

Subdivision of Precambrian time – methods and terminology currently used by Danish geologists

A meeting was called on October 29–30, 1981 under the auspices of the Danish National Committee for Geology to discuss current Danish practises in the subdivision of the Precambrian with Professor K. Rankama, Helsinki, who was visiting Copenhagen at this time. Professor Rankama is a member of the Subcommittee on Precambrian Stratigraphy under the IUGS, and the main purpose of his visit was to hear views and collect information for the next meeting of the Subcommittee which is expected to be held at Tanta, Egypt, in November 1982.

Two approaches to the subdivision of the Precambrian are currently used by Danish geologists working in the Precambrian, particularly in Greenland, the choice of approach depending on the geology of the area concerned:

a) The classical combination of biostratigraphy and lithostratigraphy developed over the past 200 years for the subdivision of the Phanerozoic.

b) A combination of mapping and isotopic age determinations aimed at establishing sequences of recognisable and accurately dated igneous and plutonic events.

The first approach – that of combining bio- and lithostratigraphical methods – is only applicable in the 1350–600 Ma old platform and foreland sediments in North Greenland and in the late Precambrian sediments within the Caledonian fold belt. However, in spite of recent advances, biostratigraphical methods have not the same precision in the upper Precambrian as they have in the Phanerozoic. In Greenland, divisions based largely on assemblages of acritarchs have been erected and named using stratigraphic terms that were introduced in Scandinavia and Russia, for example Varangerian (Varangan), Vendian and Riphean. However, no attempt has been made to impose these terms on North Greenland geology, and individual workers have been left to decide for themselves in this matter.

The greater part of the Precambrian in Greenland consists of crystalline rocks – gneisses, granites and metamorphosed and deformed supra-crustal rocks. The few well-preserved sequences

of sedimentary rocks occupy restricted and isolated areas and therefore cannot be used as a basis for a chronostratigraphic division of the pre-1350 Ma Precambrian of Greenland, even if it should prove possible to date the time of deposition of these rocks. Subdivision of the higher-grade Precambrian terrains in Greenland has been designed largely for the purpose of producing maps with divisions which can be applied throughout the country. Given the character of the geology, the only practicable subdivision is into tectonic units corresponding to the major structural provinces of the Canadian shield. The term “Ketilidian” had at one time both orogenic and chronostratigraphic connotations, but is now used exclusively for a tectono-magmatic province in South Greenland. There has also been ambiguity in the use of term “Nagssugtoqidian”, which was introduced (Ramberg 1949) both to designate a particular phase of tectonic activity post-dating the injection of a widespread suite of basic dykes (Nagssugtoqidian time) and for the mapped regional belt of rocks that were believed to have acquired their distinct structural character during the post-dyke tectonic event (Nagssugtoqidian structural province). Advances in field mapping and isotope geology (see papers in Korstgård 1979) have shown that many of the structures characteristic of the Nagssugtoqidian structural province were developed before the injection of the regional swarm of dykes and their deformation between 1900 and 1600 Ma. This results in the rather unfortunate circumstance that the Nagssugtoqidian structures of one author were not developed in the Nagssugtoqidian time of another. General practise in high grade areas in Greenland is now tending towards using local terms for structural provinces and isotopic ages for time divisions.

As both access to age determinations has become easier and field mapping has advanced in the last 25 years, the reader of earlier publications has to be aware that the terminology has evolved.

The chronostratigraphic terms Archaean and

Proterozoic have been used in Greenland without any formal agreement on where the boundary should be placed. This has not led to any difficulties as there is an apparent hiatus in plutonic activity between 2500 and 2300 Ma.

One chronostratigraphic term that recurs in Greenland Precambrian is "Gardar period". This has been used locally in South Greenland for a post-1500, pre-1000 Ma period of sandstone deposition, volcanism and igneous activity in this area.

The general opinions expressed at the meeting with Professor Rankama by groups working on high-grade Precambrian terrains can be summarised as follows:

- A) There is no need for a strict and detailed subdivision of the Precambrian into named chronostratigraphic units. Isotopic age determinations have become both commonplace and reliable, so figures for isotopic age limits provide a practical, unambiguous means of referring to a particular period of Precambrian time. Systematic mapping of the Greenland Precambrian did not begin until 1946, and Greenland Precambrian geology is not burdened with a cumbersome, outdated nomenclature. Event chronologies supplemented by isotopic ages have proved an adequate and flexible framework for subdivision and correlation purposes.
- B) If formal chronostratigraphic boundaries are to be made, they should be set at intervals between major dateable geological events, i.e. during apparent lulls in magmatic and plutonic activity.

In response to a questionnaire sent by Professor Rankama and circulated before the meeting, the following specific questions were discussed:

- 1) Proterozoic-Archaeon boundary: Placing the boundary at 2500 Ma is acceptable.
- 2) Proper designation of the older time unit: "Archaean" is the form used in Geological Survey of Greenland publications. "Archaezoic" is not used at present but could be if a strict Proterozoic-Archaeozoic time division is enforced, leaving Archaean as an informal term for older parts of the shield.
- 3) A division at 2100 Ma: There is no evidence in Greenland for a break at c. 2100 Ma.
- 4) A division at 1600 Ma: This would be unfortunate in Greenland since there is a suite of igneous rocks in southern East Greenland that straddles this date. A division at 1500 Ma would be preferred in Greenland, but on the other hand would lead to difficulties in southern Norway and Sweden.
- 5) A division at 2900 Ma: A division of the Archaean at 2900 Ma would be very inconvenient in Greenland where there was a continuum of events between 3100 and 2800 Ma. A division at 3500 Ma would be acceptable but there is little evidence in Greenland (or elsewhere) that it would be useful. The plutonic events in the Amitsoq-Isua complex took place in the period 3500–3850 Ma.
- 6) Names for the period before 3850 Ma: Geologists do not need a name for a period if there are no known rocks from that period.

References

- Korstgård, J. A. (ed.) 1979: Nagssugtoqidian geology. *Rapp. Grønlands geol. Unders.* 89, 146 pp.
- Ramberg, H. 1949: On the petrogenesis of the gneiss complexes between Sukkertoppen and Christianshaab, West-Greenland. *Meddr dansk geol. Foren.* 11, 312–327.

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