A new occurrence of possible Tertiary deposits in south-western Dyfed

SIR – During a mineral exploration project carried out around Treffynnon in Dyfed, by the Institute of Geological Sciences as part of the Mineral Reconnaissance Programme funded by the Department of Industry, a number of shallow boreholes, registered by the I.G.S. under the project name Llandeloy, were drilled to penetrate to unweathered solid rock. The area (Fig. 1) is largely drift-covered with no more than half a dozen exposures of solid rock. Unconsolidated sedimentary deposits, ranging in thickness from 3.35 m to over 21.95 m were encountered in seven of the boreholes. They were cored to depths of between 1.75 and 5.79 m, below which samples up to 30 cm long were taken at intervals (see Fig. 2) to a depth of 15 m. Interpretations of the succession below 15 m were made mainly from observations of the sludge, which was continuously monitored. The succession consists of two main components; an upper unit, 0.91–2.17 m thick, of glacial or periglacial deposits, not described here, and a lower unit of thinly interbedded feldspar sand and clay with less common silt and gravel beds, designated here the Tre-Nichol Formation.

The formation was encountered in thicknesses ranging from 2.44 to over 20 m. It is thickest on Tree-Nichol Farm. It consists mainly of horizontal beds 0.7 to 12 cm thick (mostly between 1.3 and 2.5 cm) of rotted clayey feldspar-sand in alternation with 0.2–0.5 cm thick laminae of clay. The clayey feldspar-sand is normally orange-brown with white speckles representing the remains of feldspar crystals. Locally the sand is white or grey, or, where the sediment is manganiferous, brown, dark brown or pink. The feldspar crystals, whole or fragmented, are up to 2 mm long and partly or entirely replaced by kaolinite. There is a small proportion of sand-size quartz grains, magnetite (except in borehole 7), pyrite, mica and shale fragments. The ratio of kaolinite pseudomorphs after feldspar to detrital orange-brown clay is difficult to estimate, but in places as much as half the sediment may be detrital clay. Each bed is massive, there being no sign of lamination or grading. Pebbles, up to 6 cm diameter, of rotted diorite, and, less commonly of other rocks, occur and locally form gravel beds.

The clay laminae and beds are brown in most boreholes, but in parts of borehole 3B they are white. Some of them wedge out or show other irregularities in thickness. The clay contains some silt and sand-size grains of quartz and feldspar. In borehole 4 a 1-cm long pebble was recovered from a clay band 5 mm thick. One bed of clay encountered in borehole 6 reaches 37 cm thick and in borehole 3B there are indications of a thicker bed of clay with pebbles at about 15 m depth.

Beds of gravel and coarse lithic sand from 6 to 28 cm thick were encountered in all the boreholes (see Fig. 2). The pebbles are much less deeply weathered than in the dioritic gravels and they are lithologically heterogeneous. The gravel matrix is sandy and muddy. Pebbles reach 5 cm long and are subangular or subrounded. Rock types in a bed sampled at 14.73 m depth in borehole 3B, which is typical, include grey siltstone, greywacke, white hornblende porphyry, small pieces of rotted diorite, a small proportion of miscellaneous sedimentary rocks and quartz. Subangular quartz grains ranging in size from 1 to 6 mm are abundant, though the principal component of the fine and medium sand fraction is feldspar with minor quartz, magnetite and hematite-coated pyrite.

In the lower parts of boreholes 3B and 4 the composition of the sludge suggests that there is a thick unit of feldspathic silt beneath the interbedded feldspar sand and clay.

The sediments are deeply weathered; whole feldspar crystals within them are kaolinitised and there is extensive secondary iron and manganese staining along planar surfaces. The depth of weathering ranges from 11.5 to over 40 m and there are from 4.5 to 37 m of weathered solid rock beneath the unconsolidated deposits.

