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Stratigraphy and structure of the Mercia Mudstone Group (Triassic) in the western part of the Wessex Basin

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In the outcropping Mercia Mudstone Group of the western margin of the Wessex Basin three new members are proposed in areas intermediate between basin margin and basin centre successions. The West Buckland Member and the North Curry Sandstone Member are useful marker horizons in outcrop and borehole sections and allow correlations that constrain the position of the Watchet-Cothelstone-Hatch (or Quantock) Fault and other structures around Taunton, Somerset. The detailed structure of late Triassic sediments in the western Wessex Basin can also be demonstrated.

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Introduction

Mercia Mudstone Group sediments of the western extremity of the present-day Wessex Basin outcrop between Bridgwater and Wellington in Somerset. In places an attenuated sequence rests unconformably on Palaeozoic strata (ie. around the Quantock Hills). Elsewhere a fuller sequence of Mercia Mudstone and Sherwood Sandstone Group sediments is found on Palaeozoic rocks. Post-Triassic faulting is indicated by juxtaposed Palaeozoic, Triassic and Jurassic strata, especially along the main structural feature of the area, the Watchet-Cothelstone-Hatch Fault of Whittaker (1972) (Figs 4, 5 and 6).

Three main types of succession can be defined in the Mercia Mudstone Group of the west Somerset area. The first is a conglomerate draping Palaeozoic massifs in the Mendip area, this is the "Dolomitic Conglomerate" (see Green and Welch 1965). The second, determined primarily from outcrop, includes up to five mappable horizons here, provisionally termed members (within undefined formations) of the Mercia Mudstone Group. Lastly, the sequence recognised in boreholes both within the area (ie. Norton Fitzwarren: Fig. 3), and in thicker, more basinal sequences to the east (Loft *et al.* 1982) where evaporite horizons are present that may correlate with calcareous members exposed farther west and with the correlatives previously suggested by Lott *et al.* (1982).

Structural variations within the Mercia Mudstone Group of this area of the Wessex Basin are difficult to determine on account of the apparent lack of widespread marker horizons. In addition, very few boreholes to the west of the hydrocarbon prospective Wessex Basin penetrate the full Mercia Mudstone Group sequence. Thus even gross thickness changes cannot be determined with any accuracy.

Recent studies have demonstrated the widespread nature of the late Triassic sandstone member known as the Weston Mouth or North Curry Sandstone Member in this area (Warrington *et al.* 1980; Warrington and Williams 1984; Ruffell and Warrington 1988). This member can be used as a correlative marker throughout the basin, and aids the construction of depth maps from borehole records. The concealed member gives rise to a strong impedance contrast to seismic wave propagation, and on seismic sections can be identified beneath the "Keuper Anhydrites" (Donato 1988); this succession can be related directly to surface exposures (in the case of the North Curry Sandstone), or to the succession recorded from the borehole at Seaborough in Dorset (Fig. 6, Locality 10). In addition, three new members within the Mercia Mudstone Group can now be defined, which also aid correlation across the Somerset area.

Stratigraphy

The Mercia Mudstone Group succession found between the massifs of the Quantock and Mendip Hills, in the western part of the Wessex Basin, can be examined at outcrop east of Wellington, around Taunton and east of Bridgwater in Somerset. The succession forms

parts of the Central Somerset Basin (Whittaker 1973; Whittaker and Green 1983) and the Western Permo-Triassic Basin of Edmonds and Williams (1985, p.55). Over the past five years detailed outcrop studies and feature mapping has resulted in the recognition of the horizons summarised below and in Figs 1 and 2.

Horizon 1. The Poole Brickpits Sandstone Member

Ussher (1906, p.23) described the sandstone found at Poole Brickpits, Wellington (ST 148217) as "bed or beds of green sandstone varying from 1 to 3 feet in thickness and irregularly associated with more calcareous matter", and remarked upon the similarity to the Schilfsandstein of Germany. The same bed is still occasionally worked in the western extremity of the brickpit. Similar lithologies can be observed in the member at Middle Green, southwest of Wellington (ST 132193) and at North End, Wellington (ST 103168).

