Chapter 11 Tectonic history

Pre-Triassic movements

In Northern Skye no pre-Triassic rocks are exposed so that the structure of the basement on which these and later deposits rest must be inferred from what can be seen in Southern Skye.

The earliest earth-movements which can be detected are those which affected the Lewisian rocks prior to the deposition of the Torridonian Sandstone. It is evident that there were at least two periods of movement, since an earlier foliation with north-north-east and north-east axis was in existence before the intrusion of the basic and ultra basic dykes which are themselves foliated at right angles to this direction, i.e. north-north-west or north-west.

The presence of crush lines running east and west may indicate a still later period of movement.

The Torridonian appears to have been laid down as a series of torrential deposits on an almost peneplaned surface deriving in the first instance most of its material from local sources. In Skye these are epidotic grits and conglomerates, best exposed in Loch na Dal in Sleat. The Torridonian sandstones in many places show excellent examples of graded, current and slump bedding, the shales, rain-pitting and sun-cracks.

The Cambrian basal quartzite, originally a coarse, current bedded sandstone everywhere rests on an only slightly undulating surface of Torridonian which had a gentle north-easterly dip at the time the quartzite was deposited.

Lewisian, Torridonian and Cambrian were all involved in the subsequent Caledonian movements which in the first instance must have affected these rocks at considerable depth as they resulted in a huge complex recumbent fold with its axis running north-north-east (Bailey 1939).

Considerably later these piled up masses were cut by thrusts as a result of pressure from the south-east. It is possible that the whole of the Cambrian and Torridonian rocks in Skye lie within a thrust belt. (Clough in Peach and others 1910, p. 8).

The zone of flinty crush and mylonite which skirts the eastern coasts of the Outer Hebrides overlies a thrust which is generally presumed to be pre-Torridonian in age, because of the fact that above it, near Stornoway, is exposed a conglomerate with lenticular layers of soft, chocolate-coloured sandstone cropping out over an area of ten square miles and which is at least 9000 ft thick.

Jehu and Craig (1934, p. 867) regarded these conglomerates as Torridonian, but they differ in several respects from the Torridonian conglomerates of Skye and the mainland. Boulders in them include sheared gneiss and are all of local origin as is usual in the Triassic conglomerates whereas in Skye the Torridonian conglomerates include rocks of unknown origin, mainly vein quartz, chert and jasper. The Stornoway conglomerate is relatively uncompacted and the feldspars are highly decomposed, whereas in Skye the feldspars of the Torridonian are remarkably fresh and are chiefly microcline, which is not generally abundant in the Lewisian, and the rock is hard.

Stevens (1914, p. 59) therefore regarded the Stornoway deposit as Triassic in age, which if correct, means that the Stornoway Thrust could be another of the Caledonian group with which it compares in dip and strike. It may in fact be the earliest and deepest of the Caledonian thrusts and between it and the latest and highest, the Moine Thrust, are included all the Torridonian and Cambrian rocks of Skye.

Some isoclinal folding and regional tilting appears to have gone on during the period of thrusting, so that the two branches of the Kishorn Thrust in the area around Ord in Sleat appear to intersect and both are folded by a fold running almost north and south—the Ord Monocline.

The thrust belt is bounded on the east by the Moine Thrust which brought forward Lewisian and Moine on to what is now the island of Skye. The slice of 'Moine' lying west of the Moine Thrust in Sleat rests on the Tarskavaig Thrust and it is not yet certain whether these rocks are true Moine brought forward from below the Moine Thrust or whether they are in fact altered Torridonian.

Since there are no representatives of Silurian, Devonian, Carboniferous or Permian strata in Skye it is not known whether the area was involved in any earth-movements during these periods.

Post-Triassic, Pre-Tertiary movements

Whatever the later Palaeozoic history of Skye, the result was a somewhat irregular surface on which Triassic conglomerates were irregularly deposited. They consist largely of material derived from the underlying rocks and were probably laid down in inland lakes.

Thin and patchy deposits of limestone, sandstone and calcareous grit of Rhaetic age form passage beds between the Trias and the Lias. The formation of the elliptical basin between the mainland and the Outer Hebrides in which the Jurassic strata were laid down was a gradual process many times interrupted. Sandstones with quartz pebble conglomerates, but no Torridonian Sandstone, in the lower beds of the Lias suggest that the Torridonian outcrop was now submerged and the sedimentary material was being derived from the Lewisian and Moine. Nevertheless, that the sea remained shallow is evidenced by a white sandstone with rootlets seen east of Ardnish.

