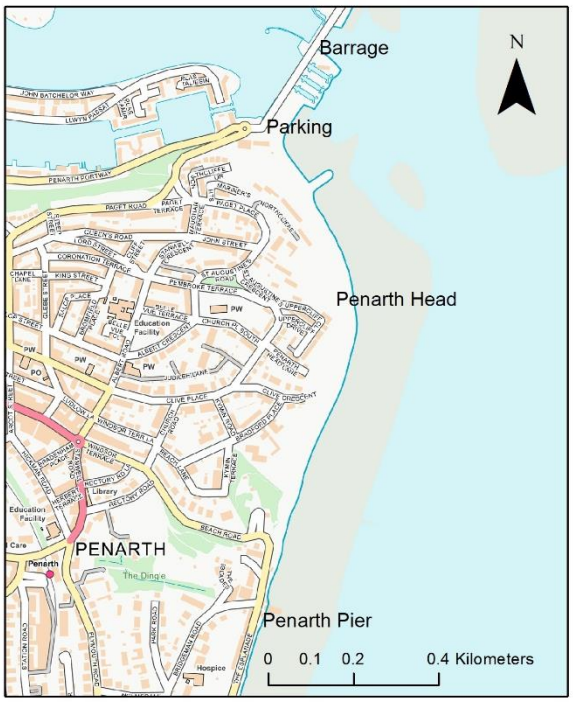
Geology of Penarth Head

The headland at Penarth is a great place to examine rocks deposited at an interesting time in Wales geological past when an ancient desert was inundated by the sea. The area is known for its gypsum deposits which have been used as an ornamental building stone and is also a good place for fossil hunting.

Location and access: The site is the headland at Penarth which can be reached by walking along the beach north from Penarth town or on the path along the coast from south from Cardiff Bay. The National Grid reference for the site is ST 19178 72003.

When to go: At low tide so that you can keep away from the base of the cliffs. Fossils are mostly found amongst the lose rocks of the beach which are covered at high tide.

Caution: The rocky can be slippery when wet or seaweed covered. Some of the boulders on the beach are loose and unstable. Be careful when you walk on the beach and stay away from the base of the cliffs and from the edges of the cliffs as they are loose and overhanging in places and fall from time to time. You need to check the tide tables as on spring high tides you can get cut off.



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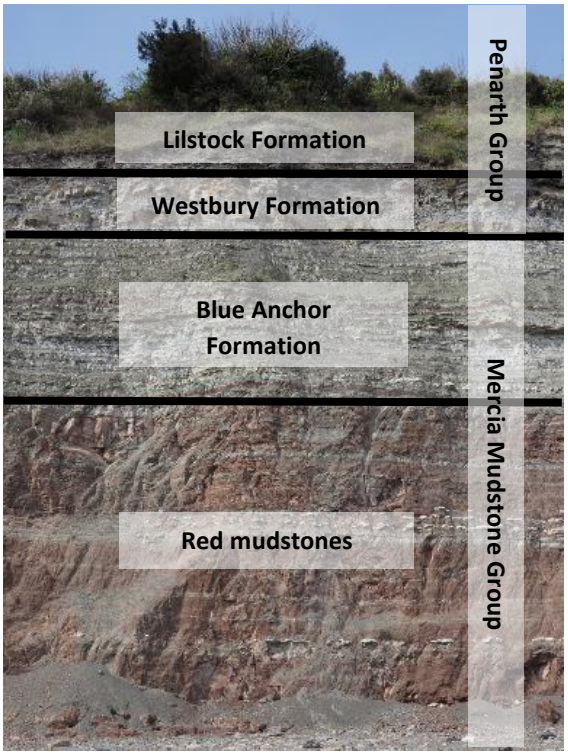
For the most part, the cliffs at Penarth Head comprise beds of striking red and green dolomitic/calcareous mudstone with bright bands of white and pink gypsum, deposited during the upper part of the Triassic Period (225- 200 million years ago), when this part of Wales was an arid desert with an eroded hilly landscape on the northern margin of an ancient sea. These rocks, which make up the ***Mercia Mudstone Group,*** and their sediments mostly accumulated in lakes which periodically evaporated under the hot desert sun. Gypsum, the hydrated form of calcium sulphate, was precipitated as a sediment when the shallow lagoons, which contained calcium sulphate, partially evaporated in the hot climates.