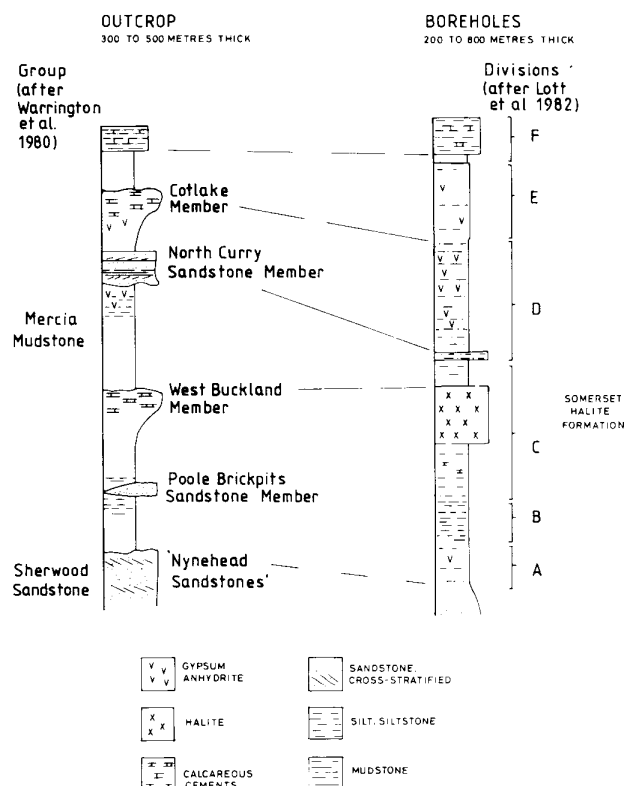


Figure 1. Stratigraphical summary logs of the outcrop and subsurface Mercia Mudstone Group in the western Wessex Basin. No vertical scale.

