South Fersness Bay, Eday, Orkney

[HY 531 346]–[HY 543 332]

E.A. Pickett

Introduction

The South Fersness Bay GCR site extends for about 2 km along the south-west side of Fersness Bay on the west coast of Eday. It lies on the western limb of the Eday Syncline and provides a complete section through the Lower Eday Sandstone, Eday Flagstone and most of the Middle Eday Sandstone formations of the Middle Devonian Eday Group. The oldest part of the sequence is represented in the western part of the site by the Rousay Flagstone Member (forming the upper part of the Upper Stromness Flagstone Formation). The site is important because it contains an uninterrupted, well-exposed and accessible section through much of the lower part of the Eday Group. The rocks are not only representative of the stratigraphy of this part of the Orcadian Basin, but also contain a range of sedimentary structures that suggests the interaction of several depositional environments, including lake-beach, lake, braided river and aeolian dune-field. The site is therefore very important in palaeoenvironmental interpretations and for comparison with sites elsewhere in the Orcadian Basin.

Description

The rocks at the site young from west to east and form the western limb of the Eday Syncline, the axis of which runs approximately north-south through the centre of Fersness Bay. At the western end of the site, Fers Ness is composed of about 170 m of the Rousay Flagstone Member (formerly the Rousay Flags) at the top of the Upper Stromness Flagstone Formation (Figure 2.33). These comprise grey, Baggy rhythmic sequences of laminated, fish-bearing mudstone, siltstone and fine-grained sandstone. A distinctive pebbly sandstone at the top of the Rousay Flagstone Member (the Sacquoy Sandstone Member) is about 4 m thick and contains pebbles of quartzite, psammite and dolomitic limestone, with lesser amounts of quartz, granite and chert (Astin, 1990).

The Sacquoy Sandstone Member is overlain by the Lower Eday Sandstone Formation, which is about 200 m thick and consists of two main facies types (Mykura, 1976; Astin, 1985). The lower fades comprises reddish purple, medium-to coarse-grained, trough cross-bedded sandstone. Pebbly lenses and conglomeratic beds lie about 30 m above the base. The pebbles in the conglomerate are up to 7 cm across and include pink granite and pegmatite, granitic gneiss, quartzite, chert and vein quartz, with lesser amounts of sandstone (Mykura, 1976). The upper facies is a predominantly yellow, medium-grained, planar and trough cross-bedded sandstone with fewer pebbles.

The overlying Eday Flagstone Formation is relatively thin (less than 20 m) at this locality and consists of two cycles with fish beds. The cycles comprise a basal finely laminated fish-bearing fades, and overlying fiaggy siltstone and mudstone with subordinate sandstone which pass up into bufl yellow or red sandstone and sandy siltstone.

A higher fish-bearing, calcareous siltstone [HY 530 335] lies about 110 m above the base of the overlying Middle Eday Sandstone Formation. The Middle Eday Sandstone Formation is an orange-yellow, pebbly and locally conglomeratic, trough cross-bedded sandstone containing scour structures, pebbly lags, mudstone rip-up clasts, convolute bedding and ripple-drift lamination (Figure 2.34). Some parts of the section contain abundant pebbles, up to 6 cm across, of quartz, porphyritic and spherulitic rhyolite, scoriaceous basic lava and granite/gneiss. The rocks locally display carious 'honeycomb' weathering and diagenetic red and yellow mottling.

Interpretation

The rhythmic units or 'cycles' that form the Rousay Flagstone Member of the Upper Stromness Flagstone Formation are interpreted as reflecting fluctuations in water-level and sediment input into a large, shallow lake that extended across

Orkney and Caithness in Mid-Devonian times (e.g. Fannin, 1970; Mykura, 1976; Astin, 1990). The development of the Orcadian Basin was probably tectonically controlled, with the rhythmic sedimentation being caused by the interplay of tectonic and climatic changes. The dark, calcareous, fish-bearing siltstone/mudstone laminites at the base of each cycle represent deposition from suspension when the lake was at its deepest. Progressive shallowing culminated in mudflats that periodically dried up. Alluvial fans prograded across the shallow or dried-up lake floor producing fine-grained, rippled sandstones and siltstones. These fluvial sediments were deposited as sheet-flood and channel sands and show sediment transport to the south and southwest (Astin, 1990). The base of the following cycle is marked by an abrupt reversion to the deeper-water fish-bearing facies.

