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Periglacial slope deposits at Wiggaton in the Otter Valley, East Devon

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Shallow temporary sections exposed during preparation of foundations for two houses on adjacent sites (SY 103937) at Wiggaton, about 3km south of Ottery St Mary (Fig. 1a), revealed the upper 3m of slope deposits proved nearby to be at least 8.5m thick. Benches for the houses had been cut at mid-slope positions between the 200ft (61m) and 250ft (76m) contours on the southfacing, 9° slope of a spur of Otter Sandstone (Geological Survey Sheet 326), producing at each site a pair of short sections meeting at right-angles.

Sections ABC and DEF (Figs. 1b, lc) are drawn to scale from photographs. Six soil and sedimentary units are described from field observations.

1- 25-65cm of dark grey-brown unstratified loam with many angular chert fragments up to 2cm across, passing down into light grey-brown sandy loam.

2- 25-65cm of reddish-brown unstratified loamy sand, with some angular chert fragments to 4cm across.

Section DE - the upper part contains a layer of buff sand (80cm long, 4cm thick) beneath pinkish-brown clay (1cm thick), and near E a mass of pinkish-brown sandy clay.

Section BC - the unit comprises discontinuous seams of buff to brown silty-clay up to 10cm thick deformed in 'wave' structures of 5 to 8cm amplitude. Diagenetic deposition of hydrous oxides of iron and manganese (henceforth referred to as Fe-Mn) makes parts of the unit dark, almost black, in colour.

3- *Section ABC* - 10-30cm of pinkish-red silty clay with small scale blocky structure. In AB it is cut out by the descending base of Unit 2. In BC it thins down slope with sand partings deformed with the clay by the 'wave' structures (Fig. 1b). The under-surface of the unit is plane, sharply defined and parallel to the ground surface.

4- *Section DEF* - 60-75cm of reddish brown laminated silts with frequent discontinuous fine sand partings and occasional angular chert fragments less than 1cm across. Near the top is a lens of yellow-brown sand (90x8cm) with much Fe-Mn at its base. Both laminations and the whole unit are parallel to the ground surface. In DE the base rises and the silts pass diffusely into Unit 2.

5- Greenish-yellow to buff sands, medium to coarse in texture. Generally 75cm thick in ABC with thin (less than 2cm) seams of brown silty-clay, 2-30cm apart. In DEF the sands contain thin layers and isolated clasts (slabs) of

