
AN OPHIOLITE SUITE ON THE LIZARD, CORNWALL

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The geology of the Lizard is complex and, in part, still open to debate (*fig 1*). There is, however, a general opinion that certain of the rocks preserve a record of events at a former constructive plate margin. Such a sequence is known as a Ophiolite Suite.

During a collision between tectonic plates, the constructive plate margin on the subducting plate will arrive at the subduction zone. When this happens, the part comprising the upper mantle usually subducts and is re-absorbed whilst the crustal material, including volcanic output, is accreted at or near the surface to form island arcs, prisms or actual continents. Sometimes, however, circumstances result in part of the upper mantle remaining at or near the surface. In the case of the Lizard, low-angle thrust faults have brought this about and subsequent planing off of the beds has exposed a series of rocks that commences at the now depleted and altered peridotite of the former upper mantle and continues to the much altered sedimentary rocks of the former seabed that were originally derived from a continental shelf.

Fig 2 illustrates a simplified sequence of events at the former constructive plate margin that is now exposed at the Lizard and *Fig 3* shows in diagrammatic form the sequence of rocks between Coverack Bay and the coast 1 km north of Porthallow Bay that relate to *Fig 2*.

When the peridotite comprising the upper mantle was heated from below, plagioclase feldspar and pyroxene, the minerals with the lower melting point, liquefied and formed a magma chamber at the base of the crust (*fig2*). Final location and rate of cooling of these minerals determined the resultant rock type. Slow deep cooling produced gabbro, containing towards the base feldspar that produced pegmatite gabbro.

A more rapid cooling, as in the dyke swarm at Porthoustock quarry, produced the fine grained dolerite, and the very rapid cooling at the seabed vent resulted in the very fine grained basalt pillow lavas. In time sedimentary deposits were laid down away from the immediate margin including some ultimately derived from the continental shelf by avalanche processes down the continental slope.

The peridotite, now depleted of some minerals was composed mainly of epidote which upon exposure to near surface conditions has been converted to serpentinite, a rock composed of the various serpentine minerals. It is this colourful rock that is worked locally into souvenirs and sold under the name 'serpentine'.

The rocks of the Lizard ophiolite suite, which date from the Devonian, and illustrate the processes described above, start at the South side of Coverack Bay, with peridotite 30% altered to serpentinite and which contains gabbro dykes. This is the least altered peridotite on the Lizard. By the centre of the bay, this gives way to gabbro that in places has a foliated structure, reflecting shearing and crushing deformation. This area of the bay also contains dolerite sills. Toward the north of the bay are dolerite and basalt dykes and areas of pegmatite gabbro with large phenocrysts of plagioclase feldspar. In moving between the two major rock types of peridotite and gabbro, one crosses the Mohorovicic discontinuity or 'Moho', the junction between the Earth's mantle and crust.

The rocks in the quarry at Porthoustock are from further up the sequence with dolerite dyke swarms in gabbro country rock. These sheeted dykes have chilled margins typical of injection in submarine conditions at a mid-oceanic ridge. Higher again in the sequence are the basaltic pillow

Fig. 1

lavas on the north side of Porthallow Bay and in nearby Nelly's Cove. The final part of the sequence is completed by the Roseland Breccia, representing former sediments, being material from continental sources. Following the coastal footpath north from Porthallow for about 1 km leads to a huge quartzite block on the cliff top. This marks easy access to the beach where the Roseland Breccia is well exposed.

Fig 2: An Active Plate Margin showing parts now exposed on the Lizard, see fig. 3

The material forming this breccia originated on a continental shelf, and, through instability, descended the continental slope in avalanche form. When such material is unconsolidated, the resultant deposit takes the form of turbidites, but in this case, the continental rocks were consolidated and clasts varying in size from a pea to an office block were brought down in what must have been a very impressive process. The clifftop quartzite block is one such clast, now exposed by weathering of softer material. Such a melange is classed an olistostrome and the clasts, olistoliths. The matrix represents the softer unconsolidated sediments of the slide, now metamorphosed to phyllite, an intermediate grade between slate and schist. The olistoliths represent every type of continental rock, many showing evidence of having been worked and re-worked many times before arriving at this final resting place.

Fig 3: Parts of a former Active Plate Margin now exposed on the Lizard, see fig 2.

Besides this impressive sequence, the Lizard includes many outstanding geological exposures; the fluxion banded gneiss, the troctolite gabbro, both at Kennack Sands, are good examples. Perhaps, however, the Lizard is best known for its ornamental 'serpentine'. The tremolite serpentinite at Kynance Cove, dark green when fresh, red when weathered, is justly famous. If visiting Porthallow to view the pillow lavas, the south-side of the bay is well worth a visit, where an exposure of dunite serpentinite is faulted against hornblende schist; the resultant crush zone yields superb polished specimens.

With the complexity of its geology and the many unanswered questions it poses, the beauty of its setting and the unfailing pleasure of being in Cornwall, there is no doubt that the Lizard will continue to attract geologists for the foreseeable future.

References:

British Geological Survey maps, series 1:50,000, no. 359 Lizard

British Geological Survey: Geology of the Lizard and Meneage, 2nd ed.

Memoir to the above map.

Grid references: Ordnance Survey Landranger 204 Truro, Falmouth and surrounding area.

Kennack Sands SX 739167

Coverack SX 783185

Porthoustock Quarry SX 810215

Porthallow SX 799232