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EXPLANATORY NOTES

INTRODUCTION

As part of the International Polar Year (IPY) 2007-08 and 2008-09 activities, and related obligations of the Commission for the Geological Map of the World (CCGM), nations of the circumpolar Arctic have co-operated to produce a new bedrock geology map and related digital products covering the Arctic. This map, at 1:5 000 000 scale, is based on a polar stereographic projection using the World Geodetic System (WGS) 84 datum, includes complete geological and physiographic coverage of all onshore and offshore bedrock areas north of latitude 60°N.

Identified applications of the map and map database include: 1) providing a new geological, geophysical, and geographic digital database for scientific study of the Arctic; 2) providing a Pharanozoic map units that can be shown at 1:5 000 000 scale in the Arctic polar region; 3) documenting and understanding the spatial relationships between mineral/energy resources and onshore/offshore geology and morphology; 4) encouraging frontier mineral and energy exploration through wider dissemination of national and international geologic data sets; 5) providing a modern geological framework for environmental and resource management, planning; 6) providing a geological context for resource and ecosystem management, environmental-impact assessment, geotechnical concerns, and infrastructure development; 7) providing a framework for studies of Arctic ocean and coastal zone, surficial, freshwater, subsea, subsurface and groundwater issues; and 8) providing an interpretation of geology that can be used by governments and land claimants to help evaluate sovereignty and jurisdictional claims.

Data sources that contributed to the map include new regional and national compilations, digital databases, and digital geologic maps at scales ranging from 1:1 000 000 to 1:250 000. 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 compilations used include those for the provinces of Canada (1:2 000 000), Greenland (Kalaallit Nunaat, 1:2 500 000), Yukon (1:1 000 000), and other selected parts of Arctic Canada (1:5 000 000). Captured analog sources cover the northwest Atlantic Ocean, northeast Pacific Ocean, and Arctic Ocean offshore of North America (1:5 000 000).

While a short-term objective was the production of a new bedrock geology map for the circumpolar Arctic, the true value of this major synthesis effort is the underlying database. This archive of digital spatial data for the circumpolar Arctic represents a treasury for the production of thematic derivatives and for more detailed regional and local studies. The bedrock map 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 (August 2009 version) published by the International Commission on Stratigraphy (ICS) (http://www.stratigraphy.org/upload/ISChart2009.pdf), which shows on the absolute scale for geologic time the ages of major chronostratigraphic units (chronozones). The GeoSciML GSL GSC database features 155 divisions of geological time based on maximum and minimum age ranges of compilation map units. This includes 105 divisions in the Phanerozoic and 30 in the Precambrian.

COMPOSITIONAL UNITS

Lithological variation is expressed by 28 compositional units (Sheet 2), which include one supracrustal (sedimentary and/or volcanic, undivided) and eight sedimentary associations: carbonate platform (shallow marine), carbonate (undivided), clastic continental, clastic deltaic and nearshore, clastic shallow marine, evaporite, carbonate, sedimentary slope and deep water, marine sedimentary (undivided); six extrusive associations (alkalic, felsic, intermediate, mafic, ultramafic, volcanic arc); six plutonic associations (alkalic, felsic, intermediate, mafic, gabbroic, peridotitic, anorthositic, syenitic, kimberlitic, carbonatitic, undivided); an undivided igneous association; an undivided metamorphic association; an impact structure association; and a melange association.

METAMORPHIC CONDITIONS

Data on metamorphism have also been collected and grouped in the following eight categories (Sheet 2): not specified; not metamorphosed; metamorphosed and not metamorphosed; metamorphosed low grade; metamorphosed low to medium grade; metamorphosed medium grade; metamorphosed high grade; and metamorphosed high pressure.

TECTONIC DOMAINS AND REGIONS

Map units in the Pharanozoic are grouped and coded by their host tectonic domain wherever possible. These domains, the locations of which are shown on the geological domain insert map on Sheet 2, include ten Archean cratons (Anabar Shield, Hearne Craton, Kaniklian Craton, Murmansk Craton, North Atlantic Craton, Oklodite inlaid, Omolon inlaid, Rae Craton, Slave Craton, Superior Craton, Wyoming Craton); Paleoproterozoic orogens (Akitkan, Birkenian, Caledonian, Makarovian, Nadanhan, Penokean, Pumasi, Quitralican); nine magmatic arcs and suites (Burwell Arc, Cumberland batholith, Dalai-Rapakivi Domain, Gardar Province, Great Bear magmatic zone, Mackenzie igneous suite, Nain plutonic suite, Pan-African, Transgondwanan); fold-thrust belts, and foiled regions (Baikal-Patom fold-thrust belt, Caledonian Orogen, Cherepy-Polouyanovik fold-thrust belt, Cordilleran Orogen, Ellesmerian-Inglefield belt, Ellesmerian Orogen, Grenville Orogen, Hercynian Orogen, Chukotka folded region, Selwyn-Boothia folded region, Scandinavian and Laplandian orogens, Innuitian-Inuitian Orogen, Oenian-Taconian Orogen, Pan-African Orogen, Timanian-Timanian Orogen, Timanian-Timanian Orogen, Yana-Kolyma fold-thrust belt, Yenisei-Turukhanok-Noril'sk fold-thrust belt); and twelve post-orogenic basins and cover sequences (Hornby Bay and Amundsen basins, Anabar-Olenek basin, Belt basin, Dnepr-Donets basin, Franklinian basin, Hudson Bay basin, Mackenzie basin, Belfast Bay-Cape Ingram, Fury and Hecla Basin, Independence Fjord Group, Nordaustlandet, Thelon Basin, Thule Supergroup, Timan fold belt). These divisions, also identified in the geological domain insert map, and Pharanozoic correlation chart (Sheet 3), facilitate and highlight the correlation of diverse, but once contiguous, low- to high-grade terranes located within widely separated continental nuclei.

