DEVONIAN SLATES, SANDSTONES AND VOLCANICS

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Hangman Grits – 'Old Red' sandstones of Devonian age exposed in sea cliffs along the north Devon coast near Martinhoe

CONTENTS

1. BRIEF DESCRIPTION

Slates, sandstones and volcanics are types of rocks which form large parts of Devon. They date from a geological period which is called the Devonian period and are the oldest rocks found in Devon, formed about 400 million years ago when Devon was under the sea. Slates, sandstones and volcanics are found in south Devon from Torbay to Plymouth, and on Exmoor in north Devon.

Devon is unique as the only British county to give its name to be used and recognised worldwide as a geological time period and system of rocks – and Devonian age rocks are found in many other countries across the world.

Great thicknesses of rock were formed in Devonian times, during a period of continental collision and mountain building. This activity triggered lots of erosion, creating the sand and mud sediments which became deeply buried and turned into rock. Devon was at the centre of great dynamic activity which created the interesting variety of rocks we can find today, including slates, sandstones, limestones, volcanics and schists.

Life was fairly primitive in Devonian times. Fossil records in Devon include fish, corals and other sea life.

(Devonian Limestones and Devonian Schists are described in separate sections)

2. GEOLOGICAL DETAIL

Large parts of Devon are founded upon old rocks, mainly slates, sandstones and limestones of the Devonian system, that have been hardened by pressure from deep burial and tectonic earth movements. They are the oldest rocks in the county, formed between 416–359 million years ago (the time interval known as the Devonian Period), and underlie two large parts of the county, the Exmoor area in north Devon and south Devon between Torbay and Plymouth.

The Devonian rocks take their name from the county, and this is the only county name to be used and recognised worldwide for a geological system. The name was chosen in 1840 by two distinguished geologists: Revd Adam Sedgwick of Cambridge University and Sir Roderick Murchison, later to become the Director of the Geological Survey, who realised that the rock strata seen in the Exmoor area and across south Devon were older than the coal-bearing Carboniferous rocks of South Wales and the Midlands, but about the same age as the underlying Old Red Sandstone that was widespread in those areas.

For more than 100 million years there was a vast process of mountain building over South West England – during the *Devonian* and *Carboniferous* periods (about 400 to 300 million years ago) and into the early *Permian* period. Caused by the collision of moving plates of the Earth's crust – known as *'plate tectonic*s' or *'continental drift'* – deep troughs (or basins) formed below the narrowing sea and received vast volumes of sediments from the erosion of the nearby continents – from land to the north (Wales and North America) and to the south. The sand and mud sediments became deeply buried and turned into rocks, which were then folded and contorted and thrust up into mountains by the dynamic collision of the continental plates. This continued for over 100 million years, during which many kilometres thickness of rocks were formed (slates, mudstones, sandstones, etc). Great reefs of limestones formed along shallow sea ridges and there were also large volcanoes producing volcanic rocks (basalts, tuffs) and sills of dolerite. Later, molten granitic magmas were created deep beneath the mountains to form the granites of Dartmoor and Cornwall. This long period of earth movements and mountain building is known as the 'Variscan Orogeny'. It created a range of mountains across modern South West England (similar to the modern Alps, Atlas and Rockies), extending from eastern Europe to North America.

Exmoor has high ground and steep coastal cliffs largely because of the very hard sandstone layers in the sequence, formed as delta deposits at the mouths of rivers flowing down from the Welsh mountains. Between these layers lie slates and other deposits, including limestone. Slates are common in south Devon, together with reefal limestone masses and some volcanic rocks.

An interesting feature of the Devonian sandstones of deltaic and lagoonal origin is the fish fossils they contain; most had armoured heads as protection against predators. Some of these were primitive and jawless but others had well-functioning jaws. The evolution of the jaw was a most significant and valuable development to vertebrates, and it took place in Devonian times.

A gap in the Devonian outcrop between north and south Devon, of at least 35km, exists because of the overlying Carboniferous (Culm) outcrop, where a deep trough of these younger rocks hides the Devonian. So there is some uncertainty about the nature of the submerged rock strata, and correlation of northern with southern strata is also incomplete.

