MINN – Mineral resources in North Norway

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This thematic issue of Norwegian Journal of Geology is devoted to studies within the mapping programme "Mineral resources in North Norway" (MINN), carried out by the Geological Survey of Norway (NGU) over the last five years. The programme has benefitted from a dedicated funding in the period 2011–2014 from the Norwegian Government. Additional funds were also allocated to NGU in 2015 for continuation of the programme, but a proposed extension of the programme in 2016 was withdrawn from the final budget of the Government. MINN is aimed at improving the coverage of basic geophysical, geological and geochemical data relevant to the assessment of the mineral potential in the three northernmost counties: Nordland, Troms and Finnmark.

The programme includes improved coverage of high-resolution geophysical data (magnetic, electromagnetic and radiometric) as well as ground follow-up in North Norway. A total of 20,600 km² was covered by helicopter-borne geophysics in 2011–2015 (Fig. 1), including the following areas: Rana, Holandsfjord, Rombak, Austvågøya, Langøya, Kvæfjord, Evenes, Gratangen, Mauken, Finnsnes, Senja, Vannøya, Kåfjord, Øksfjord, Stjernøya, Alta–Kvænangen and Repparfjord. An additional 89,100 km² were covered by fixed-wing surveys in all three counties, and about 75% of the land area is now covered by new geophysical data (Fig. 2). Airborne gravity (AGG) and land-seismic surveys have been conducted in prospective areas. Processed data are released free of charge on the NGU website as they become available (<http://www.ngu.no/prosjekter/minn>).

The results of geochemical reanalysis of 2,200 till samples from the whole of northern Norway initiated follow-up sampling programmes in the Nordkinn and Tysfjord areas, which showed anomalous values of rare-earth elements (REE) and various other special metals (Fig. 3). Anomalous values of base metals were observed in Hattfjelldal. Geological investigations have been carried out in key metallogenic areas with a high potential for orogenic gold, sedimentary copper and iron, VMS copper–zinc, magmatic nickel–copper–PGE as well as iron–titanium–vanadium. The potential for REE, graphite, carbonate and apatite as well as dimension stone and rock aggregates has also been evaluated, and the mineral-resource databases have been updated (Figs. 4 & 5).

The scientific variety and broad geographical distribution of the studies carried out in the MINN programme are demonstrated in this thematic issue, where we find presentations of both regional and more detailed geophysical and geochemical studies. The bedrock geology studies have emphasised structural mapping and interpretation as well as geochronological analyses, to improve our understanding of the geological evolution, mineral potential and the stratigraphic correlations between areas (Fig. 6). The key results of these regional and more detailed geophysical, geochemical, structural and geochronological studies are presented in this thematic issue. In short, these results include:

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Figure 1. Geophysical helicopter surveys along the coast of Senja, Troms. Due to the rough topography the survey lines follow the height contours and not parallel profile lines as is usually the case.

Figure 2. Aeromagnetic map of North Norway with the major ore (yellow circles) and industrial mineral (grey circles) deposits marked. The compilation of the magnetic data is based on the geophysical surveys carried out by the MINN programme. The data and references to all the surveys are found at <http://www.ngu.no/prosjekter/minn>.

Figure 3. Geochemical sampling of soil on the Nordkinn Peninsula, Finnmark. More than 800 localities were sampled, mostly by walking along traverses, but helicopter and boat transport were used to a minor degree.

Figure 4. Trenching of graphite mineralisation after ground geophysical surveys in Vesterålen, Nordland. High-quality graphite deposits have been surveyed both in Vesterålen and on Senja in Troms.

Figure 5. Tamping of explosives and cartridges before blasting in the Trælen graphite mine in Skaland, Troms. The mine is operated by Skaland Graphite AS, a subsidiary of the LNS group, and is the only producer of crystalline graphite in Europe.

Nasuti et al. (2015a): This article presents a compilation of the new aeromagnetic and radiometric data acquired during the MINN programme, as well as newly processed data from older surveys. The authors show how these data can be used to modify or update existing geological maps, particularly in poorly exposed areas, and provide an important framework for developing exploration strategies.

