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Investigation of Geomechanical Features of the Rock Mass in Mining of Two Contiguous Deposits under Tectonic Stresses

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Abstract

The paper presents the results of research about the stress-strain state in the eastern part of the Khibiny massif (the Kola Peninsula, North-Western Russia) where the Niorkpahk and Oleniy Ruchey contiguous deposits are being mined by open technologies. There are plans to develop the Oleniy Ruchey deposit by underground methods in the near future. The underground mining operations will be restricted by protecting pillars because of nearby open-pits. High horizontal stresses and brittle rock have a significant influence on mining operations and indicate rockburst hazardous conditions.

For estimating mutual influence of open-pit and underground mining in progress, the authors have designed a numerical geomechanical model which includes basic geological and mining-engineering factors. Based on the results of numerical modeling it has been found that the mutual influence occurs when underground mining reaches the rock mass under the open-pit. This conclusion suggests that the protecting pillars' boundaries can be revised for the purpose of the further decrease. This will increase volume of reserves mined and efficiency of underground mining.

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Keywords: stress-strain state; numerical modelling; open-pit and underground mining; protecting pillar

1. Introduction

The Niorkpahk and Oleniy Ruchey apatite-nepheline ore deposits are located in the southern-eastern part of the Khibiny massif [1, 2] North-Western Russia, see Fig. 1a. The deposits are mined by JSC Apatit and North-Western Phosphorous Company (NWPC), respectively. The region given is characterized by a variable

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mountainous relief. The elevations points above mean sea level (MSL) vary within +200 and +700 m, respectively. Relative heights reach 500 meters. Now the Niorkpahk deposit is being mined by open-pit techniques. There are plans to extract the reserves by underground technologies in the near future.

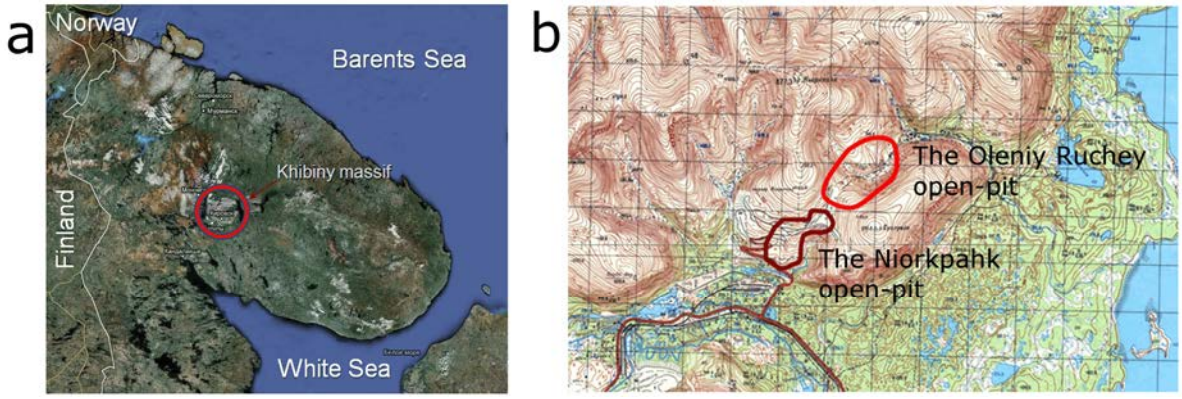

Fig. 1. (a) Khibiny massif location; (b) Oleniy Ruchey and Niorkpahk open-pits.

The Oleniy Ruchey deposit [3] is also being mined by open-pit technologies; in the near future an underground mine will have been constructed. Due to close distance between the Niorkpahk and Oleniy Ruchey deposits the underground mining operations will be restricted by the protecting pillars from both the Niorkpahk and Oleniy Ruchey open-pits sides, see Fig. 2.

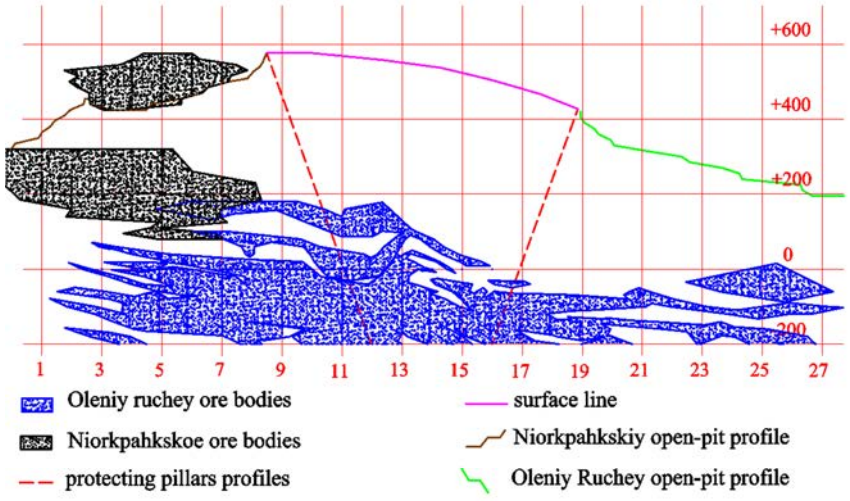

Fig. 2. Location scheme of ore bodies, Oleniy Ruchey and Niorkpahk open-pit.

The efficient combination of open-pit and underground mining must be provided by the open-pit slope stability, from the one side, and underground mining safety, from the other side. To reduce ore loss is possible by decreasing the dimensions of the protecting pillars between open-pits and underground mines. The aim of the research was to study the possible reduction of the pillars dimensions. This will allow increasing economic efficiency of underground mining.

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