Erosional unconformity at the base of marine Lower Triassic at Wegener Halvø, central East Greenland

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The Permian–Triassic boundary in East Greenland has been studied mainly in the areas of Kap Stosch (Nielsen, 1935; Teichert & Kummel, 1973) and Wegener Halvø (Trümpy, 1961; Grasmück & Trümpy, 1969), and to a lesser extent in western Scoresby Land (Aellen, *in* Trümpy, 1961; Perch-Nielsen *et al.*, 1972, 1974). According to Nielsen (1935) the boundary is not recognisable in the westernmost exposures at Kap Stosch where the lowermost Triassic *Glyptophiceras triviale* Zone was found. Further to the east the boundary is marked by a sharp change in facies from limy or shaly (Upper Permian) to sandy (Lower Triassic) deposits, the *G. triviale* Zone is missing, and locally a minor conglomerate appears at the base of the Triassic.

At Wegener Halvø, a hiatus between the Upper Permian and the Lower Triassic Wordie Creek Formation is suggested on faunal evidence (Grasmück & Trümpy, 1969): the lowermost *Glyptophiceras triviale* Zone is missing, and the deposits of the *Glyptophiceras martini, Otoceras boreale* (= *Metophiceras subdemissum* Zone of Trümpy, 1969; Grasmück & Trümpy, 1969) and *Ophiceras commune* zones are transgressive toward the east (Callomon *et al.*, 1972).

In the area of Schuchert Dal and Werner Bjerge (Scoresby Land) the lithologies of the Upper Permian and the basal Lower Triassic (Wordie Creek Formation) are often very similar (silty shales). The Lower Triassic shales with *Glyptophiceras martini* and early Triassic fishes conformably overlie the Upper Permian ones with *Cyclolobus kullingi*. The *Glyptophiceras triviale* Zone is missing, but no visible break in deposition was recognised (Perch-Nielsen *et al.*, 1972, 1974; Birkelund *et al.*, 1974; Birkelund & Perch-Nielsen, 1976).

Field evidence for the erosional unconformity

In southern Wegener Halvø a well pronounced erosional unconformity appears at the base of the Wordie Creek Formation. The best exposures of the contact of the Formation with the Upper Permian rocks are at Lille Cirkusbjerg and in the valley between Lille Cirkusbjerg and Lille Ravnefjeld, immediately east of peak 810 (fig. 27).

At Lille Cirkusbjerg the top part of the Upper Permian 'reef' limestone which is about 145 m thick, is represented by grey, bituminous, poorly bedded limestone devoid of macrofossils. Its upper surface is very uneven, cut by erosional channels (fig. 28) filled with Lower Triassic grey, coarse sandstone to fine conglomerate with well-rounded quartz pebbles (0.3 to 2 cm in diameter), and with very numerous angular fragments 1–50 cm in diameter of Upper Permian black or grey bituminous limestone rich in brachiopods (Productids, Spiriferids), algal balls, bryozoans, sometimes also corals.

Another exposure, slightly further south (fig. 29), shows the axial part of a channel 35 m deep and more than two hundred metres wide which also cuts into the Upper Permian 'reef' limestone. The channel-fill consists of Lower Triassic sediments, with sedimentary breccias

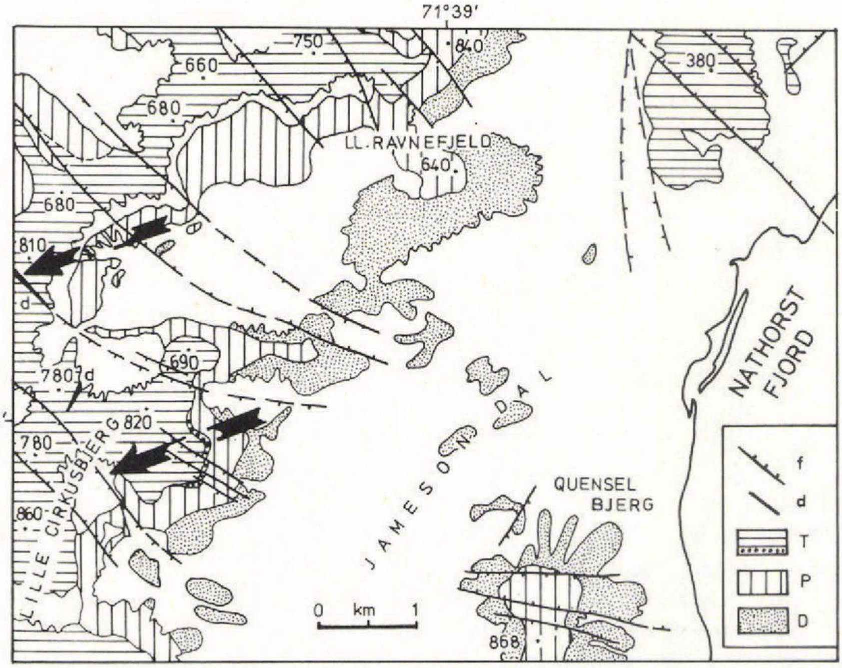

Fig. 27. Geological map of a part of southern Wegener Halvø, central East Greenland. f: faults; d: Tertiary dolerite dykes; T: Lower Triassic (with sedimentary breccia at the base); P: Permian (mainly Upper Permian); D: Middle–Upper Devonian. Thick arrows indicate the direction of channels at the base of the Lower Triassic.