The sediments in the Tre-Nichol Formation are entirely water-laid. Their feldspathic nature, the abundance of detrital magnetite and the high copper content (locally as much as 640 ppm) reflect very closely the composition of the adjacent and subjacent bedrock, which is composed of a cupriferous, magnetite-bearing complex of intermediate intrusive rocks emplaced within a succession of greywacke and volcanic rocks. Transport of the material, therefore, could not have been far. Geochemically the sediment appears to have been inert, which suggests that it was probably transported and deposited in fresh water. Indeed, Sly (1978) claimed that coarse-grained, chemically

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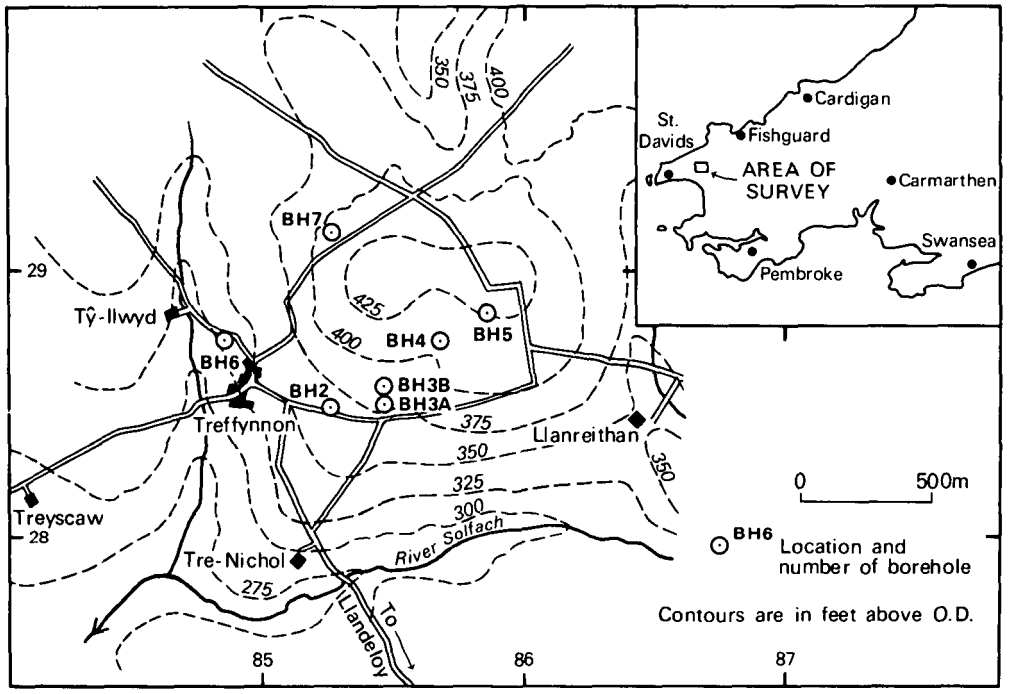

Figure 1. Location of boreholes.

