Pre-Palaeogene rocks of the Isle of Skye

Figure 2 Geological sketch-map of the Tarskavaig and Moine Thrust Sheets of the Sleat Peninsula (modified from Cheeney and Matthews 1965)

Table 2 Stratigraphic column for Jurassic
Chapter 2 Pre-Tertiary rocks

(A) Lewisian Gneiss

The oldest rocks preserved on Skye are gneisses of Lewisian age (Archaean–Middle Proterozoic), the bulk of which are exposed on the east side of the Sleat Peninsula, between Isleornsay in the north and Ard Thurinish in the south (Figure 2). Thin bands of similar material crop out on the west side of the peninsula, near Tarskavaig, and as an intrusion-bound mass at Creagan Dubh, in the Strath district. Exposure is typically limited to the coast and a few stream-sections and road-cuts. These rocks are described by Peach and Horne (1907), Peach et al. (1910), Bailey (1955), Cheeney and Matthews (1965), Matthews (1967) and Matthews and Cheeney (1968).

All of the Lewisian Gneiss on Skye has suffered some degree of tectonic transport. The material on the east side of the Sleat Peninsula sits above the Moine Thrust Plane and constitutes a significant portion of the large Moine Thrust Sheet, which can be traced northwards along the west Coast of the Scottish mainland. Within the Moine Thrust Sheet on Skye, Matthews and Cheeney (1968) recognise the axial trace, dipping to the east, of the so-called Knock Synform. This Lower Palaeozoic structure can be traced from Knock Bay to Isleornsay and causes a repetition in rock-types from NW to SE. These flaggy rocks are acid to intermediate in composition and are typically devoid of zones of mylonite—a feature more readily noted in the material around Tarskavaig. Gneissose banding is well developed, with layers consisting of quartz plus feldspar and layers rich in chlorite, hornblende and actinolite. The thickness of individual bands is extremely variable, ranging from a few millimetres up to several tens of centimetres.

Associated with these gneisses are smaller masses of more mafic hornblende-chlorite gneiss, most common in the area around Isleoronsay. These rocks possibly represent metabasites which have undergone deformation and metamorphism during the development of the Lewisian Complex in Proterozoic times. It is not uncommon to find developed within these mafic rocks hornblende crystals up to 5cm in length, together with garnet porphyroblasts.

Matthews (1967) describes several zoned ultrabasic pods which occur within the gneiss between 

rocks on Skye.
Knock Bay and Isleornsay. They consist of cores of talc and dolomite (often with magnetite), rimmed by succeeding zones of actinolite and biotite. Most of these pods tend towards lenticular forms, parallel to the foliation of the enclosing gneiss, with lengths of up to 3m and length:breadth ratios of approximately 5:1. It is concluded that the pods have formed by reaction between ultrabasic intrusions and the more acid 'country-rock' gneisses during a period of regional metamorphism (either in Proterozoic or Lower Palaeozoic times).

Also of probable igneous origin is a band of highly-altered serpentinite, which trends NE-SW between Knock Bay and Camascross, and which can be traced along strike for a distance of at least 2km. The serpentinite weathers to a rusty orange and is best exposed on the ridge to the west of Loch Baravaig. Serpentine and Fe-carbonates dominate this rock, which also contains stringers of magnetite up to 15cm thick.

The gneiss to the west of the Moine Thrust, at Tarskavaig, and further south on the north side of Gleann Meadhonach, shows a much greater degree of deformation. It lies above the Tarskavaig Thrust (and the associated Caradal and Lamascaig Faults) and has been intensely deformed. This is best observed on the coast 1.5km south of Tarskavaig Bay, where the gneisses are intimately associated with the Moine Schists (see Section (2C), below).

In the Strath district, 6km west of Broadford, a small inlier of gneiss is preserved between the Inner and Outer Granites of the Eastern Red Hills Centre. It has a surface area of approximately 0.5km² and has a faulted contact to the NW against Jurassic strata. Lying unconformably above the gneiss are subaerially-erupted basic lavas of Lower Tertiary age. The unconformity is somewhat irregular, but can be traced from the base of Creagan Dubh, NE to where it is exposed in the Alt na Teangaidh. This gneiss shows the development of a strong mineral banding, with alternating salic and mafic portions. It is agmatitic in places and, when examined in thin-section, there is evidence that a melt phase has developed. Abundant micrographic intergrowths of quartz and alkali feldspar are readily noted, suggesting that sufficient heat was present during Lower Tertiary times to enable partial fusion to take place (see Section (12D) of Chapter 12). Furthermore, breakdown of primary mafic minerals such as pyroxene and amphibole has occurred, resulting in the extensive development of secondary chlorite and epidote.

