Sleat 4:

Ord

The Ord (tectonic) Window on the Sleat Peninsula, part of the Moine Thrust Zone, comprises outcrops of Lower Palaeozoic strata with complex thrusted relationships. On Eilean Gaineamhach an Arda, NE of Ord, coralline seaweed (maërl), unlike most seaweed, grows a hard outer (exo-) skeleton (thallus) composed of calcium carbonate and tends to grow where there are significant currents. It grows unattached to the seabed, forming balls that roll around due to tidal currents. Colour is lost when exposed to the bleaching effect of direct sunlight and has the effect of causing the shallow water near the beach to take on a pale blue hue.

Aspects covered: Various Lower Palaeozoic and Late Proterozoic ('Torridonian') clastic and chemical (carbonate) sedimentary lithologies in complex thrusted relationships; present-day coralline seaweed (maërl) deposits.

Route: Coille a' Chuaraidh – Ord – bay opposite Eilean Gaineamhach an Arda – Ord – coast SW of Ord (- return Ord).

Distance: 3 kilometres (2 miles).

Time: 5 hours.

General comments: Parking is available on the west (coastal) side of the road immediately north of the Ord River. The mainly coastal exposures require low tidal conditions. The one inland exposure is in an abandoned quarry on the north side of the public road at Coille a' Chuaraidh: access will depend upon the current state of the quarry floor.

The best way to start the coastal traverse part of the excursion is to head north along the metalled track on the north side of the road at [NG 6179 1313] (which accesses various properties in north Ord), which ultimately becomes a track leading to the house located on the raised beach opposite Eilean Gaineamhach an Arda.

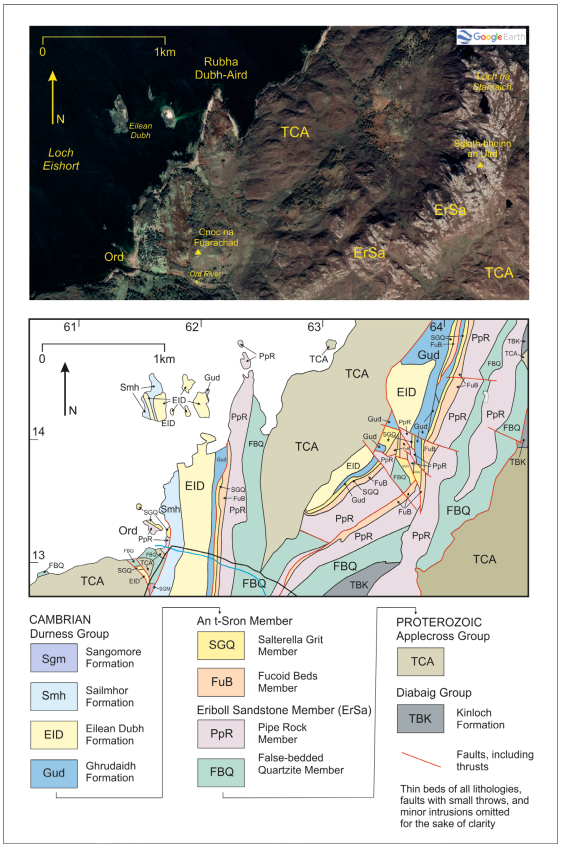

Figure Sleat 4.1: Simplified geological map and annotated Google Earth® image of the area around Ord.

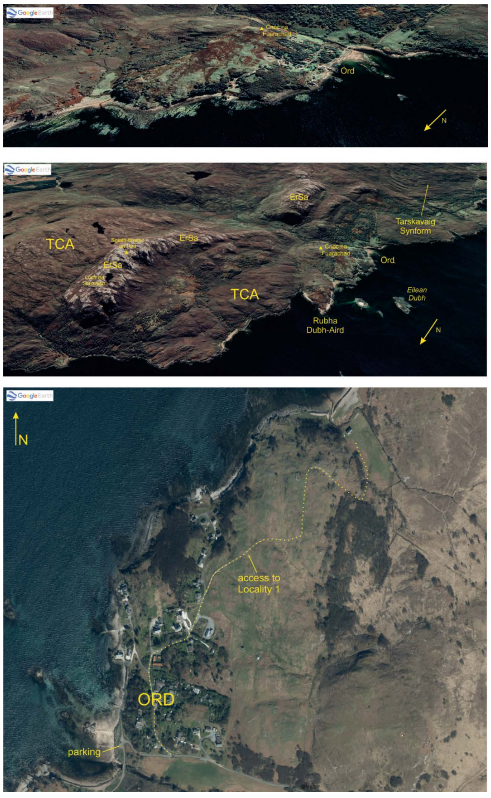

Figure Sleat 4.2: Annotated oblique and vertical Google Earth® images of the area around Ord.

