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Formation of zirconium-hafnium-rare earth deposits of Lovozero complex: settling or emerging upward

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In the central part of Kola Peninsula there are two complexes of highly alkaline nepheline syenites (Khibina and Lovozero massifs). The Lovozero massif, the largest of the Globe layered peralkaline intrusion, comprises super-large loparite (Na, Ce, Ca)2 (Ti, Nb)2O6) rare-metal (Nb, Ta, REE) deposit and eudialyte(Na13(Ca,Sr,REE)6Zr3(Fe,Nb,Ti)3(Si3O9)2[Si9$O_2$4(OH,Cl,S)3]2 ores-the valuable source of zirconium, hafnium and rare earth. The Lovozero Pluton) [1] consists of three intrusive phases: (1) medium-grained nepheline and hydronosean syenites; (2) differentiated complex of urtites, foyaites, and lujavrites; and (3) eudialyte lujavrites. Zirconium-hafnium-rare-earth deposit is saturated in the upper part of Lovozero intrusion as horizontal lentiform bodies. Morfology of eudialyte grains is changed with depth of Lovozero intrusion. In the lower part of the intrusion eudialyte forms anhedral interstitial crystals and crystallised when rock-forming minerals generated well-developed framework when convection ceased and accumulation of eudialyte is impossible. In the upper part of Lovozero stratigrafic section eudialyte forms euhedral grains which were formed at the early stage of crystallization. Thus the initial magma of Lovozero complex was undersaturated with this mineral. The melt became saturated with eudialyte after the approximately two-third of the volume of the massif solidified. Compositional evolution of eudialyte has been investigated through a 2.35 km section of the Lovozero massif using CAMECA microprobe and LA-ICP-MS . The composition of cumulus eudialyte changed systematically upward through the third intrusion with an increase in Na, Sr,Nb,Th , Nb/Ta , U/Th and decrease in REE, Zr,V,Zn,Ba and Ti.The specific gravity of eudialyte is much higher then initial alkaline melt .Nevertheless eudialyte accumulated in the very upper zone of Lovozero intrusion. We suggest that eudialyte formed very small crystals (nanoctystals) which were stirred in melt and under the conditions of steady-state convection eudialyte emerged upward. Later eudialyte crystals recrystallized and increased in size.