FIELD EXCURSION TO THE IGNEOUS AND SEDIMENTARY ROCKS OF THE CREDITON TROUGH, 5TH JANUARY, 2012

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The purpose of the field excursion was to examine rocks of Permian age cropping out in the Crediton Trough. The trip included visits to five locations where a range of sedimentary strata and igneous rocks was exposed.

Keywords: Permian, sedimentary strata, igneous rocks, Crediton Trough.

INTRODUCTION

The red sedimentary rocks of predominantly Permian age in the Crediton Trough of Devon are included in the Exeter Group - a term introduced (Edwards and Scrivener, 1999) to include all the formations between the unconformity at the base of the New Red Sandstone and the overlying Aylesbeare Mudstone Group of Triassic age (Table 1). Locally interbedded with the sedimentary rocks are lavas collectively known as the Exeter Volcanic Rocks.

The sedimentary history of the Exeter Group (Edwards and Scrivener, 1999) began with the deposition of the Cadbury Breccia on the northern margin of the Crediton Trough and was concentrated in the east of the basin. Sediment supply was from the north and gave rise to a thick, coarse, clastic alluvial fan sequence. As the Crediton Trough developed with continued extension, alluvial-fan sedimentation switched to the west, the Bow Breccia was formed and the direction of sediment supply changed with a likely source from the west or south-west. The Knowle Sandstone represents the upper, outer and finer-grained part of the Bow Breccia alluvial fan. A prolonged period of active extension and uplift occurred before the deposition of the Creedy Park Sandstone, and was probably responsible for the abandonment of the Bow Breccia alluvial fan. The overlying Creedy Breccia indicates a change in the direction of basin filling from west to east, to south-west to north-east. The overlying Newton St Cyres Breccia has features suggestive of deposition on the lower parts of an alluvial fan, transitional to a proximal braidplain, and it shows a distal thinning and fining into the Shute Sandstone. Active extension of the Crediton Trough is likely to have ceased towards the end of the Permian and was marked by the deposition of the aeolian Dawlish Sandstone under the influence of a northerly directed wind.

The volcanic rocks associated with the Exeter Group include basalts and lamprophyres with minor occurrences of rhyolite and agglomerate. Radiometric dating indicates they were erupted just before the intrusion of the Dartmoor granite at 280 Ma (Edwards and Scrivener, 1999).

WEST SANDFORD [SS 8107 0285]

The Bow Breccia and Knowle Sandstone, which are of Early Permian age, are exposed at this locality. The Bow Breccia typically contains clasts of Culm sandstone, shale, slate, vein quartz, hornfels, a minor fraction of argillised and iron-stained acid igneous rocks and riddled lamprophyres in a matrix of red-brown silty sandstone. Igneous pebbles dominantly present are quartz-porphyry, acid tuff and rhyolite (ignimbritic). The sandstone component increases upwards through the formation. The Bow Breccia is interbedded with lamprophyric lavas and basalts at the junction with the overlying Knowle Sandstone. In some locations the Bow Breccia can be seen to overly the Cadbury Breccia, suggesting a disconformable contact. Spores sampled from the base of the Bow Breccia at Lower Creedy House, suggest an Early Permian age, but these may have been reworked from Carboniferous rocks. The depositional environment of the Bow Breccia was dominated by debris flows and grain flows, and in some areas partly reworked by sheet floods as part of the alluvial system in the Crediton Trough at the time.

The Knowle Sandstone is a reddish brown, moderately to well cemented and well bedded sandstone. Interbeds of breccia are visible and breccia clasts are similar to those in the Bow Breccia. Lavas of the Exeter Volcanic Rocks are interbedded at two levels and these include lamprophyric microsyenites and olivine basalts. The base is gradational from the underlying Bow Breccia and the top is marked by a strong disconformity overlain by the Creedy Park Sandstone. At West Sandford Barton there is a lamprophyric lava flow resting on the Knowle Sandstone and components of this are visible in the rocks found here and in thin section (Figures 1a and b). The breccia beds are sharply or erosively based and overlain by beds of sandstone with sharp or abruptly transitional bases. Breccia clasts include sandstone, slate, vein quartz, hornfels and igneous rocks including ignimbritic acid tuff and quartz porphyry. In the lowest part of the section the sandstone is ashy and tuffaceous.
Field excursion to the Crediton Trough

Knowle Hill Quarry [SS 789 022]

An outcrop of lamprophyre is exposed in this quarry where it was described by Teall in Ussher (1902) from faces up to 30 m high, as having close affinity with minette. The upper levels were recorded as being vesicular and, in part, scoriaceous, but the rocks were more massive below. At the present day, the quarry is overgrown and partly backfilled (Figure 2a), but there are several exposures, mostly of the more massive type of material. It is composed of feldspar, biotite and olivine, the last mostly showing alteration to ‘iddingsite’ (Figure 2b). Secondary carbonate veining of the lamprophyre is also common (Figure 2c).