From Broadford, head south along the Broadford-Armadale (A851) road for 16km (10 miles) to the Ord turn-off and then west along the minor road for *c.* 6km (*c.* 4 miles) towards Ord. Stop at the disused quarry at Coillie a' Chuaraidh (parking available) on the north (right-hand) side of the road.

Locality 1 [NG 6262 1263]:

Within the west face of the disused quarry are good exposures of overturned white sandstones of the Pipe Rock Member of the Eriboll Sandstone Formation. These strata contain well-developed pipes of the trace-fossil *Skolithos,* comprising narrow (3-10mm diameter), cylindrical burrows. These trace-fossils developed as escape features during periods of sediment inundation, with pipe lengths related to sediment deposition rates, typically several cm up to *c.* 1m. The environment of deposition is interpreted as being a barrier-island to tidal-flat.

Figure Sleat 4.3: Inclined Eriboll Sandstone Formation strata within disused quarry at Coille a' Chuaraidh.

Figure Sleat 4.4: Detail of inclined Eriboll Sandstone Formation strata on the west (left-hand) wall of the disused quarry at Coille a' Chuaraidh. Iain Allison for scale.

Figure Sleat 4.5: Detail of inclined Eriboll Sandstone Formation strata within the disused quarry at Coille a' Chuaraidh. Pole *c.* 1m long.

Figure Sleat 4.6: Detail of inclined Eriboll Sandstone Formation strata within disused quarry at Coille a' Chuaraidh, with circular sections through the pipe structures. Coin *c.* 24mm across

Continue west to Ord. Parking is available on the west side of the road, north of the Ord River. Return a short distance east along the road to a metalled track (which is not a public road) and follow it north. Once clear of the houses, it is unmetalled and continues NE and eventually reaches the coast at [NG 6216 1389] where a solitary NW-facing house sits on the raised beach.

Locality 2 [NG 6216 1389]:

The recent beach deposits in this bay consist of fragments of coralline seaweed (maërl). Maërl; unlike most seaweed, it grows a hard outer (exo-) skeleton (thallus) composed of calcium carbonate and tends to grow where there are significant currents. There are two types or species of maërl in the Coral Sands, *Phymatolithon calcareum* and *Lithothamnion glaciale*. It grows unattached to the seabed, forming balls that roll around due to tidal currents. The area where this magenta seaweed is slowly growing is off Eilean Gaineamhach an Arda. Colour is lost when exposed to the bleaching effect of direct sunlight. The carbonate has the effect of causing the shallow water near the beach to take on a (pleasant and unexpected) pale blue hue.

Figure Sleat 4.7: View towards Eilean Gaineamhach an Arda, with beach deposits of fragments of coralline seaweed (maërl). The bedrock lithology is Eilean Dubh Formation dolostones.

Figure Sleat 4.8: Detail of view towards Eilean Gaineamhach an Arda, with beach deposits of fragments of coralline seaweed (maërl). The bedrock lithology is Eilean Dubh Formation dolostones. On the far side of Loch Eishort are Lower Jurassic Pabay Shale Formation marine strata, and, beyond, Beinn na Caillich, composed of a Paleocene granite. View is towards NNW.

Figure Sleat 4.9: Storm beach dominated by cobbles of Eriboll Sandstone Formation. The house is located atop a 7m ('25 Foot') raised beach. In the distance is the ridge of Sgiath-bheinn an Uird, composed of Eriboll Sandstone Member 'quartzite'. View is towards the SE.

Figure Sleat 4.10: Storm beach dominated by cobbles of Eriboll Sandstone Formation. The house is atop a 7m ('25 Foot') raised beach. View is towards the NE. The rocks in the distance are of the Eriboll Sandstone Formation and the rocks in the far-left middle ground (seaweed-covered beach) are of the An t-Sron Formation (Fucoid Beds and Salterella Grit members).

