



The stratigraphy of the Kimmeridge Clay Formation (Jurassic) at Westbury, Wiltshire, U.K.



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ABSTRACT

The former Blue Circle Cement quarry at Westbury, Wiltshire exposed extensive sections in the lower part of the Kimmeridge Clay Formation, and a continuously cored borehole proved the lowest part of the formation and the underlying succession down to the top of the Oxford Clay Formation. The succession exposed in the quarry between 1979 and 2001 ranged from the Cymodoce to Eudoxus zones, and that in the borehole from the Baylei to Mutabilis zones. Taken together, the quarry and borehole proved the most complete section through the Kimmeridge Clay in a region where much of the formation has never been exposed. The lithological and palaeontological successions proved at Westbury are closely similar to those proved in continuously cored boreholes throughout the English outcrop and subcrop of the formation and can be matched in detail with that exposed in the type area on the Dorset coast. When the quarry was in work the sections yielded a profuse ammonite fauna that enabled the Cymodoce–Mutabilis and Mutabilis–Eudoxus zonal boundaries to be studied in detail. They also yielded a diverse bivalve and vertebrate fauna.

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1. Introduction

In May 1979, the Institute of Geological Sciences (IGS) now the British Geological Survey (BGS) was asked by Blue Circle Group to survey their quarry in the Kimmeridge Clay Formation (KCF) at Westbury Cement Works, Wiltshire [ST 885 529] (Fig. 1) and to log a continuously cored borehole through the lower part of the formation at the same site in order to determine the 3D distribution of organic-rich mudstones (oil shales of authors) that were detrimental to cement-making. The present author, who had recently completed a nationwide study of organic-rich mudstones in the Kimmeridge Clay as a possible source of synthetically generated hydrocarbons for the Department of Energy (Gallois, 1979a), made a geological map of the quarry and recorded the succession proved in the quarry and the borehole. Blue Circle Cement and the IGS agreed at that time that the geological map and stratigraphical report (Gallois, 1979b) would remain commercial-in-confidence for an estimated 2–3 years, after which time the borehole cores would be transferred to the IGS core store and the report would be placed on open file. The report and map remained commercial in confidence until 1982 when it was copied to a research team led by Prof. Tove Birkelund to assist them in a

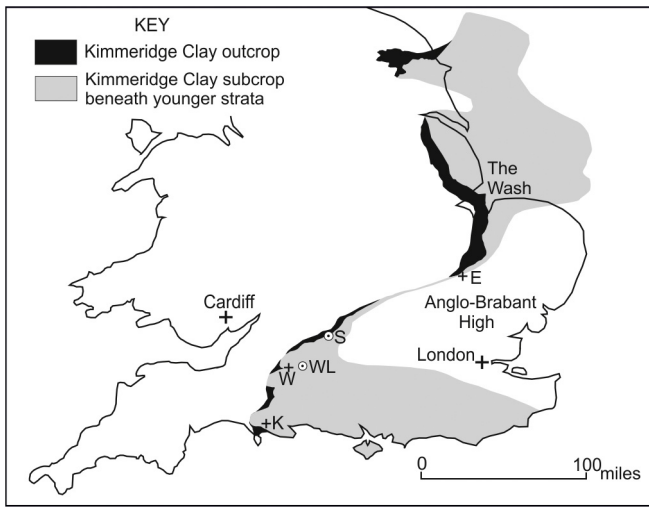
biostratigraphical study of the succession (Birkelund et al., 1983; Nøhr-Hansen, 1986).

2. Stratigraphy

One of the results of the Department of Energy survey, which included continuously cored boreholes along the Kimmeridge Clay outcrop from Yorkshire to Dorset, was that stratal units (currently numbered KC 1 to KC 63) based on a combination of lithological, palaeontological and geophysical features that had been shown to be applicable in The Wash area of south Lincolnshire and west Norfolk (Gallois and Cox, 1974, 1976), could be extended and applied to the whole of the English outcrop and subcrop including the KCF type section exposed on the Dorset coast (Cox and Gallois, 1981; Gallois, 2000). Comparison of the standard sequence with the Westbury succession showed that the quarry exposed KC 15 to KC 30; the borehole penetrated KC 1 to KC 19 and the underlying Corallian Group (Wright, 2016).

In 1979, the quarry (the old quarry of Fig. 2) comprised three faces separated by a gently sloping scraped area which together exposed a continuous succession through part of the Lower Kimmeridge Clay (KC 15 to KC 30). The lowest part of the quarry, which at that time was partially flooded, could not be safely accessed. It contained intermittent exposures in the more durable beds in KC 15 to KC 17, notably a calcareous siltstone in KC 17 and a

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E...Roslyn Hole, Ely S...Swindon Borehole W...West Lavington Borehole W...Westbury cement works K...Kimmeridge

Fig. 1. Geological sketch map of the outcrop and subcrop of the Kimmeridge Clay Formation showing the position of localities referred to in the text.

line of cementstone doggers in KC 18. The fauna of the lowest part of the quarry was recorded by Prof. John Callomon in 1976 at a time when the water level was unusually low, and the remainder of this previously inaccessible part of the quarry was measured and collected in detail by Birkelund et al. (1983). The 1979 lower face

exposed pale grey calcareous mudstones (c. 50% CaCO₃) in the middle to upper parts of KC 18 overlain by the medium and dark grey mudstones of KC 19 to KC 23. The lower face was capped by a cemented silty mudstone (KC 24) which could be traced across the intervening area to the top of the middle face, and from there eastwards to the edge of the quarry, a total of c. 500 m of outcrop. Between the middle face and the south face, a gently sloping scraped area exposed KC 25 to KC 30. A prominent line of fossiliferous calcareous doggers could be traced across the full width of the quarry floor within the pale grey calcareous mudstones of KC 30.

