EESTI NSV TEADUSTE AKADEEMIA TOIMETISED. GEOLOOGIA
ИЗВЕСТИЯ АКАДЕМИИ НАУК ЭСТОНСКОЙ ССР. ГЕОЛОГИЯ
PROCEEDINGS OF THE ACADEMY OF SCIENCES OF THE ESTONIAN SSR. GEOLOGY

1989, 38, 2

УДК 551.8 : 551.733(481+485)

D. L. BRUTON

ORDOVICIAN PALAEOGEOGRAPHY OF THE WESTERN BALTIC SHIELD

Bruton and Harper (1988) and Bruton et al. (1988) have recently classified Ordovician successions in the deformed Scandinavian Caledonides on the basis of the tectonic position of each, together with the age and biogeography of their faunas. Those belonging to the Parautochthon and Lower Allochthon of southern Norway, were deposited in a variety of environments on or outboard to the westward edge of the Baltoscandian platform. Here, emergent siliciclastic sources contrast with those carbonate environments in the Oslo Region and eastwards.

Parautochthonous successions on Hardangervidda and allochthonous sequences in East Jotunheimen, Norway, contain brachiopods (identified by D. A. T. Harper, University College, Galway, Ireland), conodonts (identified by J. E. Repetski, U. S. Geological Survey, Reston, Va.), trilobites and graptolites. These fossils, from early and late Tremadoc and late Arenig-early Llanvirn, permit the correlation of strata and events across the entire Baltoscandian platform.

The occurrence of *Dictyonema flabelliforme* both in the Parautochthon and Lower Allochthon, confirms the uniformity of the Alum Shale facies across large parts of the platform. On Hardangervidda (Figs 1, 2), younger Tremadoc rocks are presumably represented by a sandy facies similar to the succeeding Arenig-Llanvirn dated by brachiopods (Bruton et al., 1985) and hitherto undescribed trilobites and cephalopods. This fauna is typically Baltic and can be compared with that known from the Orthoceras Limestone developed in a limestone facies to the east.

The Lower Allochthon in East Jotunheimen (Figs 1, 2) contains, in ascending order, the Aurdal, Synnfjell and Valdres thrust sheets. The former (Strand, 1954) has facies similar to those in the Oslo Region, whilst the upper two units have less carbonate but contain equivalents to the Ceratopyge Limestone (Upper Tremadoc — *Paltodus deltifer* Zone), identified from trilobites, brachiopods and conodonts (Bruton et al., 1988), the Tøyen Shale with Arenig graptolites similar to those described by Williams (1984) from Gausdal, and the Asaphus Shale (Arenig-Llanvirn), based on brachiopods.

Comparison of sections (Fig. 2) shows that 1) the highest alum shale deposits, containing *Dictyonema flabelliforme*, have a wide distribution across the Autochthon, Parautochthon and Lower Allochthon, 2) facies variants of the Tremadoc Ceratopyge Shale and Ceratopyge Limestone have been recognized in all tectonic units within the Lower Allochthon, 3) the post-Tremadoc rocks of the Parautochthon differ markedly from those in the Oslo Region and further east and show transitions westwards and northwards from a shelf to deeper water facies of the miogeocline (Andresen, 1978; Andresen, Færseth, 1982), 4) within the Lower Allochthon of East Jotunheimen, the development of turbidite facies may be related to the early destruction of the Baltic margin (Nickelsen et al.,

1985). In the Sunnfjell thrust sheet, turbidites are developed at levels above the Tremadoc, whilst within the higher Valdres thrust sheet, they are distinctly older.

The suggested diachronous development of these turbidites is thought to be related to the movement, from the northwest, of the highest basement nappe of the Middle Allochthon (e. g. Jotun Nappe), preceded by an apron of siliciclastic sediment (Nickelsen et al., 1985). A reappraisal of the biostratigraphy of the Lower Allochthon suggests initiation of this event within the Arenig. It has been estimated that parts of the Lower Allochthon may have been translated some 200—400 km southeastwards (Nystuen, 1981). The detailed palinspastic reconstruction of Hossack et al. (1985) indicates a minimum translation of 290 km for the Jotun Nappe of the Middle Allochthon (Fig. 2), whilst restoration of the thrust sheets of the Lower Allochthon requires the existence of a shelf some 400 km wide (Nickelsen et al., 1985). This extensive shelf was bounded to the northwest by the miogeocline (Fig. 3), whose post-Tremadoc advance

