Old Red Sandstone of Shetland, Western outcrops

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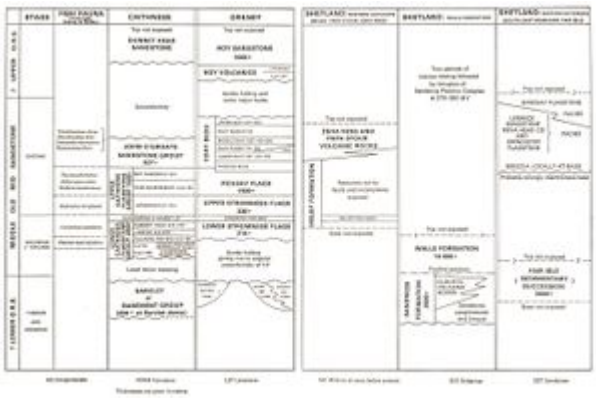
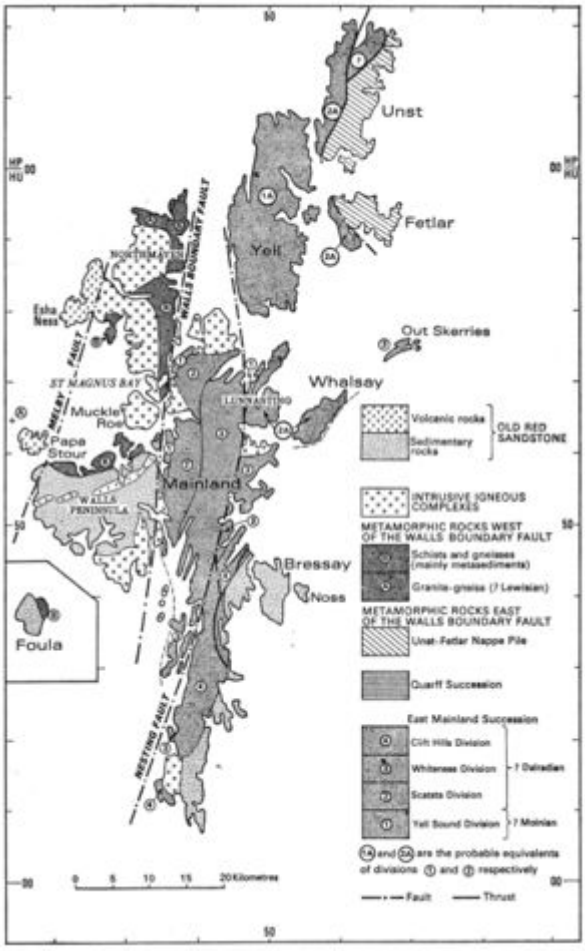
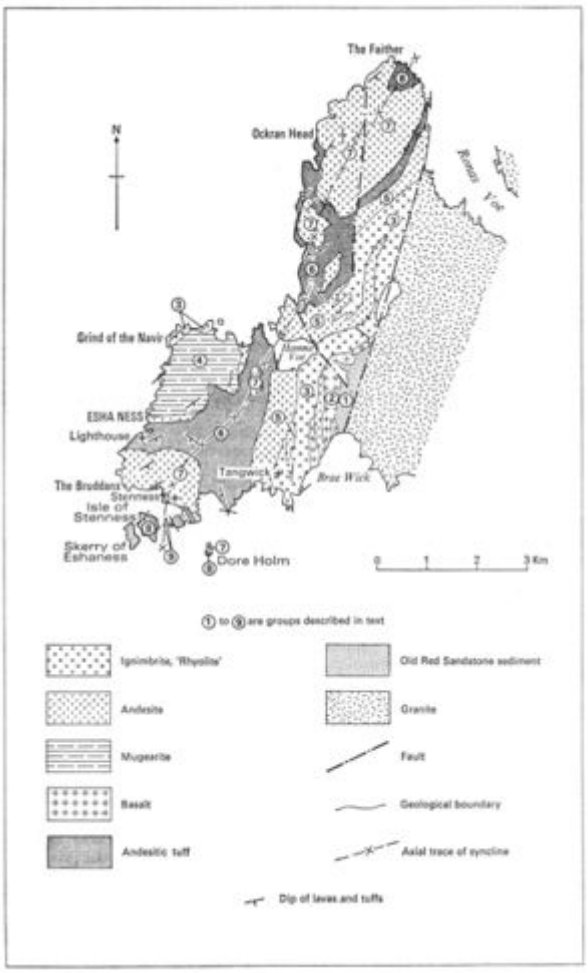


Possible correlation of the Old Red Sandstoneof Shetland, Orkney and Caithness. P915600.



Geological sketch-map of Shetland.
P915566.



