Natural Resources Canada | Ressources naturelles Canada

Index of countries

SPONSORSHIP

International Agency Sponsors
United Nations Educational, Scientific and Cultural Organization (UNESCO)
International Polar Year (IPY)
International Union of Geological Sciences (IUGS)
Commission for the Geological Map of the World (CGMW)

National Agency Sponsors
Natural Resources Canada (NRCan)
Geological Survey of Canada (GSC)
A.P. Karpinsky All-Russian Institute of Geological Research (VSEGEI)
All-Russia Research Institute for Geology and Mineral Resources of the World Ocean (VNIIOkeangeologia)
United States Geological Survey (USGS)
Geological Survey of Norway (NGU)
Geological Survey of Sweden (SGU)
Geological Survey of Denmark and Greenland (GEUS)

Regional Sponsors
Canada-Nunavut Geoscience Office (CNGO)
Northwest Territories Geoscience Office (NTGO)
Yukon Geological Survey (YGS)
Polar Continental Shelf Project (PCSP)

Project management
Oleg Petrov (VSEGEI, St. Petersburg)
Jeannine-Marie St-Onge (GSC, Calgary)
Bruce Gamble (USGS, Anchorage)
Valery Kaminsky (VNIIOkeangeologia, St. Petersburg)
John Percival (GSC, Ottawa)

GEOLOGICAL COMPILATION

Project Leaders
Christopher Harrison (GSC, Calgary)
Marc R. St-Onge (GSC, Ottawa)

Lead Geological Compilers
Sergey Strelnikov (VSEGEI, St. Petersburg)
Boris Lopatin (VNIIOkeangeologia, St. Petersburg)
Sergey Shokalsky (VSEGEI, St. Petersburg)
Freddie Miller (USGS, Anchorage)
Sukhrat Telia (GSC, Ottawa)
Chad Hults (USGS, Anchorage)
Stefan Bergman (SGU, Uppsala)
Hans Jepsen (GEUS, Copenhagen)
Arne Solli (NGU, Trondheim)
Tatyana Koren (VSEGEI, St. Petersburg)

Regional Geological Compilers
Robert Blodgett (USGS, Anchorage)
Tom Brent (GSC, Calgary)
Eugeny A. Gusev (VNIIOkeangeologia, St. Petersburg)
Vasily Ya. Kabanʼkov (VNIIOkeangeologia, St. Petersburg)
Benno Kathol (SGU, Uppsala)
Gordon Oakey (GSC, Dartmouth)
Sally Pehrsson (GSC, Ottawa)
Magnus Ripa (SGU, Uppsala)
Tom Skulski (GSC, Ottawa)
Alison Till (USGS, Anchorage)

DIGITAL COMPILATION

Lead digital compilers
Dianne Paul (GSC, Ottawa)
Tracy Lynds (GSC, Ottawa)

Regional digital compilers
Anatoly Buntsky (VNIIOkeangeologia, St. Petersburg)
Peter Davenport (GSC, Calgary)
Celine Gilbert (CNGO, Iqaluit)
Ram Krishna (SunRise Systems, Mississauga)
Keith Labay (USGS, Anchorage)
My Le (GSC, Calgary)
Larry MacDonald (GSC, Calgary)
Michel Pawlina (Gismo Solutions Ltd., Edmonton)
Viktor Snezhko (VSEGEI, St. Petersburg)
Staffan Zetterlund (SGU, Uppsala)

DIGITAL CARTOGRAPHY

Managing cartographer
Mike Sigouin (NRCan-ESS, Ottawa)

Copy editor
Jo Gray (NRCan-ESS, Ottawa)

Senior digital cartographer
Eleanor Everett (NRCan-ESS, Ottawa)

Digital cartographers
Olga Andrianova (VSEGEI, St. Petersburg)
Vic Dohar (NRCan-ESS, Ottawa)
Steve Orzeck (NRCan-ESS, Calgary)
Julia Sirota (VSEGEI, St. Petersburg)
Darren Viner (NRCan-ESS, Ottawa)

EXPLANATORY NOTES

INTRODUCTION

The International Polar Year (IPY) 2007-08 and 2008-09 activities, and related stand-alone of the Commission for the Geological Map of the World (CGMW), nations of the circumpolar Arctic have cooperated to produce a new bedrock geology map and related digital map database at 1:5 M scale. The present map (Sheet 1), released in north polar stereographic projection using the WGS 84 datum, includes complete geological and physiographic coverage of all onshore and offshore bedrock areas down to 60 degrees north.

Versatile applications of the map and map database include: 1) providing a new geological, physiographic, and tectonic compilation and database context for all Precambrian and Phanerozoic map units that can be shown at 1:5 M scale in the Arctic polar region; 2) documenting and portraying the nature of the Arctic's bedrock geology in terms of its age, composition, tectonic setting, geology and morphology; 3) encouraging frontier mineral and energy exploration through wider dissemination of national and international geologic databases; 4) delivering publicly-accessible tools to facilitate industry, university, and government project planning; 5) providing geological context for resource and ecosystem management, environmental impact assessment, geotechnical concerns and climate change considerations; 6) providing geological context for studies of contaminant pathways in the environment, watershed and groundwater issues; and 7) providing an interpretation of geology that can be used by governments and land claimants to help evaluate sovereignty and jurisdictional claims.