The only other direct evidence of a Lewisian Gneiss basement below Skye is the presence of gneiss xenoliths within the ferrodiorite intrusion of the Western Red Hills Centre (see Section (6H) of Chapter 6). Most of these xenoliths are 5m in largest dimension and are leucocratic to mesocratic. They contain quartz, sodic plagioclase and alkali feldspar in the light-coloured bands, whilst pyroxene is present within the darker bands. Most of these xenoliths have been found in Harker's Gully, on Marsco. Also, Thompson (1981) recognises a two-pyroxene granulite xenolith within the ferrodiorite intrusion at the head of the Alt Coire nam Bruadar.

(B) Torridonian sedimentary rocks

On Skye, four main areas of Torridonian (Upper Proterozoic) sedimentary rocks have been identified: (1) on the Sleat Peninsula, west of the Moine Thrust Plane; (2) in the Strath district, south of Broadford; (3) in the area north of the Western Red Hills, between Sconser and Mael na Gainmhich, including the islands of Scalpay and Longay; and, (4) in the area south of the Cuillin Hills, between Camasunary Bay and the Sound of Soay (including Soay).

The following groupings were recognised by Peach et al. (1910):
Applecross Group (Middle Torridonian)
Red and chocolate arkoses with pebbles of quartzite, felsite, jasper, pegmatite and other rocks +1500

Diabaig Group (Lower Torridonian)

Kinloch Formation
Dark grey sandy shales and fine-grained grey and buff grits with thin calcareous lenticles 1100

Beinn na Seamraig Formation
Fine-grained buff or grey-green grits with some bands of grey sandy shale 750

Loch na Dal Formation
Dark grey gritty or sandy shales with fine-grained buff grits and small calcareous lenticles 800

Epidote Grit Formation
Beds with abundant pebbles of epidote and epidotised feldspar, occasional bands of purple green shale 100

The Torridonian sedimentary rocks of the Sleat Peninsula are preserved within the Kishorn Thrust Sheet and are exposed in the tract of ground between Kyleakin, on Loch Alsh, in the NE, and Loch a' Ghlinne (4km NW of Ardvasar), in the SW. These rocks form an important part of the Lochalsh Syncline which is overturned towards the west. The axial plane of this structure can be traced from Loch na Beiste, south of Kyleakin, to the Sound of Sleat (at Meall Port Mealary). West of this line the strata are the correct way up and show few signs of deformation, whilst to the east they are inverted, and in places are heavily fractured and contain a cleavage.

The lowest exposed part of the sequence is the Epidote Grit Formation, which crops out on the Sound of Sleat, at Meall Port Mealary, where approximately 100m of strata are preserved. The name of this formation is derived from the presence of epidote and epidotised feldspar, often in the form of pebbles, which represent eroded debris from the Lewisian basement gneisses (see Section (2A), above). Grits and sandstones, as well as mudstones and shales, are present within the sequence and it has been concluded that they were deposited in fast-flowing, braided channels and shallow seas, respectively.

Above the Epidote Grit Formation, Peach et al. (1910) recognised an alternating coarse- and fine-grained sedimentary sequence, with rapid variations in grain-size. These rocks, referred to as the Loch na Dal Formation, are best exposed on the NE side of the loch of that name, on the east coast of the Sleat Peninsula. Thicknesses of individual units are very variable, ranging from a few centimetres, up to 2 or 3m. The presence of desiccation-cracks, ripple-structures and fine laminations lead Sutton and Watson (1964) to conclude that these sediments were deposited in some form of intertidal environment.

The Beinn na Seamraig Formation is dominated by thick-bedded sandstones, which frequently show the development of cross-bedding, with foresets up to half a metre in height. Disturbance structures are also present, in the form of distorted laminae which now appear as upward-facing peaks separated by broad, rounded hollows (Sutton and Watson 1964). The mechanism of formation of these structures is thought to be dominated by vertical movements of quicksands or from the dewatering of saturated sediments.

At the top of the Lower Torridonian succession is the Kinloch Formation. It is best exposed north of the Kylerhea River and Glen Arroch, and can be traced south as far as Gleann Meadhonach. Its lower boundary, with the Beinn na Seamraig Formation, was determined by Peach et al. (1910) to be transitional, being defined as where the various units, both coarse- and fine-grained, become thicker. Both current-bedding and disturbance structures are common. At the top of the formation
there is a return to thin-bedded, fine-grained rocks, which alternate with thick sandstone units (Peach et al. 1910; Sutton and Watson 1964).

