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Discussion on thrust tectonics of S Devon

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MR D. K. SMYTHE writes: Coward & McClay's (1983) radical reconstruction of S Devon structure depends crucially on the postulate of a major thrust (T_1), with a displacement of at least 13 km, invoked to account for the sequence of presumed right-way up older Dartmouth Beds, overlying the younger Meadfoot Group. I suggest that their interpretation of the major structures of the Brixham–Dartmouth area is unlikely, for several reasons:

(1) Their use of bedding-cleavage relationship as a way-up criterion is often unreliable here, where folds are isoclinal or near-isoclinal, and as their fig. 3 shows.

(2) The most northerly exposure of the Dartmouth Beds, 100 m S of the inferred Dartmouth–Meadfoot contact at Kingswear (their critical locality *m*, grid reference 88245087), reveals downward-facing graded sandstones. In this coastal section bedding and cleavage are parallel, but a number of northerly-overturned, nearly isoclinal folds can be inferred on the basis of sedimentary way-up criteria combined with repetition of lithologies.

(3) Similarly, on the E coast, at Scabbacombe (Coward & McClay's critical locality *l*), correlation of grit bands and bedding-cleavage geometry suggests that a fold axial plane 100 m S of the Dartmouth–Meadfoot transition is antiformal, and that the contact itself is probably downward-facing; but, as Coward & McClay also note, no reliable sedimentary way-up criteria have been observed here. However, the reconstructed stratigraphic succession, comprising the topmost 300 m (post-flattening) of the Wembury Siltstones (Dineley 1966) of the Dartmouth Beds, can be closely matched to the similar succession S of Kingswear (point (2) above).

(4) The Channel coast exposure of the Meadfoot Group between Sharkham and Scabbacombe can be satisfactorily (and conventionally) interpreted with some ten or a dozen northerly-overturned anticline-syncline pairs, rather than by a single major 'Man Sands antiform'. The deformed stratigraphic thickness of the Meadfoots is estimated at about 300 m, including the Staddon Grits at the top.

Therefore, there is no compelling evidence here or elsewhere along the northern margin of the Dartmouth Beds outcrop (Hobson 1976) for the postulated major thrust T_1, since the Dartmouth–Meadfoot contact can be assumed to be stratigraphically overturned, even if locally faulted (Hobson 1976). However, there are many small thrusts and normal faults approximately parallel to bedding and cleavage. One of the larger of these is the Sharkham Point thrust, which I interpret as cutting up section in the hanging-wall transport direction (Smythe 1973), rather than being folded around the supposedly later St Mary's Bay anticline (Coward & McClay 1983, fig. 2, section P'P). My interpretation stresses the close relationship between the development of the folding, thrusting and the oblique-slip wrench faulting (Smythe 1973, fig. 5). The last of these, which is not accounted for in Coward & McClay's two-dimensional sequence of thrusting and folding, includes the big NW–SE dextral wrench faults crossing S Devon, and which I have suggested are Hercynian, not Tertiary (Dearman 1963), in origin. Furthermore, the strongly diachronous character and greatly varying rheologies of the middle Devonian succession cannot be ignored in attempts to reconstruct the structural development (*cf.* Coward & McClay 1983, fig. 11, and Smythe 1973, fig. 4).

The above comments are not intended to refute the concept, in principle, of major thrusting in S Devon. The progressive northward overturning towards recumbency of the folding, with the inferred progressively inclined principal stress axes (Smythe 1971, fig. 7) suggests that the area now exposed was perhaps deformed within an upper-crustal duplex thrust system, the exotic nappes above which have since been removed. Whether or not some of the rocks north and west of Torbay are remnants of these conjectural nappes (*cf.* Coward & McClay's evidence), is another question.

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M. P. COWARD & K. R. MCCLAY reply: We welcome Dave Smythe's support for thrust and related fold tectonics in S Devon though he obviously differs from us in the importance of individual faults. Our composite cross-section (figs. 7 and 9, Coward & McClay 1983) suggests that the Torbay thrust sheets are linked from fault (T_1) at the northern boundary of the Dartmouth Slates. According to this interpretation, fault T_1 climbed stratigraphic section in its transport direction, one of the criteria for thrust tectonics affecting flat layer-cake stratigraphy. For this criterion to be met, the only other possible fault in S Devon which could link with the Torbay sheets, would be the Start Point thrust. This latter model, which gives a larger displacement to the Torbay sheets than that suggested by Coward & McClay (1983), is

presumably the one preferred by Dave Smythe, in that such a Start Point–Torbay Thrust could form the roof to his upper crustal duplex.

An alternative interpretation, however, is that the rocks were not flat layer-cake sediments before thrusting, but had been folded. There is clear evidence for pre-cleavage folding at Ansteys Cove and Daddy Hole on the Torquay Headland and also at Beesands (Coward & McClay 1983, pp. 218–9). We considered this early folding to be only a local phenomenon, but if it had been widespread, later thrusts such as that at the base of the Torbay sheets need not have climbed stratigraphic section in the movement direction but could have cut across these folds and locally cut down stratigraphy. Following this model, the Torbay thrusts could link with any major fault S of Berry Head, such as the St Mary's Bay thrust (Smythe's Sharkham Point thrust), assuming that it has the geometry described by Dave Smythe above.

We again emphasise that our composite section is only one of many possible cross-sections explaining the stratigraphic and structural data. Dave Smythe's discussion does not negate this.

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