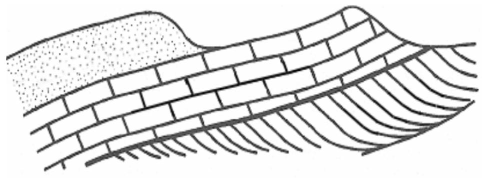
Farnham Geological Society

Farnhamia farnhamensis



www.farnhamgeosoc.org.uk
(***Founded 1970***)

A Local Group within the GA

- OUR LOCAL ROCKS -

Our local rocks, in the NW Weald, are of mid to late Cretaceous age (say 120 to 80 million years). These rocks record a major geological event > a massive global sea level rise, a consequence of plate tectonic processes rather than just climate warming.

Thee was an increase in the Earth's heat flow, during the early Cretaceous. This led to increased development of major oceanic spreading centres. The South Atlantic and Indian Oceans opened and North Africa separated from North America. A massive mantle plume developed in the Pacific. The consequent thermal expansion and uplift of huge mid oceanic ridges (particularly in the Pacific) caused a steady rise in sea level throughout the mid to late Cretaceous, inundating vast areas of the continents.

The CO_2 level in the atmosphere was higher than today; this led to higher temperatures and was partly responsible for the very high sea levels as there were no permanent ice caps, and thermal expansion increased the volume of the water.

HOW DO OUR ROCKS IN THE NW WEALD RECORD THIS EVENT?

The local sequence of sediments is shown in figure 1.

Early Cretaceous palaeo-geography: the London-Brabant Hills to the north separated us from the North Sea. To the west were the Cornubian and Welsh Highlands (figure 2).

Early Cretaceous (Wealden) sediments in SE England were terrestrial - rivers, lakes, swamps - deposited in low lying areas close to sea level. The early Aptian sea level rise planed off the top of the Wealden sediments. Atherfield Clay and Hythe Sand were deposited in a shallow marine embayment. The rising sea encroached and eroded the London-Brabant Hills. During the late Aptian / early Albian these hills were breached via the Leighton Buzzard Trough (an incised river valley) to form a tidal seaway connecting the newly opening Atlantic with the North Sea.

As sea level rise continued, Bargate and Folkestone Sand were deposited in water depths of ~10-15m, which were strongly influenced by tidal currents. Subsequently, Gault Clay was deposited in water depths of ~40-60m), Upper Greensand and Lower Chalk (~100m), and Middle and Upper Chalk (several hundred metres).

As the sea spread there was less land to weather, erode and provide sediment. Consequently, the clastic sediments that were eroded and transported from the nearby land, became finer grained and decreased up-sequence. Ultimately, pure Chalk limestone was deposited in warm clear seas.

TO-DAY, OUR LOCAL ROCKS ARE ABOVE SEA LEVEL – WHY?

Our local rocks were deposited in a gently subsiding Basin – the Weald Basin. The Basin had existed (and subsided) since Triassic times, ~210 million years ago. Subsidence ceased during the Upper Cretaceous. Subsidence was fault controlled, with a major "down-to-the-

south" fault system beneath what is now the Hog's Back (this fault system extends along the north margin of the Weald Basin and is still active).

During the early Palaeocene, uplift of the Weald Basin resulted in substantial erosion and removal of the uppermost Cretaceous sediments. During Miocene times (Miocene was 5-23 my ago), Africa's collision with southern Europe compressed the Weald Basin, reversed the fault system, and resulted in substantial uplift which "domed" the Weald into a large anticline. This basin uplift is referred to as "basin inversion" (figure 3). So far, total uplift has been ~1,600m (~5,250').

To-day, the highest point in the Weald is less than 1,000' (300m); thus, more than 4,000' (1,200m) of sediment has been eroded from the centre of the anticline. This sediment was transported by rivers into the English Channel, and into the North Sea via the Thames river system.

The Wealden anticline has a number of small folds (wrinkles !) and numerous faults and fractures. Generally, the dip of the beds is gentle, except along the line of the Hog's Back where the rocks dip downwards at some 30º to 40º towards the north.

HOW DO OUR LOCAL ROCKS INFLUENCE THE LANDSCAPE?

The clay formations (Atherfield Clay, Gault Clay) weather and erode relatively easily, to form fertile clay vales such as the Vale of Holmesdale.

The sand formations (Hythe, Bargate, Folkestone) include hard beds, less easy to erode, which result in a hilly landscape.