The Middle Torridonian is represented by the Applecross Group and is dominated by medium-grained sandstones and arkoses, with few intercalations of fine-grained material. These strata are exposed over a wide tract of ground running from Lusa and Kyleakin in the north, to Loch Eishort in the south. Along the NW side of this area, they are covered unconformably by Mesozoic strata. Applecross Group rocks are also found along with Cambro-Ordovician strata in the area around Ord, on the west side of the Sleat Peninsula, and are interpreted as part of a foreland sequence below the Kishorn Thrust Plane.

Below the strata of the Applecross Group which crop out in the Strath district, south of Broadford, are Cambro-Ordovician carbonates, in a thrust relationship. Evidence for this relationship is less obvious in the Creag Strollamus and Coire-chat-achan areas, west of Broadford, where, again, both rock-types crop out.

Sandstones and arkoses of Torridonian age are also preserved on the islands of Scalpay and Longay, NW of Broadford Bay, and between Sconser and Maol na Gainmhich, in the vicinity of Loch Sligachan, on Skye. In both these areas Mesozoic strata unconformably cover the Torridonian rocks and it would appear reasonable from field relationships on the island of Raasay, to the north, that they rest directly on foreland Lewisian Gneiss.

The only other outcrops of Torridonian strata are found south of the Cuillin Hills, in Camasunary Bay, and between Eilean Reamhar and An Leac, on the Sound of Soay, and on the island of Soay itself. The Camasunary Bay outcrops dip at shallow angles to the NW and are composed of massive sandstones and arkoses, together with occasional gritty horizons in the east side of the bay, and more shaly material on the west side, especially on the west bank of the Abhainn Camas Fhionnairigh. Clough and Harker (1904) suggest that these strata belong to the Diabaig Group, although they have, in places, been subjected to intense thermal effects by the nearby Cuillin Complex, resulting in rheomorphism and partial melting of material up to a distance of 100m from the margin of the intrusion. (see Section (4M) of Chapter 4). The strata exposed on both sides of the Sound of Soay are coarse, pebbly sandstones and arkoses, generally dipping to the west at angles of 15°, or less. From their lack of tectonic features, Clough and Harker (1904) suggest that these rocks lie to the west of the Moine Thrust Zone and have not suffered tectonic transport. Cross-bedding, ripples and water-escape structures are all present within these rocks. From their general appearance it is possible to correlate them with the Applecross Group.

(C) Moine schists

On the west side of the Sleat Peninsula, below the Moine Thrust Plane and above the Kishorn Thrust Sheet, Peach and Horne (1907) recognised a series of low-grade, deformed schistose rocks (Figure 2) which they called the Tarskavaig Moine Series (Middle-Upper Proterozoic). Directly below is a thin strip of deformed Lewisian Gneiss (see Section (2A), above). Originally, Peach and Horne (1907) considered that these low-grade, schistose rocks belonged to the Torridonian group of strata, but further investigations showed that they were much more granulated and it was concluded that they represent a less-deformed portion of the Moine Schist Series. However, subsequent detailed investigations by Cheeney and Matthews (1965) suggests that a correlation between Torridonian and Moine rocks can be made (see below).

Cheeney and Matthews (1965) made use of sedimentary structures within these rocks in order to produce a local stratigraphic column. The deduced sequence is:
MOINE THRUST PLANE

Aruisg Psammite Group
Laidhe na Greine Group
Capistal Psammite Group
Lewisian Gneiss

TARSKAVAIG THRUST PLANE

The Capistal Psammite Group overlies deformed Lewisian Gneiss and contains rare pelitic beds near its base, which increase in number near the transitional contact with the overlying Laidhe na Greine Group. The middle unit of the Tarskavaig Moine sequence consists of psammites, semi-pelites and pelites, some of which show well-developed graded-bedding. A return to dominant psammites is recorded in the Aruisg Psammite Group, with pelites only locally developed. Cross-bedding is present, although tectonic deformation has frequently lead to the destruction of these features.

