BROWN'S FOLLY

Victoria Warington-Smyth, Charlotte Sealy and Siobhan Moore

The following is a compilation of work by UVI Geologists at Stonar School, on the palaeoenvironment at Brown's Folly, Monkton Farleigh, following extensive fieldwork.

There are seven different limestones occurring at this site. All are of Middle Jurassic age, about 170 million years old, and must have been deposited during about 10 to 15 million years. The main aim of this piece of work was to gain evidence from detailed studies of the limestones and to draw conclusions about the environments that existed during this time. The succession of rocks at the site can be seen in the accompanying diagram.

Although it is referred to as an oolitic limestone, the Combe Down Oolite was found to contain about 40% broken shell fragments. Sedimentary features included cross-bedding and bioturbated worm-burrows. The clear cross bedding is terminated by almost horizontal bedded layers above it and this must have been caused by erosion of the original series of sediments before the next sediments were laid down. The cross bedding would have been produced in shallow water with strong tidal currents. The ooids and shell fragments indicate a high energy area, again, possibly tidal.

One bed near the upper part of this sequence contains a large number of whole brachiopods indicating that the conditions were stable in the area for a period. The fact that the shells are now rimmed inside with calcite with no sediment inside the shell, indicates that they were shut tight when they were buried and they may well have been buried in their life position by a sudden influx of material. This may have originated from heavy rainfall bought down by streams carrying sediment. When these streams entered the sea, their speed slowed and sediment was deposited, aided by flocculation.

It is quite difficult to gain access to the next group of rocks, the Twinhoe Beds. These contain about 90% ooids but they are hard to see as they have suffered iron replacement. Bands vary in this bed from being very fossiliferous to soft sediment like clay. Algal growths are also found amongst the ooid-like particles. It is probable that these beds were formed in slightly deeper waters than the Combe Down Oolite because rather

Succession by Ron Smith

quieter conditions were needed for the algae and clay bands to settle.

The next rock we studied was the Bath Oolite. Deeper conditions are needed for the ooids found in this bed to form so perfectly. The water was shallow, warm and constantly moving, with high evaporation rates. A chemical change in the sea water must also have taken place. Very little shell fragments are found; instead, superbly formed ooids indicating a very high energy environment where organisms find it hard to become established. The Bath Oolite is homogeneous and quite hard and this makes it a good building stone for the local area.

The Roof Bed, the lowest division of the Upper Rags, is mainly made up of fossils, for example, corals and bivalves, and is clearly different from the Bath oolite. The fossils are mostly in good condition implying a very stable environment; a low energy area allowing organisms to flourish. The fossils covering the surface in places are the shells of oysters, which suggests that the rock must have been consolidated before the next bed was deposited as oysters need a firm surface on which to attach. The surface also showed evidence of having been bored into by organisms, probably bivalves. It is very hard rock and provided a roof for the mining of the oolite below.

The White Oolite on top of the Roof Bed indicates that there was a change back again to the type of environment in which the Bath Oolite was formed, but this rock is more shelly than the Bath oolite. The remains of small vertical burrows show that there were small organisms living in the oolite (probably bivalves) indicating that there was a period of stability during the deposition of the oolite that enabled organisms to be established.

The Brown Shelly Limestone at the top of the Upper Rags is mainly made up of large fragments of shells indicating quiet conditions because the creatures were able to grow to a substantial size and some were even preserved complete. This limestone grades horizontally into a patch reef which again forms in very quiet conditions, often within lagoons. The patch reef would have been the habitat for a variety of marine organisms such as corals, brachiopods and bivalves, all of which can now be found as fossils. The presence of a patch reef is evidence that the area must have been warm, either tropical or subtropical, because corals require these types of temperatures to exist. The water must have been clear for the corals to obtain adequate sunlight. Sunlight cannot penetrate murky waters so the sea must have been clear of clastic muds. Corals need both food and oxygen which is supplied by waves and tides in shallow waters.

The clay and marl at the base of the Forest Marble series contains well preserved fossils and could represent lagoonal mud, with abundant food and oxygen which caused life to be prolific. The lagoonal muds were formed largely by the breakdown of organic material, particularly algae. This deposit formed in oxidising conditions because it is an orange colour. Clay particles, quartz crystals stained with iron, broken shells, faecal pellets, washed-in ooids and other fossils such as bivalves, crinoids and bryozoa were found in a sieved sample. Since many tiny particles were present the waters must have been very still and quiet for them to settle out.

Lastly, we investigated the Forest Marble Limestone. This rock contains bands of shells, some whole, but most fragmented, revealing a fairly high energy environment. Thin clay bands between the limestone bands are common. These bands are due to the deposition of sediments from flowing water. The large scale cross bedding consists of several units with beds sloping in different directions, which has resulted from the deposition of sediment possibly from a tidal area. During this period high energies occurred so the sediments deposited are coarse and have been subjected to sorting and abrasion caused by currents.

Conclusions

The story of the limestones at Brown's Folly reflects sea level change. At first the sea here was shallow with strong tidal currents which swept ooids and shell fragments into the area and formed the Combe Down Oolite sediment. The Twinhoe Beds, Bath Oolite, Roof Bed and Upper Rags White Oolite were all deposited in slightly deeper water than the Combe Down Oolite. The Bath

Oolite were formed under high evaporation rates, in high energy, agitated water but the Roof Bed represents a period of calm more stable conditions when strong currents were not present. The sea was probably slightly deeper here at this time. When the White Oolite was deposited the sea level must have returned to the same level that existed during the deposition of the Bath Oolite because the two sediments formed are very similar and must have derived from similar depositional environments.

However, for the deposition of the Upper Rags brown shelly limestone, the sea level must have dropped again allowing the formation of the patch reef. The clay and marl at the base of the Forest Marble probably represent a lagoonal, low energy environment but conditions changed once again for the deposition of the Forest Marble brown, shelly, hard limestone. We suggest that this bed was formed by the deposition of sediments in a lagoonal area from flowing water that drained into the sea off the land causing the formation of the clay bands within the sediment. The bands of clay in between the limestone represent times when rainfall on land was more significant. This bed was formed under shallow water because it was affected by the influx of fresh water. There were strong, high energy currents capable of breaking up the shells of the many creatures that lived in this warm, shallow water.

It seems therefore that during the 10 million years or so that these limestones were forming, there was a slight marine transgression, giving a deepening of the sea at Brown's Folly, followed by a slight marine regression, with many fluctuations on this overall pattern.

Victoria at Site One, Brown's Folly.
The Roof Bed can be seen clearly above the Bath Oolite.
This is an adit mine, the roof of which has collapsed
(Photograph by Siobhan Moore)