Above the present-day beach is a *c.* 7m (25-Foot) raised beach, upon which is a substantial NW-facing house. Continue north for 100m along the beach to a point where a steeply-inclined, irregular Paleocene dolerite dyke can be traced from the backwall onto the foreshore. 10m north of the dyke are thinly-bedded, distinctly pink-weathering quartz arenites of the Pipe Rock Member of the Eriboll Sandstone Formation. These steeply inclined bedding surfaces show excellent outweathered examples of the trace-fossil *Skolithos*. Typical burrow diameters are 1cm, with the length of the burrow usually equal to the thickness of the bed in which it occurs (unless the bed is particularly thick). Within the sequence are thin bedding-parallel shear zones, in more shale-rich units.

Figure Sleat 4.11: Paleocene dolerite dyke within inclined Pipe Rock Member strata on the north side of the small bay opposite Eilean Gaineamhach an Arda.

Figure Sleat 4.12: Detail of inclined Pipe Rock Member strata on the north side of the small bay opposite Eilean Gaineamhach an Arda. Pole *c.* 1m long.

Figure Sleat 4.13: Detail of inclined Pipe Rock Member strata on the north side of the small bay opposite Eilean Gaineamhach an Arda. Coin *c.* 24mm across.

Figure Sleat 4.14: A thin, bedding-parallel shear zone, in a more shale-rich unit of the Eriboll Sandstone Formation. Hammer *c.* 30cm long.

Approximately 10m to the west, between the High- and Low-Water lines, the Eriboll Sandstone Formation gives way (abruptly) to the overlying Fucoid Beds Member. The first *c.* 9m of this rock consists of brown-weathered, purple, sandy shales mixed with thin, yellow, calcareous siltstones. Within this interval, lenticular bands of ferruginous dolostone occur, one of which, almost 2m thick, can be located *c.* 2m above the base of the Fucoid Beds Member. The next *c.* 20m of strata to the west consists of greenish-grey or bluish-purple shales, together with thin, brown, sandy layers.

Figure Sleat 4.15: Foreshore of the bay with poorly exposed members of the An t-Sron Formation. Typically, the Saterella Grit Member is better exposed, forming minor ridges trending N-S across the bay. Strata of the Fucoid Beds Member typically occur on lower seaweed-covered exposures. Complex thrust relationships cause these two members to repeat in this foreshore section. Exposure will depend significantly upon the amount and distribution of seaweed. View is towards the north.

Figure Sleat 4.16: Inclined strata of the Fucoid Beds Member, comprising orange-weathered, thinly laminated calcareous siltstones and variegated (green-red) shales on the foreshore of the bay. Coin *c.* 24mm across.

Figure Sleat 4.17: Detail of a bed of variegated (green-red) shale of the Fucoid Beds Member on the foreshore of the bay. Hammer *c.* 30cm long.

Figure Sleat 4.18: Colour heterogeneity of a shale of the Fucoid Beds Member on the foreshore of the bay. Coin *c.* 24mm across.

The Salterella Grit Member begins with a 0.5-1m high ridge, where the beach gives way to seaweed-coated rock. This arenaceous rock has a thickness of *c.* 6m and gives way, to the west, to a sand-covered area with a width of *c.* 8m, which marks the outcrop of a further thickness of the Fucoid Beds Member.

Figure Sleat 4.19: Inclined strata of the Salterella Grit Member, comprising orange-weathered, calcareous sandstones on the foreshore of the bay. Pole *c.* 1m long.

Figure Sleat 4.20: Fresh surface of a sandstone in the Salterella Grit Member, with characteristic orange coloration, on the foreshore of the bay. Coin *c.* 24mm across.

To the north, this outcrop of Fucoid Beds Member can be seen to pinch out. Based on the likely stratigraphic thicknesses of the Salterella Grit and Fucoid Bed members, the boundary between the Salterella Grit Member and the second outcrop of Fucoid Beds Member must be tectonic. West of the second outcrop of Fucoid Beds Member, as far as the Low-Water Line, are further exposures of the Salterella Grit Member. Approximately 35m of grit can be identified, and the boundary between these strata and the second occurrence of Fucoid Beds Member, to the east, is also tectonic. This anomalously thick sequence of Salterella Grit Member consists of a series of ridges and troughs running parallel to the coast and most probably comprises thrusted sheets in a complex association.

Proceed to the south side of the bay, crossing a small pebble beach which provides good samples of the Pipe Rock Member quartz arenite.