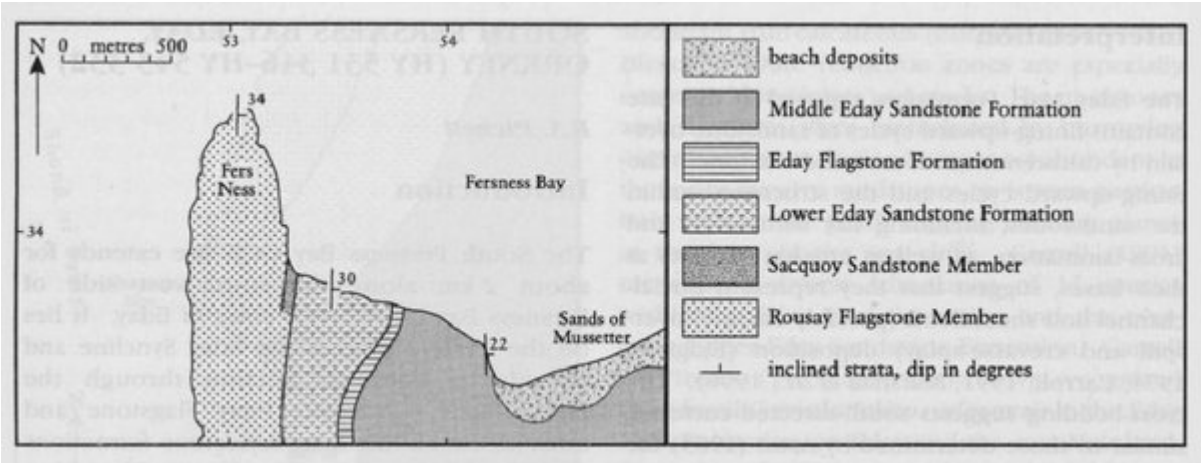
The Rousay Flagstone Member passes up into the Sacquoy Sandstone Member, which has distinctly different palaeocurrent directions, having been deposited from eastward-flowing rivers. This marks the first incursion of alluvial-fan sediments prograding from the northwesterly basin margin, probably sourced from metamorphic rocks or older Devonian conglomerates lying to the west and exposed as a result of footwall uplift on a basin-margin fault (Astin, 1990). The lower facies of the overlying Lower Eday Sandstone Formation was probably deposited in the channels of large, fast-flowing rivers in a fan system prograding southeastwards. The yellow sandstones of the upper facies include large-scale cross-bedded dune sets up to 3.5 m thick and are interpreted as aeolian sands (Astin, 1985). In western Eday (e.g. [HY 535 336]) these aeolian sandstones form part of a distinct unit up to 70 m thick, interbedded with fluvial sandstones.

The Eday Flagstone Formation represents a break from the predominantly fluvial regimes of the Lower and Middle Eday Sandstone formations and a return to cyclic, lacustrine sedimentation. However, in contrast to the Rousay Flagstone Member, the cycles contain thick channel-fill sequences of yellow and red sandstones. As with the Lower Eday Sandstone Formation, palaeocurrents indicate flow towards the south-east. The thick channel-fill sandstones indicate that the lake was fed by larger and higher-energy rivers than those present during deposition of the Rousay Flagstone Member. The overlying Middle Eday Sandstone Formation is entirely fluvial, and this, together with SE-directed palaeocurrents, shows that a fan system similar to that of the Lower Eday Sandstone Formation prograded over the whole area.