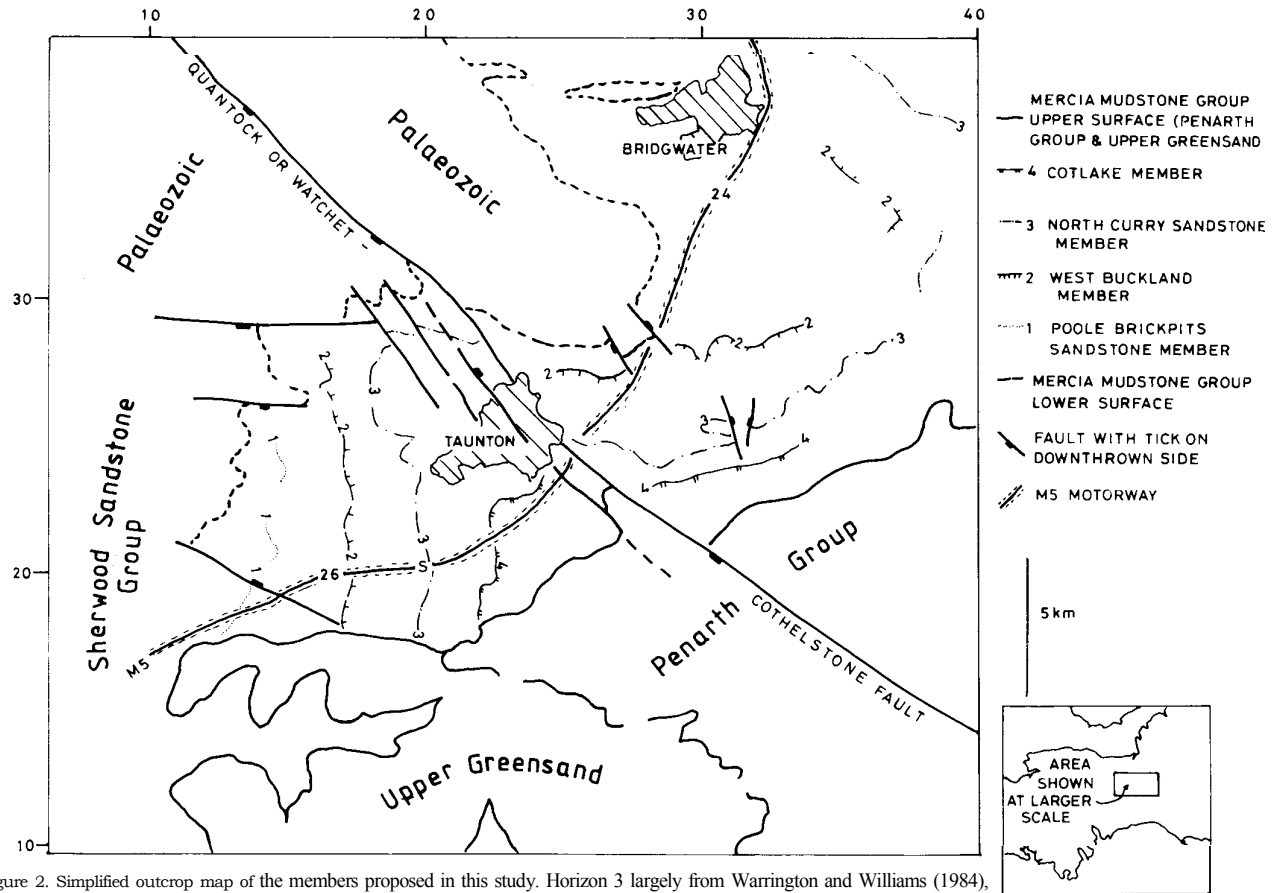


Figure 2. Simplified outcrop map of the members proposed in this study. Horizon 3 largely from Warrington and Williams (1984), Edmonds and Williams (1985), and Ruffell and Warrington (1988); other outcrops from author's mapping.

Horizon 2. The West Buckland Member

Previously unrecognised, this calcareous and occasionally arenaceous member forms a low topographic feature around the type locality and across much of the Vale of Taunton Deane. The member in the type area is seen in disused marlpits on a ridge extending from Blackmoor (ST 1685 1868) northwards to West Buckland (the best outcrop being in the lane at ST 1740 2055). The beds continue through Hockholler Green (ST 1700 2130) to Bradford on Tone (ST 1733 2271). East of Taunton, a topographical feature formed by the member can be recognised running parallel to the mapped North Curry Sandstone Member (Fig. 2) from Taunton to Lyng (ST 3341 2900). Outcrops are scarce in this area, the best section being the railway cutting at ST 3082 2833. The West Buckland Member forms the topographical feature at Athelney Hill (ST 3465 2931).

Horizon 3. The North Curry Sandstone Member

The North Curry Sandstone Member west of Taunton is described by Edmonds and Williams (1985), and in Ruffell and Warrington (1988) and an account of the type locality east of Taunton is given by Warrington and Williams (1984). The eastern limits of the member can now be extended via Othery (G. Warrington, *pers. comm.*) to the Sutton Mallet area, north west of Bridgwater. Both Buckland (1836) and Ussher (1906) noted this outcrop, although it is not shown on the Geological Survey (Glastonbury) sheet. The excellent exposures include Mill Batch Quarry (ST 3707 3655); Godfrey's Farm (ST 3740 3650); Moorlinch (ST 3930 3685); and Sharpenton Hill (ST 3993 3575).

Horizon 4. The Cotlake Member

This member is identical lithologically to the West Buckland Member (a calcareous, commonly arenaceous orange to red nodular or rubby siltstone). However it is less easily traced, and is apparently restricted to two outcrops either side of the Watchet-Cotelstone-Hatch Fault, south east of Taunton (Fig. 2). Nodular red calcareous siltstones are

visible at the type locality in the lane at Kibbear, on Cotlake Hill (ST 2257 2196). Small exposures of calcareous silty mudstone occur on the slopes of Thorn Hill, Thornfalcon (ST 2870 2339). To the south and east of these localities the associated topographical feature dies away.