Locality 3 [NG 6209 1384]:

The first exposure at the High-Water Line consists of strata belonging to the An t-Sron Formation (Fucoid Beds and Salterella Grit members), which represent the continuation of the outcrops on the north side of the bay.

Figure Sleat 4.21: Continuation of An t-Sron Formation strata above the foreshore west of the house on the raised beach. View is towards the SE.

10m to the SW is a brecciated, light grey dolostone, with a disrupted boundary between it and the An t-Sron Formation strata, most easily interpreted as a fault. The stratigraphic position of the dolostone is not easily ascertained but may be the Eilean Dubh Formation.

Figure Sleat 4.22: Light grey veined dolostone with impersistent layers of chert, attributed to the Eilean Dubh Formation, on the south side of the bay. Pole *c.* 1m long.

Continue SW along the beach, over exposures of the dolomitic Eilean Dubh Formation. The following features should be noted within these steeply inclined strata:

White, black and grey masses of chert, in the form of layers, lenses and nodules;
Narrow, anastomosing fractures, commonly haematite-coated;
Tectonic carbonate breccias;
Stylolites (pressure solution seams);
Ripples and laminations, best seen on wave-cut surfaces;
Outwash channel structures.

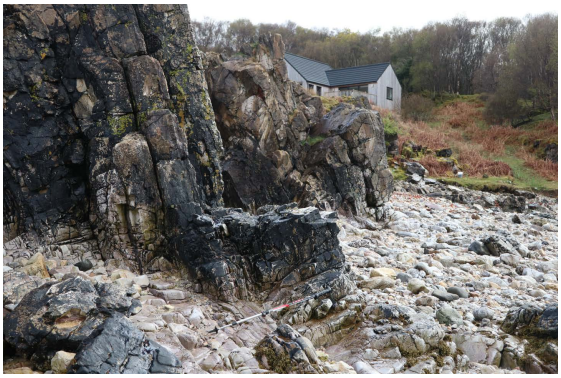

Figure Sleat 4.23: Eilean Dubh Formation dolostones on the foreshore north of the cluster of chalets. Pole *c.* 1m long.

Figure Sleat 4.24: Wave-washed surface of Eilean Dubh Formation dolostones on the foreshore, illustrating the well bedded character of these strata. Pole *c.* 1m long.

Figure Sleat 4.25: Laminated and rippled calcareous mudstones of the Eilean Dubh Formation. Coin *c.* 24mm across.

Figure Sleat 4.26: Localised brecciation within laminated calcareous mudstones of the Eilean Dubh Formation. Pole *c.* 1m long.

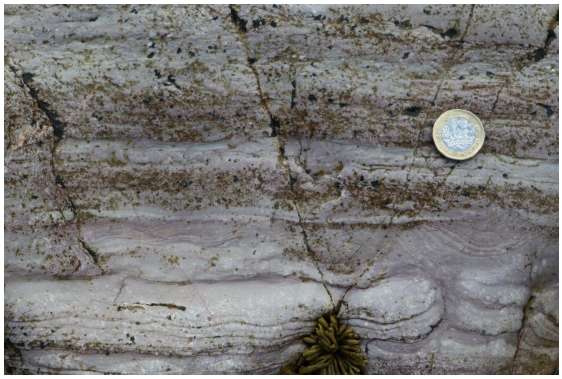

Figure Sleat 4.27: Truncated surfaces within laminated calcareous mudstones of the Eilean Dubh Formation. Coin *c.* 24mm across.

Figure Sleat 4.28: Rip-up clasts within laminated calcareous mudstones of the Eilean Dubh Formation. Coin *c.* 24mm across.

Figure Sleat 4.29: Chert nodules within laminated calcareous mudstones of the Eilean Dubh Formation. Pole *c.* 1m long.

Figure Sleat 4.30: Intensely veined calcareous mudstones of the Eilean Dubh Formation. Coin *c.* 24mm across.

Low-angle faults disrupt these typically steeply-inclined strata.

Figure Sleat 4.31: Low-angle faults disrupting Eilean Dubh Formation strata. Pole *c.* 1m long.

Figure Sleat 4.32: Stylolites within the Eilean Dubh Formation. Coin *c.* 24mm across.