Melezhik et al. (2015a): In this article a broad spectre of data is used to reconstruct the depositional environment and age of the Palaeoproterozoic sedimentary-volcanic succession in the Alta-Kvænangen Tectonic Window (AKTW) in West-Finnmark. It also presents a valuable contribution to improved understanding of the widespread Na and Cl metasomatism in the Fennoscandian Shield.

Nasuti et al. (2015b): The extensions of polyphase dolerite and metadolerite dykes are clearly detected in the new high-resolution aeromagnetic data from northern Finnmark. Three ages of mafic dykes are known from previous isotopic dating studies — Ediacaran, Late Devonian and Early Carboniferous. They are variably exposed, but show up as positive linear magnetic anomalies over distances of many kilometres, and help in our understanding of the tectonic setting in Carboniferous time.

Melezhik et al. (2015b): The deposition of the meta-sedimentary rocks of the Karasjok Greenstone Belt (KGB) in Finnmark had until now been poorly dated. In this study, carbon isotope chemostratigraphy has been applied to provide an apparent depositional age of the carbonate units and associated metasupracrustal rocks in the KGB. The Palaeoproterozoic Lomagundi-Jatuli isotopic event is recorded in the succession, and an alternative correlation of units along the linear belt is discussed.

Andersson et al. (2015): Follow-up geochemical sampling of soil in the Hattfjelldal area in southern Nordland is presented in this publication. Several multi-element anomalies are present within the survey area, and the results are discussed in relation to newly acquired, high-resolution geophysical data and bedrock geology.

Henderson et al. (2015): New structural and geophysical data are used to present a new geotectonic model for the Palaeoproterozoic Kautokeino Greenstone Belt (KkGB) in West Finnmark, and to discuss the relationship between the structures and gold mineralisation. Comparison of the tectonic evolution of the KkGB and other Archaean–Palaeoproterozoic domains in northern Norway is also discussed.

Figure 6. Intense discussions of the geological evolution of the Karasjok Greenstone Belt during an excursion in the Lakselv area, Finnmark. The Palaeoproterozoic greenstone belt is assumed to have high potential for both Ni–Cu ± PGE and Cu ± Au deposits.

Bingen et al. (2015): Zircon U–Pb geochronological data from 19 samples from Finnmarksvidda and one sample from the Repparfjord Tectonic Window, have been used to constrain the evolution of the Palaeoproterozoic Kautokeino Greenstone Belt and its relationship with the neighbouring units. The tectonic implications of the results in a Fennoscandian context are also discussed.

Torgersen et al. (2015a): In this publication, results from new bedrock mapping, structural analysis and whole-rock geochemistry from the northwestern part of the Repparfjord Tectonic Window (RTW) in West Finnmark in association with high-resolution geophysical data are used to present a revised stratigraphy for the Palaeoproterozoic successions in the RTW and to discuss their palaeotectonic setting. The results also have implications for the correlation of the RTW succession with similar volcano-sedimentary belts and copper mineralisations in northern Norway.

Bjerkgård et al. (2015): Mapping of bedrock and gold mineralisation, including isotopic dating and structural interpretation, has been carried out in the Mauken basement window in Troms in order to propose a structural–tectonic–metalogenic model for the area. The results are compared to other areas with similar Au–As mineralisations.

Slagstad et al. (2015): The Altevatt area in eastern Troms represents the northwesternmost part of the Norrbotten Province in Sweden, and has been investigated to see if it contains the same prolific metallogenic units found across the border. However, the results of the mapping and dating show that only a poorly exposed, high-magnetic gabbro reveals interesting values of Fe, P, Ti and V, which will provide an interesting target for follow-up prospecting.

In addition to the publications mentioned above, the MINN programme has motivated a series of articles in international journals, including those of Schilling et al. (2014), Torgersen & Viola (2014), Torgersen et al. (2014, 2015b) and Melezhik et al. (2015c).

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