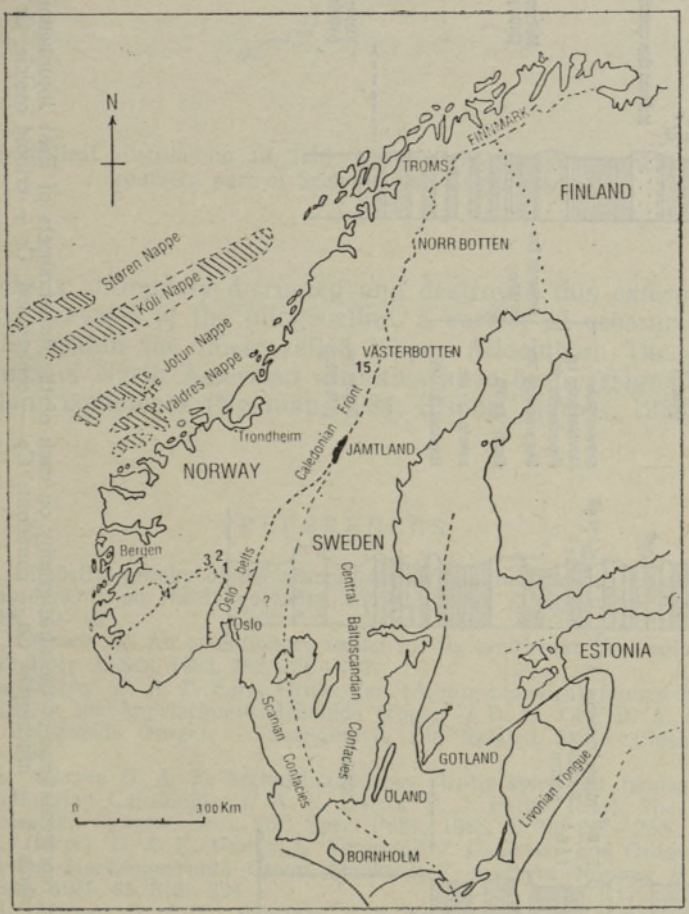

Fig. 1. Map of Scandinavia and adjacent Baltic area indicating localities discussed in the text. Presumed pre-thrust positions of four of the allochthons, prior to the Scandian event, are superimposed as are the Baltoscandian confacies belts.
Numbered localities: 1 — Aurdal, 2 — Synnfjell, 3 — Mellane, all East Jotunheimen, Lower Allochthon, 4 — Hardangervidda, Parautochthon.