Stratigraphical summary

The lowest and uppermost members defined here (Poole Brickpits Sandstone and Cotlake Members) are the most impersistent and difficult to trace laterally by feature mapping. In the former case this may be due to restriction to channels cut into the top of the Sherwood Sandstone Group; in the latter it appears to be related to the Watchet-Cotelstone-Hatch Fault. By contrast, the West Buckland and North Curry Sandstone Members are very widespread and make reliable datum horizons, although some difficulty exists in the positive identification of the West Buckland Member in boreholes. Comparison of the outcrop and shallow borehole succession with that described from deep boreholes suggests that the arenaceous calcareous members described here (West Buckland and Cotlake), occur at similar stratigraphical levels as the evaporites of the Somerset Halite Formation and 'Keuper Anhydrites' respectively.

Structure

Reliable measurements of Mercia Mudstone Group thickness in the western parts of the Wessex Basin are scarce (see Whittaker 1985); information from the Burton Row (Whittaker and Green 1983), Puriton (Ussher 1911, McMurtrie 1912) and Compton Dundon (Moore 1881; Ussher 1911) boreholes suggests a thickness of 400 to 500m. This diminishes rapidly adjacent to Palaeozoic massifs, as in the Bruton Borehole (Holloway and Chadwick 1984; Warrington *et al.* 1986).

