REE distribution in the Mesoproterozoic uranium-bearing sandstones from the Karku deposit (NW Russia)

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The main subject of the study is relationship between U and REE content in the sandstones drilled from the Karku unconformity-type deposit. Three groups of sandstones are identified according to alteration grade and uranium content: 1) low-grade (with 0-5 ppm of U content), moderately-grade (5-100 ppm) and high-grade (above 100 ppm).

Total REE content shows significant variation (from 10 ppm to 430ppm) both within the individual wells and between them. All the analyzed samples display LREE enrichment relative to HREE with flat to slightly depleted HREE patterns and variable Eu-anomalies. Eu-enrichment is typical for low- and moderately-grade altered sandstones and Eu-depletion in high-grade altered sandstones. The average REE content and calculated ratios are given in table.

	Low-grade	Moderately-grade	High-grade
∑REE	110	154	164
La/Lu	131	133	211
La/Sm	5	6	9
Eu/Eu*	0,93	1,14	0,65

U show positive correlation with LREE (0.80), but not with HREE.

Sandstones are divided into groups in accordance with predominant secondary mineral content: hematite-chlorite bearing, carbonate-bearing or clay-bearing show averaging in the REE content and calculated ratios. However, only clay-matrix sandstones display LREE enrichment comparable with that in highly altered sandstones.

^{26}Al-^{26}Mg systematics and petrological study of chondrules in CR chondrites

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Chondrule formation ages have been obtained from primitive chondrirtes (type 3.0-3.1) using ^{26}Al-^{26}Mg systematics (a half life 0.73 Ma), ranging 1-3 Ma for L, LL and CO [1-3], and 2-4 Ma for CR chondrites [4] after CAI formation with the initial ^{26}Al/^{27}Al of 5×10^{-5}. Detailed petrological study, however, reported that even type 3.0 chondrites show lower grade metamorphism [5]. In order to evaluate if the ^{26}Al-^{26}Mg systematics were disturbed after the formation of chondrules, we examine isotopic and petrological study of plagiocalse of chondrules from CO3.05 [6] and CR2 chondrites.

Mangesium isotopic compositions of plagioclase were measured in three type I chondrules from CR2 chondrites, Yamato-793495 and Yamato-790112 using the Cameca ims-1270 SIMS. One of three type I chondrules show ^{26}Mg-excess corresponding to the initial ^{26}Al/^{27}Al ratio of $(5.2\pm2.1)\times10^{-6}$. For the other chondrules, we obtained the upper limit of the initial ^{26}Al/^{27}Al ratios of $< 7.8\times10^{-6}$ and $< 1.3\times10^{-6}$. The relative age of the chondrules would be 2.4(-0.4/+0.6) Ma, > 2.0 Ma, and > 3.3 Ma, respectively, with the initial ^{26}Al/^{27}Al of CAI, 5×10^{-5}. These results are consistent with those obtained from other CR chondrites, which indicate slightly later chondrule formation relative to ordinady and CO [4]. We examined elemental distributions in plagioclase by line-analyses with EPMA, and found that some plagioclase grains in the CR chondrules show chemical zoning in terms of MgO. The zoning patterns of MgO and its high abundance (0.8-1.0 wt%) in plagioclase would be due to crystallization at high temperature. Therefore, we concluded that lower initial ^{26}Al/^{27}Al ratios in these chondrules are primary.

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