The Hythe sand is soft, with numerous thin beds of very hard silicified sand. A hilly landscape with, predominantly, gentle slopes is typical

Much of the Bargate sand includes eroded limestone particles; some of this limestone was dissolved and then precipitated as a cement binding the sediment together to form a hard rock. The Bargate forms very distinctive features in the landscape. Where the beds are horizontal, a plateau can form, as at Godalming. Where a river cuts through the beds, a very steep slope may be formed, as at the Chantries near Guildford.

The Folkestone sand is very poorly cemented and easy to erode; locally there are well developed ironstones (ferricretes, also know as carstone). The Folkestone forms gentle hills; steep-sided hills form where there is a pronounced development of carstone, as at St Martha's Hill near Guildford and the Devil's Jumps near Churt

The Hythe and, particularly, the Folkestone sand lack nutrients and are characterized by poor quality farm land and heathland. The Bargate beds have a greater variety of minerals and, consequently, are more fertile. In the landscape, Bargate beds stand out as a fertile strip of farmland between the Hythe and Folkestone sands.

The Upper Greensand and Chalk forms the well-known hilly, downland landscape. The Upper Greensand (a chalky quartz silt) forms the gentle, lower slopes of the downlands.

The Chalk has been divided into about 9 separate formations. For this note, we will use the old fashioned sub-divisions of Lower, Middle and Upper.

The Lower Chalk is inter-bedded limestone and marl (clayey limestone), relatively soft, and forms gentle slopes. The Middle Chalk is a very clean hard limestone, picked out in the landscape by relatively steep slopes. The Upper Chalk is a soft limestone, forms more gentle slopes, and can be recognized by its characteristic horizons of very hard flints.

The GEOLOGICAL STRUCTURE has a very important influence. The evolution of the Wealden anticline had a profound effect on the development of the river systems and hence erosion and transport of material.

Professor Richard "Dick" Selley, at Mole Valley Geological Society, has produced a very elegant illustration (figure 4) of the erosion of the Wealden anticline and the effect on the paths of the rivers. As the anticline rose, rivers such as the Mole, Wey and Blackwater, ran down the northern slope towards the Thames river system. When the relatively hard Chalk carapace at the crest of the anticline was breached, soft easily eroded Gault Clay was exposed; E-W river systems evolved, which eventually resulted in river capture, eg of the Blackwater River at Farnham.

A significant effect of the recent glacial cold period is the occurrence of dry valleys in the Chalk. Chalk is porous and permeable; this inhibits the development of permanent streams or rivers. During cold glacial periods, there was permafrost, effectively making the Chalk impervious and impermeable. Rain and meltwater could flow across, and erode, the surface, to form river valleys. Dry valleys were left behind when the permafrost melted. There are particularly well-developed examples either side of the Mole Gap at Dorking.

