

Shales (B) and Porthkerry Formation (C) can easily be recognised. At the Point the bedding planes of the limestones contain large groups of the oyster *Liostrea*. Walking westwards, and therefore onto younger beds, the flattened, coiled shells of the ammonite *Psiloceras* are quite common.

**Locality 12.** Roughly halfway across the bay a small fault cuts obliquely across the foreshore, disrupting the outcrop of the beds. This occurs near the centre of the **syncline**, and downthrows the rocks about 3.5 metres to the southwest.

**Locality 13.** Nearing the western end of the bay the bedding planes are rich in fossils, including ammonites, bivalves and fragments of stems of crinoids ('sea lilies'), and are cut by a series of cross-cutting cracks (joints). The surfaces of many bedding planes have been weathered into strange shapes by the sea. From this point to the slipway at St. Mary's Well Bay the strata descend once more to the Westbury Formation.

**Locality 14.** To the right of the slipway the junction between the **Lilstock and Westbury formations** are visible, and ripple-marked sandstones are present within the former.

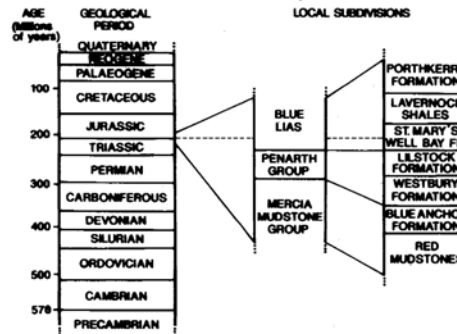
*Leave the beach by the slipway and turn right at the top in front of the Caravan Park, and proceed towards Lavernock Point via the cliff path. Keeping to the cliff path cross the stile by the holiday camp (A) and then obliquely across the field to the road (B). Turn right to Lavernock Point.*

*Pass the church and cross the stile at the end of the road. Turn left behind the farm buildings onto the cliff path (C) which leads back to Cliff Parade.*

Prepared by S.R. Howe

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#### OUTLINE OF THE GEOLOGY

The rocks exposed along this stretch of coast were deposited during the end of the **Triassic** and at the beginning of the **Jurassic** periods (220-195 million years ago). This part of South Wales was then a low-lying desert which gradually was inundated by a sea that covered what is now continental Europe and spread northwards.

The cliffs are made up of layers (**beds**) of **sedimentary rocks**. These were originally soft muds, silts, sand and lime that over long periods of time became solidified into rock.

The oldest rocks exposed are the **red mudstones** of the **Mercia Mudstone Group** which are predominantly mudstones, with intermittent bands and nodules of white and pink **gypsum** (a mineral salt deposited through evaporation of water). These rocks were deposited in a temporary lake on the edge of the desert. They are of late Triassic age.

Overlying the red mudstones is a series of green and yellow mudstones, siltstones and limestones that make up the **Blue Anchor Formation**. They were deposited in fairly shallow water, at first brackish and later marine, as the sea gradually invaded the area.

Above the Blue Anchor Formation are the black shales and thin limestones of the **Westbury Formation** and the light grey mudstones and limy sandstones of the **Lilstock Formation**. Together these form the **Penarth Group**, which was deposited in a shallow sea. The Westbury Formation contains many fossil bivalve shells. At the base of the Lilstock Formation occur some beds of sandstone with prominent, ripple-marked surfaces, indicating that they were laid down in shallow, wave-affected water.

The youngest rocks are the blue-grey limestones, mudstones and shales of the fully marine **Blue Lias** which are divisible into three formations. At the bottom is the **St. Mary's Well Bay Formation**, with roughly equal amounts of limestone and shale; in the middle the **Lavernock Shales** with more shale than limestone, and uppermost the **Porthkerry Formation** with more limestone than shale. These rocks contain large numbers of fossils. The lowest beds of the Blue Lias are still of Triassic age and contain abundant fossil oysters such as *Liostrea*. Higher beds are rich in **ammonites** (extinct coiled-shelled relatives of the squids and octopus) - and it is the incoming of these fossils that indicates the beginning of the Jurassic Period.

Since these rocks were deposited they have been deformed by movements within the Earth's crust into a series of gentle upfolds (**anticlines**) and downfolds (**synclines**). In places the rocks have broken apart along fractures (**faults**).

## GEOLOGICAL WALKS IN WALES

### PENARTH, LAVERNOCK AND ST. MARY'S WELL BAY



#### LOCATION

This coastal section is 12km to the south of Cardiff and 12km east of Barry, South Glamorgan.

#### MAPS

O.S. 1:50,000 Landranger Sheet 171 (Cardiff, Newport and surrounding area) O.S. 1:25,000 Pathfinder Sheet ST 06/16 (Barry) British Geological Survey 1:50,000 Sheet 263 (Cardiff)

#### ACCESS

From Penarth (ST 185 704), Lavernock Point (ST 186 681) and St. Mary's Well Bay (ST 176 674)

#### WALKING DISTANCE

Penarth to Lavernock Point and return, approximately 6km. Lavernock Point to St. Mary's Well Bay and return, approximately 3km.

