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Igneous layering in the peralkaline intrusions ,Kola Peninsula :leading role of gravitational differentiation

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In the center of Kola Peninsula there are two large layered intrusions of agpaitic nepheline syenites – Khibina and Lovozero.
. The Khibina alkaline massif (Kola Peninsula,Russia) hosts the world's largest and economically most important apatite deposit. The Khibina massif is a complex multiphase body built up from a number of ring-like and conical intrusions. The apatite bearing intrusion is ring-like and is represented by a layered body of ijolitic composition with a thickness of about 1 - 2 km. The upper zone is represented by different types of apatite ores. These rocks consist of 60-90% euhedral very small (tenths of mm)apatite crystals. The lower zone has mostly ijolitic composition. The lower zone grades into underlying massive urtite consisting of 75-90% large (several mm) euhedral nepheline. Our experimental studies of systems with apatite demonstrated the near-eutectic nature of the apatite-bearing intrusion, resulting in practically simultaneous crystallization of nepheline, apatite and pyroxene.
The mathematical model of the formation of the layered apatite-bearing intrusion based on the processes of sedimentation under the conditions of steady state convection taking account of crystal sizes is proposed. Under the conditions of steady-state convection large crystals of nepheline continuously had been settling forming massive underlying urtite whereas smaller crystals of pyroxenes, nepheline and apatite had been stirred in the convecting melt. During the cooling the intensity of convection decreased causing a settling of smaller crystals of nepheline and pyroxene and later very small crystalls of apatite in the upper part of alkaline magma chamber.
The Lovozero massif, the largest of the Globe layered peralkaline intrusion, comprises super-large rare-metal (Nb, Ta, REE) deposit. The main ore mineral is loparite (Na, Ce, Ca)2 (Ti, Nb)2O6 which was mined during many years. The composition of cumulus loparite changed systematically upward through the intrusion with an increase in Na, Sr, Nb, Th, Nb/Ta, U/Th and decrease in REE, Zr, V, Zn, Ba and Ti. Our investigation indicates that the formation of loparite ore was the result of several factors including the chemical evolution of highly alkaline magmatic system and mechanical accumulation of loparite at the base of convecting unit.