RUTHENIUM/IRIDIUM RATIOS IN THE CRETACEOUS-TERTIARY BOUNDARY CLAY: IMPLICATIONS FOR GLOBAL DISPERSAL AND FRACTIONATION WITHIN THE EJECTA CLOUD.

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Ruthenium (Ru) and iridium (Ir) are the least mobile platinum group elements (PGEs) within the Cretaceous-Tertiary (K-T) boundary clay (BC). The Ru/Ir ratio is, therefore, the most useful PGE interelement ratio for distinguishing terrestrial and extraterrestrial contributions to the BC. The Ru/Ir ratio of marine K-T sections (1.77 ± 0.53) is statistically different from that of the continental sections (0.92 ± 0.28). The marine Ru/Ir ratios are chondritic (C1 = 1.48 ± 0.09), but the continental ratios are not. We discovered an inverse correlation of shocked quartz size (or distance from the impact site) and Ru/Ir ratio (see Fig. 1). This correlation may arise from the difference in Ru and Ir vaporization temperature and/or fractionation during condensation from the ejecta cloud.

Postsedimentary alteration, remobilization, or terrestrial PGE input may be responsible for the Ru/Ir ratio variations within the groups of marine and continental sites studied. The marine ratios could also be attained if ≈15% of the boundary metals were contributed by Deccan Trap emissions. However, volcanic emissions could not have been the principal source of the PGEs in the BC because mantle PGE ratios and abundances are inconsistent with those measured in the clay. The Ru/Ir values for pristine Tertiary mantle xenoliths (2.6 ± 0.48), picrites (4.1 ± 1.8), and Deccan Trap basalt (3.42 ± 1.96) are all statistically distinct from those measured in the K-T BC.

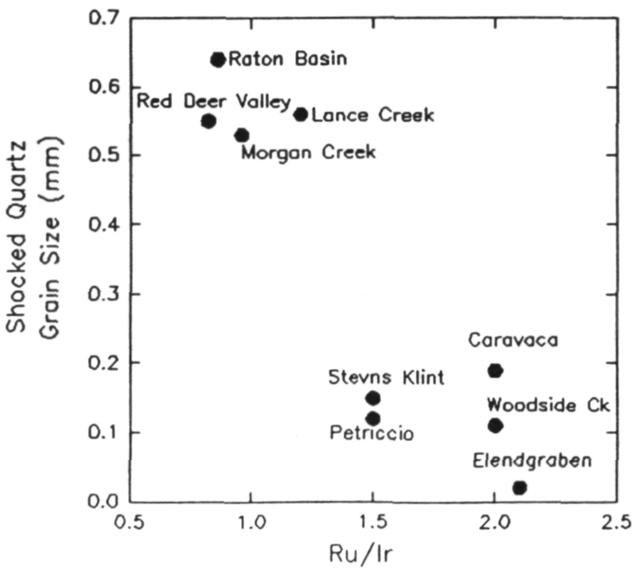

Fig. 1.

DIAPLECTIC TRANSFORMATION OF MINERALS: VOROTILOV DRILL CORE, PUCHEZH-KATUNKI IMPACT CRATER, RUSSIA.

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Vorotilov core has been drilled in the central uplift of the Puchezh-Katunki astrobleme to a depth of 5.1 km. Impactites are revealed in the rocks of the core beginning from a depth of 366 m: suevites (66 m), allogenic breccias (112 m), and autogenic breccias (deeper than 544 m). These rocks are represented by shocked-metamorphic gneisses, schists, amphibolites of Archean age, and magmatic rocks (dolerites, olivines, and peridotites) that lie between them.

According to the preliminary data, the intensity of the diaplectic mineral transformation in the crystalline rocks is decreased from 45–50 GPa at the top to 15–20 GPa at a depth of 4 to 4.5 km. The rocks at the upper part of the section are transformed more uniformly. In contrast, one may observe unchanged plagioclase and maskelynite in the same thin section of the rocks from the lower part of the section. Sometimes the thermal metamorphism is superimposed on the shock metamorphism. Due to this superposition, impact glasses and diaplectic minerals are recrystallized to fine-grained granoblastic aggregates (often monomineralic). The data obtained with SEM (Camscan with energy-dispersive analyzer AN-10,000) show the nonisochemical character of the element migration process, which often accompanies intensive diaplectic transformation. The result is formation of the aggregated pseudomorphs. They contain components missing from the original minerals. For example, the shocked, thermally decomposed biotite is transformed to a plagioclase-titanomagnetite-pyroxene-glass aggregate; amphibole is decomposed to a andesite-magnetite-clinopyroxene-amphibole aggregate; garnet is decomposed to a titanomagnetite-plagioclase-orthopyroxene aggregate.

The process of diaplectic feldspar and diaplectic feldspar glasses formation is also nonisochemical; K-rich, Na-poor diaplectic plagioclases and maskelynites, and Ca-rich, K-poor diaplectic orthoclases (in comparison with the initial feldspars) are revealed. The final product of this process is a melt glass that is composed of a mixture of both feldspars. Different grains of plagioclases (and different parts of some grains) appear to be variously transformed because of the nonuniform distribution of the shock load in the rock. In polysynthetically twinned plagioclases, transformations always begin more intensively in one system of the twinning, which is revealed under a pressure of 20 GPa. Very often one system of the twinning is completely isotropic, i.e., it is transformed into a diaplectic glass, while the other is not yet transformed. In a more transformed system a Na deficit is observed, i.e., Na is carried out. As a result, anorthite component enrichment and decrease of the sum of cations in the plagioclase formula is observed. Potassium enrichment of plagioclase in a more transformed twinning system is observed for samples containing K-rich minerals. At a load of more than 30 GPa, plagioclase is partially or completely transformed into impact melt glass. Impact melt plagioclase glasses are often recrystallized into fine-grained secondary plagioclase aggregate. Sodium decrease and more intensive decrease of the sum of cations in the plagioclase formula is observed in the recrystallized impact glasses in comparison with the slightly transformed diaplectic plagioclases. This effect may be observed even in a single grain.

The investigation of diaplectic transformation of rock minerals in the Vorotilov drill core is continuing.