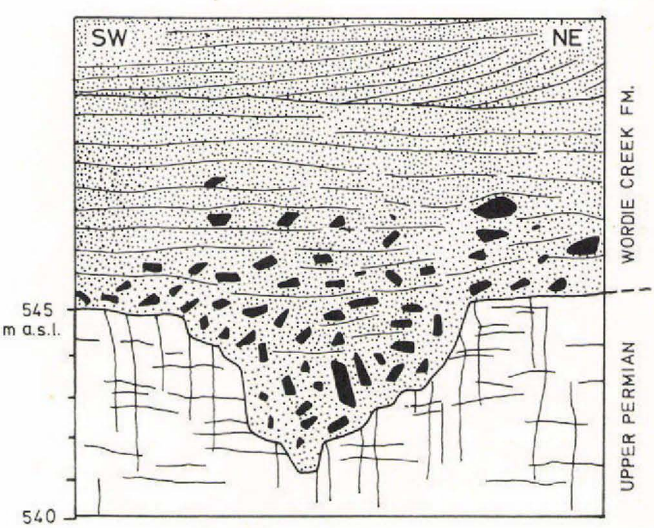

Fig. 28. Erosional channel at the base of the Lower Triassic (Wordie Creek Formation) cut in the Upper Permian 'reef' limestone, Lille Cirkusbjerg, east slope, central East Greenland. Upper Permian blocks at the base of conglomeratic Lower Triassic sediments in black.

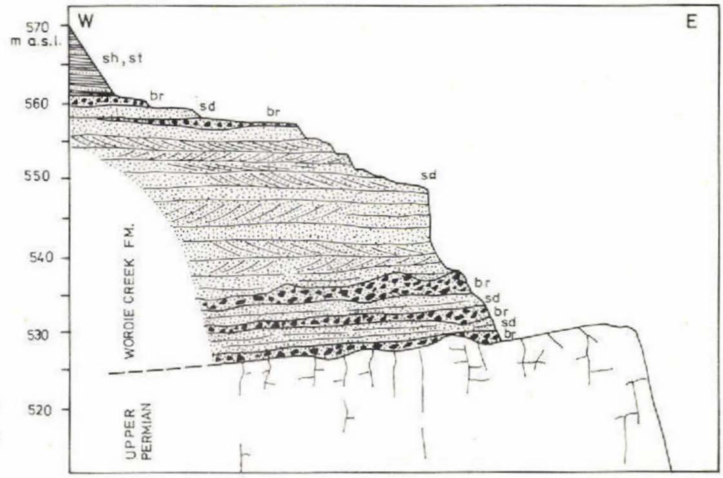

Fig. 29. Boundary of the Lower Triassic (Wordie Creek Formation) and the Upper Permian ('reef' limestone) at Lille Cirkusbjerg, east slope, central East Greenland. br: sedimentary breccias with Upper Permian blocks (in black); sh: shale; st: siltstone; sd: sandstone, conglomeratic sandstone.

composed of Upper Permian fossiliferous dark bituminous limestone fragments forming bands up to 2 m thick, which alternate with grey, arkosic, coarse sandstone to fine conglomerate in the bottom and top parts of the channel, and are replaced by sandstone–fine conglomerate complex with large-scale cross-bedding in the middle part of the section. Here the foresets dip at low angles (5–10°) with respect to the bounding surfaces of the sets, within a narrow sector of azimuths between 205 and 245° (exceptionally 180°), indicating southwesterly palaeocurrents; this is also the direction of the channel (fig. 27).

The coarse Lower Triassic basal clastics are followed by green shales with platy siltstone or fine-grained sandstone intercalations (0.2 to 1 m thick), the latter showing a variety of sedimentary structures: ripple marks (symmetric, crescentic), current markings (groove, prod and flute casts) and mudcracks, and with poorly preserved ammonoids.

The fragments of the Upper Permian rocks in the channels shown in figs. 28 & 29 differ markedly from the underlying 'reef' limestone and have no close equivalents in the upper Permian strata exposed in the nearest vicinity.

