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 $\delta^{34}S$ values of +11.4‰ and +11.9‰ are comparable to late Permian seawater values whereas $^{87}Sr/^{86}Sr$ ratios of 0.7188137 and 0.7191609 indicate the influence of freshwater. This proposed 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 conglomerates 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 72ºN and 74ºN 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

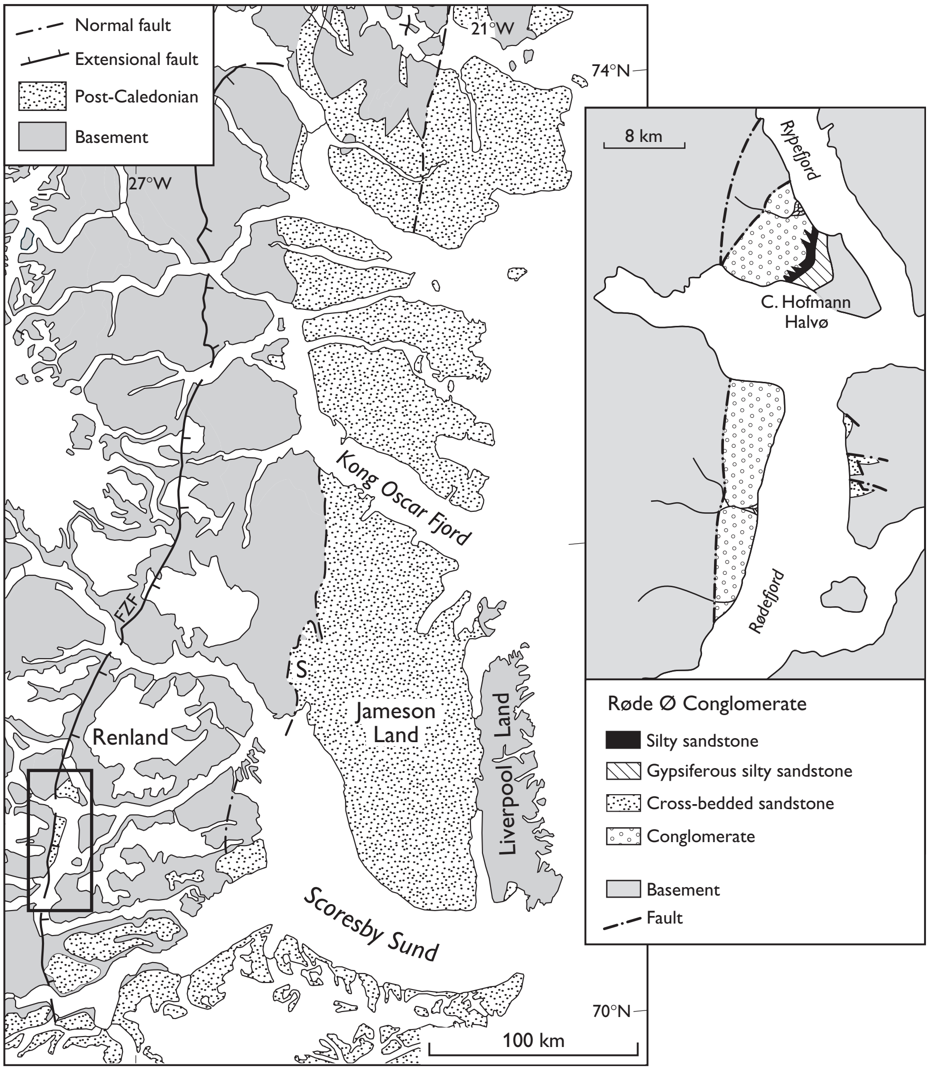

Fig. 1. Map showing the distribution of post-Caledonian sediments in East Greenland together with the main faults. FZF: Fjord Zone Fault; S: Schuchert Dal. Inset map is modified from Collinson (1972).

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 $\delta^{34}S$ +11.9‰ ± 0.2‰ and $^{87}Sr/^{86}Sr$ 0.7188137 ± 0.0000127, whereas the sample GGU 477719 from the upper part of the succession gave $\delta^{34}S$ +11.4‰ ± 0.2‰ and $^{87}Sr/^{86}Sr$ 0.7191609 ± 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.

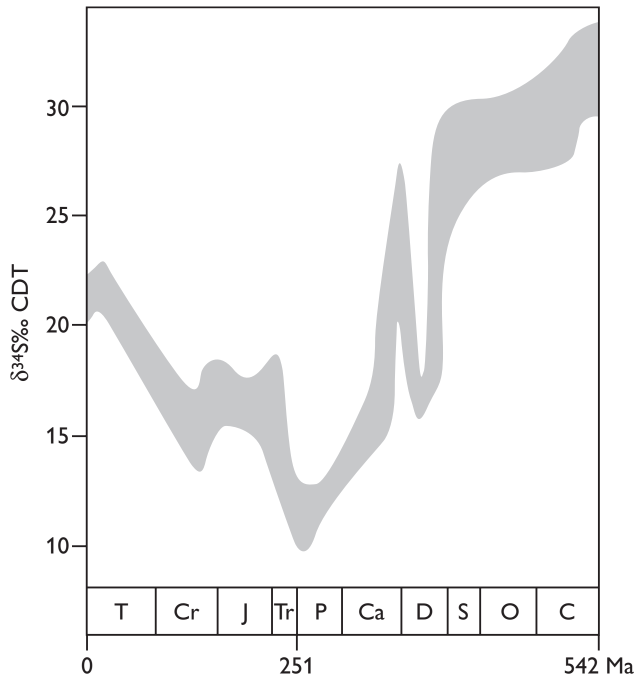

Fig. 2. Sulphur isotope age curve for marine sulphate showing an overall Phanerozoic low of 10–11‰ in the latest Permian. Modified from Claypool *et al.* (1980).

Clemmensen 1980; Stemmerik 1987), and in our opinion it is most likely that deposition took place during this time interval. The δ^{34}S values of 11.4‰ and +11.9‰ obtained from the Røde Ø gypsum compare to δ^{34}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 δ^{34}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 δ^{34}S in marine sulphates in the latest Permian (Fig. 2). The δ^{34}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 of 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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