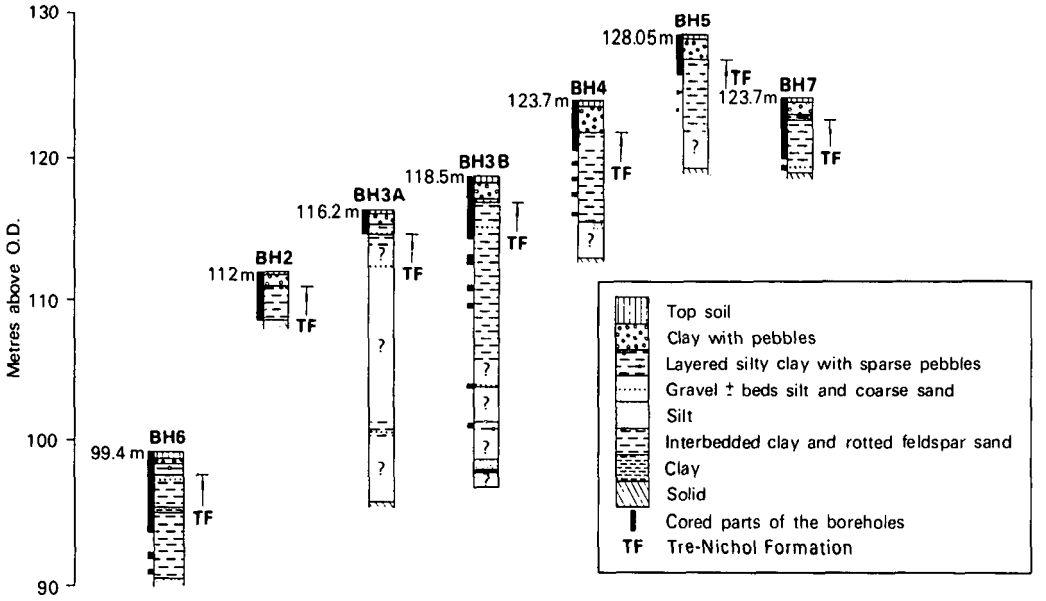

Figure 2. Graphic logs of seven boreholes near Treffynnon.

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inert sediments within which heavy metals remain concentrated are characteristically deposited in shallow, nearshore zones of lakes. The rhythmic alteration of feldspar sand and clay must reflect a regularly varying rate of inflow of sediment, perhaps indicating torrential deposition, in a semi-arid regime, of rapidly eroded coarse material during wet seasons and slow settling of clay during the intervening dry spells.

The sediments occur through a vertical range of 90.56–126.22 m OD; that is, they represent a deposit at least 35.66 m thick. The height of the top of the deposit (Fig. 2) ranges from 97.63 to 126.22 m OD, suggesting that it has been deeply eroded, but the highest occurrence of the sediments is above most of the surrounding countryside. Thus, regardless of any uplift that may have occurred after deposition, it is difficult to define the margins of the lake in which the sediments accumulated. The nature of the sediments and their source suggest that one lake shore, however, must have been close to the present site.

Weathering to the depths encountered here is not common in Great Britain. It is usually demonstrable that post-glacial weathering is superficial. Where the depth reaches 10 m or more as, for example, locally in north-east Scotland, Fitzpatrick (1963) was able to show that it is almost certainly the result of weathering in pre-glacial times. In the boreholes, the pebbles of intermediate rocks in the glacial or periglacial deposits are fresh compared with those underneath in the rotted feldspar sands, and there are in these deposits remnants of unweathered material. It is likely therefore that the deep weathering of the Tre-Nichol Formation and the rock beneath took place before the glacial or periglacial deposits were laid down. By comparison with modern analogues (Thomas, 1966) it probably took place under humid tropical or subtropical conditions. The remaining countryside marginal to the lake would also have been deeply weathered at this time and it is suggested that subsequent erosion accounts for the lack of any sign of the lake shoreline now. Thus, it is necessary to postulate a semi-arid period during deposition of the sediments followed by a prolonged warm, humid period for the deep weathering both of the remaining source rock and the deposit.

There is no direct evidence of the age of these sediments. They contain no megascopically visible organic remains and samples of clay examined for pollen by Dr R. Harland of I.G.S. proved barren.

The sediments are certainly pre-Devensian in age. Whether or not deep weathering could have happened during the early and middle Pleistocene interglacials is not known, but there is circumstantial evidence to suggest that the deposit may be Tertiary in age.

Non-marine sediments of Tertiarry age are well known off the Welsh coast: Fletcher (1975) reported 340 m of Palaeogene strata in the Stankley Bank basin, east of Lundy Island; and Dobson (1977) showed a basin of Tertiary deposits in St George's Channel. Onshore, however, the only recorded occurrence of probable Tertiary sediments in south-west Wales is in pipes within Carboniferous limestone at Flimston, south of Pembroke (Dixon, 1921), though Freshney, Beer & Wright (1979) described great thicknesses of Palaeogene lake sediments in Devonshire along the Sticklepath–Lustleigh fault zone, in places at heights up to 637 ft (194 m) OD. It is possible, therefore, that parts of lowland south Wales could also have been covered by non-marine Tertiary sediments and it is suggested that the deposit comprising the Tre-Nichol Formation at Treffynnon is a remnant of that cover.

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