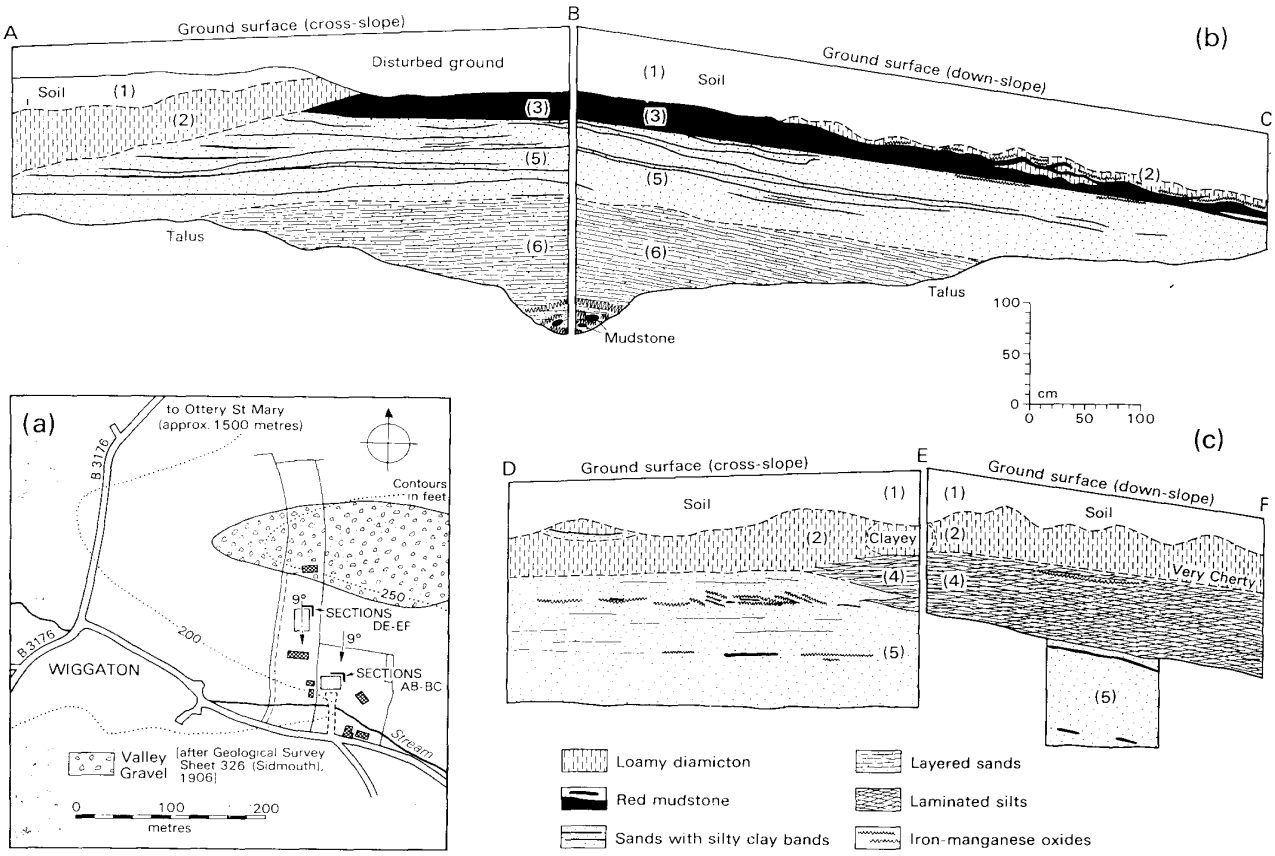

Figure 1. Location map and temporary sections at Wiggaton, east Devon.

pinkish-red clay at various horizons, mostly associated with Fe-Mn. Weak stratification, parallel to the ground surface.

6- Dense greenish-yellow and buff sands in layers 1-4cm thick with blocky structure, seen in ABC only. At B the sands at depth are heavily impregnated with Fe-Mn and contain several pebblesized clasts of red clay.

Unit 1, the soil, is a freely-drained stony brown earth. Its parent material is Unit 2, a diamicton regarded as a 'head' deposit produced by gelifluction. This consists partly of reworked clays, silts and sands of Units 3, 4 and 5 but also includes a substantial number of chert fragments. The clay of Unit 3 appears to be reworked Mercia Mudstone. It spreads thinly both upslope and eastward of the section and is interpreted as a mud-flow. Its sharp plane base points to flow over a compact undeformable surface of the underlying sands of Unit 5. It most probably derives from an outlier of Mercia Mudstone capping the spur beneath the patch of Valley Gravel. Wetting from an exceptional thaw of ground-ice and snow could have exceeded the liquid limit of the Mudstone, allowing gravity-controlled flow of the clay over still-frozen sands. The laminated silts of Unit 4 appear to thicken east into a former shallow gully beyond which is the mud-flow. The silts, affected by sheet-wash, could have an aeolian component. The sands of Units 5 and 6 are also slope deposits, derived largely from the Otter Sandstone. The thin silty-clay seams (Section ABC) and the layers and clasts of red clay (Section DEF) may represent deposition of fines by sheet-wash or wind action, and of slabs of Mudstone by sliding, on successive slope surfaces. If so, the sands aggraded as discrete layers when wetted sufficiently to render them mobile. Near Section DEF the deposits were angered to 5-8m and foundation piles for the house entered bedrock at a maximum of 8.5m. This depth, given the geometry of the slope, indicates that the sands, which form the bulk of the deposits, probably gathered at the foot of a bluff cut into the Otter Sandstone by the valley stream.