In the Taunton area many wells pass through a sandstone unit here

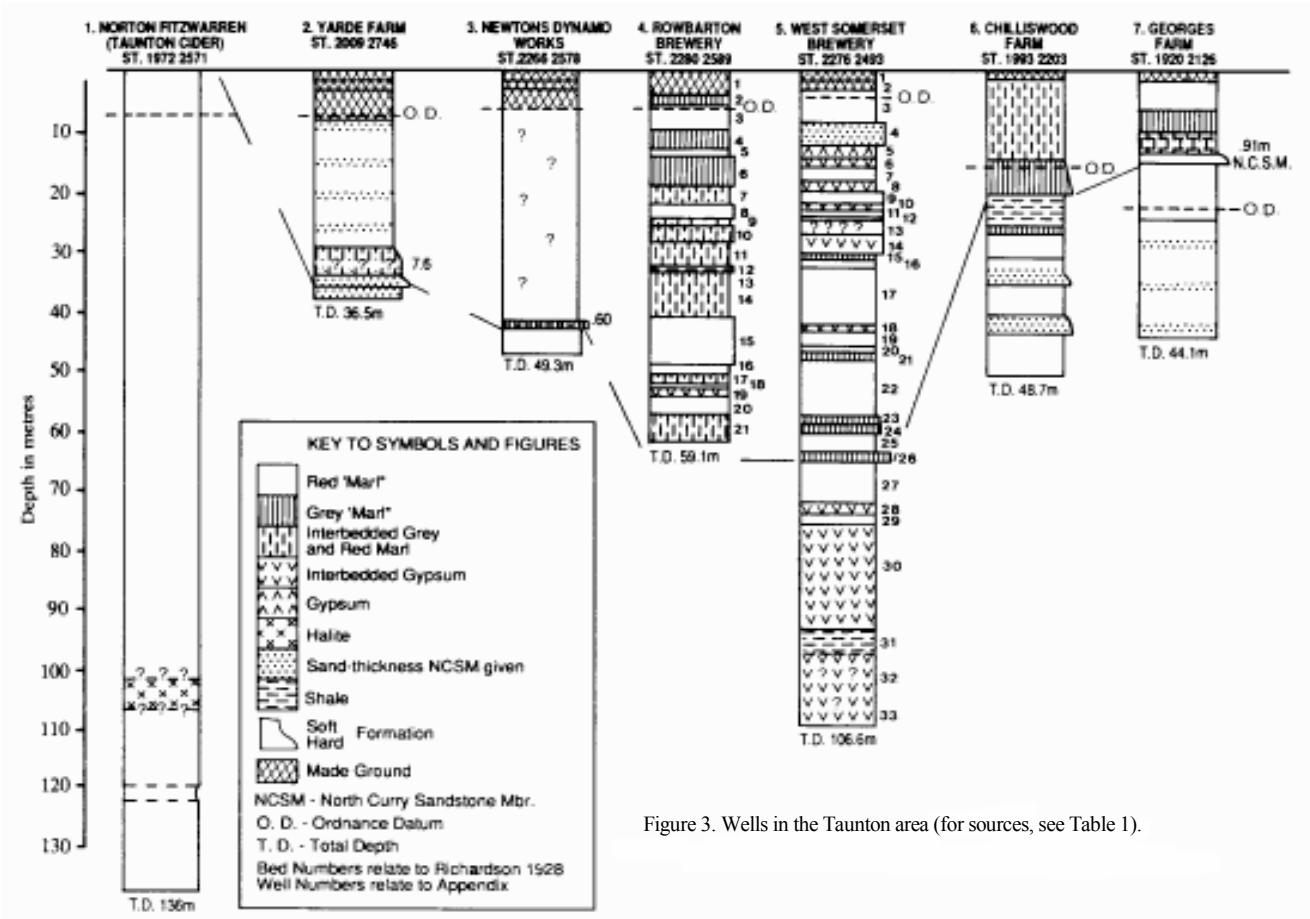


Figure 3. Wells in the Taunton area (for sources, see Table 1).

interpreted as the North Curry Sandstone Member, on account of the distinctive lithologies described and the ease with which it can be related to nearby outcrops. This provides a useful datum in estimating subsurface structure, from which the members defined at outcrop above and below can be better constrained (Fig. 5). The records for many such wells are not in the public domain, or are in old publications using imperial measurements. New interpretations have been made and a correlation of the logs is given in Fig. 3. The use of the North Curry Sandstone Member as a datum in wells 3,4 and 5 (Table 1) suggests some gross facies changes in the beds above and below. However, a more uniform stratigraphy can be imposed upon the area by postulating a NW-SE trending fault acting antithetically to the Watchet-Cothelstone-Hatch Fault. This in effect would downthrow the strata in the Rowbarton well (number 4); it supports Ussher's (1911) suggestion that this borehole section is higher in the succession than in adjacent boreholes. A similar structure is recorded further to the north by Edmonds and Williams (1985, their Fig. 14). On seismic data shot to the south of Taunton by Goal Petroleum plc (Donato 1988), the Hatch Fault is clearly visible with a number of antithetic faults joining it. Combining the outcrop geology, borehole records and seismic data allows construction of a simplified cross-section across the fault (Fig. 5), which shows that the actual downthrow is minimal. The clear imaging of the fault on seismic, and the extent of mapped offsets in the Mesozoic- Palaeozoic must be the product of strike-slip motion, as suggested for the Somerset coast area by Whittaker (1972).

Shearman (1967) suggested, from experimental studies, that the observed dextral wrench movement of the Watchet-Cothelstone-Hatch Fault (Webby 1966; Whittaker 1972) could produce E-W faults in the Mesozoic section to the east. The structure of the Triassic basin based on depth maps drawn from borehole data (Fig. 6) suggests that the Watchet-Cothelstone-Hatch Fault swings into an EW orientation. Examination of the Goal Petroleum plc seismic

dashows a NW-SE trend in the Palaeozoic basement, passing up into a series of en-echelon "splay" faults in the Permo-Triassic, and eventually E-W normal faults in the Jurassic (Donato 1988). It should be stated that such an interpretation is at variance with the published data of Whittaker (1985), where the Watchet-Cothelstone-Hatch Fault terminates the E-W trending Cranborne Fault. The 'swing' of the former fault is a product of tracing the structure within the Mercia Mudstone Group, whereas the N-W orientation can be seen to continue southwards in the Palaeozoic.

