TECTONIC MAP OF THE EARTH’S POLAR REGIONS

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Objectives:

The existing overview tectonic maps of the Arctic and the Antarctic were published more than 20 years ago. Since then a vast amount of new data was accumulated in both Polar Regions, especially in their oceanic parts and continent-to-ocean transition zones, and a considerable progress was made in understanding their tectonic evolution. This enables compilation of up-to-date tectonic maps of the Arctic and the Antarctic, given adequate coordination and scientific guidance required for integration of abundant data that are either disseminated in the literature and/or held by multinational organizations involved in high-latitude earth science research. The principal objective of such undertaking will be to conceive both the common features and dissimilarities in geological history of the Arctic and the Antarctic by summarizing the existing evidence in the form of bi-polar tectonic map compiled in a unified legend and projection. The optimal scale of compilation (in the range between 1:10,000,000 and 1:5,000,000) is to be chosen depending on definition of the level of detail and geographical limits of the map. The map should be accompanied by explanatory notes highlighting the main tectonic features of the Polar Regions in a comparative context.

Rationale:

The Arctic and the Antarctic are not only geographic antipodes but also the examples of strikingly contrasting morphostructural settings. The fundamental “asymmetry” of their tectonic arrays is evident from the present-day general topography: the circum-Arctic geodepression with broad peripheral shelf and central deep oceanic core is matched on the opposite side of the globe by the near-pole swelling of thick continental crust that gradually thins out beneath the surrounding marginal seas and towards the adjacent oceanic deeps. The late Mesozoic and Cenozoic history of oceanic seafloor was also basically different: while the growth of young oceanic crust in the Arctic was constrained by lack of spreading space and occurred at ultraslow rate in an intracontinental environment, the breakup of Gondwana and subsequent separation of the southern continents enabled a more speedy opening and faster maturation of the Southern Ocean.

Despite these and many other distinctions, there is a curious symmetry of some transregional structural lineaments (both submarine and sub-aerial) that not only demonstrate a similar orientation in both the Arctic and the Antarctic but in some cases appear almost exactly antipodal. This in the first place refers to systems of Arctic submarine ridges and intervening oceanic-deep elongated basins (Gakkel and Lomonosov Ridges; Nansen, Amundsen and Makarov Basins) that mirror the prominent south-polar discordance represented by high-standing chain of the Transantarctic Mountains and subsided subglacial continental rifts bordering the latter on both sides. Among non-linear features, the major rift-related deep sedimentary basins in one polar region appear antipodal to principal shield areas in the other (e.g. Canada Basin in the Arctic versus the oldest Antarctic cratonic nuclei, or the Wilkes Subglacial Basin in East Antarctica versus the Greenland Shield).
The nature of this phenomenon is not understood. It may indicate the influence of planetary-wide tension fields that affected the Polar Regions during formation of their present-day morphostructural framework. Moreover, the general geodynamic background was probably essentially similar in both areas and related to tectonic forcing by plumes, the principal differences resulting from variations in time and degree of the plumes’ maximal activity and/or peculiarities of the overlying lithosphere.

**Anticipated outcome:**

Improved understanding of the Earth’s geological history by means of state-of-the-art characterization of tectonic structure and evolution of Polar Regions.

**Proposed research activities:**

New expeditions are not planned. The entire project is envisaged as a moderate-cost indoors exercise involving only expenses for labor, exchange of visits of leading researches from participating countries/organizations, computer adaptation, editorial procedures, printing, etc.; sharing these expenditures between national and international sources seems a feasible possibility. The main focus will be to search for, select and capture the already existing relevant data (probably with minor additional analytical work) and systematize them with a view to develop a comprehensive geodynamic concept enabling the cartographic presentation of tectonic structure and evolution of both Polar Regions in a unified legend.

The optimal scale of compilation (most likely in the range between 1:10,000,000 and 1:5,000,000) must be chosen depending on definition of the level of detail and geographical limits of the map. The accompanying explanatory notes will highlight the basic principles laid down in elaboration of the legend and describe in a comparative context the common features and dissimilarities in geological history of the Arctic and the Antarctic.

**International cooperation:**

The compilation and printing of the map will require a cooperative effort of numerous scientists in many countries and can therefore best be performed under the auspices of CGMW, with endorsement by International Arctic Science Committee (IASC) and Scientific Committee on Antarctic Research (SCAR). The project is open for participation by all IASC and SCAR countries willing to contribute relevant earth science data, qualified labor/expertise and/or share of funding.

Since CGMW is seen as the principal sponsor and supervisor of the compilation, it is proposed to place the main activity in hands of its three sub-commissions, namely the S/C for tectonic maps, S/C for Northern Eurasia and S/C for Antarctica. All three sub-commissions are chaired by Russian scientists (Acad. Yu. Leonov, Prof. Ju. Pogrebitsky and Dr. G. Grikurov, respectively) who will be prepared to accept responsibility as project co-leaders and organize compilation efforts at their respective home organizations (GIN RAS, VNIOkeangeologia). For the larger part of the Arctic pertaining to “Russian sector” the original compilation will be made in Russia, while North American, Danish and Norwegian scientists will be expected to take similar obligations for their respective “sectors”. For Antarctica the Russian specialists will commit themselves for compilation of the entire original draft. The project co-leaders will ensure that subsequent adequate discussion of the drafts takes place among all participating parties through appropriate representation at CGMW, IASC and SCAR, as well as by direct communication with leading national Polar institutions and earth science specialists.
Timeframe:

Final draft of the map in digital print-ready format will be approved by all participating parties and reported to CGMW General Assembly in 2008 in conjunction with 33 IGC.