Map units in the Pharanozoic are associated with 35 informally defined regions located and identified on the geographic regions meet map of Sheet 2. Pharanozoic regions are based on major physiographic features of the Arctic, both onshore and offshore. These have been used to produce a separate correlation chart for the Pharanozoic (Sheet 4 and Sheet 5) that should facilitate 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 cinder cones, diapirs, and kimberlite diatremes.

COLOUR DESIGN

Onshore geology

The colour design of the map for onshore Pharanozoic sedimentary and metamorphic units follows the CCGM colour scheme for Precambrian units on the Bedrock Geology of Arctic Map of the World (www.rgdm.net), with new colour shades added for broader age divisions. For volcanic rocks, shades of green were selected, with lighter shades used for felsic and darker shades for mafic compositions. For plutonic rocks, shades of red were used for felsic rocks the following colour shades were utilized: lighter and darker pink tones for granitic, syenitic, and tonalitic rocks; orange for carbonatitic rocks; and shades of lilac and purple for gabbroic and peridotitic rocks.

An effort has been made to choose colours for Pharanozoic units (Sheets 1 and 3) not used for the Pharanozoic. In general the colours utilized reflect lithological compositions: shades of yellow, grey, and brown for clastic rocks; shades of blue for carbonates; shades of green for volcanic rocks; and shades of red, pink, lilac and purple for plutonic rocks. Distinctive colours for metic and ultramafic units; and shades of pale pink and orange for anorthosites. Some colours, however, are repeated.

In order to emphasize dominant attributes of Pharanozoic map units (Sheets 1 and 3), differing colour palettes were utilized for different tectonic domains (e.g. the Archean Slave, Kaniklian, and Superior cratons are distinguished by shades of grey and salmon, shades of pink and shades of orange, respectively).

Sea caps are shown only locally on Sheet 1, such as in the eastern Arctic Islands of Canada, Greenland (Kalaallit Nunaat), Iceland, northern Russia, and Alaska. Small icefields are generally 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 from one another, a contrasting colour background is used. In order to provide a white buffer seaward of the coastline (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 seabed (mostly volcanic) or by the full age range of sedimentary cover presumed to overlie oceanic crust. This approach has been used to provide and useful geological context for map units preserved within the oceanic theatre, highlighting the Pharanozoic tectonostratigraphy preserved in the Pacific Ocean, along the margins of the continental margins of the North Atlantic and Arctic oceans which formed during seafloor spreading.

PATTERNS AND SYMBOLS

Patterns are used in Pharanozoic rocks to illustrate selected compositional units with, notably, sedimentary units, patterns for carbonate units and patterns for clastic units. There are also patterns for sedimentary facies: two dipple patterns for clastic deltaic and nearshore, and clastic continental units; a pattern for slope and deep water sedimentary rocks, and one for carbonate rocks (reefal, limestone and dolostone). Other depositional settings are also expressed by patterns. However, each ephanaurent label documents a unique age and specific 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 Pharanozoic age. In addition, numerous other lithological descriptions are provided in the Pharanozoic correlation chart on Sheet 3.

This map is dedicated to the memory of Dr. Tatiana Nikolaevna Koren (1935–2010), VSEGEI, Saint-Petersburg

Cette carte est dédiée à la mémoire de Tatiana Nikolaevna Koren (1935-2010), VSEGEI, Saint-Petersburg

Эта карта посвящается памяти Татьяны Николаевны Корень (1935–2010 гг.), ВСЕГЕИ, Санкт-Петербург

