/Ni ratios correcting the influence of the Ir terrestrial components are not very variable in the target rocks and display some evidence for the presence of an extraterrestrial component in the impact deposits. In fact stratigraphical analysis of Ir distribution through the Kara suevite complex (Fig. 1 in [7]) shows increasing of Ir/Cr and Ir/Ni ratios to the top of the crater deposits. The ratios in the upper suevites and in the overlying sediments are distinctly higher than those in the mantle and tend to the cosmic proportions. It suggests that Ir of extraterrestrial origin resides in the Kara impactites. The location of the extraterrestrial component at the top of the crater deposits is correlated with that of shocked quartz [7] and demonstrates that the component is associated with high speed ejecta. The similar association has been found in the Ries crater [8]. It is interesting that the overlying sediments are high in the cosmic component as well as in the shocked quartz. From this point of view the rocks can be considered to be similar in their origin to the K/T boundary sediments.

Thus the study demonstrates that an Ir extraterrestrial component occurs in the Kara crater rocks. However the high Ir, Ni, and Cr background abundances do not allow to identify the composition of the extraterrestrial material.

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