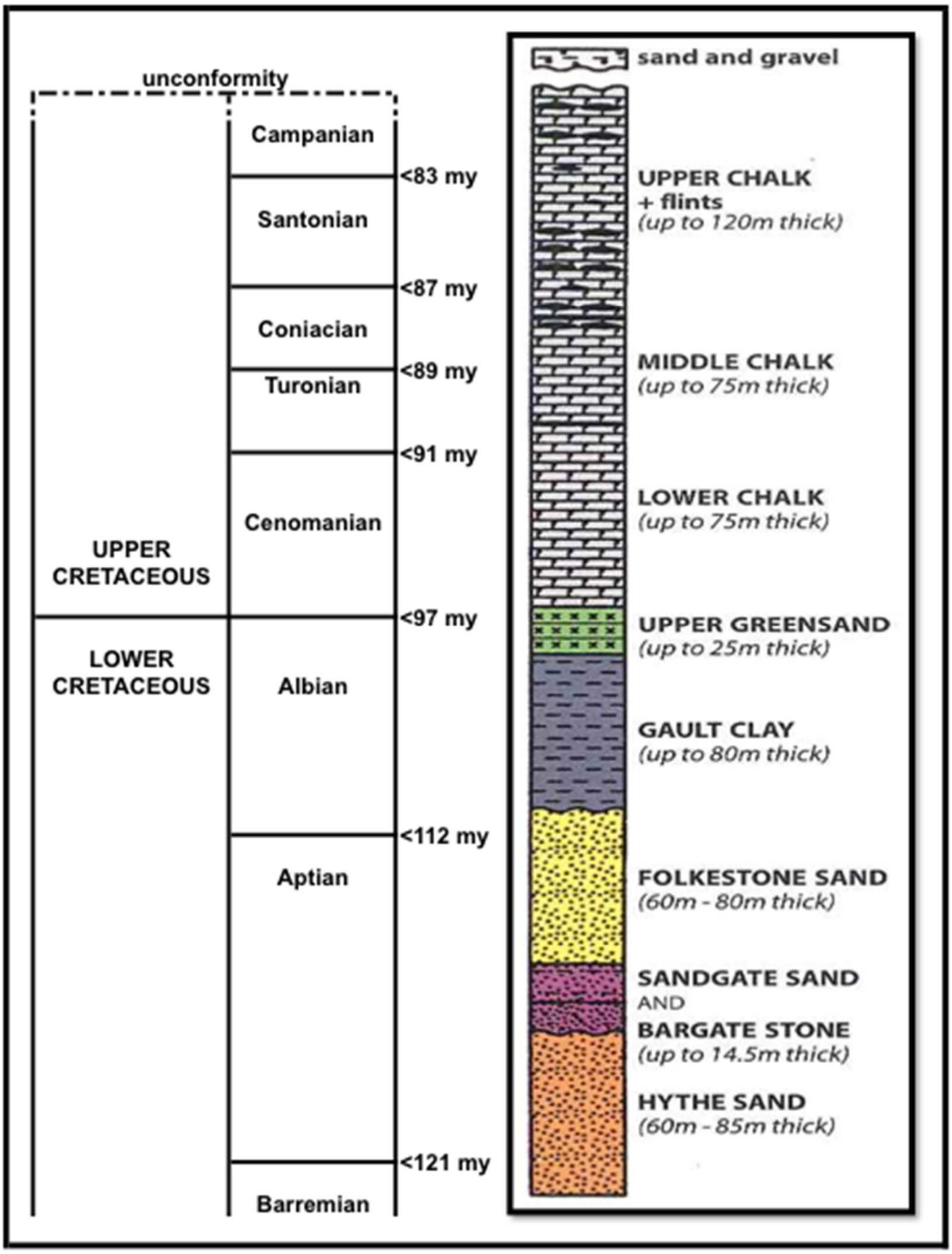


Figure 1. NW WEALD STRATIGRAPHIC COLUMN
(modified from Surrey RIGS' Newlands Corner-Albury Geological Trail)

