

# Isotopic evidence for the age of the Røde Ø Conglomerate, inner Scoresby Sund, East Greenland

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On the basis of sulphur and strontium isotope data of sedimentary gypsum it is suggested that the Røde Ø Conglomerate at C. Hofmann Halvø, East Greenland was deposited during the mid- to late Permian. The  $\delta^{34}\text{S}$  values of +11.4‰ and +11.9‰ are comparable to late Permian seawater values whereas  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios of 0.7188137 and 0.7191609 indicate the influence of freshwater. This pro-posed mid- to late Permian age for the Røde Ø Conglomerate makes it an equivalent to the Huledal Formation in the Jameson Land – East Greenland basins to the north-east.

*Key words:* Permian, Røde Ø Conglomerate, gypsum, isotopes.

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The Røde Ø Conglomerate in inner Scoresby Sund is one of the few sedimentary units in East Greenland that still remains undated due to absence of both macro- and microfossils in the formation. The more than 1000 m thick conglomerate-dominated succession was briefly described by Bay (1896) and Bütler (1957), but it was not until mapping of the area in 1970 that the sedimentology and depositional setting of the succession were described in more detail (Collinson 1972). The Røde Ø Conglomerate is a syntectonic succession of red alluvial conglomerates that eastwards pass into floodplain sandstones and siltstones with gypsum nodules and layers (Collinson 1972). Deposition took place in a N–S elongated, less than 20 km wide, westward-tilted half-graben, bounded to the west by the southern extension of the Fjord Zone Fault (Fig. 1). This structure is a major Caledonian lineament with a highly disputed history (e.g. Larsen & Bengaard 1991; Dallmeyer *et al.* 1994; Leslie & Higgins 1994; Strachan 1994; Hartz *et al.* 2000), and dating of the Røde Ø Conglomerate will therefore help to constrain timing of later movements along the structure.

The sediments rest on a peneplain of Caledonian affected migmatites and granites, and are intruded by tertiary dykes (Bütler 1957; Collinson 1972), thus constraining deposition to the Devonian–Cretaceous interval. Bütler (1957, 1961) suggested, on the basis of lithological comparison, that the Røde Ø Conglomerate was of the same age as the non-marine con-

glomerates along Schuchert Dal (Traill Ø Group). The proposed age thus shifted from Carboniferous (Bütler 1957) to Early Permian (Bütler 1961) as new biostratigraphic data emerged from the Schuchert Dal outcrops. The Schuchert Dal outcrops are now regarded as being of Stephanian (Late Carboniferous) age (Piasecki 1984; Vigran *et al.* 1999). Subsequently, Larsen & Bengaard (1991) suggested a Middle Devonian age for the conglomerates based on their proposed fault history of the Fjord Zone Fault between 72°N and 74°N in North-East Greenland. The Røde Ø Conglomerate is, however, indicated as Carboniferous on the most recent geological maps of the Geological Survey of Denmark and Greenland (Escher & Pulvertaft 1995; Henriksen 2003).

The present paper summarises the results of a brief visit to the outcrops at C. Hofmann Halvø in 2003 and discusses the age of the Røde Ø Conglomerate in the light of the large amount of modern sedimentological and palaeoenvironmental data obtained from the post-Caledonian succession in East Greenland since the pioneering work of Collinson (1972).

## Material and results

Twenty siltstone and mudstone samples and three gypsum nodules from the gypsiferous silty sandstone, silty sandstone and cross-bedded sandstone