Relating the structure of the Triassic in the Somerset area to the rest of the Wessex Basin can also be achieved using similar correlative horizons as those described above. The geophysical log divisions of Lott *et al.* (1982) include a possible correlative of the North Curry Sandstone Member (at the base of their division D), which can be matched on subsurface depth maps to the area studied in detail around Taunton (Fig. 6). This suggests that the Central Somerset and Western Permo-Triassic basins of Whittaker and Green (1983) and Edmonds and Williams (1985) coalesce in the Wessex Basin to the south east (Fig. 6).

Conclusion

The Mercia Mudstone Group is often regarded as a thick, homogeneous succession with little internal variation. The lithologically distinctive North Curry Sandstone Member forms a useful datum in structural analyses of the western margin of the Wessex Basin, suggesting that the faults observed on seismic profiles can be linked to outcrop patterns. This work also suggests that other correlative horizons to the North Curry Sandstone Member exist; such members show greater vertical facies variation within the Mercia Mudstone Group succession than have been appreciated, possibly reflecting the palaeoenvironmental changes of Simms and Ruffell (1990).

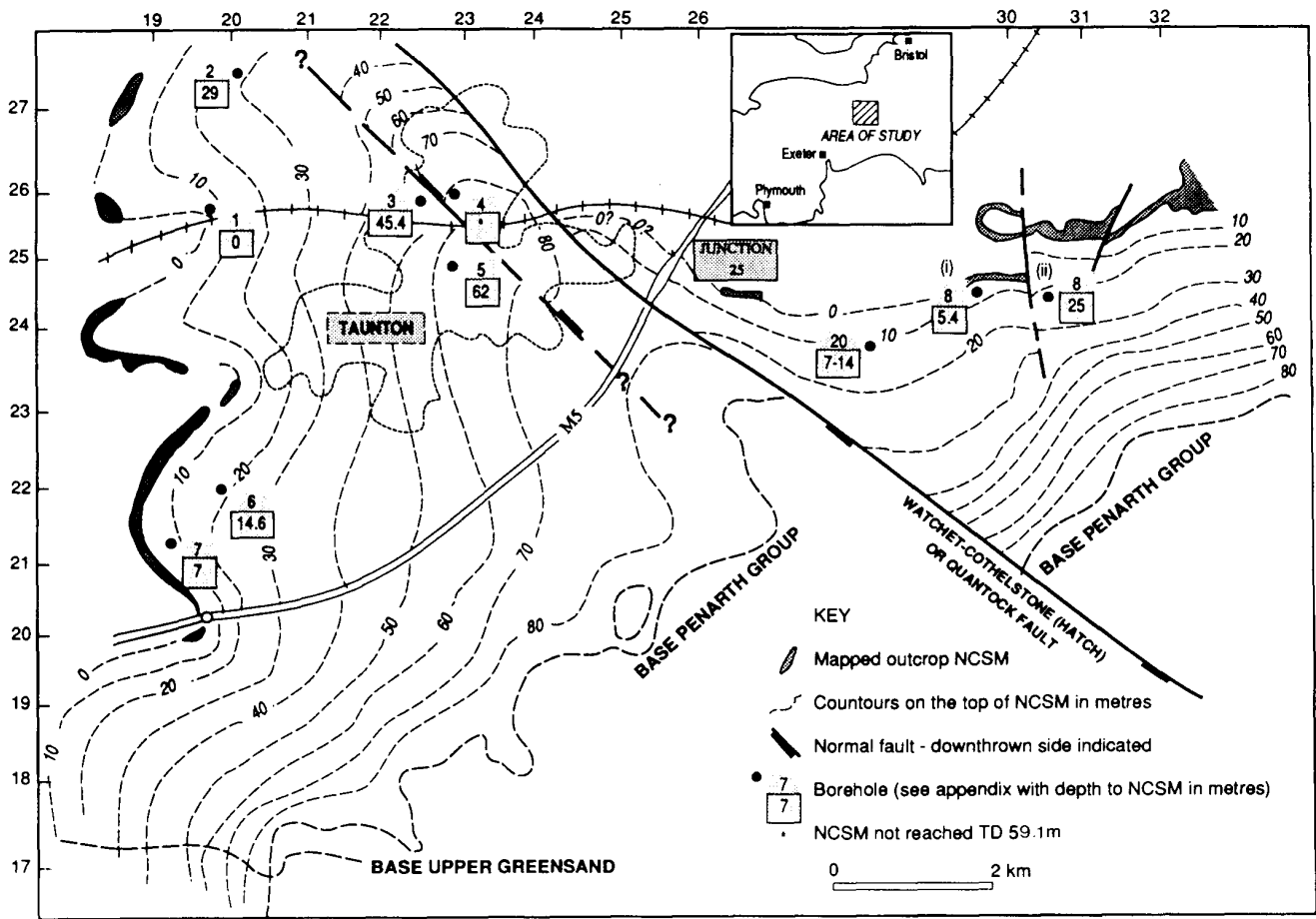


Figure 4. Structure contours on the presumed North Curry Sandstone Member (NCSM) in the Taunton area, showing the postulated fault antithetic to the Watchet-Cothelstone-Hatch Fault.

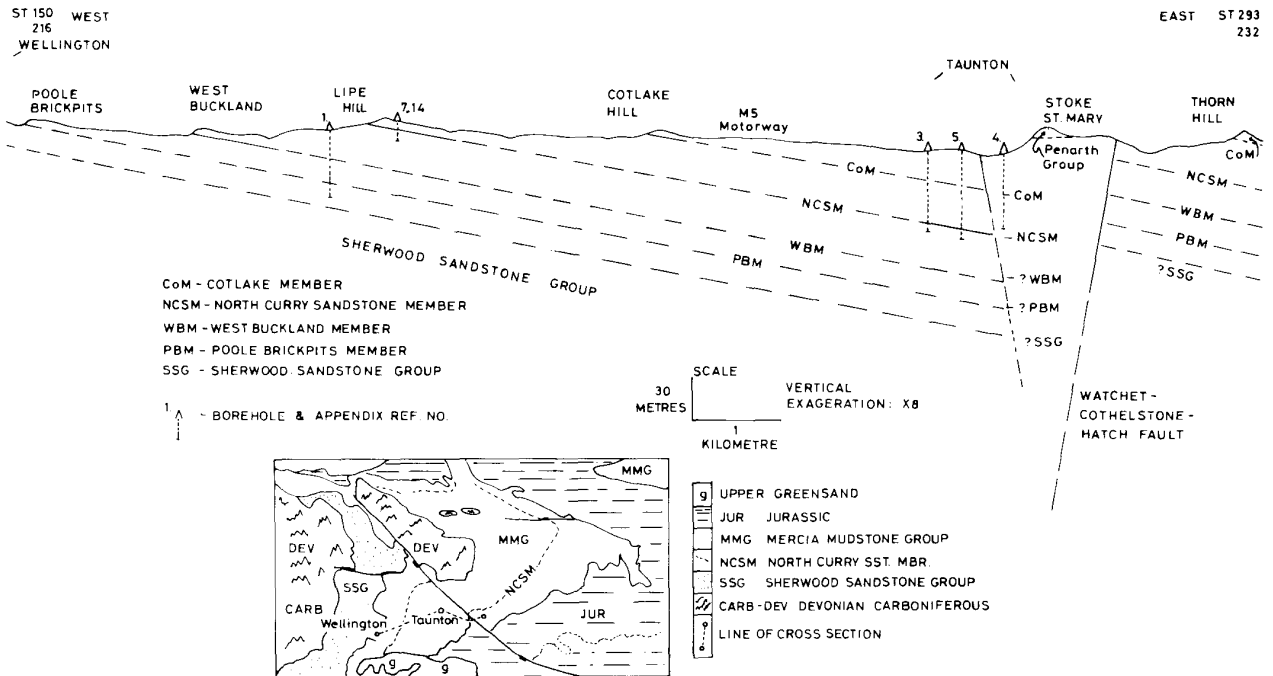


Figure 5. East-west cross-section from Wellington to Taunton, across the Watchet-Cothelstone-Hatch Fault, constructed from well data (Fig. b) and seismic data around the fault (courtesy Goal Petroleum plc).