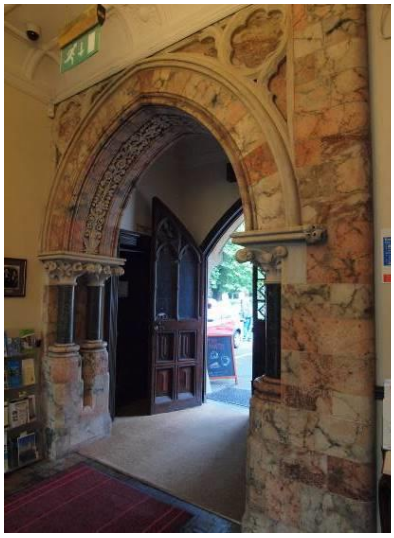
Geological Formations at Penarth Head

Towards the top of the cliff, the grey coloured rocks record a gradual change from a terrestrial lacustrine (lake) environment to marine conditions. These rocks are known as the ***Penarth Group*** which comprise beds of mudstone and limestone. Of especial interest amongst the formations which make up the ***Penarth Group*** is the ***Westbury Formation*** which contains a 'bone bed' in which fragments of fish bone and tiny black shiny teeth and be found (there are three bone beds but the basal one is the one with the most bone, the others being mainly all fish). Look out for these amongst the pebbles on the beach as well as slabs of fossilised ripples from the ***Lilstock Formation.*** On the beach, most of the pebbles are formed of Lower Jurassic aged limestones and mudstones which are best seen further south of Penarth Head where the ***Lias Group*** makes up more of the cliffs. These are the dominant pebbles because they are much harder than the Triassic material, which is easily eroded away. Within these pebbles are many fossils. Two very distinctive ones found here and along the coast of the Vale of Glamorgan are *Gryphaea* and *Plagiostoma* but there are many others to find such as: burrows, ammonites like *Schlotheimia* and *Psiloceras*, other bivalves such as *Modiolus*, *Liostrea*, *Cardinia* and *Chlamys*. You may even be lucky enough to find ichthyosaur teeth and vertebrae or fish coprolites!

Plagiostoma (left) and Gryphaea (right) from the Lias Group.

The gypsum layers seen at Penarth Head and the surrounding area are also known as Penarth Alabaster and this has been worked at least as far back as the 17th Century. Examples of its use as an ornamental building stone can be found across south Wales and beyond. Examples include the main staircase in Cardiff University's Main Building, a doorway inside the clock tower and the spectacular smoking room at Cardiff Castle (remodelled by William Burgess and the 3rd Marques of Bute). At Insole Court in Llandaff, Cardiff, it is put to use in number of ways including a stone balustrade, window arches, columns and fireplaces. Another interesting example is at St. Margarets Church in Roath, Cardiff, where it is extensively (and probably also expensively!) used in the walls of the nave, chancel, sedilia and pulpit. This church contains the mausoleum of the Bute family.

A selection of gypsum fragments from the beach with slabs of fossils ripples from the Lilstock Formation.



The entrance hall at Insole Court

Part of the pulpit at St. Margarets Chruch, Roath

The staircase in Main Building of Cardiff University

Examples of the Penarth Alabaster in buildings in Cardiff

This is an extensional (pull apart) fault at Penarth Head, possibly caused by extensional tectonics associated with opening of the Atlantic Ocean.

Further Reading:

•Be a Geological Detective. Cindy Howells. South Wales Geologists Association. www.swga.org.uk

•M Statham. 2017. Penarth Alabaster. Welsh Stone Forum

•Waters, R.A., Lawrence, D.J.D. 1987. Geology of the south Wales coalfield, Part III, the country around Cardiff. 3rd Edition. Mem, Br. Geol. Surv, Sheet 263 (England and Wales).

•iGeology is a free smartphone app to view geological maps of Britain wherever you go https://www.bgs.ac.uk/technologies/apps/igeology-app/

Text and photos by R.S. and A.J. Kendall. 2021

We hope you enjoyed this short tour of Penarth Head. If you'd like to learn more about our local geology, take a look at the South Wales Geologists' Association website: www.swga.org.uk