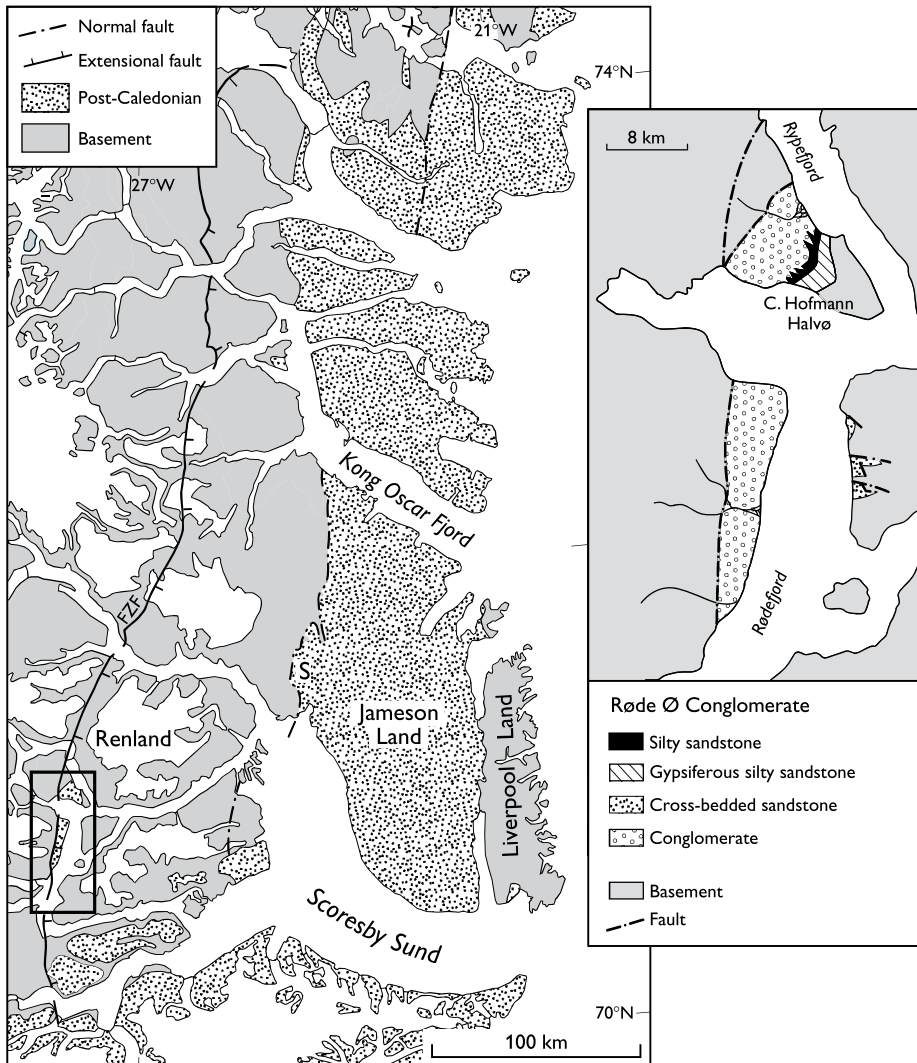


Fig. 1. Map showing the distribution of post-Caledonian sediments in East Greenland together with the main faults. FZF: Fjord Zone Fault; S: Schuchert Dal. Inset map is modified from Collinson (1972).

associations of Collinson (1972) have been processed using standard palynological methods. All samples were barren.

Two samples of gypsum (GGU 477713, 477719) from the gypsiferous silty sandstone association of Collinson (1972) have been analysed. The gypsum forms 15–20 cm thick, laterally continuous beds in a rhythmic succession of red siltstone, fine-grained sandstone and gypsum. Analyses of gypsum from the lower part of the succession (GGU 477713) gave  $\delta^{34}\text{S} +11.9\% \pm 0.2\%$  and  $^{87}\text{Sr}/^{86}\text{Sr} 0.7188137 \pm 0.0000127$ , whereas the sample GGU 477719 from the upper part of the succession gave  $\delta^{34}\text{S} +11.4\% \pm 0.2\%$  and  $^{87}\text{Sr}/^{86}\text{Sr} 0.7191609 \pm 0.0000188$ .

## Discussion

The lack of both micro- and macrofossils in the Røde Ø Conglomerate precludes biostratigraphic dating of the succession, and so far all proposed ages have been based on lithological or structural comparisons (e.g. Bütler 1957; Larsen & Bengaard 1991). The presence of gypsum in the Røde Ø Conglomerate indicates deposition in an arid climate, and by comparison to the post-Caledonian succession in the Jameson Land – East Greenland basins this feature restricts the age of the formation to the Middle–Late Devonian, Late Permian and Triassic. Depositional models for the Traill Ø Group indicate that the climate was humid during the Carboniferous (e.g. Surlyk *et al.* 1984; Vigran *et al.* 1999), so the correlation originally suggested by Bütler (1957, 1961) is unlikely.

