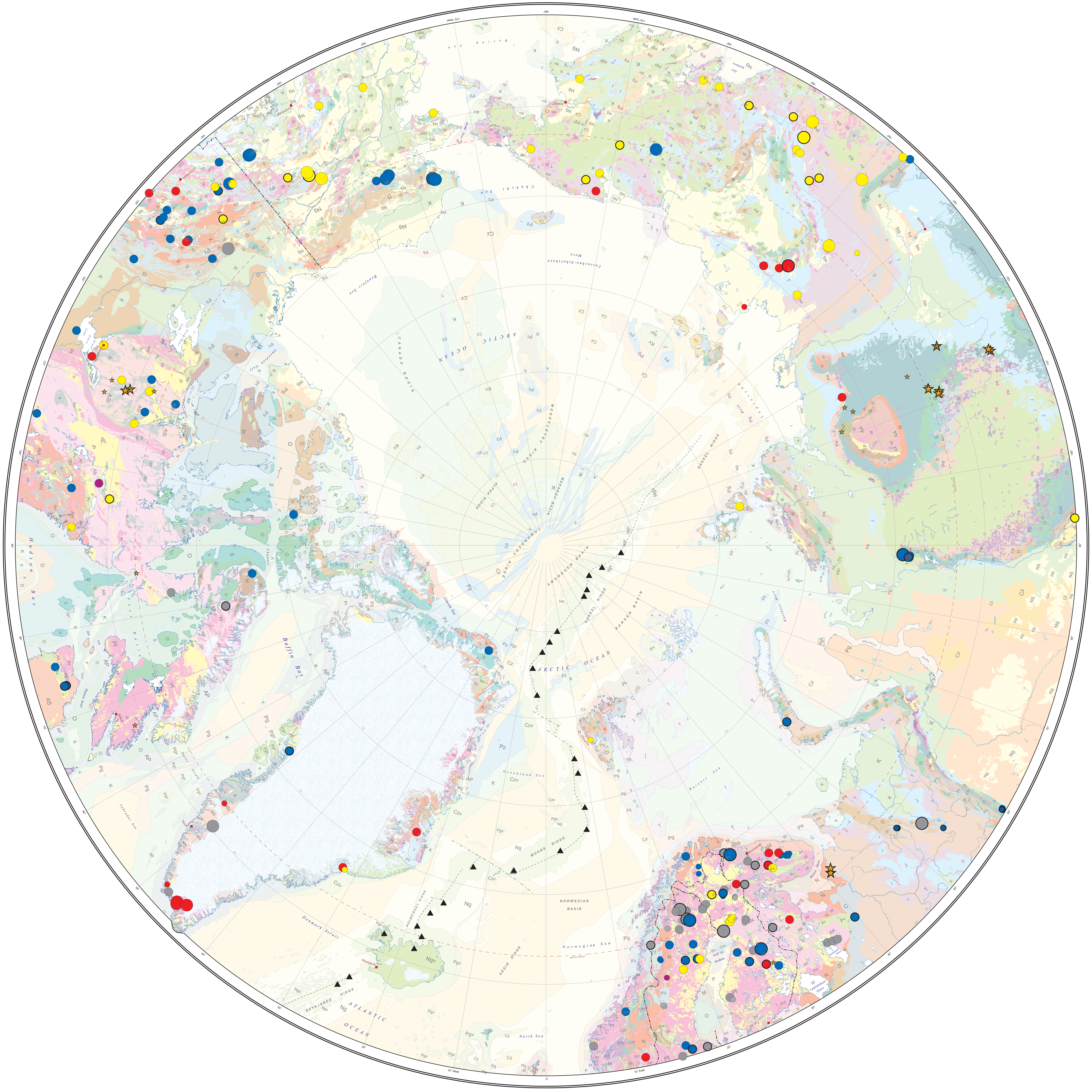
METAL AND MINERAL DEPOSITS OF THE ARCTIC



Scale 1:10 000 000

Stereographic North Pole Projection
Standard Parallel 70°N Coordinate System WGS 1984
Prime Meridian: Greenwich (0.0)

Deposits

- Diamonds
- Hydrothermal fields
- Energy metals: U, Th
- Precious metals: Ag, Au, Pd, Pt, Rh
- Special metals: Be, Li, Mo, Nb, REE, Sc, Sn,Ta, W, Zr
- Base metals: Al, Co, Cu, Ni, Pb, Zn
- Ferrous metals: Cr, Fe, Mn, Ti, V

Size and activity

- Active mine
- No mine
- Very large with active mine
- Very large
- Large with active mine
- Large
- Potentially large with active mine
- Potentially large

North Atlantic Ridge

- Ridge
- Transform fault

Sedimentary and or metamorphic, undivided: lighter shades of each are offshore

Cz	Cenozoic
Ng	Neogene and Quaternary
Pg	Paleogene
K	Cretaceous (often includes Paleogene)
J	Jurassic (often includes Cretaceous)
T	Triassic (often includes Jurassic)
Pz	Paleozoic (mostly Cambrian to Devonian)
Pe	Permian (often includes Triassic)
C	Carboniferous (often includes Permian)
D	Devonian (often includes Carboniferous)
S	Silurian (often includes Devonian)
O	Ordovician (often includes Silurian)
Cm	Cambrian (often includes Ordovician)
Pr	Proterozoic (up to Devonian in Yukon and Alaska)
N	Neoproterozoic (often includes Cambrian)
M	Mesoproterozoic
P	Paleoproterozoic
A, AP	Archean, Archean and Paleoproterozoic

