TRENCH SEDIMENTATION IN THE LOWER PALAEOZOIC OF THE SOUTHERN UPLANDS

SIRS,—This letter draws attention to similarities in the sedimentology of the Southern Uplands in the Lower Palaeozoic with that of an active present-day trench—the eastern Aleutian Trench off southern Alaska (von Huene and Kulm 1971.) The comparison supports Dewey’s (1971) contention that the Southern Uplands marked the site of an active trench.

The eastern Aleutian Trench off southern Alaska terminates to the east in the Queen Charlotte Islands Transform Fault. This transform fault and the trench separate the Pacific Plate from the North American Plate. To the west, the topographic trench is interrupted by Kodiak Seamount, which prevents transfer of sediment to the deeper part of the trench south of the Aleutian arc. The mean depth of the Pacific Ocean floor south of the trench is about 4 km, but near the trench this abyssal plain rock sequence plunges rapidly, reaching a depth of about 6 km in the trench axis. The axial part of the trench is filled with a wedge of horizontally-bedded sediment 25 km wide and up to 1 km thick, and is characterised by a very high rate of sedimentation; it gradually becomes deeper westwards with increasing distance from the transform fault. The abyssal plain rock sequence consists of almost 1 km of pelagic sediment and interbedded turbidites, transported across the Queen Charlotte Islands Transform Fault from mountainous areas on the American Plate. The trench fill consists almost entirely of turbidites, with a minor contribution from slumps. Sands are restricted to a zone near the trench wall: most of the trench fill is silt and mud. Most of this sediment is derived from the mountains of southern Alaska, and is transported directly down the trench wall. Some may be transported axially from the shallow eastern end of the trench. Axial flow gives a prominent turbidity current channel at the foot of the trench wall, which appears to rework submarine fans built up by lateral supply. Lateral turbidites may swing round to an axial direction on reaching the trench floor.

Reconstructions of the proto-Atlantic Ocean (Briden, Smith and Drewry 1971) suggest there was a simple linear trench in the Southern Uplands, not offset by any major transform. There was also a subduction zone on the other side of the proto-Atlantic (Dewey 1969). Thus the sediment on the oceanic plate would have been entirely pelagic, unless trenches became completely filled by sediment. Thus the supply of sediment to the Southern Uplands Trench must have been lateral. The down-bowing of the proto-Atlantic Plate towards the trench would prevent turbidity currents travelling far oceanwards: they would be deflected to flow axially. With no terminating transform fault imposing a
strong axial gradient, this axial flow might be in either direction, possibly dependent on local tectonism and sediment supply.

This model conforms with sediment distribution patterns in the Southern Uplands (Walton 1965). In the north, several kilometres of sediment with a northern provenance and a dominant transport direction to the south or south-east (i.e. lateral) have accumulated as submarine fans, often with important control of topography by faults running parallel to the trench, presumably on the trench wall (e.g. Williams 1962). Further south, finer turbidites are found, with petrography indicating a northern provenance, but with axial palaeocurrents both to the north-east and south-west. These then give way to the thin graptolitic shales of the "axial zone" of Walton (1965), deposited on the proto-Atlantic Plate. The absence of turbidites in this zone is thus due to the "moat" formed by the downbowing of the proto-Atlantic Plate towards the trench.

In the Aleutian Trench, the stratigraphic data from Deep Sea Drilling Project Leg 18 (von Huene and Kulm 1971) suggest active tectonism, probably by diapiric intrusion of wet subducted abyssal plain muds. The trench wall appears to be extending rapidly oceanwards. Mud diapirism also occurs where turbidites on the Juan de Fuca Plate have been subducted beneath British Columbia and Washington (Tiffin et al. 1972). In the Southern Uplands, Dewey (1971) suggests an oceanward growth of the trench wall during the Ordovician and Silurian. However, there is no evidence of diapirism similar to that in the Aleutian Trench. Structural analysis of rocks from several areas (Rust 1965; Warren 1964; Williams 1961) suggest that the first fold phase was associated with the formation of major northward-facing folds. Detailed palaeogeographic interpretations (e.g. Williams 1962) have shown the importance of faults parallel to the trench, rather than local diapirs. The very thin subducted abyssal plain sediment in the Southern Uplands was perhaps insufficient to produce diapirs.

Down-bowling of the proto-Atlantic Ocean Plate towards a Southern Uplands trench thus simply accounts for the major patterns of sediment dispersal in that region during the Lower Palaeozoic. The nature of the subducted rock sequence may be of great importance in determining the type of initial tectonics on the trench wall. Published sediment thicknesses for the Southern Uplands are probably considerably greater than in modern trenches and trench walls.

REFERENCES


SODIC ROCKS OF METASOMATIC ORIGIN IN THE MOINE NAPPE

SIRS,—With reference to the paper by Tanner and Tobisch (1972) recent work by the Highlands and Islands unit of the Institute of Geological Sciences enables the field relationships of sodic rocks to be somewhat more precisely defined and adds further detail to their distribution and mode of occurrence.

Distribution and field relations. Bodies of metasomatic sodic rock can be traced southwards from the Loch Hourn area to the Carnach valley at the head of Loch Nevis, continuing the roughly north to south zone mentioned by the authors. These bodies cut the regional pegmatite veins (post F3), and an isolated occurrence near Bunchaolie, Loch Quoich, is cut by metamorphosed felsic porphyrites and microdiorites of the late-Caledonian suite described by Dearnley (1967).

Mode of Occurrence. In addition to the groups described by the authors there is a sheet of strongly schistose sodic microsyenite on the north shore of Loch Hourn. This sheet, composed essentially of albite, green pyroxene and actinolite, is flanked by metasomatized country rock, and is emplaced along a joint parallel to those occupied by sheets of schistose microdiorite in the same area (Locality 2 of the authors). In view of the age relationships mentioned above comparison is invited with the Ilordleq area, South Greenland where potash metasomatism apparently preceded the intrusion of dykes similar to those of the microdiorite suite (Watterson 1968).

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Other albitic rocks. Albitites occur at isolated localities in western Inverness-shire associated with apinites of the microdiorite suite. No metasomatic effects have been recorded in connexion with these.

REFERENCES


WATTERSON, J. 1968. Plutonic development of the Ilordleq area, South Greenland Part II: Late-kinematic basic dykes. Grönlands Geologiske Undersøgelse Bull. 70, 46.

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