Sedimentary gypsum is only known from Upper Permian and Triassic deposits in East Greenland (e.g.

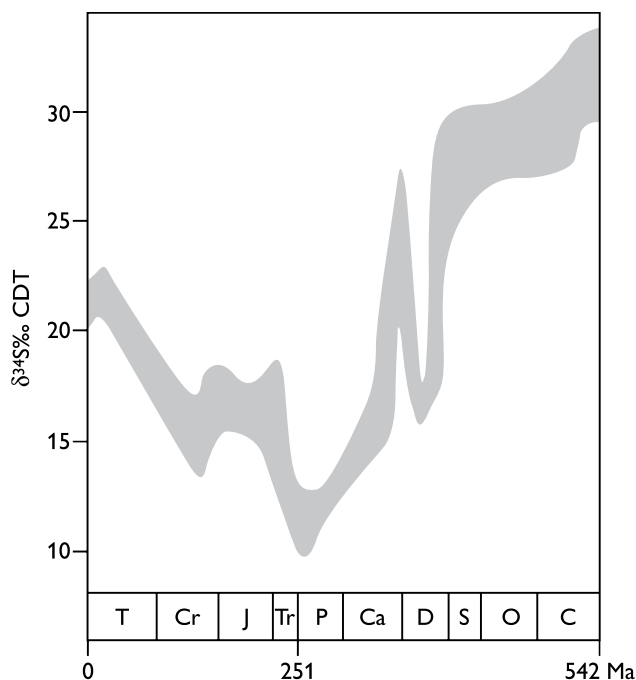


Fig. 2. Sulphur isotope age curve for marine sulphate showing an overall Phanerozoic low of 10–11‰ in the latest Permian. Modified from Claypool *et al.* (1980).

Clemmensen 1980; Stemmerik 1987), and in our opinion it is most likely that deposition took place during this time interval. The  $\delta^{34}\text{S}$  values of 11.4‰ and +11.9‰ obtained from the Røde Ø gypsum compare to  $\delta^{34}\text{S}$  values of 9.2–12.0‰ reported from marine gypsum in the Middle–Upper Permian Karstryggen Formation in Jameson Land (Stemmerik *et al.* 1988), and are considerably heavier than  $\delta^{34}\text{S}$  values of –0.2‰ to +8.2‰ reported by Clemmensen *et al.* (1984) from gypsum in the Triassic Gipsdalen Formation. Claypool *et al.* (1980) reported an overall Phanerozoic low of +10.5‰ for  $\delta^{34}\text{S}$  in marine sulphates in the latest Permian (Fig. 2). The  $\delta^{34}\text{S}$  values are thus compatible with a Late Permian seawater source for the Røde Ø gypsum. However, the Sr isotopes are too radiogenic to reflect deposition directly from Late Permian seawater and imply input of highly radiogenic strontium from continental weathering, in accordance with the overall depositional setting proposed by Collinson (1972). The analysed gypsum beds overlie well-developed caliche horizons and are interpreted to reflect events of rising watertable. It is therefore suggested that the dissolved sulphate was provided by infiltration of marine water into the basin during times of rising sea level whereas the strontium was continentally sourced.

The Middle–Late Permian age inferred from the isotope data implies that the Røde Ø Conglomerate

is a lateral equivalent of the Huledal Formation conglomerates in the Jameson Land – East Greenland depositional basins further to the north-east (Surlyk *et al.* 1986). Deposition thus took place following a prolonged period of uplift and erosion spanning the latest Carboniferous and Early Permian and marks the onset of protracted Permian–Triassic rifting in eastern Greenland.