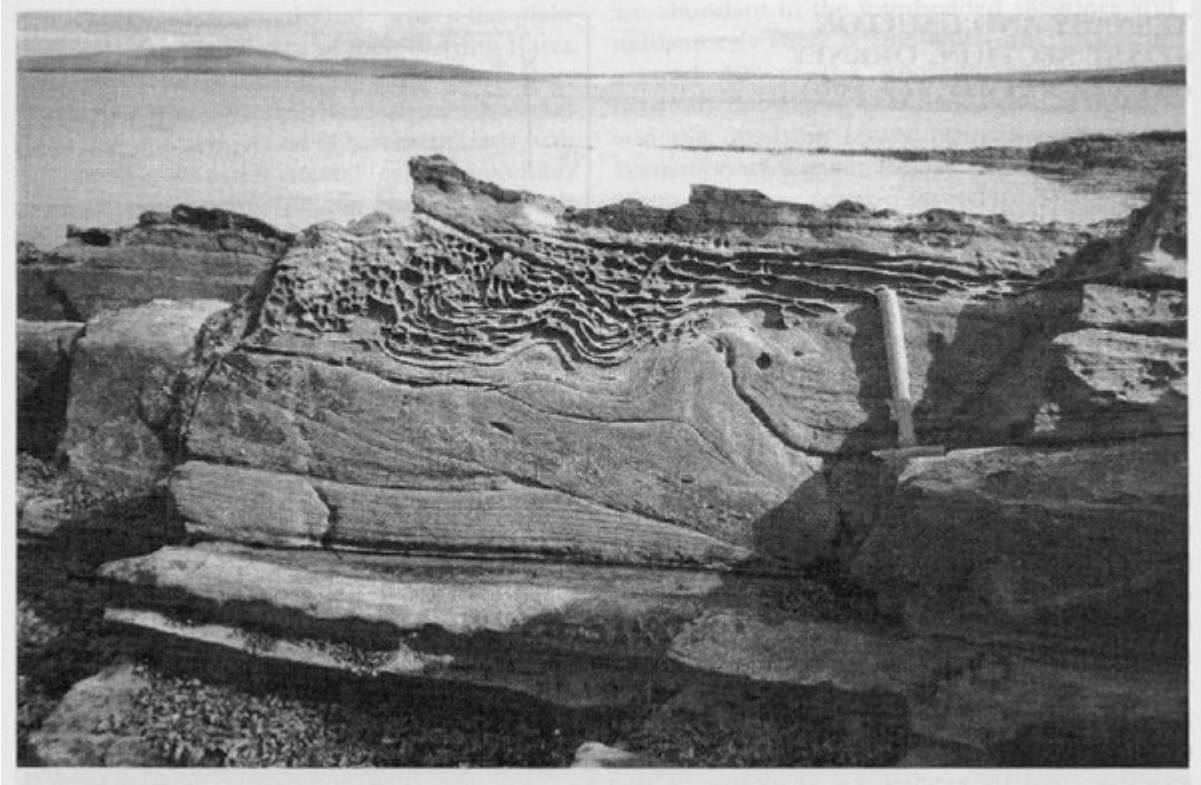
Conclusions

The site at Fersness Bay is very important in the reconstruction of environments existing in the Orcadian Basin during Mid-Devonian times. The site provides a complete section through the Lower Eday Sandstone, Eday Flagstone and most of the Middle Eday Sandstone formations. The sequences record changes in the environment of deposition within the Orcadian Basin from lakes to mudflats to aeolian dune-fields and alluvial fans. Against this background of overall shallowing, smaller-scale fluctuations and periodic returns to deeper water are recorded in the cycles of the Rousay Flagstone Member and the Eday Flagstone Formation. These probably reflect the interplay between climatic changes, basin subsidence and sedimentation rates and tectonic activity along basin-bounding faults.

References



(Figure 2.33) Geological sketch map of the south-west side of Fersness Bay. Based on Mykura (1976) and British Geological Survey (1999).



(Figure 2.34) Middle Eday Sandstone Formation at Fersness Bay showing cross-bedding, convolute bedding and calcareous weathering. View towards the ENE. (Photo: E.A. Pickett.)