Data sources contributing to the map include new regional and national compilations (see Sheet 2) simplified from original spatial data at scales ranging from 1:50 000 to 1:5 000 000. New compilation work includes Sweden, onshore and offshore Russia, the United States in Alaska, and two of the northern territories of Canada (Nunavut and Northwest Territories). Existing published material derives from digital maps of northern Europe (1:4 000 000), Greenland (1:2 500 000), Yukon (1:1 000 000), and the rest of Canada (1:5 000 000). Offshore areas of new compilation cover the northwest Atlantic, northeast Pacific, and Arctic offshore of North America (1:5 000 000).

While a short term objective has been the production of the new hardcopy geology map for the circumpolar Arctic, the true value of this major synthesis effort is the underlying database. This archive of digital data will be used to produce additional products in the future, including a variety of digital products and also informal paper-printed map products. Collectively, these data can serve as a model for expanded digital map coverage, both into the subsurface and to other parts of the globe.

TIME SCALE

Standardization of map unit attributes has been facilitated by the International Stratigraphic Chart (2008 version) published by the International Commission on Stratigraphy (ICS), http://www.stratigraphy.org/chro.pdf, which shows on the absolute scale for the Precambrian and the relative time scale for Ediacaran and younger rocks. The map and GIS database feature approximately 100 divisions of geologic time based on maximum and minimum age ranges of compilation units. This includes 100 divisions in the Phanerozoic and 40 in the Precambrian.

COMPOSITIONAL UNITS

Bedrock geology is portrayed by 28 compositional units (see Sheet 2), which include: one supracrustal (undivided) and eight sedimentary associations based on gross depositional setting (continental clastic, deltaic and nearshore clastic, carbonate, shallow marine clastic, slope and deep water, undivided marine sedimentary, evaporite, undivided sedimentary, undivided sedimentary and extrusive); six extrusive associations (alkalic, felsic, intermediate, mafic, ultramafic, undivided); nine plutonic associations (alkalic, anorthosite, carbonatite, felsic, intermediate, peridotitic, pyroxenitic, syenitic, tonalitic, carbonatite, undivided); an undivided igneous association; an undivided metamorphic association; an impact association; and a mélange association.

METAMORPHIC CONDITIONS

Metamorphic map units have been collected and grouped in the following eight categories (see Sheet 2): not metamorphosed, metamorphosed and not metamorphosed, very low and low grade, medium grade, high grade, high pressure, undivided metamorphosed, and not known.

TECTONIC DOMAIN AND REGIONS

Map units in the Phanerozoic are grouped and coded by their host tectonic domain wherever possible. These domains, the locations of which are shown on the geological domain inset map on Sheet 2, include: ten Archean cratons (Arvabar Shield, Hearne craton, Karelian craton, Murmania craton, North Atlantic craton, Ohotskii massif, Slivenian massif, Rae craton, Slave craton, Superior craton); four pericratonic terranes and ophiolites (Alaskan domain, Hottah terrane, Mikkvichogda terrane, Wopmay orogen); two Paleoproterozoic basins (Belcher basin, Thelon basin); seven Grenville-Mackenzie domain, Ellesmian province, Great Bear batholith, Hepburn batholith, Hudson suite, Nemajuaq arc, Nuellin suite); eighteen orogens, fold/thrust belts, and folded regions (Baikal-Patom fold/thrust belt, Caledonian orogen, Chersky-Kolymia fold belt, Cordilleran orogen, Ellesmere-Ingefield belt, Ellesmerian orogen, Eskimo domain, Kelloidian orogen, Ohotsk folded region, Selwyn-Richardson fold belt, Taconian orogen, Timanide orogen, Uda-Maya folded region, Uralian orogen, Severnaya Zemlya fold region, Taibuo-Thelon orogen, Ural folded region, Wopmay orogen, Yana-Kolymia fold thrust belt, Yenisei-Taymyrian-Norilsk fold/thrust belt); and twelve pericratonic basins and cover sedimentary (Amerasian basin, Anabar-Olenek uplift, Baffin cover, Barents basin, Belcher Bay Supergroup, Pechorovorkutian Shield-Belchorsk Bay-Dolgo Groups, Pury and Hecla Bay Groups, Timan-Pechora basin, Western Siberian basin, Yenisei-Khatanga basin). These tectonic divisions, also identified in the column headings of the Precambrian correlation chart (see Sheet 3), facilitate and highlight the correlation of diverse but once contiguous medium and high grade terranes located within widely separated continental nuclei.

Map units in the Phanerozoic are associated with 56 informally-defined regions located and identified on the geographic inset map of Sheet 2. Phanerozoic regions are based on major physiographic features of the Arctic, both onshore and offshore. These have been used to produce a series of paleogeographic maps for the Phanerozoic (Sheet 4 and 5) that should facilitate an understanding of the spatial distribution of rock composition and depositional environments through time.

