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The non-marine Lower Cretaceous Wealden strata of southern England

Jonathan D. Radley [a,*], Percival Allen [b,1]

[a] School of Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK
[b] Postgraduate Research Institute for Sedimentology, The University of Reading, PO Box 227, Whiteknights, Reading RG6 6AB, UK

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ABSTRACT

The non-marine Lower Cretaceous Wealden strata of the Wessex-Weald Basin (southern England) are introduced, with reference to the depositional model developed by Professor Percival Allen FRS (Allen, 1975). To demonstrate this model and the development of Wealden palaeoenvironments through time, Wealden sites have been selected for the Geological Conservation Review programme. Site selection rationale is briefly outlined.

1. Introduction to the Wealden

Following Martin (1828) and other nineteenth century workers, geologists use the term 'Wealden' for non-marine sandstone and mudstone-dominated successions of Lower Cretaceous age, that have been documented through north-west Europe (Allen, 1967a) and further afield. The name derives from the Weald, a picturesque area of south-east England where Wealden rocks outcrop.

In southern England as a whole, Wealden strata are found in both the largely onshore Weald Sub-basin of south-east England, and the northern part of the partly offshore Wessex Sub-basin of southern and south-west England. These depocentres are effectively separated by the Purbeck-Isle of Wight structure (Allen, 1981; Gale, 2000) and collectively make up the Wessex-Weald Basin (Figs. 1 and 2). The Wealden strata of the Weald Sub-basin outcrop in the counties of Kent, Sussex, Surrey and Hampshire; the Wealden type-area (Topley, 1875; Allen, 1975). The Wessex Sub-basin successions are seen on the Isle of Wight and in south Dorset (White, 1921; Arkell, 1947a; Fig. 1). Scattered, poorly exposed patches of Lower Cretaceous strata of Wealden aspect occur along the north-western margin of the Wessex-Weald Basin in the English South Midlands (Arkell, 1947b; Casey and Bristow, 1964; Horton et al., 1995; Fig. 1). In north-eastern England, the coeval Lower Cretaceous strata are wholly marine in origin (Rawson, 1992a,b, 2006).

The Wealden successions preserved within the Weald and Wessex sub-basins (Fig. 2) differ to varying extents in terms of their relative age, styles of facies architecture, and their enclosed fossil assemblages. To a degree, these differences reflect contrasting tectonic contexts and perhaps their differing climatic histories (Allen, 1981, 1998). Taken as a whole, the southern English Wealden ranges in age from upper Berriasian to lower Aptian, equating to approximately 15 million years of Earth history (Allen and Wimbledon, 1991).

Broadly, the Wealden comprises two major facies associations as developed in both southern English sub-basins. These are (a) largely oxidised mudstones, siltstones and fine to coarse-grained sandstones indicating distal meanderplain to proximal braidplain and possible fan settings (arenaceous formations), and (b) relatively fossiliferous mudstone-dominated successions deposited in lakes, channels, coastal lagoons and on mudflats of fluctuating but mainly low salinities (argillaceous formations; Allen, 1981, 1989).

In the Weald Sub-basin, the arenaceous formations that typify the lower part of the Wealden succession (the Berriasian – Valanginian Hastings Beds Group; Allen and Wimbledon, 1991; Callomon and Cope, 1995; Fig. 3) generally coarsen upwards, overall. Typically they have a relatively high content of kaolinite amongst the clay minerals. Fossils tend to be sparse and/or localised in these formations, but include remains of land plants, freshwater molluscs, fish and dinosaurs (Topley, 1875; Allen, 1975, 1998). The argillaceous formations generally have lower kaolinite content and amongst their relatively abundant fossil biotas there are many ostracods, small, fresh to brackish-water molluscs and fish, together with remains of aquatic and land plants, reptiles including dinosaurs (Allen, 1975, 1989, 1998),

* Corresponding author.
E-mail address: j.d.radley@bham.ac.uk (J.D. Radley).
[1] Deceased.