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## References

- Bay, E. 1896: Den østgrønlandske Expedition, udført i årene 1891–92. VI. Geologi. Meddelelser om Grønland 19(6).
- Bütler, H. 1957: Beobachtungen an der Hauptbruchzone der Küste von Zentral-Ostgrønland. Meddelelser om Grønland 160(1), 79 pp.
- Bütler, H. 1961: Continental Carboniferous and Lower Permian in central East Greenland. In: Raasch, G.O. (ed.): Geology of the Arctic 1, 205–213. Toronto.
- Claypool, G.E., Holser, W.T., Kaplan, I.R., Sakai, H. & Zak, I. 1980: The age curve of sulfur and oxygen isotopes in marine sulfate and their mutual interpretation. *Chemical Geology* 28, 199–260.
- Clemmensen, L. 1980: Triassic rift sedimentation and palaeogeography of central East Greenland. *Bulletin Grønlands Geologiske Undersøgelse* 136, 72 pp.
- Clemmensen, L., Holser, W.T. & Winter, D. 1984: Stable isotope study through the Permian–Triassic boundary in East Greenland. *Bulletin of the Geological Society of Denmark* 33, 253–260.
- Collinson, J.D. 1972: The Røde Ø conglomerate of inner Scoresby Sund and the Carboniferous (?) and Permian rocks west of the Schuchert Flod. *Bulletin Grønlands Geologiske Undersøgelse* 102, 48 pp.
- Dallmeyer, R.D., Strachan, R.A. & Henriksen, N. 1994:  $^{40}\text{Ar}/^{39}\text{Ar}$  mineral age record in NE Greenland: implications for tectonic evolution of the North Atlantic Caledonides. *Journal of the Geological Society of London* 151, 615–628.
- Escher, J. & Pulvertaft, T.C.R. 1995: Geological Map of Greenland, 1: 2 500 000. Geological Survey of Greenland, Copenhagen.
- Hartz, E.H., Andresen, A., Martin, M.W. & Hodges, K.V. 2000: U-Pb and  $^{40}\text{Ar}/^{39}\text{Ar}$  constraints on the Fjord Region Detachment Zone: a long-lived extensional fault in the central East Greenland Caledonides. *Journal of the Geological Society of London* 157, 795–809.
- Henriksen, N. 2003: Caledonian Orogen, East Greenland 70°–72°N. Lithotectonic map 1: 1 000 000. Geological Survey of Denmark and Greenland, Copenhagen.
- Larsen, P.-H. & Bengaard, H.-J. 1991: Devonian basin initia-

- tion in East Greenland: a result of sinistral wrench faulting and Caledonian extensional collapse. *Journal of the Geological Society of London* 148, 335–368.
- Leslie, A.G. & Higgins, A.K. 1994: On the Caledonian geology of André Land, Elnore Sø and adjacent nunataks (73°–74°N), East Greenland. *Rapport Grønlands Geologiske Undersøgelse* 28, 11–28.
- Piasecki, S. 1984: Preliminary palynostratigraphy of the Permian–Lower Triassic sediments in Jameson Land and Scoresby Land, East Greenland. *Bulletin of the Geological Society of Denmark* 32, 139–144.
- Stemmerik, L. 1987: Cyclic carbonate and sulphate from the Upper Permian Karstryggen Formation, East Greenland. In: Peryt, T.M. (ed.): *The Zechstein facies in Europe. Lecture Notes in the Earth Sciences* 10, 5–22. Springer-Verlag, Berlin.
- Stemmerik, L., Rouse, J.E. & Spiro, B. 1988: S-isotope studies of shallow water, laminated gypsum and associated evaporites, Upper Permian, East Greenland. *Sedimentary Geology* 58, 37–46.
- Strachan, R.A. 1994: Evidence in North-East Greenland for Late Silurian – Early Devonian regional extension during the Caledonian Orogeny. *Geology* 22, 913–916.
- Surlyk, F., Hurst, J.M., Piasecki, S., Rolle, F., Scholle, P.A., Stemmerik, L. & Thomsen, E. 1986: The Permian of the western margin of the Greenland Sea – a future exploration target. In: Halbouty, M.T. (ed.): *Future petroleum provinces of the World. American Association of Petroleum Geologists Memoir* 40, 629–659.
- Surlyk, F., Piasecki, S., Rolle, F., Stemmerik, L., Thomsen, E. & Wrang, P. 1984: The Permian basin of East Greenland. In: Spencer, A.M. & others (eds): *Petroleum geology of the North European Margin*, 303–315. Graham and Trotman, London.
- Vigran, J.O., Stemmerik, L. & Piasecki, S. 1999: Stratigraphy and depositional evolution of the uppermost Devonian – Carboniferous (Tournaisian–Westphalian) non-marine deposits in North-East Greenland. *Palynology* 23, 115–152.