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The North Devon Basin: a Devonian passive margin shelf succession

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ABSTRACT

The North Devon Basin, situated in a more proximal passive margin regime than the rift basins to the south, is not constrained but its succession is thought to represent in large part the sediments debouched from a northerly hinterland. Rather than that immediate source being South Wales an original location of the basin well to the south-east and west of the Ardennes massif is considered probable, with its present position being attained by Carboniferous displacement along the Bristol Channel-Bray Fault. The basin's thick (6000 m) succession comprises terrestrial and marine deposits that form two major sedimentary cycles, which are apparently closely linked to rift basin formation to the south. The GCR sites span a relatively straightforward shelf succession that extends from the late Early Devonian to the Carboniferous. The sedimentology, palaeontology, and depositional environments of terrestrial and marine facies lithostratigraphical units are detailed, some sites providing the macrofossil assemblages important in the identification and definition by Sedgwick and Murchison of the Devonian System.

Contents

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1. Introduction (B.E. Leveridge)

The Devonian rocks of north Devon and west Somerset (Fig. 1), in association with a Mississippian succession were deposited in the North Devon Basin (Fig. 3; Leveridge and Hartley, 2006). The nature and extent of this basin, unlike the passive margin rift basins to the south, are not well constrained, but Leveridge and Hartley (2006) suggested that its depocentre was located in the north where sediment had debouched in front of an elevated hinterland. The Devonian location of the basin was long assumed to have been in a similar relative position to the Old Red Sandstone (ORS) non-marine facies of southern Wales as today (e.g. Edmonds et al., 1975). Indeed Tunbridge (1984, 1986) provided sedimentological evidence, principally palaeocurrent and heavy mineral data, which suggested that Middle Devonian sediments in northern Devon were sourced by end-Caledonian uplift and erosion of Lower Old Red Sandstone deposits in southern Wales. However, it was found necessary to invoke a transient 'Bristol Channel Landmass' controlled by uplift along an active Bristol Channel Fault Zone to account for localized sources of exotic lithic clasts. That interpretation was questioned by the work of Holder and Leveridge (1986) and Higgs (1986), and a Late Devonian–Early Carboniferous location for North Devon (and the south-west province as a whole), probably in excess of 200 km to the south-east along the Bristol Channel/Bray Fault, was proposed in order to restore the continuity of Rhenohercynian geotectonic boundaries and Carboniferous successions. In such a reconstruction north Devon would have a Mid-Devonian location south of Britain approximately to the west of the present-day Ardennes Massif. The latter concept was utilized by others in their interpretation of Variscan geotectonics (e.g. Day et al., 1989; Franke, 1989) and more recently re-invoked by those interpreting the relationship between the British Caledonides and the European Variscides (e.g. Dewey and Strachan, 2003; Woodcock et al., 2007; Leveridge and Shail, 2011).

The basin succession, unlike those of the southern basins, was considered by Edmonds et al. (1985) to be relatively straightforward without major repetition by thrust faulting as had been proposed earlier (Prentice, 1960; Reading, 1965; Holwill et al., 1969). It is deformed by gently plunging upright to northward verging minor and major east–west folds (Sanderson and Dearman, 1973) and an associated axial plane slaty cleavage, which is locally intense, transposing sedimentary features and fossils. Apart from the Lynton Anticline, a major fold in the north that plunges gently to the SSE from Lynmouth Bay, where the Hangman Sandstone Formation (Edwards, 1999) crops out on both limbs, the succession youngs to the south in a simple manner (Fig. 1). Deformation has precluded consistent determinations of formation thicknesses, but Edmonds et al. (1985) provided estimated thicknesses of its composite formations, which give a total for the Devonian succession of *c.* 6000 m.

The nomenclature of the lithostratigraphical divisions of the Devonian rocks of the North Devon Basin appearing in relevant literature is largely inherited from the first mapping survey of the region. Amendments over many years have been inconsistent or not in accord with accepted stratigraphical guidelines. Some corrections have been made where there has been more recent mapping revision. For example, the old 'Hangman Grits' were termed the Hangman Group by Tunbridge (1983), but, as its subdivisions were all essentially sandstone and lacked broad mapping continuity, Edwards (1999) renamed the division appropriately as the Hangman Sandstone Formation. In an overview of the Carboniferous stratigraphy of the province by Waters et al. (2009), the North Devon Basin succession forms the major part of their Exmoor Group, with the main lithostratigraphical divisions being formations with any subdivisions being members. In their revised nomenclature the Pilton Shales are termed the Pilton Mudstone Formation. Such practice extended is implemented in the fifth edition of the British Regional Geology of South-West England (Leveridge et al., in press) and is adopted in this chapter.

Details of the main elements of the Devonian succession are provided in the following selected GCR sites, but the succession as a whole is illustrated in the graphic log of Fig. 2. Together with the interpreted depositional environments, it illustrates clearly that the very thick succession describes two major depositional cycles, although minor fluctuations of relative sea-level and associated changes in sedimentation have been recognized throughout (Edmonds et al., 1985). Each cycle commences with a transgressive