Various generations of folds are present within these rocks, including a set of early, large, isoclinal folds, the Capistal Antiform and Synform. The Capistal folds and the subsequent smaller Doire na h-Achlais folds developed before the main movements of the Tarskavaig Thrust Plane, as some of the brecciated rocks within the thrust plane contain Doire na h-Achlais folds. The Tarskavaig Thrust Plane was then folded by the later Caradal folds, giving rise to the Tarskavaig Synform and the Caradal Synform and Antiform. Finally, generations of small folds, named the Port a' Chuil and Conjugate folds by Cheeney and Matthews (1965), have been recognised to post-date the Caradal folds. Following this, movement on the Moine Thrust Plane took place, involving the tectonic transport of Lewisian Gneiss westwards over Torridonian sedimentary rocks (see Section (10B of Chapter 10).

Possible correlations between the Moine Schists and the Torridonian sedimentary rocks (see Section (2B), above) are as follows:

Aruisg Psammite Group = Beinn na Seamraig Formation Laidhe na Greine Group = Loch na Dal Formation Capistal Psammite Group = Epidote Grit Formation

(D) Cambro-Ordovician sedimentary rocks

The youngest group of rocks which have been involved in the Lower Palaeozoic (Caledonian) orogenic events of NW Scotland are those of Cambrian and Ordovician (Cambro-Ordovician) age. Detailed studies indicate that rocks of this age were completely covered by Torridonian strata of the Kishorn Thrust Sheet during the Lower Palaeozoic, and that post-Caledonian erosion stripped off this material to expose the Cambro-Ordovician strata at various stages in the subsequent evolution of the district.

Peach et al. (1910) determined the following stratigraphic sequence:

<table>
<thead>
<tr>
<th>(Durness) Dolostone or Limestone</th>
<th>Ben Suardal Dolostone</th>
</tr>
</thead>
</table>
Strath Suardal and Beinn an Dubhaich Dolostone —
Sangomore Dolostone —
Sailmhor Dolostone 80
Eilean Dubh Dolostone 150
Ghrudaidh Dolostone 35
Salterella Grit 15
Fucoid Shale 17
Quartzite
Upper Division or Pipe Rock 80
Lower or False-bedded Division 100

These rocks crop out in two main areas: (1) in a foreland sequence around Ord, on the west side of the Sleat Peninsula (all units except the Ben Suardal, Strath Suardal and Beinn and Dubhaich Dolostones); and, (2) the Strath district, in a broad tract of ground running south from Broadford, towards Torrin (chiefly the Ben Suardal, Strath Suardal and Beinn an Dubhaich Dolostones).

The units up to, and including, the Sailmhor Dolostone, are of Lower Cambrian age, whilst those above are of Lower Ordovician age (Palmer et al. 1980).

The oldest rocks of the sequence are found at Ord, where Caledonian thrusts greatly complicate the local stratigraphy. Here, Cambro-Ordovician strata rest with slight disconformity upon Torridonian strata of the Applecross Group (see Section (2B), above). At the base of the Cambro-Ordovician sequence is a thin pebbly unit, sometimes conglomeratic, above which is a cross-bedded quartzite horizon. Above this, the sequence passes up into the Pipe Rock, named after the presence of various pipe-like structures which have been recorded from it. These pipes are believed to represent the dwelling burrows of suspension-feeding worm-like organisms (Hallam and Swett 1966). Two trace-fossils are recognised: Skolithos (formerly referred to as ‘ordinary pipes’); and, Monocraterion (formerly referred to as ‘trumpet pipes’). The form Skolithos is cylindrical (3–10mm in diameter) and probably developed during periods of negligible sedimentation, whilst the form Monocraterion is funnel-shaped (15–30mm in diameter, tapering downwards) and developed during periods of sedimentation, whilst the organism moved upwards. The quartzites form a distinct ridge of hills east of Ord, the most obvious summits being Sgiath-bheinn an Uird and Sgiath-bheinn Chrossavaig, both of which are distinctly white in appearance and achieve heights in excess of 250m O.D. Small outcrops of quartzite are found at Boreraig and in Glen Boreraig in the southern part of Strath, as well as at Coire-chat-achan, to the north of Loch Cill Chriosd, also in Strath.

Stratigraphically above the quartzite is the Fucoid Shale, as seen on the west side of Sgiath-bheinn an Uird, where it forms smooth grassy ground and hollows, before passing up into the Salterella Grit. The Fucoid Shale weathers to a rusty brown and contains horizons of yellow, calcareous siltstones and sandstones, which pass upwards into greenish-grey shales. Trace-fossils, originally believed to be fucoidal (seaweed) impressions, and from which the name of this unit was originally derived, have more recently been identified as feeding burrows, and are referred to as Planolites. The trilobite Olenellus has also been found in these beds.