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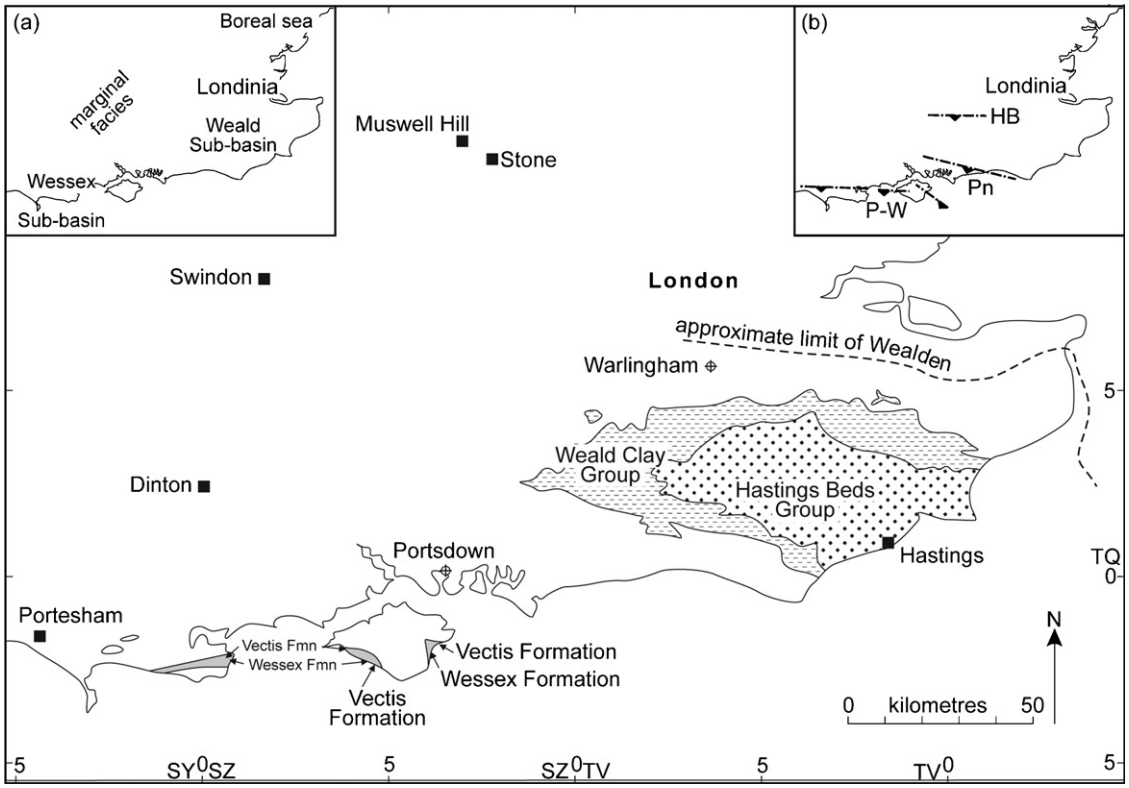
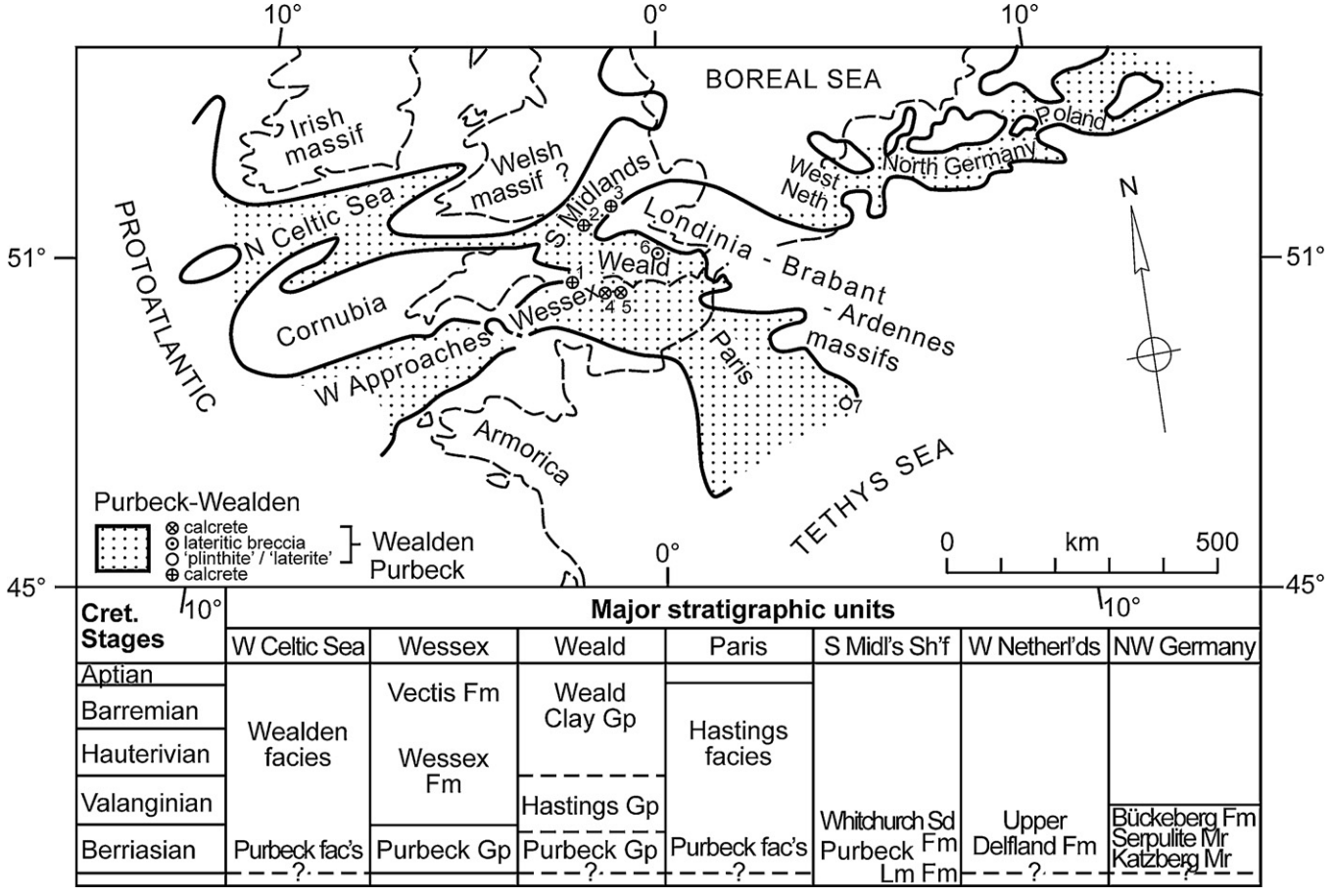