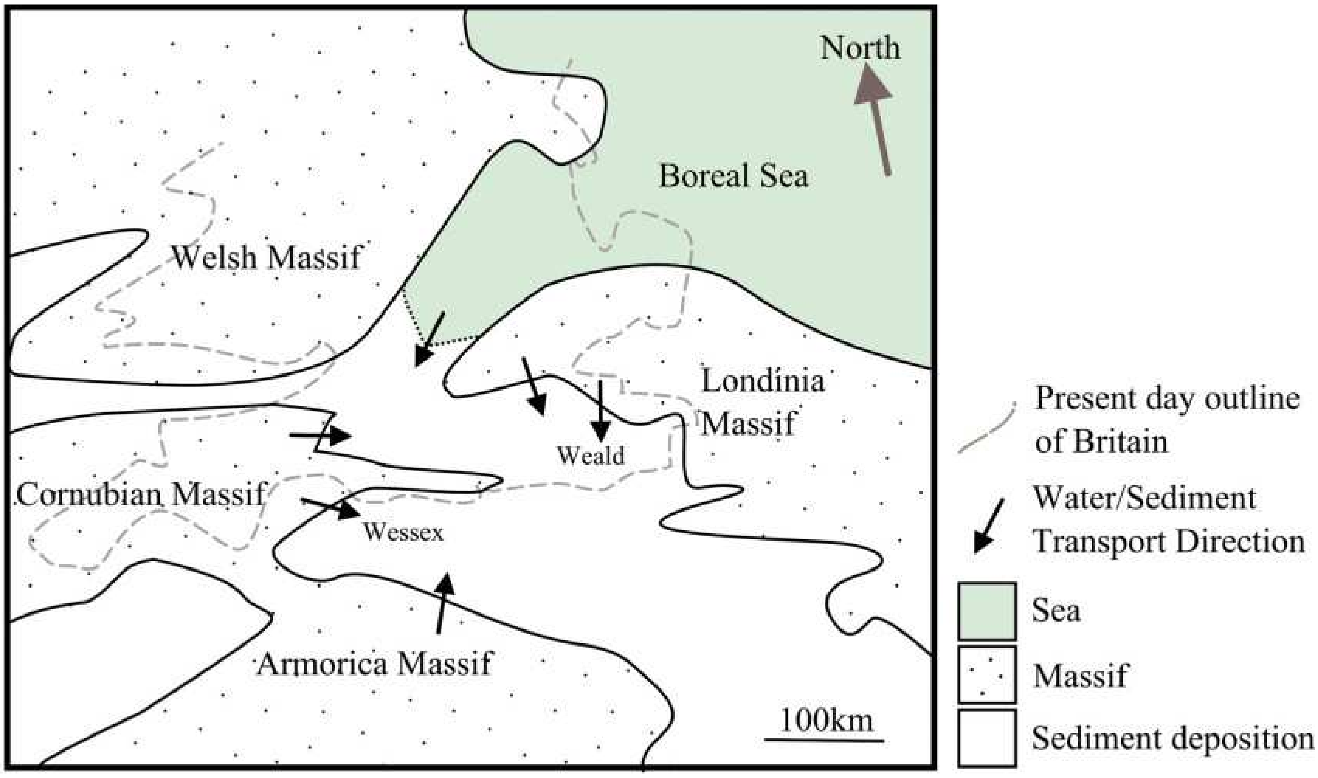


Figure 2. GEOGRAPHY OF SOUTHERN ENGLAND DURING THE LOWER CRETACEOUS

Modified from Allen, 1998.

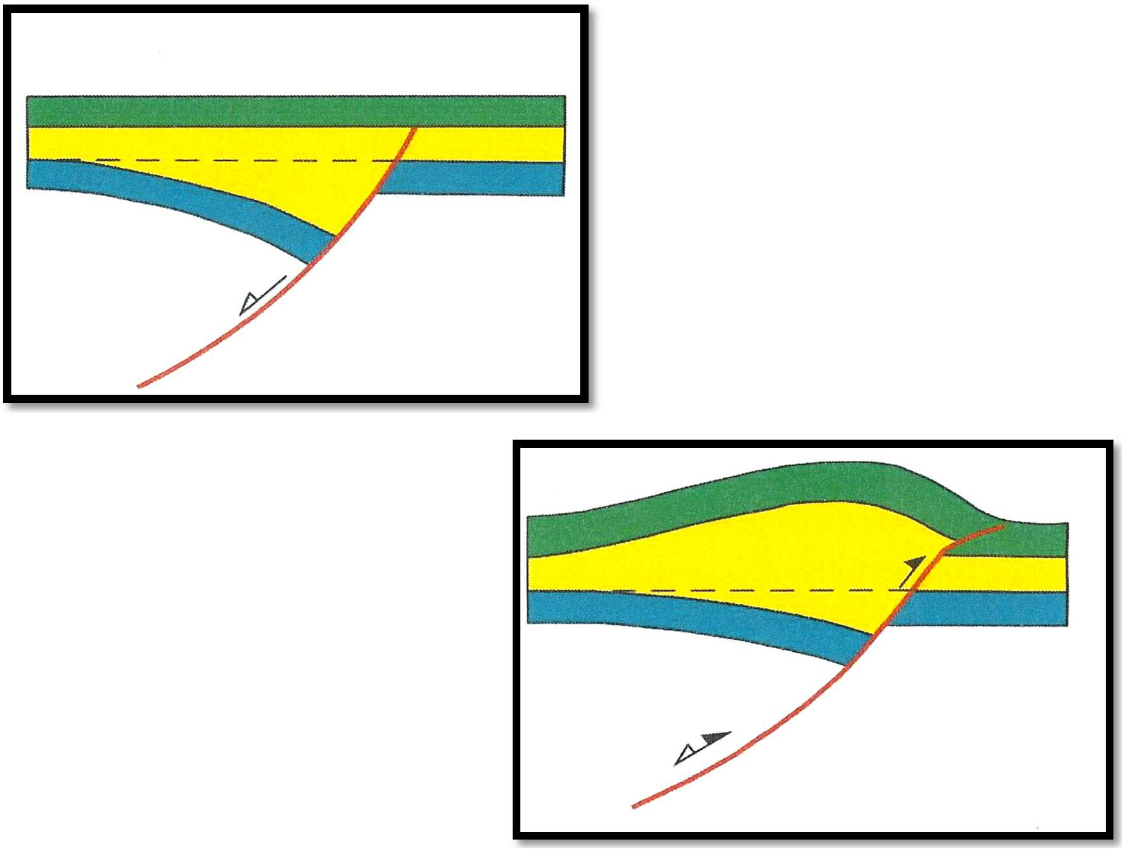


Figure 3. SCHEMATIC – BASIN INVERSION

Left: fault controlled subsidence creates basin; note thicker sediment sequence in basin.
Right: compression, from left, reverses the fault movement leading to elevation of the basin.