The Salterella (formerly Serpulite) Grit lies conformably above the Fucoid Shale on the west sides of Sgiath-bheinn Tokavaig and Cnoc na Fuarachad, as well as from the coast, 900m ESE of the islet of Sgeir Gormul, inland, along the west side of the Sgiath-bheinn an Uird ridge. Exposures are also present in the Ord Bay area, where Peach et al. (1910) record specimens of Serpulites, now referred to the genus Salterella, and variously interpreted as: (i) worm tubes; (ii) an orthoconic nautiloid; and, (iii) a thick-walled, spiral gastropod. This unit is relatively variable in composition, although it is
predominantly coarse-grained. In places it is slightly calcareous.

Above these detrital sediments are a series of carbonates, referred to as the Durness Dolostones or Limestones, after their type-locality in the NW part of the Scottish mainland. In the vicinity of the Lower Tertiary granites, especially around Beinn an Dubhaich, in Strath, they have been thermally metamorphosed and metasomatised. This aspect is dealt with more fully in Section (7I) of Chapter 7. All of these carbonates are, to a certain extent, dolomitised, and have been subjected to tectonic deformation.

In the Ord area the lowest four formations are preserved, whilst in the Strath district only the upper two are found.

The lowest formation is referred to as the Ghrudaidh Dolostone and is exposed on the slopes east of Ord. At the base of the sequence it is partly arenaceous, for a thickness of up to 5m. Above, is some 20m of granular carbonates containing occasional cherts. A distinct banding is visible throughout this unit.

The Eileen Dubh Dolostones lie directly above, and constitute a major component of the whole carbonate sequence. They are exposed on the coast north and NE of Ord, and consist of coarse-grained carbonates which are white or cream-coloured, occasionally tending towards grey. Chert nodules are common near the base and top of the unit. These beds pass upwards, with no break, into the Sailmhor Dolostones, which contain abundant chert, and which are generally much darker. They are best observed on the coast, NE of Ord, and on the roadside near the coast, SSW of Ord.

Finally, in the Ord area, are the Sangomore Dolostones, which crop out on the west side of the Sailmhor Dolostones, SSW of Ord. They are characterised by bands of white chert, often up to 1m thick.

Other than the rare patches of quartzite noted above, no part of this portion of the Cambro-Ordovician sequence is preserved in the Strath district. In Strath, the extensive carbonate units present are considered to be from a higher stratigraphical level.

First, there is the Strath Suardal Dolostones (including the so-called Beinn an Dubhaich Dolostones, which are probably highly metamorphosed and metasomatised equivalents), which are exposed on the west side of the Broadford River, in Strath Suardal, as well as around the granite of Beinn an Dubhaich, and as small patches on Ben Suardal. These beds are typically dark grey to black, with a granular texture, and contain numerous chert nodules (up to 5cm in diameter).

The highest stratigraphical unit in the Cambro-Ordovician sequence is the Ben Suardal Dolostone, forming most of Ben Suardal itself. These beds are fine-grained, dark when fresh, and weather to a pale grey. Abundant nodules of black chert are present, together with horizontal pipe-like structures which are interpreted by Peach et al. (1910) as representing worm-casts.

Small patches of Cambro-Ordovician strata are preserved around Creag Strollamus, west of Broadford, where they are in thrusted contact with Torridonian sedimentary rocks. Details of the field relationships are difficult to discern due to a lack of good exposure at certain critical outcrops, and it is not possible to conclude whether the dolostones have been thrust over the Torridonian strata, or vice versa.

The bulk of the Cambro-Ordovician strata of the Strath district clearly lie directly below the Kishorn Thrust Sheet, which is composed of Torridonian sedimentary rocks belonging to the Applecross Group (see Section (B), above). This relationship is seen on the east side of the road, at the sharp bend, 2km SW of Broadford. Large-scale flexures of these strata, probably attributable to both
Lower Palaeozoic (Caledonian) deformation processes and phenomena related to the intrusion of the Lower Tertiary granites of the district, have given rise to a broad antiformal axis running WSW through Ben Suardal, swinging round to an almost E-W trend in the vicinity of Beinn an Dubhaich.

(E) Triassic sedimentary rocks

Sedimentary rocks of Triassic age which crop out on Skye are found chiefly in the Strath district and achieve a maximum thickness of approximately 50m. Other smaller exposures include: (1) at An Leac, south of the Cuillin Hills on the Sound of Soay; (2) around Sconser, north of the Western Red Hills; and, (3) around Tarskavaig, on the west side of the Sleat Peninsula.

