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Use of Digital Elevation Models to understand map landforms and history of the magmatism Khibiny Massif (Kola Peninsula, Russia)

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This work presents an improved geomorphological methodology that uses 3D model of relief, remotely-sensed data, geological, geophysical maps and tools of Geographical Information Systems. On the basis of maps of 1: 50,000 and 1: 200,000 the Digital Elevation model (DEM) of Khibiny massif was developed. We used software ARC / INFO v10.2 ESRI. A DEM was used for analyzing landform by extracting the slope gradient, curvature, valley pro?les, slope, aspect and so on. The results were gradually re?ned from the interpretation of satellite imagery and geological map Geomorphological analysis will allow us to determine spatial regularities in inner massive construction. We try to found areas where gas emissions (CH4/H2) enrich, according to morphometry, geology, tectonic and other
environments.
The main regional blocks were de?ned by different morphological evidences: impression zone, similar to subsidence caldera; uplift zone, domed area (located in the highest part of massif and zone of intersection of main faults) and others. It says that there are the few stages in the development of the Khibiny massif. There is no common concept of the consequence of intrudes magmatic phases now. And we hope that our geomorphical analysis take a new evidences about this problems.
Locations of the blocks' borders (tectonic zones) were recognized by lineament analysis of valleys and tectonic faults presented in relief. Erosion system is represented by valleys of 4 ranks. It inherits the zone of tectonic disturbances
3 groups of faults were recognized:
1) Global lineament system cross whole peninsula – existing before Khibiny massif intrusion;
2) Faults associated with the formation of the intrusive phases sequence and magma differentiation and with later collision history during magma cooling;
3) Crack system related to neotectonic process.
We believed that if different magmatic phases intrude in similar tectonic environment, the common spatial system of faults will be formed.
Really we observed a confederated system of contraction faults for different phases suggests that the differentiation within the intrusion is implemented as a single magma chamber for different intrusive phases.
It remains an open question - which fault system (old or young) is more productive to gas emissions?
The discrepancy of the geological structures and land forms is established.
• Impression zone is represented by foyaites (high-strength rocks)
• Uplift zone – rischorrites, khibinites (low-strength rocks)
• Trough valley – weakened zone of tectonic faults - yuvites, urtites, rischorrites (low-strength rocks)
• In the lowest part of depression zone – carbonatite stock
It looks like an inversion of lithomorphic properties and the rock's morphological expression - it is a subject to uplift tectonics. Positive forms of relief (domed area and swells) could be formed due to the intrusion of secondary highly differentiated melts of low density.
Also our early studies con?rm that rischorrites is one of the more rich ?uid gases rocks in Khibina massive. And we expect the strong emission of gas in the areas of distribution of these rock. Low density and increase buoyancy of magma, as a result of high gas concentration, can increase difference between density of cumulus minerals and intercumulus melts. This inversion between melt density and cumulus density, which are formed during chamber melt differentiation, and their low viscosity can cause formation of the local swells. Swells are located in the areas of crossing tectonic faults. This can lead to vertical movements, caused by elevating power of micro diapirs. Such diapirs forms are observed on the block diagrams of apatite ores in Koashve (Ivanyuk et. al., 2012).
We observe such structure in middle zone of Khibiny massif, near Kuelporr deposit, about 15 km long and 5 km width and one with less size near Rasvumchorr deposit, about 10x3 km. This is the area of rischorrite's

appearance. And in this area we see locations of the most intense free gas emission.
The technical possibilities that are offered by Remote Sensing (RS) and Geographical Information Systems (GIS) facilitate the geomorphological investigation of inhospitable and inaccessible mountain areas Digital Elevation Models (DEMs) are valuable tools for approximation of the real world's continuous surface.
They allow a visual analysis of the earth's surface morphology, quanti?cation of sediment volumes and the calculation of topographic derivatives such as the slope gradient, slope aspect and pro?le curvature that consume ?eld investigations and optimize time
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Reference
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