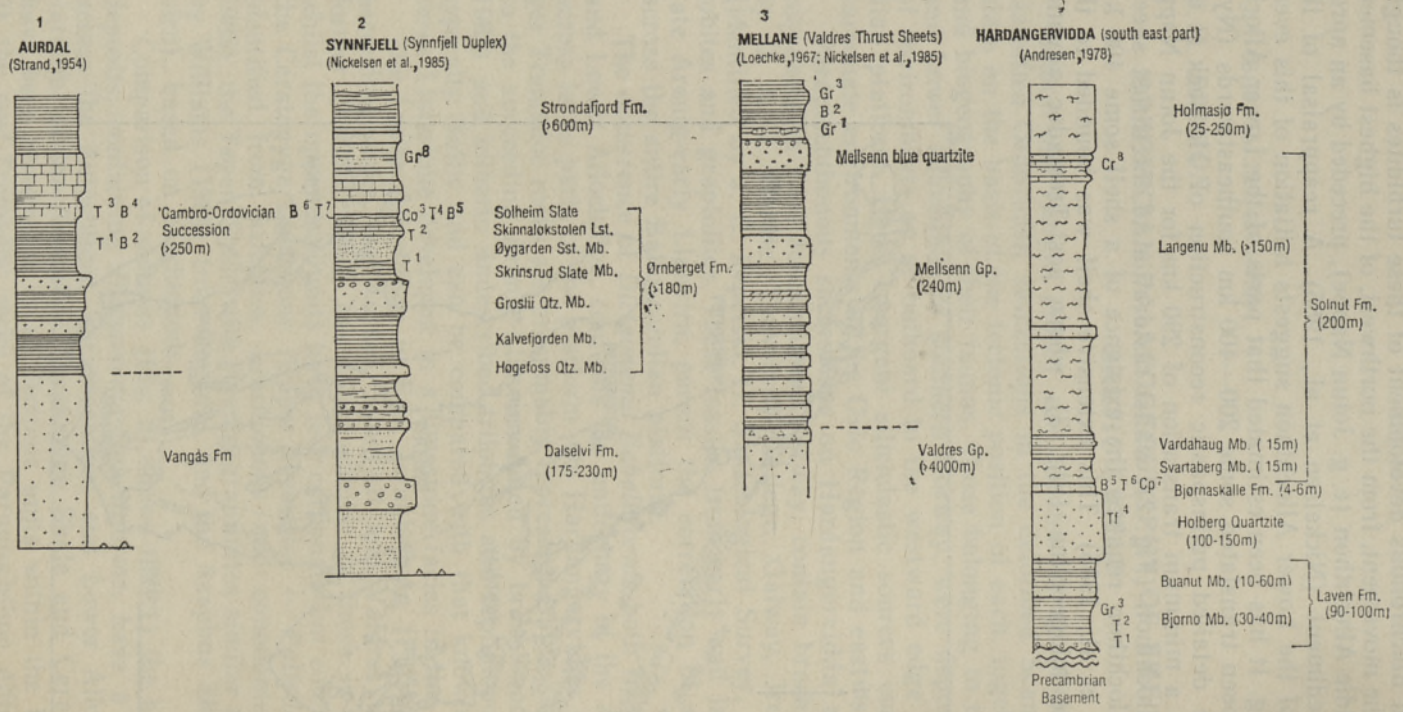

Fig. 2. Schematic representations of the stratigraphy on each of the thrust sheets of East Jotunheimen, and that of the Parautochthon on Hardangervidda. Faunal symbols: B — brachiopod, Co — conodont, Cp — cephalopod, Cr — crinoid ossicle, Gr — graptolite, T — trilobite and Tf — trace fossil.

Aurdal, 1, 2 — Middle and Upper Cambrian trilobites and brachiopods; 3, 4 — Late Tremadoc (Ceratopyge Limestone) trilobites and brachiopods.
Synnfjell. 1, 2 — Middle Cambrian trilobites; 3—5 — Tremadoc (Dictyonema Shale, Ceratopyge Limestone) conodonts, trilobites and brachiopods; 6, 7 — Arenig-Llanvirn shelly fauna; 8 — Arenig-Llanvirn graptolites.
Mellane. 1, 2 — Tremadoc (Dictyonema Shale) graptolites and brachiopods (?Ceratopyge Shale); 3 — Arenig-Llanvirn graptolites.
Hardangervidda. 1 — Lower Cambrian faunas; 2 — Middle Cambrian trilobites; 3 — Tremadoc (Dictyonema Shale) graptolites; 4 — tube-like traces; 5—7 — Arenig-Llanvirn shelly fauna; 8 — Middle Ordovician echinoderm.

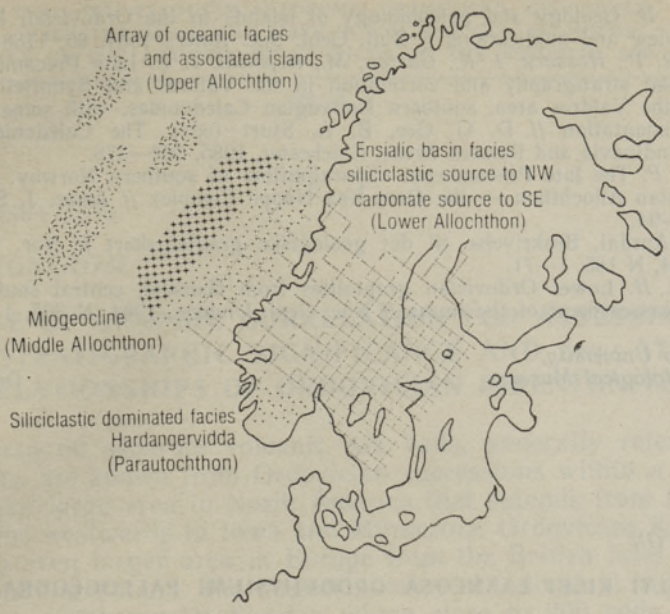

Fig. 3. Hypothetical distribution of late Arenig-early Llanvirn magnafacies across southern part of Scandinavian Caledonides.

southeastwards, ultimately disrupted and destroyed this external part of the orogen. Seaward of the miogeocline, a variety of oceanic facies are now located within the far-travelled Upper Allochthon. The associated shelly faunas of North American affinities have been assigned to intra-Iapetus island complexes (Neuman, 1984; Bruton, Harper, 1985).