In 1994, an additional excavation became available for examination (the new quarry of Fig. 2). This proved a similar succession to that in the old quarry with part of KC 16 and KC 17 to KC 29 well exposed; part of KC 30 was poorly exposed in the south-east corner. As in the old quarry, the thick calcareous mudstone KC 18, the calcareous siltstone KC 24 and three lines of cementstone doggers (in KC 18, KC 24 and KC 30) formed prominent marker beds. On the east side of the quarry the KC 24 separated low angle (c. 5°) slopes in the upper part of the excavation from steeper (up to 35°) slopes in the lower part. Much of the north face was graded at a continuous 35° which allowed more accurate thicknesses to be measured for KC 17 to KC 29 than in the old quarry.

The composite Kimmeridge Clay succession proved in the quarries and in Borehole 79/1 is summarised below and graphically in Fig. 3, together with that recorded by Birkelund et al. (1983). The thicknesses for KC 5 to KC 17 are based on the Westbury 79/1 Borehole, and those for KC 18 to KC 29 on measurements made in the north face of the new quarry. The latter differ in minor detail at some levels from those made by the

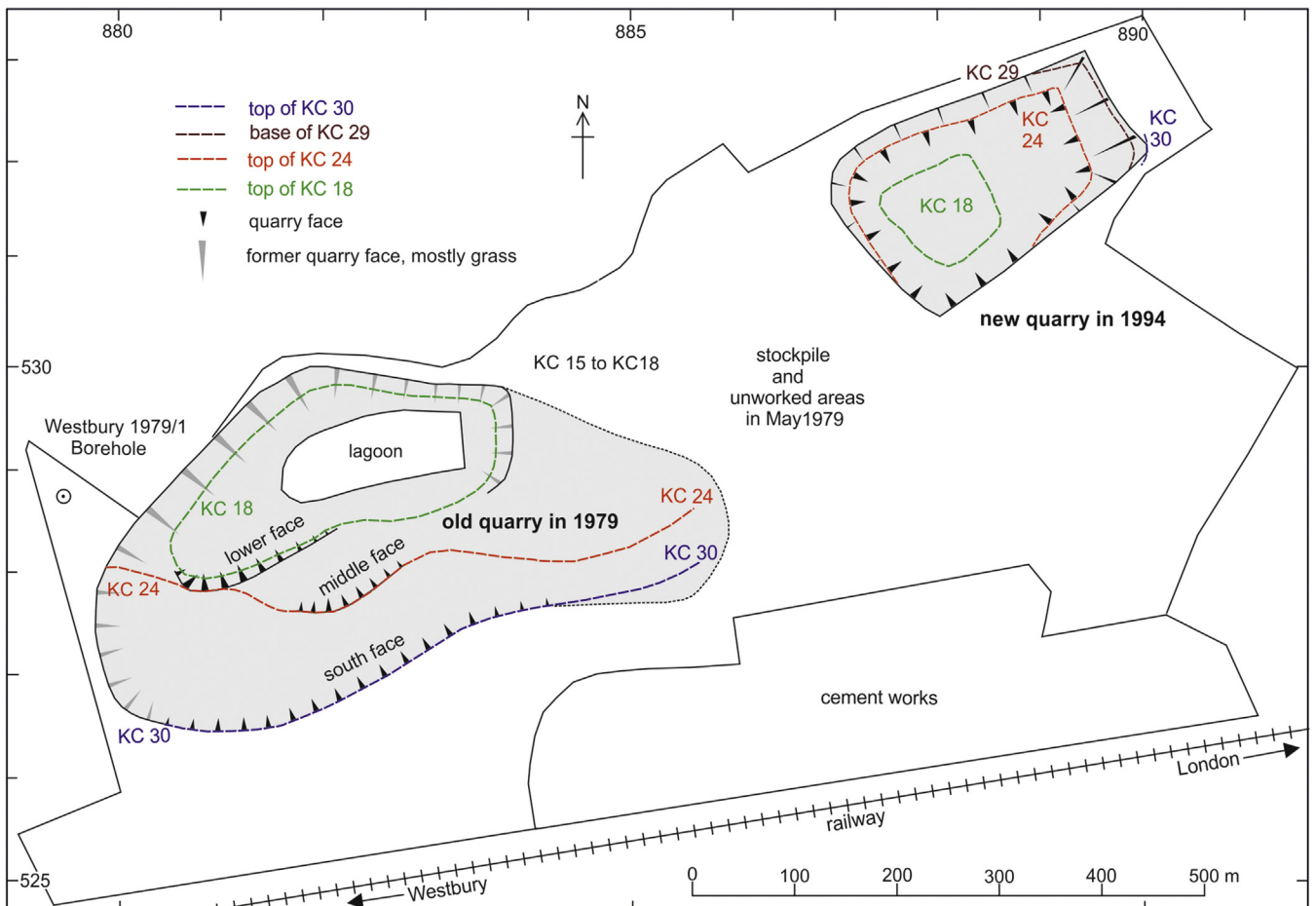


Fig. 2. Geological sketch section of the old and new quarries at Blue Circle Cement works showing the outcrop of some of the key marker beds.

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