The deposits at both sites accumulated on a succession of vegetation-free surfaces under conditions which ensured that water remained at or close to the ground surface. A periglacial environment, which allowed deep frozen ground on a southfacing slope and geomorphological processes dominated by mass movement and wash seems most likely. The slope has been inactive since deposition of the head (Unit 2), affected only by Flandrian pedogenic processes and diagenetic introduction of Fe-Mn by groundwater. Present slope form and the deposits are so closely related that they were most probably produced about the end of the cold Devensian Stage of the Quaternary.

The chert fragments (Units 1, 2) cannot have been supplied directly from the Greensand, but from the outlier of Valley Gravel which is one of many inter-tributary, spur-crest remnants of a once extensive sheet (Geological Survey Sheet 326). Only after deepening of the Wiggaton tributary valley could the slope deposits accumulate and chert be incorporated in them. Therefore at least two periods of chert transport and deposition can be identified, separated by a phase of valley erosion.

The slope deposits gave rise to unanticipated difficulties in preparing foundations for the houses. Their textural variability, down-slope stratification and control on groundwater flows meant that the prospect of slope failure under non-uniform distribution of loads, and at least of differential settlement, was high. Accordingly the houses were eventually supported on piles driven to bedrock. Because similar heterogeneous deposits are likely to occur elsewhere in the Otter basin, their significance in engineering terms should not be ignored.

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Abstracts of other papers read at the Annual Conference, January 1988

High quality sandstone resources of SW England. *R. C. Scrivener, British Geological Survey, 30, Pennsylvania Road, Exeter EX4 6BX.*

A Department of Environment-funded project to examine resources of high-quality sandstones for aggregate usage has been carried out by the British Geological Survey in parts of SW England and S Wales. The study in SW England comprised a review of the properties and distribution of Devonian and Carboniferous sandstones from an area bounded in the south by National Grid line northing SX90 and extending east to include the Quantock Hills.

Approaches to local government departments, commercial operators and national laboratories yielded a limited amount of aggregate test data and these were supplemented by the collection and testing of samples specifically for the study. Tests included Polished Stone Value (PSV), Aggregate Impact Value (AIV), Aggregate Crushing Value (ACV), Aggregate Abrasion Value (AAV), water absorption and relative density. PSV and AAV are particularly relevant to the selection of sandstones intended to provide skid-resistant road surfaces. Test results for these factors are presented for three geological formations, namely, the Crackington Formation (Upper Carboniferous), Bude Formation (Upper Carboniferous) and Hangman Grit (Middle Devonian). Variations in AAV and PSV are related to sandstone petrology, degree of weathering, and siltstone/mudstone content. The need for further work on aggregate weathering properties is indicated.

This abstract is published with the approval of the Director, British Geological Survey (NERC).

Recent investigations into the Bovey Formation at Beacon Cottage Farm, St. Agnes, Cornwall. *N.L. Jowsey, D. L. Parkin, A.P.C. Smith, P. T. Walsh. Geology Laboratory, Department of Civil Engineering, City University, London EC1 V 0HB.*

The mid-Oligocene sediments forming the Beacon Cottage Farm Outlier at St. Agnes, Cornwall, have a stratigraphical/geomorphological importance which is out of all proportion to their modest residual bulk (i.e. ca 3 x 105m3).

There has been no continuous exposure of this outlier since the 1940s and, apart from a very limited programme of hand-augering in 1974, no sampling of the sediments since 1932.

During 1986/7, some 60 holes have been sunk into the area surrounding the farm, many of these into the Palaeozoic floor below the outlier. Collectively, these show that all previous interpretations concerning the extent, stratigraphy and structure of the outlier are substantially incorrect.

It is demonstrated that the outlier preserves beneath it widespread zones of rotten rock in granite and killas of pre-mid-Oligocene age. The sub-Oligocene unconformity is nowhere flat and varies in altitude by at least 20m. The local Bovey Formation succession comprises a two-member sequence of basal sands, which are often pebbly, overlain by candle clay, the whole totalling 8.4m in maximum development. There is considerable indirect evidence that either the rotted Palaeozoic floor has palaeoslopes which locally exceed 45° or that several post-mid-Oligocene faults (and, possibly, a WNW-ESE fold axis) have affected the outlier.