Within the exposures above the High-Water Line, on the beach below the cliff-top chalets, are the bores of marine molluscs, indicating a previous higher-than-present water line. The bores are circular in cross-section (12–15mm) with depths of several centimetres. They do not contain any remains of organisms. One interpretation is that these bores were formed during the so-called Flandrian (post-glacial) shoreline maximum, approximately 6,700 years ago.

Figure Sleat 4.33: Bores of marine molluscs formed during the Flandrian (post-glacial) shoreline maximum, approximately 6,700 years ago. Pole *c.* 1m long.

Figure Sleat 4.34: Detail of bores of marine molluscs formed during the Flandrian (post-glacial) shoreline maximum, approximately 6,700 years ago. Hammer *c.* 30cm long.

Locality 4 [NG 6174 1364]:

Approximately 100m SW of the bay in which the cliff-top chalets are located, the near-vertical junction between the Eilean Dubh Formation and the overlying Sailmhor Formation crops out. The following distinctive features should be noted within the Sailmhor Formation:

More obvious careous weathering;
More abundant chert;
Evidence of extensive bioturbation, especially within sandy layers, giving rise to the term 'Leopard Stone'.

Good examples occur in the crags immediately west of the first cottage encountered on a traverse south from the cliff-top chalets.

Figure Sleat 4.35: Dolostone of the so-called Leopard Rock of the Sailmhor Formation due to bioturbation. Coin *c.* 24mm across.

Figure Sleat 4.36: Detail of Dolostone of the so-called Leopard Rock of the Sailmhor Formation due to bioturbation. Coin *c.* 24mm across.

Continue south to the bridge over the Ord River.

Locality 5 [NG 6168 1311]:

Immediately north of the road bridge over the Ord River, the exposures closest to the road are of Eilean Dubh Formation strata. Cross a small sandy beach to the promontory north of the mouth of the river. These exposures are of the Eriboll Sandstone Formation.

Figure Sleat 4.37: Exposures of the Eriboll Sandstone Formation north of the Ord River. View is towards the NW.

Proceed via the road bridge to the headland immediately south of the bay.

Locality 6 [NG 6154 1309]:

On the south side of the bay, the *c.* 5m-high cliff immediately south of the river is composed of arkoses and sandstones of the Late Proterozoic ('Torridonian') Applecross Group. They have a distinctive chocolate-red coloration, with poorly developed bedding, dipping to the south at a shallow angle.

Figure Sleat 4.38: Overturned Torridonian arkoses and sandstones of the Applecross Group south of the Ord River. Pole *c.* 1m long.

On the wave-cut platform NW of the cliff (i.e. on the seaward side), are exposures of white-weathering quartz arenite, consisting of pebbly layers, with individual clasts up to 5mm in diameter, characteristic of the False-bedded Quartzite Member of the Eriboll Sandstone Formation.

Figure Sleat 4.39: Overturned False-bedded Quartzite Member strata of the Eriboll Sandstone Formation, south of the Ord River. Pole *c.* 1m long.

Careful examination of the exposures below the boulders at the High-Water Line demonstrates that the contact between the Applecross Group strata and the False-bedded Quartzite Member strata is not tectonic, but is an unconformity, with the younger quartz arenite dipping beneath the arkoses and sandstones. Thus, it may be deduced that the sequence is inverted.

Figure Sleat 4.40: Overturned (Torridonian) arkoses and sandstones of the Applecross Group above the Basal Quartzite Member of the Eriboll Sandstone Formation south of the Ord River. In the foreground is a brown-weathering Paleocene dolerite dyke. Pole *c.* 1m long.

Proceed around the headland in a south-westerly direction, passing over a *c.* 75cm-thick trachyte dyke and a 1.5m-thick dolerite dyke. In the backwall of the beach, a NW-SE -trending gully defines a faulted junction between the Applecross Group strata and the False-bedded Quartzite Member strata. Further along the beach, to the SW, the False-bedded Quartzite Member strata are folded, with cross stratification that indicates that they are inverted.

Figure Sleat 4.41: Antiformal syncline of False-bedded Quartzite Member strata south of the Ord River.

Figure Sleat 4.42: Detail of False-bedded Quartzite Member strata within the antiformal syncline south of the Ord River, with inverted cross stratification. Hammer *c.* 30cm long.

A low-angle brittle fault disrupts the quartz arenites.

Figure Sleat 4.43: Low-angle brittle fault disrupting False-bedded Quartzite Member strata south of the Ord River. Pole *c.* 1m long.

Return to the parking location.

End of excursion.