Table 1. List of boreholes and wells

Text reference number	Locality	Date completed	Source of data
1	Norton Fiizwarren (ST 1972 2571)	1985	Taunton Cider Co. Ltd.; Saxon Deep Drillers
2	Yarde Farm (ST 2009 2746)	1974	B.G.S.S.R. Shepherd Ltd.
3	Newton's Dynamo Works (ST 2266 2578)	1925	Ussher 1908; Richardson 1928
4	Rowbarton Brewery (ST 228026R9)	unknown	Whittaker and Woodward 1893; Ussher 1908; Richardson 1928
5	West Somerset Brewery (ST 2276 2493)	1885	Whittaker and Woodward 1893; Ussher 1908; Richardson 1928
6	Chilliswood Farm (ST 1993 2203)	1965	B.G.S.; F.W. Sherrell
7	George, Farm (ST 1920 2126)	1962	B.G.S.; F.W. Sherrell
8 i)	New Barn (ST 2963 2447)	unknown	Warrington and Williams 1984
i)	Borough Post (ST 3055 2430)	unknown	Warrington and Williams 1984
9	Chard (ST 3430 0653)	unknown	B.G.S.; of Energy
10	Seaborough (ST 4348 0620)	1974	Lott et al. 1982
11	Marchwood (SU 0341 0907)	1980	Lott et al. 1982
13	Nettlecombe (SY 5053 9544)	1972	Lott et al. 1982
14	Winterborne Kingston (SY 8470 9796)	1979	Rhys et al. 1982; Lott et al. 1982
15	Cranborne (SU 3408 9073)	1972	Lott et al. 1982
16	Bruton (ST 6896 3284)	unknown	Holloway and Chadwick 1984; Warrington et al. 1986
17	Burton Row (ST 3356 5208)	1971	Whittaker and Green 1983
18	Puriton (ST 3197 4080)	1911	Ussher 1911
19	Compton Dundon (unknown)	1867	Moore 1881; 1908
20	Thornfalcon (unknown)	unknown	Ussher 1906

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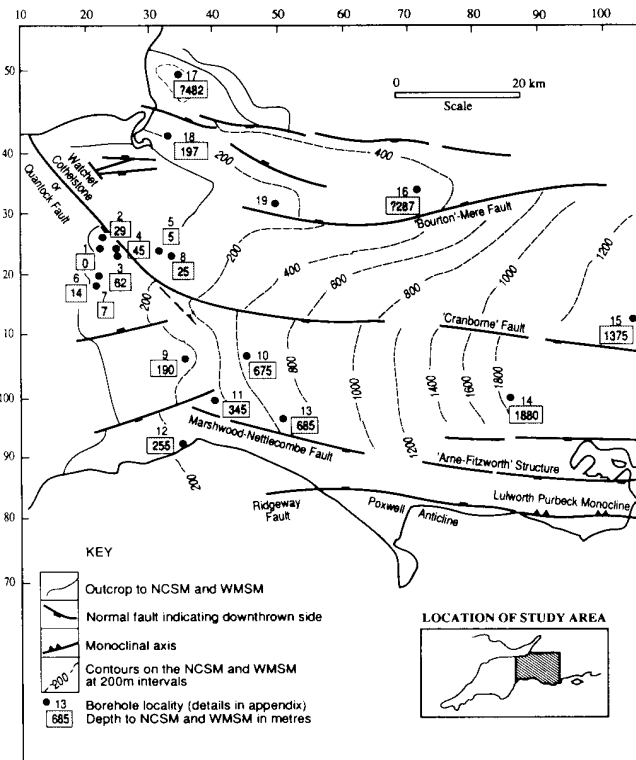


Figure 6. Structure contours on the presumed North Curry Sandstone/Weston Mouth Sandstone Member (NCSM/WMSM), or base of Division D of Lott et al. (1982).