In north Devon, the sandstones in the Exmoor area are similar to the Old Red Sandstone in Wales, having been deposited in deltas of rivers draining from the Welsh mountain ranges. These flowed across the area where the Bristol Channel now lies, and emptied into a sea that covered most of Devon, part of the much-larger Rheic ocean (now lost due to plate movements). The rivers dropped their sediment load at the coast so that deltas built out southward – creating the thick sandstone deposits of Exmoor, now hardened by time and uplifted by earth movements to form the upland areas. They commonly have a reddish-brown colour caused by tropical weathering in the climate where they were formed. These are the Hangman Grits, the Pickwell Down Sandstone and the Baggy Sandstone, rock units that were named after the prominent coastal features they create. Being of deltaic origin, these rock formations contain no marine fossils, but fresh-water fish have been found at several levels. The Ilfracombe Slate Group, containing several formations including sandstone and limestone beds, overlies the Hangman Grits, and is in turn overlain by the greenish-grey Morte Slates. With a few interbedded sandstones, these are resistant enough to form the headland of Morte Point. The Pickwell Down Sandstone is another deltaic deposit, and underlies the moorland of its name south of Morte Bay, creating the prominent Baggy Point, which also includes the Upcott Slate and the Baggy Sandstone. The outcrops of these formations extend eastward along the Exmoor upland, disappearing beneath Permian rock strata in Somerset, but reappear in the Quantock Hills where a large fault lifts them up to surface again.

In south Devon, slates are widespread, formed by earth pressures on marine mud deposits, and great thicknesses are present in some areas. The oldest rocks in this area are the distinctive red, green and purple Dartmouth Slate, which forms a wide band of Lower Devonian rocks across the South Hams from Dartmouth to Plymouth. Within the slate are a few beds of sandstone and conglomerate that are similar to the Old Red Sandstone, so at that stage deltas from the north may have extended this far south. Above the slates, the Meadfoot Slate and Staddon Grit are prominent, the latter forming hills because of its hard sandstone beds. Higher still are the Norden Slate and Gurrington Slate, the former having important limestone deposits with abundant reef-type fossils, mainly corals and algae, in the Torquay and Plymouth areas. Britain had a tropical climate during the Devonian, as it then lay south of the equator.

Devonian rocks also form the hard schistose rocks of the Start–Bolt coastal ridge on the south coast, which are dealt with separately. Devonian limestones are also dealt with separately.

3. USES

The predominant use of Devonian rocks is quarrying for limestone and other rocks for aggregate use, and limestone was formerly used for cement production. Limestone has been extensively used as building stone in areas near outcrops, and likewise the sandstones of the Staddon Grit and those of the Exmoor area. In earlier times the distance of transport was a significant cost factor, so local deposits were usually preferred. Igneous volcanic rocks occur among the Devonian slates, especially basalt, and these are also utilised as roadstone.

Devonian sandstones and slates in the past have been extensively used for local building stones with characteristic red or grey sandstones present in many villages.

Gritstone quarries were important local sources of aggregate and roadstone. Quarries in important dolerite outcrops were worked in south Devon.

In south Devon around Kingsbridge, there were important quarries for roofing-slates which were exported to other parts of Devon.

Silver and lead mining was a flourishing local industry in the Combe Martin district in the latter half of the nineteenth century.

4. PLACES TO VISIT

Please refer to the safety guidance about visiting geological sites on our website before visiting the places listed below.

Lynmouth [NGR SS 728 496 – 735 495]

The shoreline section east of Lynmouth shows strongly cleaved slates of Lynton Slates which, at the eastern end, are faulted against the Hangman Grits.

Combe Martin [NGR SS 578 473]

The shoreline east of Combe Martin shows Ilfracombe Slates including prominent sandstones and shelly limestones. Along the shoreline west of the beach, the Combe Martin Beach Limestone is seen within the Combe Martin Slates.

Croyde [NGR SS 430 397]

The rocky foreshore westward from Croyde Bay exposes Lower Pilton Shales with fossil brachiopods, and a thin band of volcanic ash is visible (at SS 433 396).

Hope Cove, Outer Hope [NGR SX 675 402]

Meadfoot Slates outcrop on the northern side of the cove with numerous quartz veins. On the south side of the beach bands of grey mica schist are present marking the northern boundary fault of the Start Point Complex.

Meadfoot Bay, Torquay [NGR SX 936 633]

Meadfoot Slates are exposed east of the beach with numerous sedimentary structures, and fossils (brachiopods, bivalves and corals) occur in thin calcareous sandstones.

5. PHOTOGRAPHS

North dipping interbedded sandstones and shaly mudstones of the Pilton Shale Formation at Bray Valley, north Devon © DJC Laming

Ripple marks on slabby sandstone bedding indicating intertidal sedimentation conditions, at Bray Valley, north Devon. © C Nicholas

Dartmouth Slates in sea cliffs at Blackpool Sands, near Dartmouth, south Devon. © DP Roche

Folded strata and caves in the Hangman Grits at Trentishoe on north Devon coast. © DJC Laming

Purple and green - characteristic colours of the Dartmouth Slates. © DP Roche

Devonian slates steeply dipping into the estuary at Newton Ferrers, south Devon. © PC Stephenson