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# Greenan Nev Coast, Eday, Orkney

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## Introduction

This site extends for about 700 m around the point of Greenan Nev on the west coast of Eday and provides one of the best sections through the Eday Marl Formation in Orkney. It is the only accessible section of the formation in Eday, exposing the entire thickness, and it is the type section of the formation. The site lies on the eastern limb of the Eday Syncline, the axial trace of which passes just offshore from Greenan Nev. The site is especially important for palaeoenvironmental interpretations of late Mid- to early Late Devonian times as it preserves well-exposed floodplain sandstones, calcareous mudstones and siltstones with fossil carbonate soil (calcrete) horizons, a facies association not observed elsewhere in the Orcadian Basin. The presence of abundant trace fossils including *Beaconites* and *Cornulatichnus* also adds to the importance of the site by providing further information on the depositional environments, and the habitats and types of animals that lived in the Orcadian Basin during Mid- to Late Devonian times.

## Description

At Greenan Nev (Figure 2.31), the Eday Marl Formation comprises several fining-upward sequences consisting of buff, dean, fine- to medium-grained sandstone beds up to 2 m thick, interbedded with up to 15 m of bright red, calcareous mudstones and sandy siltstones (Figure 2.32). The sandstone beds are finely laminated and cross-bedded, with foresets picked out by red coloration. They commonly contain reddish wisps of calcareous mudstone, fine mudstone partings and red mudstone rip-up lasts. Some sandstone beds have undulose bases with erosion of and slight loading into, the underlying calcareous mudstones. Sandstones containing convolute bedding and trough and tabular cross-bedding occur in an outcrop of Eday Marl Formation at the Bay of Berstane on the Mainland (Marshall *et al.*, 1996).

The red mudstones and siltstones are micaceous and contain ripple marks, desiccation cracks, small scours, hard calcareous layers and abundant pale calcareous (calcrete) concretions. Bleached white reduction zones are especially common along joints and cracks. The mudstones and siltstones were bioturbated by burrowing organisms, bioturbation being most abundant in the more massive mudstones, as is seen particularly well on the gently dipping bedding planes at the base of the sea cliffs. Carroll (1991) recorded a diverse ichnofauna of 11 species within the Eday Marl Formation and the overlying Upper Eday Sandstone Formation. Carroll and Trewin (1995) described a newly recognized trace fossil *Cornulatichnus edayensis* in the Eday Marl Formation on Eday and the east Mainland, examples of which were observed at this site. The trace consists of a sub-vertical, downward-tapering conical burrow up to 40 cm long with a wide sub-circular cross-section up to 9 cm wide. Carroll and Trewin (1995) also recorded large back-filled burrows identified as *Beaconites* along with *C. edayensis* in the Eday Marl Formation.

The ratio of sandstone to mudstone increases northwards and up-sequence and there is a gradual passage into the overlying Upper Eday Sandstone Formation approximately at the northern boundary of the site.