After the Lower Palaeozoic thrusting events of the Caledonian Orogeny, which affected the Lewisian Gneiss, the Torridonian sedimentary rocks, the Tarskavaig (Moine) Schists, and the Cambro-Ordovician succession, there is a gap in the geological column of the Skye area, until the Triassic System is reached. In Strath, overlying Torridonian and Cambro-Ordovician strata, are a series of red shaly marls, red and dull green sandstones, and conglomerates containing fragments of Torridonian sandstone and Cambro-Ordovician carbonates (Peach et al. 1910; Steel et al. 1975; Nicholson 1978). These strata are non-fossiliferous, but are of presumed Triassic age on the basis of their distinctly continental character, which allows them to be correlated with occurrences elsewhere.

The sequence preserved in the Strath district crops out along the flanks of the broad syncline which runs from Harrapool, east of Broadford, south to Boreraig, on the north side of Loch Eishort, as well as on the northern margin of the antiform which runs over Ben Suardal. Small patches of material associated with the Harrapool Syncline are found along the Broadford-Kyleakin road, around Broadford Bay. These rocks are everywhere overlain by Lower Jurassic strata.

Barrow (in Peach et al. 1910) lists the following sequence from the Allt an Daraich, on the east side of the road, just north of Heast:

<table>
<thead>
<tr>
<th>Description</th>
<th>Thickness (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marl, greenish at top, rapidly changing below to reddish, with concretionary patches of green and red sandstone</td>
<td>0.5</td>
</tr>
<tr>
<td>Fine hard greenish sandstone, slightly calcareous</td>
<td>1.0</td>
</tr>
<tr>
<td>Greenish marl, changing to red, passing into a chocolate sandstone at its base</td>
<td>1.5</td>
</tr>
<tr>
<td>Detrital limestone, mainly inorganic</td>
<td>0.3</td>
</tr>
<tr>
<td>Green and mottled marl</td>
<td>1.0</td>
</tr>
<tr>
<td>Green sandstone</td>
<td></td>
</tr>
<tr>
<td>Conglomerate</td>
<td></td>
</tr>
</tbody>
</table>

Variations on this general theme are readily noted throughout the Strath district. For example, at the top of Glen Boreraig, a conglomerate with a calcareous matrix is the dominant rock-type, whilst in the vicinity of Loch Buidhe, argillaceous rock-types are more important.

Nicholson (1978) describes a sequence of interbedded sandstones, siltstones and mudstones, referred to as rhythmites and deposited from density currents of turbid water, together with conglomerates which were spread into lakes by storms. These coarse- and fine-grained rocks, with a total thickness of 10m, are defined as the Camas Malag Formation and unconformably overlie Cambro-Ordovician carbonates on the east side of Loch Slapin, mid-way between the Camas Malag...
Steel et al. (1975) conclude that, on a regional scale, the Triassic strata of Skye were deposited in two distinct physiographic environments, which were probably penecontemporaneous. First, an alluvial fan system, in the southern half of the Strath district, and, second, a floodplain system, which drained a metamorphic terrain NE of Broadford, and dispersed towards the SW. The development of the sedimentary basin associated with these rocks is considered in Section (10C) of Chapter 10 and illustrated in (Figure 12).

(F) Jurassic sedimentary rocks

The most complete sequence of Jurassic sedimentary rocks in NW Scotland is preserved on Skye. These strata are exposed, primarily, in three areas: 1. The Strath district, in an arcuate strip of ground running south from Broadford to Loch Slapin, and around Strollamus

1. On the Strathaird Peninsula and in Camasunary Bay
2. North Skye, along the east and west coasts, including the ground south of Loch Sligachan

An excellent summary of the geology of Jurassic sedimentary rocks throughout the Inner Hebrides is provided by Hudson (1983). Details of the succession are presented in (Table 2).

In the Strath district, Jurassic strata disconformably overlie Triassic sedimentary rocks, although locally they rest upon parts of the Torridonian and Cambro-Ordovician successions. In Camasunary Bay, at the southern end of the Blaven ridge, Jurassic strata unconformably overlie Torridonian sedimentary rocks. No bases to the successions on the Strathaird Peninsula and in north Skye are seen.

The lowest divisions of the Jurassic on Skye are of Lower Liassic age and are referred to as the Broadford Beds and the Pabba Beds.