At the eastern foot of peak 810 m an erosional channel about 8 m deep and about 100 m wide cuts through the Upper Permian rocks subsequent to the 'reef' limestone: the *Posidonia* shale and the brachiopod limestone (fig. 30). The black *Posidonia* shale is about 30 m thick, the brachiopod limestone is 5–8 m thick and consists of platy or shaly, silty-sandy, sometimes siliceous, dark (yellow weathered) bituminous limestone with grey, coarse sandstone to fine, quartz conglomerate intercalations (5–10 cm). The limestone contains poorly preserved brachiopods and well preserved bryozoans and numerous spiral or straight burrows. The Lower Triassic sediments begin with sedimentary breccia 0.5–1.5 m thick, consisting of angular fragments 1–20 cm in diameter of black (weathered yellow), platy limestone often with brachiopods and bryozoans, which derived from the brachiopod limestone of the walls of the channel. There follow grey, arkosic, coarse-grained sandstone to fine conglomerate beds with angular fragments of black *Posidonia* shale up to 1 m in diameter, and with large-scale cross-bedding. In the northern part of the exposure, the

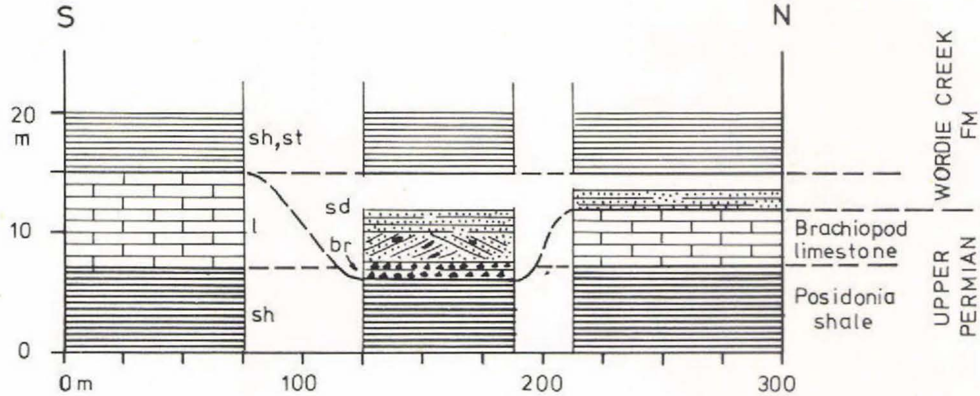

Fig. 30. Erosional channel cutting through the Upper Permian rocks and filled with coarse clastics (Wordie Creek Formation, Lower Triassic). br: sedimentary breccia with Upper Permian blocks (in black); sh: shale; st: siltstone; sd: sandstone, conglomeratic sandstone with Upper Permian blocks (in black). South Wegener Halvø, central East Greenland.

sandstone contacts immediately with the brachiopod limestone but it disappears toward the south where the brachiopod limestone is overlain directly by green shale with siltstone intercalations (Wordie Creek Formation). The section shown in fig. 30 cuts the channel transversally to its axis which is approximately NE–SW (fig. 27).

Reworked Upper Permian fossils in Lower Triassic strata

Fragments of Upper Permian limestone (maximum 5 cm in diameter) are rather uncommon in the predominantly shaly development of the Wordie Creek Formation above the basal coarse clastics. On the contrary, Permian shell detritus and well preserved, though often broken, Permian brachiopod shells (mainly Productids), crinoids and large fragments of bryozoan (e.g. Fenestellid) colonies are often characteristic elements of sandstone-conglomerate layers in the lower, ammonoid and *Claraia*-bearing shaly complex, up to about 60 m, and sometimes up to 200 m (Grasmück & Trümpy, 1969, fig. 2) above the base of the Lower Triassic.

Good preservation of Permian-type fossils and their common occurrence with typical Lower Triassic ammonoids and bivalves were interpreted by Trümpy (1961), Grasmück & Trümpy (1969) and Callomon *et al.* (1972) as an indication for survival of the Upper Permian elements in the Lower Triassic marine basin, contrary to the earlier observations by Nielsen (1935) who interpreted these Permian elements as reworked. Teichert & Kummel (1973) supported Nielsen's view.

The author's observations in the area of Profilbjerg (southern Wegener Halvø) show that the occurrence of Upper Permian fossils in the Lower Triassic predominantly shaly development is restricted to sandstone-conglomerate intercalations. These intercalations often show an association of sedimentary features characteristic for turbidity currents: graded bedding, groove, flute and prod casts. The Permian and Triassic fossils occur usually at the sole of graded layers where they often differ from each other in colour: green for the Permian brachiopods and black for Lower Triassic ammonoids. This speaks in favour of Nielsen's (1935) and Teichert & Kummel's (1973) interpretation.

Conclusions

(1) The base of the Lower Triassic Wordie Creek Formation at Wegener Halvø is erosional, often with channels down to 35 m deep and up to several hundred metres wide, cutting through the underlying Upper Permian rocks.

(2) Part of the Upper Permian rock fragments in the channels correspond to the uppermost strata of the Permian sequence which are unknown *in situ* at Wegener Halvø. A mode of transport of Permian fossils by turbidity currents rich in clay suspension would explain their good state of preservation in the Lower Triassic strata.

(3) The Upper Permian marine sedimentation was followed by a break in deposition caused by positive movements of the sea bottom, with erosion and reworking of the uppermost Permian strata and fossils.

Acknowledgements

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