Distinct lithologic suites (with age label prefix): lighter shades of each are offshore

v	Extrusive; igneous, undivided
f	Felsic intrusive suites (granite, tonalite)
b	Gabbro suite (also anorthosite)
p	Peridotite suite
x	Impact breccia

Cratons, shield areas

ASI	Slave Craton: felsic intrusive suites
AR	Rae Craton: intrusive undivided
AH	Hearne Craton: felsic intrusive suites
AM	Murmansk craton: felsic intrusive suites
AK	Karelian Craton: felsic intrusive suites
AN	North Atlantic Craton: intrusive undivided
AA	Anabar shield: sedimentary undivided

EXPLANATORY NOTES

The map Metal and Mineral Deposits of the Arctic is the fifth in a series resulting from cooperation between the national geological institutions of the US, Canada, Greenland, Iceland, Norway, Sweden, Finland and Russia which commenced in 2003 (Petrov & Smelror, 2015). The objective was to produce digital geological and geophysical maps for the Arctic region north of 60°N at a scale of 1:5 000 000 and also a 1:10 000 000 version. The first four products were:
•Geological Map of the Arctic (Harrison et al., 2008)
•Magnetic Map of the Arctic (Gaina et al., 2011)
•Gravity anomaly Map of the Arctic (Gaina et al., 2011)
•Tectonic Map of the Arctic (Petrov et al., 2013)

The Circum-Arctic Mineral Resource project was initiated at a meeting in Toronto in March, 2012. Important decisions taken at an early stage were:
•The project should focus on the largest deposits of metals and diamonds, these being the mineral resources with the highest unit values, as opposed to industrial minerals (in general), construction materials and fertilizer minerals.
•Data on the deposits should be compiled in a database modeled on the database produced in the Fennoscandian Ore Deposit Database (FODD) project (http://en.gtk.fi/informationservices/databases/fodd/index.html).
•In order to focus on the most important deposits and to restrict the database to a more manageable size it was decided that the project would consider only the deposits in the FODD categories, Large, Very Large and Potentially Large (see: Eilu et al. (2007) for definitions).
•The products of the project, in addition to the database, would include a map (this work), a web-site for distribution of the information (http://www.ngu.no/en/projects/circum-arctic-mapping), a geoscientific compilation of information about the main provinces and deposits (in English) and a briefer description of the results aimed at general-interest readers, this to be made available in several languages.
•The map showing the location of the deposits should be based on a simplified version of the Geological Map of the Arctic (Harrison et al., 2011)
Known hydrothermal fields on oceanic spreading axes should be included and shown using a black triangular symbol, without any supposition of size or grade. Metallic nodules are known to occur in several parts of the seabed in the Arctic: it was decided that these should not be included because of the lack of systematic information on their extent, nature and grade.

The Base Map
The Geological Map of the Arctic at 1:5 000 000 and its legend can be downloaded from the Natural Resources Canada site: http://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/downloade.web&search1=R=287868 This map, in order to permit the appropriate graphical focus on the metal and diamond deposits which are the topic of the Mineral Resource project, has been greatly simplified in order to create the geological base map for this map. This task has been undertaken largely by Christopher Harrison (GSC), the key compiler of the original map and therefore uniquely qualified for this task.. The shading given to the base map is subdued to ensure that the deposit symbols are the most prominent feature of the map. The seabed geology is shown with even more subdued shades in order to add prominence to the land areas, especially the islands in the High Arctic.

The Database
The database for metals follows the FODD model which can be viewed and explained using the sources listed above. Legal requirements and restrictions as well as the level of publicly available knowledge lead to unavoidable variations in the availability of data on specific deposits. Data on reserves in the deposits in Russia and on the plans for their extraction are based on official reports to central authorities: these data have been made available to the project. Data on past production in Russia are not publicly available so that it is not possible to document the total original tonnage and grade of deposits which have been in production for many years. The FODD classification "Potentially Large" exists in order to classify deposits for which the available geological information clearly indicates the overall size of a deposit though without detailed information on tonnage and grades. This category is also used for deposits from which detailed information is publicly available only for specific intersections but for which more general information gives clear indications of a major tonnage.
Diamond deposits in production and other large/very large deposits are included in a simplified FODD structure. The ProMine classification (in carats/deposit) was used and the “cut-off” is 10 million carats.
Hydrothermal vents and deposits at the North Atlantic Ridge are shown, but not classified, as their grades and tonnages are not known. Most of the data are taken from the InterRidge Vents Database (ver.3.3):

The Legend
The legend for deposit information is broadly based on that used in the FODD maps, with the addition of symbols for hydrothermal fields and diamond deposits. Aluminium is included as a base metal in this legend because of the extensive mining operations in bauxite in Russia and because of the assessment of major kyanite deposits on the Kola Peninsula as important potential sources of alumina in Russia.

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