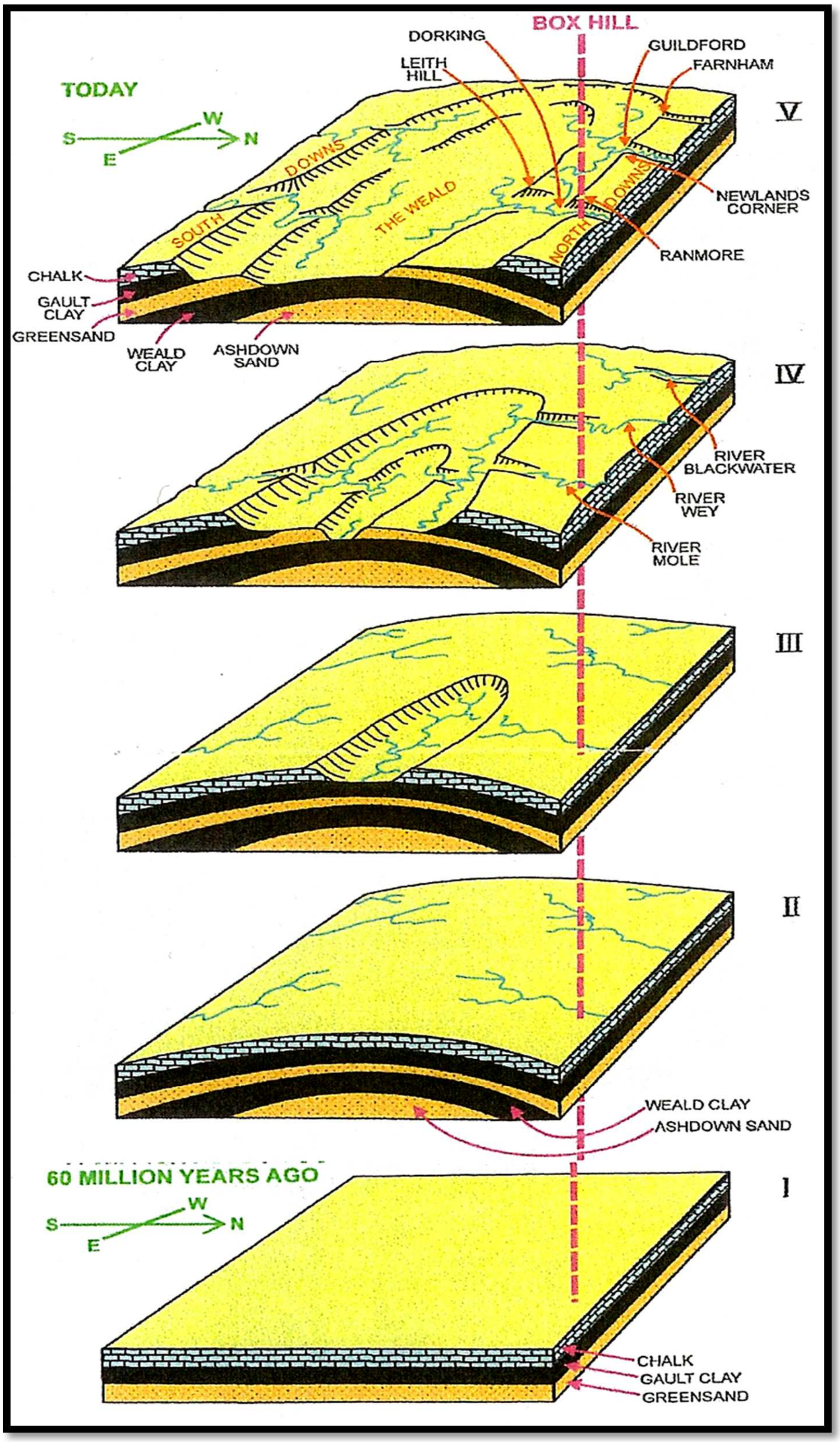


Figure 4. DICK SELLEY'S POLYCHROMATIC GEOPHANTASMOGRAM TO SHOW THE UPLIFT AND EROSION OF THE WEALDEN ANTICLINE.

Note the River Mole draining out between Box Hill and Ranmore Common. The River Wey, to the west of the Mole, eroded westwards along the Holmesdale to capture the headwaters of the Blackwater. This is why Farnham, though a 'gap' town like Guildford and Dorking, lacks its own river. The truncated Blackwater is an insignificant stream rising north of the North Downs.

Image from the Box Hill & Mole Valley Book of Geology by ***Professor Richard ("Dick") C Selley****. 2006. (C) The Friends of Box Hill.*

GMW
May 2018