The predominantly sandy strata of the Broadford Beds are succeeded by the micaceous shales, the Pabba Shales. A slight rejuvenescence of uplift, indicated by the Middle Lias sandstones, was followed by a quiescent period during which the ferruginous shales and limestones of the Upper Lias were formed. A considerable elevation of the hinterland brought an abrupt close to Liassic sedimentation and the basin became flooded with sandy deposits. These formed the calcareous sandstone of the Inferior Oolite. Sedimentation appears to have been rapid since the fossils are in general widely disseminated and scarce. Current and slump-bedding are common features and the calcium carbonate content was high enough to form large concretions or doggers. The down-warping of the basin, however, was unable to keep pace with the amount of sediment passed into it so that at the top of the Inferior Oolite the sandstones show evidence of shallow and perhaps fresh-water conditions in that they contain seams of quartz pebbles and plant debris.

In the Great Estuarine Series we have evidence that the whole area was at times elevated above sea-level without, however, essentially affecting the sedimentation pattern. The earliest deposits, the '*Estheria*' Shales consist of calcareous muds, often finely laminated and clearly representing not only extremely slow deposition, (fossils are usually found as layers of compressed shells) but also numerous alternations between marine and freshwater or brackish conditions.

There are algal beds and layers of marine ostracods, numerous layers of '*Estheria*', crushed *Neomiodon* and Bathonella. The Calcareous Sandstone which follows consists of a number of cycles each unit comprising a calcareous sandstone with doggers and sandy shales and limestones, virtually a repetition of Inferior Oolite type sedimentation but in a non-marine environment. It would seem that at this time the basin was bisected by a north-easterly trending ridge of Torridonian Sandstone crossing more or less where the Cuillin Hills now are. This ridge may not have risen above sea-level but does appear to have effectively cut off much of the coarse sediment from the southern and smaller half of the basin. The Great Estuarine Series is much thinner in Strathaird than in Trotternish and the thinning is almost entirely confined to the sandstone of each cycle.

A gradual regional down-warp brought to an end this non-marine phase and though the Callovian sediments were coarse, by Oxford Clay times the basin was again thoroughly marine and sedimentation slow. Dark blue shales with calcareous ribs were uniformly deposited throughout Oxford Clay, Corallian and Kimmeridge times, the changing ammonite fauna affording the only means of distinguishing the deposits from one another.

The events which followed into Cretaceous times can only be guessed. A few feet of grit, sandstone and limestone with chert and Upper Cretaceous fossils are all that remain. Much may have been removed by subsequent erosion but the nature of these deposits suggest that in Skye at least, the end of the Jurassic Period was marked by uplift and that

Cretaceous sediments were very limited in their extent and amount.

Late Cretaceous or early Tertiary earth-movements appear to have been limited to gentle folding and large scale faulting. A series of small folds with their axes running north-east were formed en echelon. The most northerly is a small anticline a little south of Gearran Island with, almost due south of it, a syncline in Lub Score. An anticlinal axis runs from Kilmaluag south-west across Loch Snizort to An Ceannaich on the north side of Oisgill Bay.

Owing to lack of exposures the Quirang Syncline cannot be traced southwest of Uig Bay nor can the Beinn Edra Anticline south-east of it be seen south of Kingsburgh. Still farther to the south-east a syncline at Bearreraig Bay is hidden beneath the lavas as is the Portree Anticline. These are all small folds affecting only the Jurassic rocks and somewhat obscured by the Tertiary folding.

The major tectonic feature of this late Cretaceous epoch is the Camasunary Fault, which has a downthrow of at least 1000 ft to the south-east. In Raasay, where it was first recognized by Judd, the fault crosses from North Scapadal to Loch an Rathaid, throwing Inferior Oolite and Great Estuarine Series against Torridonian. North-eastwards it perhaps runs north-north-east parallel to the east coast of Rona where recent Admiralty soundings have indicated a deep channel. South-westwards the fault cannot be traced in the Braes of Skye but a fault of this magnitude is not likely to have died out in the short distance across the Narrows of Raasay. It is intersected by the Portree Fault but unless this is a tear fault, which it is apparently not in the usual meaning of the term, the only possible explanation is that it has been displaced by the emplacement of the Cuillin granite. In fact the Camasunary Fault in Straithaird is offset from the Raasay portion by exactly the width of the Glamaig, Marsco, Glas Bheinn Mhor intrusion. In Straithaird the fault can be traced from the south-eastern side of Camas Fhion-nairidh north-north-east not far east of the Abhuinn nan Leac until it passes below the Tertiary lavas of An Da Bheinn south-east of Blath Bheinn. But for this fault it is doubtful if any Jurassic rocks would have been now preserved in southern Skye.