The Broadford Beds were deposited in a nearshore, shallow-marine environment and exhibit relatively large variations in lithology and thickness. They are dominated by micritic and oolitic limestones, sandstones and shales. Bivalves, especially Gryphaea (arcuata) in the upper part, are common throughout the sequence. Coral beds are found at both Ob Lusa (containing Isastrea (murchisoni)) and Breakish (containing Thecosmilia (martini)), between Broadford and Kyleakin. The lower part of the sequence is typically calcareous, whilst the upper beds represent a more argillaceous and ferruginous facies. A significant proportion of the clay present within the Lower Broadford Beds is thought to have been derived from a volcanic terrain (Amiri-Garrousi 1977).

The more offshore Pabba Beds are dominated by shales, although more sandy horizons, representing progressive shallowing of the sea, are present towards the top of the sequence.

Both the Broadford and Pabba Beds are found in the Strath district, and on the coast near Holm Island, 10km north of Portree. In the area south of Loch Sligachan limestones and shales of the Broadford Beds have been thermally-metamorphosed by the intrusions of the Western Red Hills Centre. The presence of Pabba Beds is likely, but lack of fossil evidence and the effects of faulting and metamorphism precludes any detailed studies.

Within the Camasunary Bay area, including the ground to the SE of Blaven, contact-metamorphosed Lower Liassic strata abut against the Camasunary Fault which crosses the east side of the bay (see Section (10D) of Chapter 10). The lithologies of these beds are similar to those described above.
Exposure of the overlying Scalpa Beds (Middle Lias) is restricted to a feather-edge of material on the Strath coast, between Creag Strollamus and Broadford, together with small patches of material on the east side of the Strathaird Peninsula. Lithologically, the Scalpa Beds are identified at a point where the shale of the underlying Pabba Beds gives way to a dominant arenaceous component.

Rocks of Upper Liassic age, equivalent to the Raasay Ironstone and Portree Shales, crop out on the east side of Strathaird, at Faoilean and Dun Liath, where slight crustal flexures brings them above sea-level, and on the east coast of north Skye. Dark shales, together with lesser amounts of chamosite oolite, are the dominant lithologies.

The Middle Jurassic sedimentary sequence on Skye consists of the Bearreraig Sandstone Formation and the Great Estuarine Group.

The Bearreraig Sandstone Formation crops out in three places: (1) at Bearreraig Bay, on the east coast of north Skye (type-locality); (2) on the east side of the Strathaird Peninsula; and, (3) at Strollamus (where they are thermally-metamorphosed). Essentially, the formation consists of: (a) massive, calcareous sandstones, with interbedded siltstones and shales, often rich in calcareous concretions ("doggers"); (b) thick, cross-bedded, calcareous sandstones, also containing calcareous concretions; and, (c) shales. These strata are wholly marine and contain abundant ammonites and belemnites.

Although spectacularly exposed at Bearreraig Bay, these strata are most easily examined on the east side of the Strathaird Peninsula, where they crop out from the coast to the level of the Broadford-Elgol road. Here, the cross-bedded facies is dominant, exhibiting relatively variable palaeo-flow directions.

Hudson (1983) suggests that vigorous erosion of a nearby source and the strong influence of tidal currents has played an important role in the development of the arenaceous rocks of the formation.

Near to the top of the formation is the 10m-thick Garantiana Clay Member, which is rich in ammonites. This rapid change in sediment input is not well understood.

The Great Estuarine Group crops out in three places: (1) on the west coast of the Strathaird Peninsula; (2) at Strollamus (where they are thermally-metamorphosed); and, (3) along the coasts of north Skye, particularly south of Staffin Bay. These strata were deposited in a marine-brackish lagoonal or estuarine environment. The various formations are listed in (Table 2).

At the base of the group is the Cullaidh Shale Formation, consisting of an oil shale which was deposited in a stagnating, restricted basin. This passes upwards, gradationally, into the Elgol Sandstone Formation, which consists of upward-coarsening, deltaic sandstones, also deposited within a lagoonal basin. These deposits show progradation to the south.

The overlying shale of the Kildonnan Member of the Lealt Shale Formation was deposited in marine-brackish lagoons with average summer temperatures of 17–22°C (Tan and Hudson 1974). Mussels covered the floors of these lagoons (for example, *Praemytilus*). At the top of the Kildonnan Member is an algal stromatolite limestone, containing pseudomorphs after gypsum. The overlying Lonfearn Member consists of interbedded shales (containing the branchiopod *Cyzicus*) and limestones (containing ooliths of ferroan dolomite) which were deposited in a shallow-marine environment. Desiccation cracks suggest that occasional emergence took place. Andrews and Hudson (1984) describe the cast of a dinosaur footprint recovered from a fine-grained limestone horizon near to the top of the Lealt Shale Formation.