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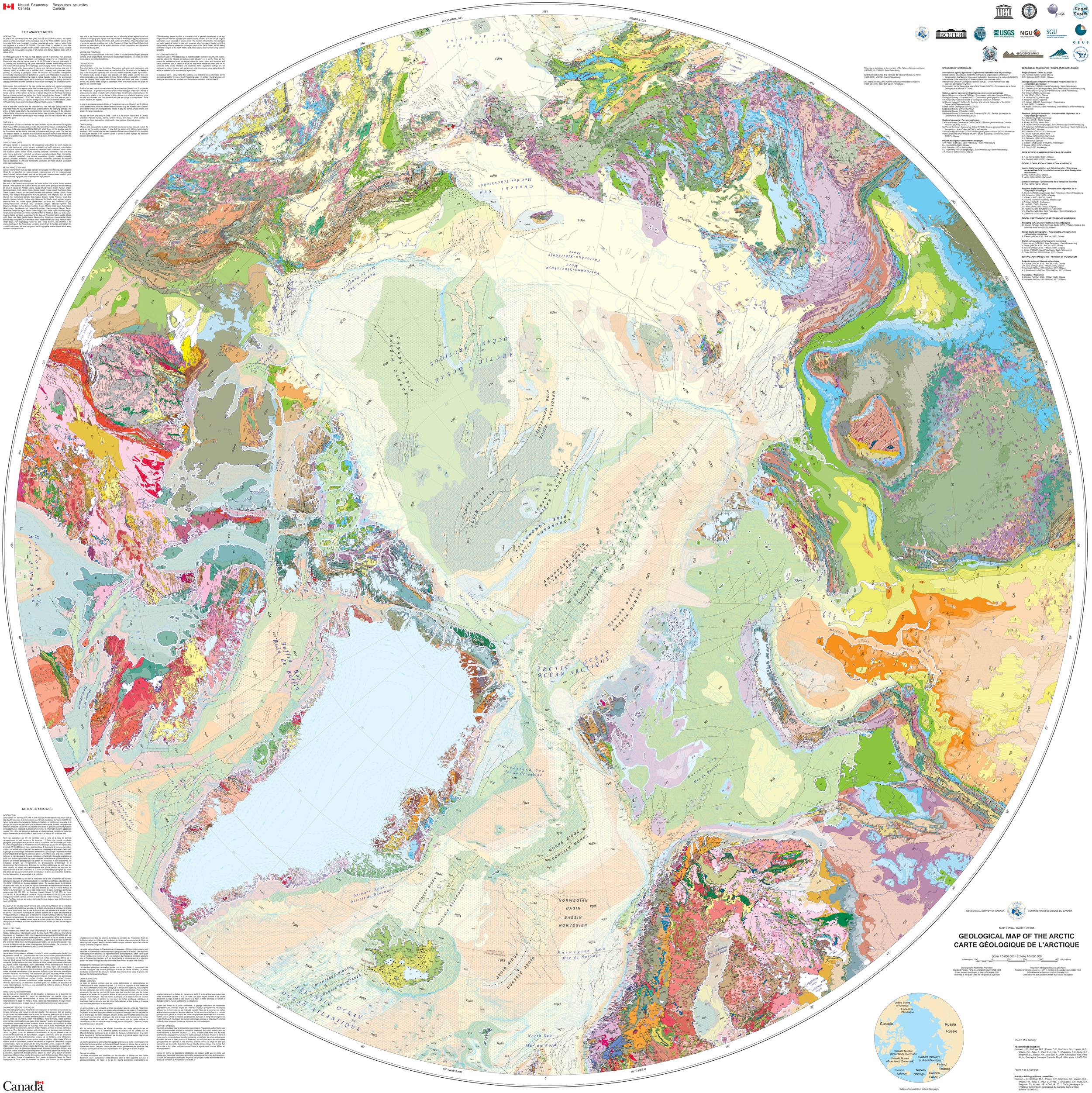
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Baie de Baffin
Hudson Bay
Baie d'Hudson
Greenland Sea
Mer du Groenland
Barents Sea
Mer de Barents
Kara Sea
Mer de Kara
Laptev Sea
Mer de Laptev
East Siberian Sea
Mer de Sibérie orientale
Beaufort Sea
Mer de Beaufort
Chukchi Sea
Mer des Tchoukches
Norwegian Sea
Mer de Norvège
North Sea
Mer du Nord
Barents Sea
Mer de Barents
Kara Sea
Mer de Kara
Laptev Sea
Mer de Laptev
Lincoln Sea
Mer de Lincoln
Davis Strait
Détroit de Davis
Denmark Strait
Détroit du Danemark
Fram Strait
Détroit de Fram
Greenland
Groenland
Ellesmere Island
Île d'Ellesmere
Baffin Island
Île de Baffin
Victoria Island
Île Victoria
Banks Island
Île Banks
Devon Island
Île Devon
Axel Heiberg Island
Île Axel Heiberg
Ellef Ringnes Island
Île Ellef Ringnes
Amund Ringnes Island
Île Amund Ringnes
Melville Island
Île Melville
Prince of Wales Island
Île Prince de Galles
Somerset Island
Île Somerset
Prince Patrick Island
Île Prince Patrick
Baffin Bay
Baie de Baffin
Davis Strait
Détroit de Davis
Hudson Bay
Baie d'Hudson
Foxe Basin
Bassin de Foxe
Hudson Strait
Détroit d'Hudson
Ungava Bay
Baie d'Ungava
Hudson Strait
Détroit d'Hudson
Foxe Basin
Bassin de Foxe
Ungava Bay
Baie d'Ungava
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Mer du Groenland
Barents Sea
Mer de Barents
Kara Sea
Mer de Kara
Laptev Sea
Mer de Laptev
Chukchi Sea
Mer des Tchoukches
Beaufort Sea
Mer de Beaufort
East Siberian Sea
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