Tertiary movements

The surface on to which the Tertiary lavas were extruded was deeply weathered during the Eocene and reduced to a peneplain on which were freshwater lakes in which the earliest Tertiary sediments (?Eocene) were laid down. The largest of these so far known lay in the neighbourhood of Portree and in it accumulated a considerable thickness of sandy sediment with plant remains prior to the effusion of the tuffs which marked the onset of volcanicity.

The collapse of the lava plateau and underlying sediments brought about by the extrusion of a vast amount of magma as lava flows and intruded as sills in the sediments resulted in the formation of a shallow depression criss-crossed by two sets of faults, a main group running north-west and a subsidiary set almost at right angles. Shallow folds, mainly developed in the north-west with axes trending north-west, broke up the Jurassic folds into a series of elliptical domes. This collapse was followed by the intrusion of many more basic dykes—often occupying a fault plane.

The gabbro laccolith had in all probability become emplaced at the time of the intrusion of the dolerite sills which appear to have originated at the same level. The doming of the lavas over the gabbro was probably due more to the collapse of the surrounding field round the rigid solidified igneous mass rather than to any upward thrust of the magma.

Later a granite plug thrust its way up on the east side of the gabbro apparently at the intersection of the Camasunary Fault and the Portree Fault. The displacement of the Camasunary Fault suggests that the country rock was literally forced apart to the full width of the intrusion.

The Beinn na Caillaich Granite, apparently later than the mass to the north, pushed the sediments to the south and east into an arcuate fold the core of which is occupied by a third intrusion, Beinn an Dubhaich Granite. If this interpretation is correct the Portree Fault must have acted as if it were a tear fault in the neighbourhood of the intrusions. The lateral shift of the Camasunary Fault is of the order of 5–6 miles, whereas to the south-east where much of the pressure was relieved by the arcuate folding, the Kishorn Thrust appears to have been displaced by less than half this amount, and if the Craig Skulamus Fault in the Strath with a displacement of about 1½ miles and the Ben Vokie Fault in Sleat displacing the Torridonian by about 1 mile and the Moine Thrust by less than mile are continuations of the same transverse fault

system, the movement is clearly dying out southwards. To the north of the granites there is no evidence that the Portree Fault is anything but a normal dislocation, with a downthrow to the west of about 1000 ft.

Westwards two parallel major faults, the Loch Greshornish Faults, together step down the lavas to the west about 1300 ft and are largely responsible for the preservation of the later mugearite and trachyte lava series. West of Ben Scudaig the Loch Bay Faults almost exactly compensate by an easterly down-throw of about 1400 ft.

No other of the numerous faults are of any great significance. The amount of throw is generally less than 500 ft and both the major north-westerly and the north-easterly cross-faults tend to compensate each other.

In the lava field structural details are almost impossible to elucidate owing to the fact that the recorded dips are depositional and not tectonic. The lava surfaces in general have an inclination which bears no relation to the true dip. For example in the Trotternish escarpment the lavas appear to have a westerly dip of 10–15 degrees whereas the surface on to which the lavas were extruded has a general westerly dip of only ¼ degree.

This gentle inclination of the whole island to the west is the latest earth-movement detected in the area and post-dates all the Tertiary volcanic phenomena.

Localized movements such as landslip and the thrust effects of the landslip sole on the underlying sediments are discussed in the following chapter.

References

BAILEY, E. B. 1939. Caledonian Tectonics and Metamorphism in Skye. Bull. Geol. Sum. Gt. Brit., No. 2, 46–62.

JEHU, T. J. and CRAIG, R. M. 1934. Geology of the Outer Hebrides. Part V—North Harris and Lewis. Trans. Roy. Soc. Ellin., 57, 839–74.

PEACH, B. N., HORNE, J., WOODWARD, H. B., CLOUGH, C. T., HARKER, A. and WEDD, C. B. 1910. The Geology of Glenelg, Lochalsh and South-East part of Skye. Mem. Geol. Surv.

STEVENS, A. 1914. Notes on the Geology of the Stornoway District of Lewis. Trans. Geol. Soc. Glasgow, 15, 51–63.