REFERENCES

Andresen, A. Lithostratigraphy of the autochthonous/parautochthonous Lower Palaeozoic metasediments on Hardangervidda, south Norway // Nor. Geol. Unders., 1978, N 388, 59—69.

Andresen, A., Færseth, R. An evolutionary model for the southwest Norwegian Caledonides // Amer. J. Sci., 1982, 282, 756—782.

Bruton, D. L., Harper, D. A. T. Early Ordovician (Arenig-Llanvirn) faunas from oceanic islands in the Appalachian-Caledonide orogen // D. G. Gee, B. A. Sturt (eds). The Caledonide Orogen — Scandinavia and Related Areas. Chichester, 1985, 359—368.

Bruton, D. L., Harper D. A. T. Arenig-Llandovery stratigraphy and faunas across the Scandinavian Caledonides // A. L. Harris, D. J. Fettes (eds). The Caledonian-Appalachian Orogen. Geol. Soc. Spec. Publ., 1988, N 38, 247—268.

Bruton, D. L., Harper, D. A. T., Gunby, I., Naterstad, J. Cambrian and Ordovician fossils from the Hardangervidda Group, Haukelifjell, southern Norway // Nor. Geol. Tidsskr., 1985, **65**, 313—324.

Bruton, D. L., Harper, D. A. T., Repetski, J. E. Stratigraphy and faunas of the Parautochthon and Lower Allochthon of southern Norway // R. A. Geyer (ed.) The Caledonide Geology of Scandinavia. Graham & Trotman Ltd., 1988, 231—241.

Hossack, J. R., Garton, M. R., Nickelsen, R. P. The geological section from the foreland up to the Jotun thrust sheet in the Valdres area, south Norway // D. G. Gee, B. A. Sturt (eds). The Caledonide Orogen — Scandinavia and Related Areas. Chichester, 1985, 443—456.

Loechke, F. J. Die Petrographie des Waldre Stalagmits zwischen Bateon und Langsøn, Süd-Norwegen // Nor. Geol. Unders., 1967, N 243, 67—98.

Neuman, R. B. Geology and paleobiology of islands in the Ordovician Iapetus Ocean: Review and implications // Bull. Geol. Soc. Amer., 1984, 95, 1188—1201.
Nickelsen, R. P., Hossack, J. R., Garton, M., Repetski, J. E. Late Precambrian to Ordovician stratigraphy and correlation in the Valdres and Synnfjell thrust sheets of the Valdres area, southern Norwegian Caledonides, with some comments on sedimentation // D. G. Gee, B. A. Sturt (eds). The Caledonide Orogen — Scandinavia and Related Areas. Chichester, 1985, 369—378.
Nystuen, J. P. The late Precambrian «Sparagmites» of southern Norway: a major Caledonian Allochthon — the Osen-Røa Nappe Complex // Amer. J. Sci., 1981, 281, 69—94.
Strand, T. Aurdal. Beskrivelse til det geologiske gradteigskart // Nor. Geol. Unders., 1954, N 185, 1—71.
Williams, S. H. Lower Ordovician graptolites from Gausdal, central southern Norway: a reassessment of the fauna // Nor. Geol. Unders., 1984, N 395, 1—24.

Oslo University,
Palaeontological Museum

Received
Dec. 14, 1988

D. L. BRUTON

BALTI KILBI LÄÄNEOSA ORDOVIITSIUMI PALEOGEOGRAAFIA

Baltoskandia Ülem-Tremadoci, Arenigi ja Llanvirni parautohtoonsed ja allohtoonsed läbilõiked on korreleeritud fossiilide sisalduse alusel. Sellest tuleneva paleogeograafilise rekonstruktsiooni põhjal on oletatud 400 km laiuse ja läänes Iapetuse ookeani saarestikeks ülemineva šelfi olemasolu.

Д. Л. БРУТОН

ПАЛЕОГЕОГРАФИЯ ОРДОВИКА ЗАПАДНОЙ ЧАСТИ БАЛТИЙСКОГО ЩИТА

Содержание окаменелостей позволило скоррелировать паравтохтонные и аллохтонные разрезы верхнего тремадока, аренига и лланвирна Балтоскандии. На основе палеогеографической реконструкции предполагается, что шельф имел ширину 400 км и на западе был связан с основной зоной океана Иапетус.