VECTOR AND POINT DATA

Geological vector data portrayed on the map (Sheet 1) include spreading ridges, geological contacts, and a range of faults. Point features include impact structures, volcanoes and circular domes, diapirs and kimberlite diatremes.

COLOUR DESIGN

Onshore geology

The colour design of the map for onshore Phanerozoic sedimentary and metamorphic units (Sheet 1, 2, 4 and 5) follows as closely as possible that of the Commission for the Geological Map of the World (CGMW) 1:25 M scale International Geological Map of the World (IGMW). Hues of blue, green, yellow and brown of green were selected, with lighter shades used for felsic and alkalic compositions, and darker shades for those that are mafic and ultramafic. For plutonic rocks the following colour shades were utilized: lighter and darker pink tones for granitic, syenitic, and tonalitic rocks; orange for carbonatites; rocks; and shades of lilac and purple for gabbroic and peridotitic map units.

An effort has been made to choose colours for Precambrian units (Sheet 1 and 3) not used for the Phanerozoic. In general the colours utilized reflect lithological composition; shades of yellow, grey, and brown for clastic rocks, shades of blue for carbonates, shades of green for volcanic rocks, shades of red and fuchsia for felsic plutonic rocks, shades of violet and purple for mafic and ultramafic units, and shades of pale pink and orange for orthogneisses. Some colours, however, are repeated.

In order to emphasize dynamical affinities of Precambrian map units (Sheet 1 and 3), differing colour palettes were utilized for different tectonic domains (e.g. the Archean Slave, Karelian, and Superior cratons are distinguished by shades of grey and salmon, shades of pink, and shades of orange, respectively).

Ice caps are shown only locally on Sheet 1, such as in the eastern Arctic Islands of Canada, Greenland, northern Russia, and Alaska. Small icefields are not shown because they interfere with a clear portrayal of bedrock geology.

Offshore geology

Offshore units are designated by labels and contact boundaries, and are coloured much in the same way as the onshore geology. In order that the onshore and offshore regions clearly stand out, a 60% transparency has been applied to offshore colours (Sheet 1 to 5). In addition a white buffer seaward of the coast line (Sheet 1) serves to further highlight the distinction between land and offshore areas.

Offshore geology beyond the limit of continental crust, is generally represented by the age range of crustal materials exposed at the sea bed (mostly volcanic rocks). Due to the full age range of sedimentary cover materials in oceanic crust, the distinction is made onshore between the full range of sedimentary and metamorphic map units, and offshore where only the youngest rocks (Cenozoic and Mesozoic) between the convergent margin of the Pacific Ocean, and the trailing continental margins of the North Atlantic and Arctic oceans which formed during sea floor spreading.

PATTERNS AND SYMBOLS

Patterns are used in Phanerozoic rocks to illustrate selected compositional units with notably separate patterns for intrusive and extrusive rocks (Sheet 1,2, 4, and 5). There are four patterns for sedimentary facies: two stipple patterns for deltaic and nearshore, and continental clastic units; a pattern for slope and deep water sedimentary and one for carbonate rocks (shallow marine and platformal). Other depositional setting are not expressed by patterns, however, each alphanumeric label implies a unique age and setting as indicated on the accompanying legend chart.

As described above, colour rather than patterns were utilized to convey information on the compositional setting for map units of Precambrian age. In addition, thumbnail group and lithological descriptions are provided on the Precambrian correlation chart on Sheet 3.

OPEN FILE DOSSIER PUBLIC
5816
GEOLOGICAL SURVEY OF CANADA COMMISSION GÉOLOGIQUE DU CANADA
2008
SHEET 1 OF 5
FEUILLET 1 DE 5

Open files are products that have been released through the GSC formal publication process.

Les dossiers publics sont des produits qui ont été publiés par des moyens officiels au sein de la CGC.

Sheet 1 of 5, Geology

Recommended Citation:
Harrison, J.C., St-Onge, M.R., Petrov, O., Strelnikov, S., Lopatin, B., Wilson, F., Tella, S., Paul, D., Lynds, T., Rhodubay, S., Hults, C., Bergman, S., Jepsen, H.F., and Solli, A. 2008: Geological map of the Arctic, Geological Survey of Canada, Open File 5816, scale 1:5 000 000.

GEOLOGICAL SURVEY OF CANADA | COMMISSION GÉOLOGIQUE DU CANADA

OPEN FILE 5816

GEOLOGICAL MAP OF THE ARCTIC

Scale 1:5 000 000/Échelle 1/5 000 000

kilometres 100 0 100 200 300 400 kilomètres

Stereographic North Pole Projection
Standard Parallel 71°N Coordinate System WGS 1984
© Her Majesty the Queen in Right of Canada 2008

Projection stéréographique pôle nord
Parallèle d'échelle conservée: 71° N, Système de coordonnées WGS 1984
© Sa Majesté la Reine du chef du Canada 2008

Canada