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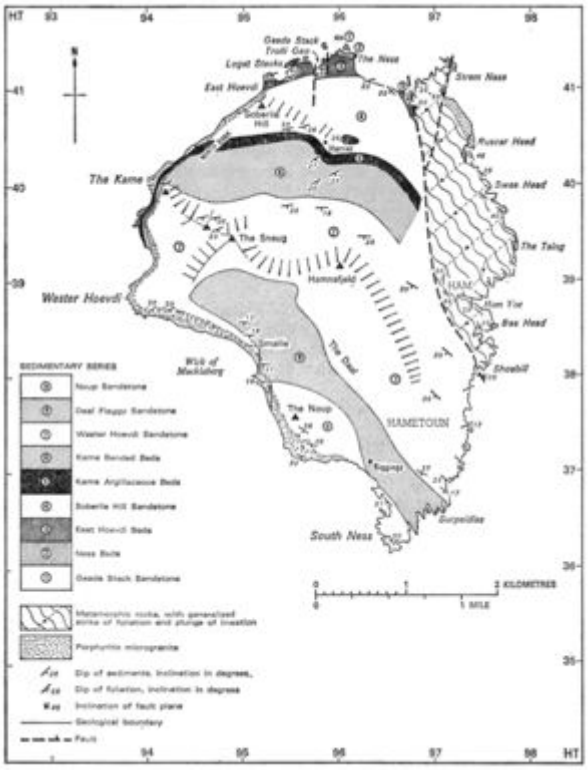

Geological map of Foula. P915577.

West of the Melby Fault Middle Old Red Sandstone sediments and volcanic rocks crop out in the north-west corner of the Walls Peninsula where they are known as the Melby Formation, on the island of Papa Stour, and in Esha Ness on the west side of north Mainland. Old Red Sandstone sediments of uncertain age form the greater part of the island of Foula.

Walls Peninsula

Melby Formation

The rocks ascribed to the Melby Formation consist of buff and red sandstones, pebbly sandstones and sandy siltstones intercalated at the top with two thick flows of silicified rhyolite or ignimbrite. Near the base of the exposed sequence there are two beds of pale grey siltstone and shale with bands and nodules rich in carbonate. These are known as the Melby Fish Beds and they contain both fish and plant remains. The fish fauna includes *Cheiracanthus* sp., *Coccosteus cuspidatus* Miller ex Agassiz, *Dipterus valenciennesi* Sedgwick and Murchison, *Glyptolepis* cf. *leptopterus* Agassiz, *Gyroptychius agassizi* (Traill), *Homostius milleri* Traquair, *Mesacanthus* sp. and *Pterichthyodes* sp. This assemblage is very similar to that of the Sandwick Fish Bed fauna of Orkney, and the fishbeds of the two areas have been confidently correlated. The lower part of the Melby Formation may thus be the stratigraphical equivalent of the Stromness Flags and may therefore range from topmost Eifelian to lower Givetian (P915600).

The sediments below the rhyolites can be divided into two major groups:

1. The lower group contains the two fish beds set in a sequence of red and buff cross-bedded sandstones. The sandstones are of fluvial origin and were deposited by currents from the west or west-north-west. It is possible that this part of the Melby Formation was laid down close to the north-western margin of the shallow but extensive Orcadian Basin. For most of the time

the area was part of an alluvial plain or fan but on two occasions it became submerged under the waters of a temporarily transgressing lake. The periods of submergence are now represented by the fish beds. The lake in which one or both of these beds was laid down may have extended to Orkney and Caithness, where it gave rise to the Sandwick Fish Bed and Achanarras Limestone respectively.

2. The upper group contains thick beds of pink feldspathic sandstone with clasts of rhyolite and basalt and many plant fragments together with thick beds of purplish bioturbated sandy siltstone. These strata appear to have been deposited by currents from the east-north-east. Prior to and during the deposition of these beds the earlier topography and drainage pattern of the area were probably drastically altered by outpourings of volcanic rocks, which led to the formation of volcanic hills to the north-east of the present outcrop. The thick beds of purple sandy siltstone are of a type normally laid down in relatively quiescent waters, suggesting that some of the drainage may have been ponded to form local lakes.

Papa Stour

The island of Papa Stour (P915566) consists of two thick flows of rhyolite with intercalated tulfs, underlain by basalts and sandstones. It is possible that the rhyolites are the equivalents of the rhyolitic flows in the Melby Formation and that the basalts are represented farther south by thin basalt flows exposed on the Holm of Melby (HU 193 585). The rocks of Papa Stour also resemble the lower part of the Esha Ness volcanic sequence, with which they have been equated.

