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4D modelling of the Hietakero area in Northern Finland

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The Hietakero area is located in Enontekiö, northern Finland. It is characterized by metamorphosed mafic volcanic rocks, minor felsic volcanites, gabbros, quartzites and sulphide-bearing schists which have been multiply folded as suggested by the complex interference pattern. The area has potential for orthomagmatic mineral deposits such as Ni-Cu and PGE-deposits, and therefore it has been selected as a target for ongoing modeling project carried out by the Geological survey of Finland (GTK). The aim of this project is to create target- and regional scale geological models to promote mineral exploration in northern Finland.

The Hietakero area has been under drilling and mapping campaigns, but the principal data for the modelling work comes from various geophysical surveys. This is because in areas such as northern Finland where glacial till cover and weathering of the uppermost basement limit possibilities for direct field observations, geophysical surveys are the most important methods to gain information for these models. In addition to national airborne measurements, a regional airborne SkyTEM survey was carried out in summer 2012. 3D inversions of airborne magnetic and ground gravity measurements were carried out to model magnetic and density variations. Furthermore, SkyTEM inversion results were utilized to map conductive horizons in 3D. In the Hietakero case, the rocks can be characterized by their geophysical features, since the mafic meta-volcanic rocks show high susceptibilities and sulphide-bearing schists display high conductive zones.

4D modelling focuses on reconstruction of the 3D geological history of the area, from its initial geometry to the present form. Geophysical inversion and modeling results, drillings and field observations were interpreted in Gocad as 3D geological-geophysical model. The geological history of the Hietakero area begins with sedimentation of quartzites and eruption of volcanic rocks. This was followed by tilting episode during which the gabbroic intrusion was emplaced. Subsequent folding episodes resulted the distinct fold interference pattern of the area best explained by roughly orthogonal N-S and E-W directed folding stages.