#### PARKING

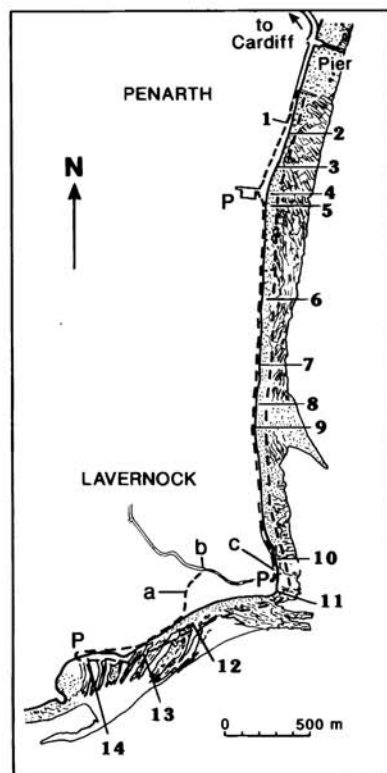
There is a large car park at Cliff Parade, Penarth and limited roadside parking alongside the church at Lavernock Point. At St. Mary's Well Bay, car parking is available during the summer period and limited roadside parking during the winter (October-April only).

#### WARNING

It is vital to check the tide tables before setting out, because **you can be cut off by rising tides** especially in the section from Lavernock Point to St. Mary's Well Bay. Walking along the foreshore can be rough and slippery, and the cliff-top path muddy in places. If you wish to collect specimens, do so from exposures or from boulders on the beach, and **do not** hammer or stand too close to the cliff faces, where there is always a danger from falling rocks. Remember to follow the Geological Code of Conduct.

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#### ITINERARY

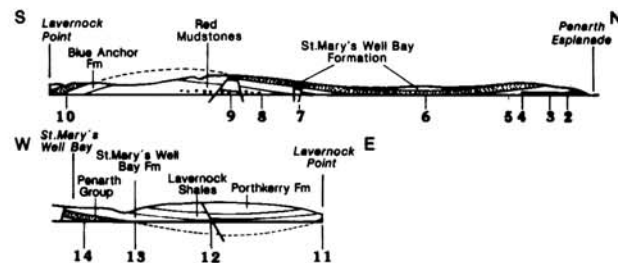
Leave Cliff Parade car park, Penarth by the cliff path and descend Cliff Hill to the Esplanade.

**Locality 1.** The wall along the outside of the road is composed of **Blue Lias** limestones capped with slabs of **Radyr Stone**. This capping stone is a **breccia** - a rock composed of coarse, angular fragments of broken rock. It is Triassic in age and comes from quarries in north Cardiff.

At the Esplanade turn right onto the beach and proceed along the foreshore towards Lavernock Point.

Between here and the Point the rocks are folded into a gentle **syncline** and **anticline** which repeat the geological sequence along the coast.

**Locality 2.** Above the old sea wall (made of **Blue Lias** limestones) the top two metres of the **red mudstones** are exposed beneath the **Blue Anchor Formation**. These are tilted (**dipping**) gently southwards towards Lavernock Point.



**Locality 3.** Above the new concrete sea wall numerous fresh scree have formed from the aerial weathering of the **Blue Anchor Formation**. Near the middle of this formation there are three distinctive bands of red mudstones, collectively known as the '**Pink Band**'.

**Locality 4.** At the end of the sea wall rocks of the **Penarth Group** are visible in the cliff face. The difference in colour between the lighter **Westbury Formation** and darker **Lilstock Formation** is very clear.

**Locality 5.** 50 metres beyond the end of the sea wall is a level where water seeps prominently out of the cliff face. The water is rich in lime, which has been deposited on the cliff face as creamy brown **tufa**. The lowest beds of the **Blue Lias** are now visible in the cliff top, and slabs of these limestones covered with *Liostrea* litter the beach.



Locality 6

**Locality 6.** The cliffs in this area display the Westbury (A), Lilstock (B) and St. Mary's Well Bay (C) formations. Numerous fallen blocks of the black **Westbury Formation** litter the beach. These are quite fossiliferous. The bivalve *Chlamys valoniensis* is common. Slabs of

ripple-marked sandstone from the base of the **Lilstock Formation** are also widespread on the beach. This point is at the centre of the **syncline**, and between here and locality 10 the dip of the beds is gently northwards.

**Locality 7.** Two faults confine a downthrown block (**graben**) between them. By tracing the prominent '**Pink Band**' across these faults it can be seen that the block has been displaced by about 6 metres. The **red mudstones** appear again at the base of the cliff.

**Locality 8.** Three prominent nodular bands of white **gypsum** occur within the **red mudstones**, blocks of which can be collected readily from the foreshore.

**Locality 9.** A set of faults has left an upthrown block (**horst**) between them. Tracing beds across the fault shows that the amount of movement has been about 4.5 metres. This location is near the crest of the **anticline**. The strata can be seen to dip south once again as the next locality is approached.

**Locality 10.** Nearing Lavernock Point the **Blue Anchor Formation** forms a prominent cliff beyond which are some new sea defences made from massive blocks of hard, grey **Carboniferous Limestone** brought in from outside the area. Between here and the Point (**Locality 11**) the **Westbury Formation** is well exposed in the cliff and foreshore. It contains a thin, irregular layer of sandstone rich in the mineral **iron pyrites** ('fool's gold') and pieces of bone and teeth of fish and reptiles. This is called a **bone bed**. Slabs of this can usually be found on the beach.



Localities 12 - 14

Westwards from Lavernock Point the **Blue Lias** is exposed, and in the cliffs of St. Mary's Well Bay is folded in a gentle **syncline**; its three divisions (St. Mary's Well Bay Formation (A), Lavernock