

## THE GEOLOGY OF THE EXCAVATIONS MADE IN 2005-6 FOR COAST-PROTECTION AND LANDSLIDE REMEDIAL WORKS AT LYME REGIS, DORSET



R.W. GALLOIS

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Excavations associated with remedial measures to stabilise the sea-front area at Lyme Regis, in particular the footings for a new sea wall and the removal of the surface layers from a large area in Langmoor and Lister Gardens, provided the opportunity to examine parts of the Shales-with-Beef Member of the Early Jurassic Charmouth Mudstone Formation that are difficult to access at outcrop. The excavations were monitored and the fossils of scientific interest were collected. The most impressive find was the remains of a 7 m-long ichthyosaur (*Temnodontosaurus*) in the Saurian Bed in the Shales-with-Beef Member in the footings for the new sea wall. This is now on display at Lyme Regis Museum. The new geological data, combined with that obtained from site investigations carried out in advance of the engineering works, has enabled the stratigraphy and geological structure and the landslide mechanism to be better understood. A 5 m-deep drainage cut-off trench above the landslides proved sandy Head Deposits resting on deeply weathered Charmouth Mudstone with 'flame' structures at the junction of the two deposits. This suggests that the sands were rapidly deposited on a softened and waterlogged clay surface, probably in a periglacial climate in the late Pleistocene.

92 Stoke Valley Rd., Exeter, EX4 5ER, U.K.  
(E-mail: gallois@geologist.co.uk)

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### INTRODUCTION

The early medieval village of Lyme Regis consisted of a cluster of houses grouped around a church (1145) at the eastern end of the present town and a small natural harbour 700 m to the south west. The village and harbour were linked by a track that ran along the foot of a low cliff of seaward-dipping mudstones in the Shales-with-Beef Member of the Early Jurassic Charmouth Mudstone Formation (Figure 1a). Until the mid 18th Century the sea cliff was largely protected by a shingle beach that was naturally maintained by the easterly longshore drift of shingle from west of the outer harbour wall (The Cobb). The closure of the gap between The Cobb and the land in 1756 (Fowles, 1991) followed by a succession of increases in the height of the sea wall interrupted the supply of beach gravel with the result that the sea cliff was unprotected for long periods of time. The town became a popular tourist resort in Regency times, and by the mid 19th Century had expanded to include a sea wall (1860) surmounted by a marine parade, sea-front cottages, a library and houses within the landslipped area on the west side of the town (Fowles, 1990). The marine parade was blocked from time to time by landslides in the lower part of the Shales-with-Beef cliff (Arber, 1973). These culminated in February 1962 after an unusually wet January (Anon, 1971) in the collapse of >10,000 tonnes of mudstone which overtopped the marine parade and resulted in the destruction of several houses (Figures 1c and d). Remedial works that were carried out from time to time included the re-grading of the slope above the sea cliff, drainage works in the areas prone to landslides, and the use of groynes, sea walls and rock armour to protect the sea wall and the developments along the sea front. None of these was lastingly successful.

In 1995, West Dorset District Council (WDDC) initiated engineering, hydrological and geological research to obtain the data necessary to enable long-term engineering solutions to be designed to minimise the risks associated with marine erosion and landslides. The detailed site investigations of the most threatened areas included the preparation of large-scale geological maps of the onshore area, and sidescan-sonar, bathymetric and seismic-reflection surveys in the offshore area (Gallois and Davis, 2001) and an extensive drilling and monitoring programme (Anon, 2002; Davis *et al.*, 2002). The general geology of Lyme Regis has been known since the time of De la Beche (1826). Woodward and Ussher (1911), Lang (1914, 1924, 1926), Lang *et al.* (1923), Hesselbo and Jenkyns (1995) and Callomon and Cope (1995) have published descriptions which, taken together, provide a detailed stratigraphy of the Lias of the study area.

The highest part of the Blue Lias Formation and the lowest part of the Charmouth Mudstone Formation, the Shales-with-Beef Member (Figure 2), crop out on the foreshore and beneath the adjacent land area. Higher parts of the Charmouth Mudstone Formation, the Black Ven Marl Member, underlie much of the town (Figure 3). Much of the outcrop of the latter is overlain by extensive sheets of sandy Head Deposits up to several metres thick that were derived by solifluction from the Upper Greensand Formation in the highest part of the town. Lyme Regis (a 'gateway town') is outwith the Dorset and East Devon Coast World Heritage Site (WHS), but the foreshore outcrops and any artificial exposures in the town are of geological interest for comparison with the cliff and foreshore sections exposed on either side of the town. The geological