The rocks from Knowle Hill Quarry have been described more recently as olivine-biotite lamprophyre and olivine microsyenite, and an Ar-Ar plateau age of 281.8 ±0.8 Ma was obtained for biotite from lamprophyre at this locality (Edwards and Scrivener, 1999).

Uton Quarry [SX 824 986]

Uton Quarry was also described by Ussher (1902), who provided an illustration of basalt resting on sandstone. This section is now obscured, but in an adjacent pit to the east there are faces in purplish grey basalt (Figure 3a), mostly massive, but veined by a vesicular variety (Figure 3b). Towards the south of this pit, the basalt is increasingly broken on subvertical fractures, and at the back face is a prominent fault, trending WNW-ESE. The fault and the minor fractures are associated with white clay-filled veins and a black manganese oxide mineral (probably pyrolusite) (Figure 3a). The basalt is a potassium-rich alkali variety, rich in altered olivine, and with much secondary carbonate (Figure 3c).

Newton St Cyres Golf Course [SX 883 999]

This locality provided exposures of the Crediton Breccia and the Shute Sandstone. The Crediton Breccia is generally a finer-grained breccia than seen in the Bow Breccia below. It contains abundant rhyolite and quartz-porphry fragments with REE and isotopic signatures suggesting a Dartmoor source and

<table>
<thead>
<tr>
<th>Period</th>
<th>Group</th>
<th>Crediton Trough</th>
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<tbody>
<tr>
<td>Triassic</td>
<td>Aylesbeare Mudstone Group</td>
<td>Crediton to Silvertown</td>
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<tr>
<td>Permian</td>
<td>Exeter Group</td>
<td>Cyst Hydon area</td>
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Table 1. New Red Sandstone Stratigraphy of the Crediton Trough (from Edwards and Scrivener, 1999).

<table>
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<tr>
<th>Formation</th>
<th>Exeter Volcanic Rocks</th>
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<td>Fm. = Formation, ^</td>
<td>Formations containing isolated volcanic members</td>
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fan, represented in its more distal extent by the Shute Sandstone. It may also have a greater affinity in composition to the Heavitree Breccia of the Exeter area than to the Crediton Breccia and, therefore, may have a slightly different source.

The Newton St Cyres Breccia, which is reddish brown in colour, is distinctive for the occurrence of 'murchisonite' (Figure 5b), which is a flesh-pink coloured potassium feldspar (perthite) that increases in abundance towards the top of the formation. It is also distinguished from the Crediton Breccia by its more sandy matrix and greater degree of cementation. Clasts, which rarely exceed 50 mm in size, include shale, slate, pelitic hornfels, chert, potassium feldspar, vein quartz, quartz-porphyry, acid lava and tuff, granite and tourmalinised igneous rocks.

A sedimentary log (Figure 5c) of the section in Cromwell's Cutting (Edwards and Scrivener, 1999) indicates sandstone beds and lenses are present in the Newton St Cyres Breccia and these were probably deposited by sheetfloods over the debris flow-dominated areas of the fan. Beds tend to be erosive and palaeocurrents, where visible, suggest flow was from west to east. The section at Cromwell's Cutting is near to the base of the formation and shows planar cross-bedded breccias suggested to be transverse bar forms within a fluvial channel (Edwards and Scrivener, 1999). Sharp bases and sharp tops are indicative of discrete episodic depositional events. Bisaccate pollen from Fordton Cross suggests the breccia to be of Late Permian age.

ACKNOWLEDGEMENTS

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REFERENCES


Figure 4. (a) Thin section of Lower Crediton Breccia under plane polarised light and at 5x magnification showing biotite in the matrix. (b) Shute Sandstone with Newton St Cyres Breccia above at Newton St Cyres Golf Course. (c) Panned concentrate of Shute Sandstone mounted in resin and analyzed with the QEMSCAN at Camborne School of Mines, University of Exeter.

Figure 5. Cromwell’s Cutting, Pitt Hill, Crediton. (a) Bedded Newton St Cyres Breccia. (b) Detail of ‘murchisonite’ clast. (c) Sedimentary log of section (after Edwards and Scrivener, 1999).