The sequence and approximate thickness of the volcanic and sedimentary rocks is as follows:

	Thickness (m)
Upper rhyolite	85 +
Rhyolitic tuff and agglomerate	2.5 – 24
Lower rhyolite	0 – 40
Rhyolitic tulf and tuffaceous sandstone in west, passing into sandstone with tuffaceous bands in east	0 – 30 +
Basalt (up to 4 flows exposed)	24 +

The basalts generally have thick scoriaceous upper zones, with vesicles filled with chalcedony, calcite, barytes and zeolite. Agates with barytes cores are present in some exposures and along the south coast fluorspar, heulandite and stilbite have been recorded. In the east of the island the highest basalt is truncated by an uneven erosion surface which contains small channels filled with the overlying sandstone, but in the south-west it is overlain by basaltic rubble. The rhyolitic tuff above this rubble not only rests on an undulating floor but is itself truncated by an irregular erosion surface. The tulf passes eastward into a much thicker sequence of sandstone with tuffaceous bands and with some beds of red bioturbated sandy siltstone. The two flows of rhyolite form the impressive orange-red sea cliffs of Papa Stour, which on the west coast are cut by long interconnected sea caves eroded along joint planes and faults. The rhyolite is strongly banded, generally sparsely porphyritic and, in many areas, full of minute spherulites. In places along the north-west and south coasts it contains larger closely packed near-spherical bodies which are up to 4 cm in diameter. These are known as lithophysae. The tuffaceous deposit between the two rhyolite flows is well exposed on the north-west coast of the island, where it rests on an uneven strongly eroded floor of rhyolite (P218521).

The Papa Stour rhyolites are completely devitrified and recrystallised and little of their original texture remains. All remaining textural evidence, such as the steeply inclined flow banding with aligned spherulites and lithophysae, suggests that the rhyolites originated as flows or domes of obsidian. The rhyolitic tuffs are probably mainly lithified air-fall deposits, originally composed largely of pumice clasts.

Esha Ness

The Old Red Sandstone rocks of Esha Ness (P915576) occupy the ground west of the probable northward extension of the Melby Fault, which here extends from Brae Wick north-north-eastwards to the mouth of Ronas Voe. The rocks consist mainly of a series of lavas, tufl"s, agglomerates, and ignimbrites, and they are folded into a shallow north-north-east trending syncline, which plunges north-east in the northern part of the area and south-west in the southern. The sequence of lavas and tuffs is most fully developed in the southern part of the area, where the succession is as follows:

9. Andesitic lavas
8. Bedded andesitic agglomerate, tuff and subordinate sandstone
7. Andesite of The Bruddans and Stenness
6. Coarse andesitic tuff and bedded agglomerate
5. Andesite-thick on east limb, but thin and discontinuous on west limb of syncline .
4. Mugearite-thick in north-west of Eshaness Peninsula, but thinning out eastwards. Absent on east limb of syncline
3. Ignimbrite and ? rhyolite. Exposed at the Grind of the Navir on the west limb of the syncline; intercalated with acid andesites (item 5) along the east limb of syncline
2. Intercalated olivine-basalts and andesites, with lenticular beds of tuff and tutfaceous sandstone (exposed on eastern limb of syncline only)
1. Reddish purple micaceous sandstones and tuffaceous sandstones.

The andesites are generally fairly acid and commonly decomposed. Both the tuffs and andesites give rise to spectacular cliffs and off-shore stacks. They are strongly jointed and break readily into large blocks which have been piled up on high-level storm beaches along the coast. The ignimbrite forming the Grind of the Navir contains flattened and welded pumice clasts and shards, which are well seen on the weathered surfaces (P219097).

The three lowest divisions of the Eshaness succession could be the equivalents of the Papa Stour rocks, but correlation over a distance of nearly 15 km in a sequence of lenticular lavas and pyroclastics must be regarded as highly tentative. It has been suggested that the volcanic rocks of Papa Stour and Esha Ness could be the time equivalents of the tuflaceous beds in the Upper Stromness Flags of Hoy in Orkney (Wilson and others 1935, p. 69)[1], but the present writer believes that they are more likely to be equated with the volcanic rocks in the Eday Flagstones, particularly as pebbles of basic and acid lavas similar to those of West Shetland are common in the Middle and Upper Eday Sandstones of Eday, which indicates that basic and acid lavas were exposed to erosion when the higher Eday sandstones were being laid down.

Foula

The greater part of the Island of Foula is formed of up to 1800 m of soft, buff-weathering sandstones with subordinate shales and siltstones (P915577). The sandstones are generally medium-grained and contain small scattered pebbles of quartz and granite. Many of the sandstones are cross-bedded and the inclination of foresets suggests that they were laid down by the currents of rivers which entered

the area from the west or north-west. Some of the shales are red and many contain sun cracks, indicating that they were deposited in shallow water. A few of the siltstones and mudstones contain plant remains, but, though these are of Devonian aspect, they are not sufficiently diagnostic to provide a precise date for the age of the sediments (Recently identified spores from the Foula sediments suggest that these rocks are of Middle Old Red Sandstone age (R. N. Donovan, personal communication)). The sedimentary rocks are separated from the metamorphic rocks to the east by a north-north-west trending fault, which at its southern end appears to have a very small downthrow, suggesting that the unconformable junction between the sedimentary sequence and the metamorphic basement may be at no great distance below sea level. The structure of the sedimentary rocks of Foula is an open southward-plunging syncline.

Bibliography

Full bibliography list

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