Fig. 1. Outcrop of Wealden (non-marine Lower Cretaceous) strata in the Weald and Wessex sub-basins, southern England. (a) Location of southern English Weald and Wessex sub-basins. (b) Location of significant growth faults. P-W: Purbeck – Wight faults. Pn: Portsdown, Hampshire. HB: Hog's Back structure, Surrey.



Cret. Stages	Major stratigraphic units						
	W Celtic Sea	Wessex	Weald	Paris	S Midl's Sh'f	W Netherl'ds	NW Germany
Aptian	Wealden facies	Vectis Fm / Wessex Fm	Weald Clay Gp	Hastings facies	Whitchurch Sd / Purbeck Fm / Lm Fm	Upper Delfland Fm	Bückeberg Fm / Serpulite Mr / Katzberg Mr
Barremian							
Hauterivian							
Valanginian			Hastings Gp				
Berriasian	Purbeck fac's	Purbeck Gp	Purbeck Gp	Purbeck fac's			

Fig. 2. Non-marine Early Cretaceous basins and source massifs in north-west Europe, and outline of major stratigraphic units. After Allen (1998, fig. 1). 1. Dorset (palaeolatitude c. 34°N), 2. Swindon, Wiltshire, 3. Hartwell, Buckinghamshire, 4. Shepherd's Chine, Isle of Wight, 5. Sandown Bay, Isle of Wight, 6. West Hoathly, West Sussex (palaeolatitude c. 29°N), 7. Mussey, France.