The Valtos Sandstone Formation consists of sandstones with occasional conglomeratic horizons. Also
present are large calcareous concretions, often in the form of elongate lenses. The dominant sediment source was the mainland, together with lesser material from the Outer Isles. Current-swept accumulations of the bivalve *Neomiodon* are found within the formation.

The Duntulm Formation records a return to marine-brackish conditions, with shales and limestones containing the oyster *Praeexogyra (hebridica)* and the brachiopod *Kallirhynchia*. Also present are nodular algal limestones.

The overlying Kilmaluag Formation consists of intercalated calcareous mudstones and shaly limestones and contains non-marine ostracods and the branchiopod *Cyzicus*. Oysters are not present and an overall period of marine regression is envisaged. Mudcracks are common within the argillaceous horizons.

The Skudiburgh Formation is dominated by red mudstones and siltstones, deposited on alluvial mudflats, together with channel-fill sands. The ostracods which typify the underlying Kilmaluag Formation are not present.

The uppermost part of the Jurassic sequence on Skye belongs to the Callovian, Oxfordian and Kimmeridgian Stages and is dominated by marine shales. These strata have been subdivided into the Staffin Bay and Staffin Shale Formations and are preserved at Staffin Bay in north Skye, on the Strathaird Peninsula (where more sandy facies are found), and in the Strollamus area.

In the type-locality area, the lower parts of the Staffin Bay Formation consist of black shales and shell beds with a brackish-marine fauna. Above, are more sandy horizons, with marine bivalves, passing into, at the top of the preserved sequence, glauconitic sandstones rich in belemnites. The presence of fragments of wood within the shales attests to the nearness of a landmass. On Strathaird, marine sandstones belonging to the Staffin Bay Formation are preserved in the vicinity of Cam Mor, and on the NW side of Ben Meabost, in Glen Scaladal. They contain brachiopods (for example, rhynchonellids) and belemnites.

The overlying, argillaceous Staffin Shale Formation is wholly marine and contains an almost complete sequence of ammonite faunas from Middle Callovian to Lower Kimmeridgian times. Bentonitic clays are important constituents of some of the horizons within the formation and have been interpreted by Knox (1977) as highly altered tuff horizons, erupted during Upper Jurassic times.

**(G) Cretaceous sedimentary rocks**

Exposures of Cretaceous sedimentary rocks on Skye are very limited. Where their presence is suspected, they are generally overstepped by the Lower Tertiary lavas. However, outcrops have been noted on the Strathaird Peninsula, and at Strollamus.

On Strathaird, between Slat Bheinn and the Camasunary footpath, a sandy limestone (chalk) unit passes downwards into a calcareous grit, containing fragments of Upper Jurassic sandstone. This material forms a sequence some 2m thick and is considered to be of Upper Cretaceous age, although no clearly identifiable fossils have been recorded. Better evidence is obtained from the strata at Strollamus, where a limestone (chalk) bed, on top of a calcareous grit, is seen to lie above Upper Jurassic sandstones. These rocks are exposed in both the Allt Strollamus and the Allt Eoghainn, with fragments of the bivalve *Inoceramus* being reported from the limestone in the latter, where the strata reaches a thickness of 5m.
(H) Pre-Tertiary minor intrusions

Several dykes of Pre-Tertiary age crop out within the Pre-Triassic rocks of Skye, especially along the east side of the Sleat Peninsula, and in the district of Strath. They typically trend E-W, and are cut by NW-SE trending dykes of the Lower Tertiary regional swarm (see Section (9B) of Chapter 9). Intrusion of the Pre-Tertiary dykes post-dates all movements of the Moine and associated thrusts (see Section (10B) of Chapter 10). They are presumed to be of Upper Palaeozoic (Devonian) age and related to one, or more, of the Caledonian intrusive complexes which crop out on the mainland (for example, Glenelg-Ratagan). As such, they are better developed on the mainland. The following rock-types are reported by Peach et al. (1910): felsite, porphyry, vogesite, minette, and other extremely altered lamprophyres (referred to as mica-traps). Several of these dykes crop out around the summit of Ben Aslak, at the northern end of the Sleat Peninsula.

References

Appendix 1: Glossary of petrological names and terms

Appendix 2: Glossary of fossil names

Appendix 3: Glossary of place names and grid references

At all times follow: The Scottish Access Code and Code of conduct for geological field work

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