
Yellow Sands Formation

The Yellow Sands Formation (Yellow Sands or Basal Permian Sands and Basal Breccia) is part of the Permian succession. There is no independent evidence for the age of the Yellow Sands Formation, but it is generally considered to be late Early Permian (approximately 270 million years old).

The Yellow Sands Formation in Great Britain

The Yellow Sands Formation covers about two-thirds of the Carboniferous-Permian unconformity in Northern England. It is a sequence of rocks restricted onshore to Northern England in Durham, Tyne and Wear, Cleveland and northernmost North Yorkshire, South and West Yorkshire. It also extends beneath the North Sea.

The Yellow Sands indicate that in early Permian times deposits were laid down in continental conditions in a hot, arid desert environment. Deserts today provide excellent analogues for understanding the ancient desert sedimentary systems of the British Permian. Examination of the ancient sand dunes enables factors such as the direction of sand transportation by winds of the time to be understood.

The Yellow Sands Formation in County Durham

The Yellow Sands Formation consists mainly of weakly cemented, yellow fine- to medium- grained, well-sorted sands or sandstone of wind blown origin. Beautifully rounded and frosted "millet seed" grains are abundant in most samples of the Yellow Sands. At outcrop the sands are typically bright yellow, due to a thin coating of limonite on many of the grains, although patches of white or light grey sand can also be seen in large sections. At depth, below the zone of oxidation, the sands are blue-grey and pyritic. The sands are normally incoherent and lack any cementing material other than limonite, but some beds, the so-called 'sand rock', contain a high proportion of carbonate. The uppermost part of the Yellow Sands, lying immediately below the Marl Slate Formation, are also characteristically cemented in this way. The name Yellow Sands was first given by Hutton in 1831 following pioneering work by Sedgwick. The western and southern edges of the Permian desert in which the sands were being deposited were fringed by rocky uplands. Breccias derived, from these uplands, and deposited at the same time as the Yellow Sands are present in the south of the county east of Bishop Auckland. The breccias are highly variable in composition and range from rocks containing small angular fragments of Carboniferous mudstone, sandstone or limestone to breccio-conglomerates. The Lower Permian breccias are patchily distributed in the south of Durham.

The Permian Yellow Sands crop out intermittently along the base of the Magnesian Limestone escarpment and dip to the east beneath the limestone. At outcrop the formation is clearly discontinuous and forms ridges of various heights. When they were deposited, the sands formed hills on the land surface and the crests of such hills have been visible in a number of exposures within the county. The ridges, which probably represent accumulations of sand dunes, are typically between one to two kilometres wide with sand thicknesses of up to almost 70 metres and are separated by belts where the sands are thin or absent. The absence of suitable sub-surface information for much of the county makes it impossible to predict accurately where they occur, although it is generally accepted that they occur in west-south- west to east-north-east trending ridges which continue beneath the limestone for some distance. The exact nature of the dunes has been the subject of much discussion and is still a topic of research.

The unconformity between Permian and Carboniferous rocks, at the base of the formation, has only been exposed at a few localities within the county, mainly in the Bishop Auckland area.

Influence on the landscape

Owing to its very limited outcrop, the Yellow Sands Formation generally has little effect on the landscape, though the sands are locally exposed in several working and abandoned quarries.

Influence on biodiversity

Surface exposure of the Yellow Sands is so restricted that they do not generally have any significant influence on biodiversity, though in both active and abandoned quarries they locally support a flora of sand-loving species.

Economic use

The Yellow Sands comprise a resource of fine aggregate and, because of their regular grain size, are mainly worked as a source of building sand, with some also being used as asphaltting sand. Resources at outcrop are limited and the sands area now worked mainly in association with the overlying Magnesian Limestone both at the escarpment edge (e.g. Crime Rigg Quarry) and where they have been exposed in the floor of quarries, (e.g. Thrislington and Raisby). Among the more unusual uses for the sands is as a surface for greyhound tracks.

Future commercial interest

Continued working of economically recoverable sand must be expected.

Environmental considerations

The highly porous nature of the Yellow Sands means that, where they are sufficiently thick, they provide a major aquifer and are important sources of groundwater. They have been tapped by many wells and boreholes. One cubic metre of Yellow Sands can hold 95 to 200 litres of water. It is also an important factor in considerations of landfilling of abandoned quarries where the formation is exposed or present beneath the base of the quarry. The large quantities of water within the Yellow Sands initially posed a major obstacle in the sinking of shafts through Permian rocks to reach the Coal Measures. Solutions to the problem, including large-scale pumping or freezing of the ground, were costly and time consuming. Coal working beneath the Magnesian Limestone and Yellow Sands needed to ensure the preservation of a minimum thickness of rock between the planned working and the waterlogged deposits. Exploration boreholes had to be sunk with care to avoid large quantities of water flowing into the working places. Many collieries had their effective working lives terminated by the cost of either pumping water from the workings or the need to leave large areas of potential reserves untouched to avoid the risk of flooding.

Wider significance

The well-preserved sand dunes, and their internal structures, give important evidence of Permian desert environments. The Yellow Sands are an important reservoir for oil and gas beneath the North Sea. Studies of the ancient sand dunes onshore within the county has enabled geologists to understand and predict the likely properties of the rocks as hydrocarbon reservoirs.

Selected references

Hirst and Dunham, 1963; Hutton, 1831; Magraw, 1963; Pattison, 1986; Sedgwick, 1829; Smith, 1970, 1971, 1981, 1994, 1995; Smith and Francis, 1967; Smith et al. 1974; Smith et al. 1986.

Photographs

(Photo 23) Hepplewhites Quarry, Quarrington. Yellow Sands overlain in turn by Marl Slate (grey) and Raisby Formation. DJD Lawrence, BGS, ©NERC, 2004.

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(Photo 23) Hepplewhites Quarry, Quarrington. Yellow Sands overlain in turn by Marl Slate (grey) and Raisby Formation. DJD Lawrence, BGS, ©NERC, 2004.