

THE RELATIONSHIP OF STRATIGRAPHICALLY CONTROLLED LITHOLOGICAL VARIATIONS IN THE MERCIA MUDSTONE GROUP (TRIASSIC) IN SOUTH-WEST ENGLAND TO WEATHERING PROCESSES AND LANDSLIDE MECHANISMS



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The principal exposures of the 350 m to 450 m thick Mercia Mudstone Group in South-West England are cliff sections on the east Devon coast between Sidmouth and Seaton, and on the north Somerset coast between Blue Anchor and St Audrie's Bay. Inland, where the mudstones weather to clays that form slopes that mostly rest at 5° to 10°, there are few exposures. The group is divided on gross lithology into four formations and nine members, each of which influences the shapes of the cliff profiles and the types of landslide mechanism. On the Devon coast, failures in the lower part of the cliffs in the red silty mudstones of the Sidmouth Mudstone and Branscombe Mudstone Formations are initiated by marine erosion acting on joints and bedding planes: in the middle part by joint-bounded rock-block failures; and in the upper part by toppling failures and the failure of weak mudstone soils in the weathered zone. Thin (<10 mm thick) beds of laminated grey mudstone in the Dunscombe Mudstone and Blue Anchor Formations give rise to rotational and translational shear failures on the Devon coast. On the Somerset coast, where there is a large (up to 12 m) tide range and the cliffs are less protected by beach deposits, the principal landslide mechanisms are rock-block and toppling failures that are strongly influenced by faulting and have little relationship to the stratigraphy. Landslides in the Mercia Mudstone Group are rare in inland Devon and Somerset except for shallow-seated failures close to the spring line and unconformity at the base of the Cretaceous Upper Greensand Formation, and in some of the narrow, steep-sided valleys (goyles) on the Upper Greensand outcrop in east Devon.

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INTRODUCTION

An almost complete section through the Mercia Mudstone Group is exposed in the cliffs between High Peak [SY 105 860], Sidmouth and Haven Cliff [SY 270 895], Seaton in east Devon (Figure 1a). There, the group crops out with a low easterly dip in a series of long sections separated by small faults. Much of the outcrop is unconformably overlain by permeable sandstones of the Foxmould Member of the Cretaceous Upper Greensand Formation in cliffs up to 160 m high. Slope angles in the mudstone cliffs mostly range from 30° to 70°. The unconformity surface is marked by seepages and springs that give rise to gullies and secondary landslides in the underlying mudstones.

All except the lowest part of the group is exposed in fault-bounded sections on the Somerset coast between Gray Rock [ST 0385 4370], Blue Anchor and Watchet Harbour [ST 0734 4345], and between there and Blue Ben [ST 1207 4380], St Audrie's Bay (Figure 1b) in cliffs that are mostly 20 m to 40 m high. The faulting brings the Mercia Mudstone into juxtaposition with the predominantly argillaceous Penarth and Lias Groups, both of which contain beds that are prone to landslide.

The Mercia Mudstone is divided on the basis of gross lithology into four formations and nine members (Figure 2) that can be recognised throughout the outcrop and subcrop in southern England. The bulk of the group (Sidmouth Mudstone and Branscombe Mudstone Formations) comprises a rhythmic succession of brownish-red mudstones and silty mudstones in

which slightly darker clay-rich mudstones commonly pass up into paler, orange-brown, more silt-rich mudstones. Each rhythm reflects a change from a wetter to a drier climate. Beds of finely laminated mudstone and partially dolomitised mudstone (commonly green in colour), and brownish red coarse-grained siltstone to fine-grained sandstone occur at a few levels. The most common subsidiary lithology is thin (up to 0.3 m thick), laterally persistent beds of green mudstone, many of which are finely laminated and/or partially dolomitised. Gypsum occurs throughout the succession as nodular geodes and fine-grained cements (gypcretes), and as fibrous satin spa veins along joints and bedding planes. It is rock-forming in the Red Rock Gypsum Member, and is especially common in the Hook Ebb Member and in the Blue Anchor Formation on the Somerset coast. The sedimentology of the mudstones and the presence of gypsum/anhydrite nodules and salt pseudomorphs indicate deposition in playa-lake environments in hot deserts.

The Dunscombe Mudstone and Blue Anchor Formations comprise laminated green, grey and red-brown mudstones with thin limestone interbeds that were deposited in shallow ephemeral lakes in wetter climates. Beds of halite up to 130 m thick are present in graben areas in the Dunscombe Mudstone in the Wessex and Bristol Channel Basins (Gallois, 2003). These are absent from the Devon and Somerset coastal outcrops which were deposited in intergraben areas. Landslides in the Sidmouth and Branscombe Mudstones at outcrop on the Devon