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North Atlantic Craton Conference: Preface to the thematic issue of *Mineralogical Magazine*

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Mineral exploration is becoming more challenging with most visible and near-surface deposits already discovered. With our increasingly metal- and resource-dependent global society, the demand for all mineral resources is escalating. Of particular note, because of concern about supply security, are the 'critical metals' such as the platinum-group elements, the rare earth elements, lithium, indium, tellurium, selenium and chromium, to name but a few. In addition, the expanding populations of 'BRICS' countries (Brazil, Russia, India, China and South Africa) will lead to greater urban and infrastructure development, requiring more base metals, iron ores, aluminium, and bulk commodities. Advances in mineral exploration, mining and mineral processing are more important than ever, and have progressed so far that they are becoming unrecognizable when compared with methods practiced during the last century. Furthermore, with increasing environmental awareness, many aspects of economic geology and mineralogy remain at the core of environmental remediation and this has facilitated the cultivation of environmental responsibility as operational practice.

As exploration models are developed, the importance of a terrane-specific approach to mineral exploration has been recognized. Some of the world's most prospective zones are in Archaean cratons, which have a long and complex geological history. The North Atlantic Craton Conference (NAC 2014) dealt with the mineral potential of the North Atlantic Craton in its entirety and was aimed at initiating and furthering trans-Atlantic collaboration in the understanding of Archaean cratonic controls on ore-deposit formation and how cratonic lithosphere has influenced this through subsequent periods of geological time.

The Archaean high-grade gneiss terrain of the North Atlantic Craton stretches from Labrador and wider Canada, through Greenland, into Scotland, Northern Ireland and Norway – thus many aspects of its geology are common across geographical and political boundaries. Acceleration in exploration efforts for various commodities across this region, particularly in Greenland, has highlighted the potential for its mineral resources. With these opportunities come unique challenges, not least in 'unpicking' the prolonged and complicated history of such ancient lithosphere. Successful exploration is increasingly reliant upon 'academic' aspects of geology and less so on traditional prospecting techniques. In addition, the retreating ice sheet of Greenland and arctic Canada means that many locations, thus far unexplored, are opening up for investigation.

In association with the Mineralogical Society of Great Britain and Ireland, NAC 2014 brought together academic, government and industry representatives. The conference was hosted by the Department of Earth & Environmental Sciences of the University of St Andrews, and was held under the banner of the Cardiff Student Chapter of the Society of Economic Geologists, in conjunction with the British Geological Survey (BGS) and the Geological Survey of Denmark and Greenland (GEUS). Generous support was provided by the Applied Mineralogy Group of the Mineralogical Society, the Mineral Deposits Studies Group, the Society of Economic Geologists, Northern Shield Resources, Avannaa Resources, Midland Valley Exploration, Aurum Global Exploration and Glasmin Resources.

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NAC 2014 hosted 85 international delegates from the US, Canada, Greenland, Denmark, Sweden, France, Democratic Republic of the Congo, South Africa, Australia, the UK and Ireland. Delegates represented various European, Canadian, American and Africa universities, as well as geological surveys (BGS, GEUS, BNP, USGS, Canadian Surveys) and 17 exploration and mining companies and consultancies. During the two day conference, 32 talks and 16 posters were presented, alongside various industry and society stands. The post-conference field trip to northwest Scotland involved 17 delegates from various industry and academic backgrounds and was guided by Kathryn Goodenough (BGS) and Hannah Hughes (Cardiff University).

Based on the success of the 2014 meeting, a second meeting will take place in 2016 under the title of 'NAC+ 2016'. This conference will encompass the adjoining craton margins and Palaeoproterozoic mobile belts around the North Atlantic Craton and into Fennoscandia and will explore the wider implications for mineralization in these areas.

This thematic set of papers, arising from NAC 2014 is dedicated to the topic of North Atlantic Craton geology and implications for mineral exploration. In the first paper, Kolb *et al*. (2015) bring together a wealth of field experience and detailed regional geological maps to summarize the geology and metallogeny of the main Greenlandic portion of the North Atlantic Craton. They highlight major mineralized areas per portion of the craton, including both precious and base-metal commodities. This work concludes that an integrated and collective approach towards a fundamental geological understanding of the craton must be used in order to generate future greenfield exploration targets.

Szilas *et al*. (2015) present new bulk-rock isotopic geochemical and geochronological data from amphibolites (supracrustal fragments within tonalite-trondhemite-granodiorite) of the Ameralik fjord region of the southern portion of the West Greenlandic North Atlantic Craton. The 3.0–2.9 Ga pods were derived from an isotopically heterogeneous and depleted mantle source, but intriguingly with regards to the ongoing debate around the initiation of plate tectonics, amphibolites with the most evolved trace-element abundances have the most depleted Hf-isotopic compositions. This hints at a subduction-controlled refertilization event recorded in their mantle source and may point towards ancient subduction at a continental margin in the Mesoarchaean.

Hughes *et al*. (2015) use mantle-xenolith bulk geochemistry and clinopyroxene compositions to constrain the upper lithospheric mantle composition of the margin of the North Atlantic Craton in northwest Scotland. They show that xenoliths in Palaeozoic intrusions from this area represent an ancient Archaean subcontinental lithospheric mantle which was metasomatically overprinted during a cratonic rifting event. This event is suggested to have taken place in the Palaeoproterozoic and to be linked to the formation of the Scourie Dyke Swarm. Thus the Archaean lithospheric keel survived both Palaeoproterozoic rifting and later Palaeozoic, Caledonian orogenesis.

Finally, Bartels *et al*. (2015) present a new comprehensive petrological and bulk geochemical dataset from two Mesoproterozoic dyke swarms of the Gardar Province of Southern Greenland ('Brown Dykes'; 1300–1250 and 1180–1140 Ma). The dykes formed during a period of significant rifting in response to back-arc basin formation between 1290 and 1235 Ma. The authors demonstrate that the enriched geochemistry of the dykes was inherited from a lithospheric mantle source that had previously been metasomatized during the Palaeoproterozoic Ketilidian orogeny. Further, the authors consider a petrogenetic link with similarly aged mafic dyke swarms in North America and Central Scandinavia.

Together, these four papers highlight the geological complexity of the North Atlantic Craton, and illustrate the importance of integrating field, petrographical, geochemical and geochronological data to understand the Precambrian tectonomagmatic history of a region. As emphasized by Kolb *et al*. (2015), such studies provide the foundations for the understanding of mineralizing systems, and hence for improved mineral exploration. Much further work remains to be done to understand the evolution of the North Atlantic Craton and to unlock its mineral potential.

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