## Interpretation

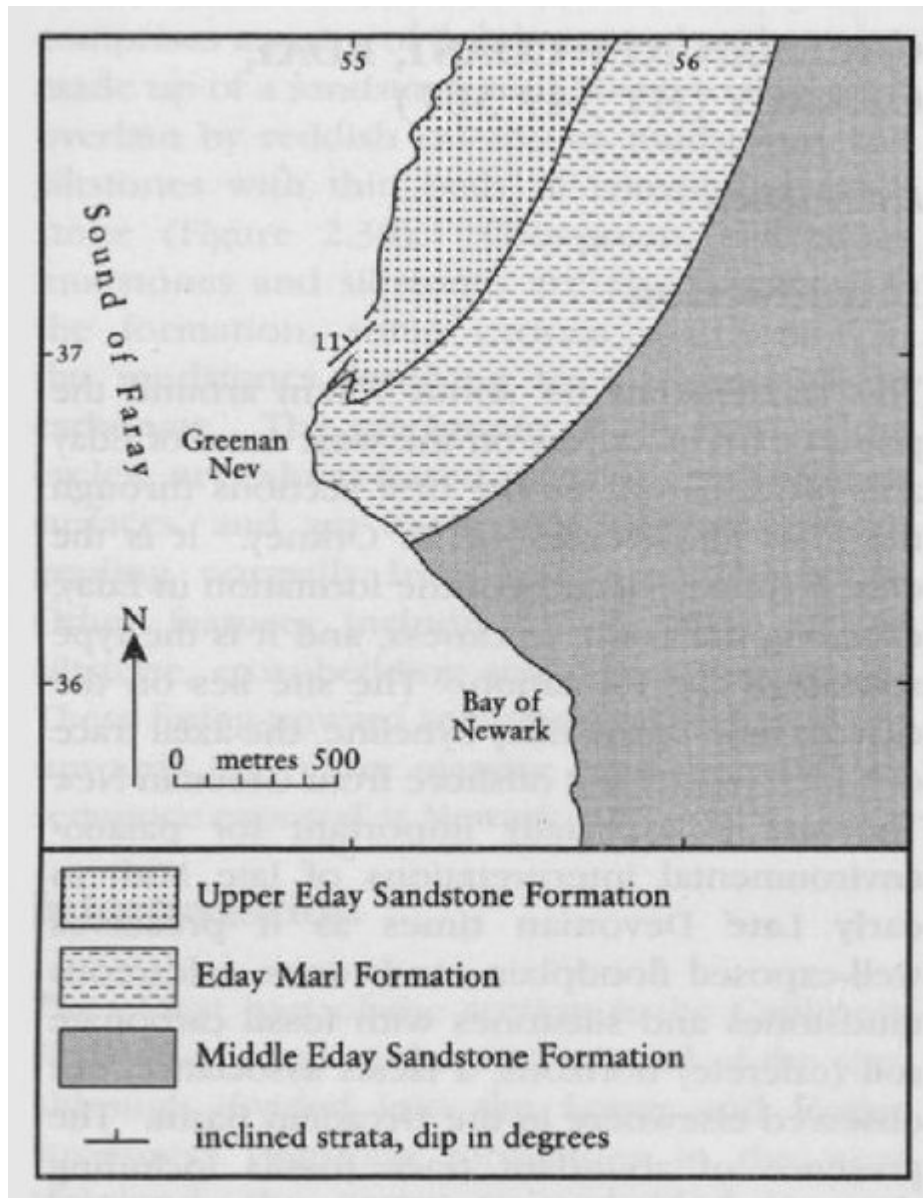
The Eday Marl Formation exposed at this site contains fining-upward cycles of sandstone overlain by calcareous mudstone and siltstone. The fining-upward cycles and the structures within the sandstones, including flat lamination and cross-lamination, as well as erosion surfaces at their bases, suggest that they represent fluvial-channel and sheet-flood (possibly channel overspill and crevasse-splay) deposition (Ridgway, 1974; Carroll, 1991; Marshall *et al.*, 1996). The cross-bedding suggests south-directed currents, similar to those determined by Astin (1985) for the Lower Eday Sandstone Formation.

The calcareous mudstones and siltstones were interpreted as floodplain overbank deposits by Mykura (1976) and as floodplain lake deposits by Ridgway (1974) and Carroll (1991). The trace fossils within the Eday Marl Formation were interpreted by Carroll and Trewin (1995) as the subaqueous shelter burrows of eel-like fish. Periodic and prolonged drying out of the floodplain is indicated by desiccation cracks and calcrete horizons. Sparite-filled vugs in the Eday Marl Formation on the Mainland have been interpreted as the moulds of evaporite nodules that formed in a sabkha-type environment (Marshall *et al.*, 1996). The marine microfauna, and pseudomorphs after halite, described by Marshall *et al.* (1996) in the Eday Marl Formation at the Bay of Berstane on the Mainland (see GCR site report, this chapter) suggest periodic marine inundation of the sabkhas and floodplains in mid- to late Givetian times.

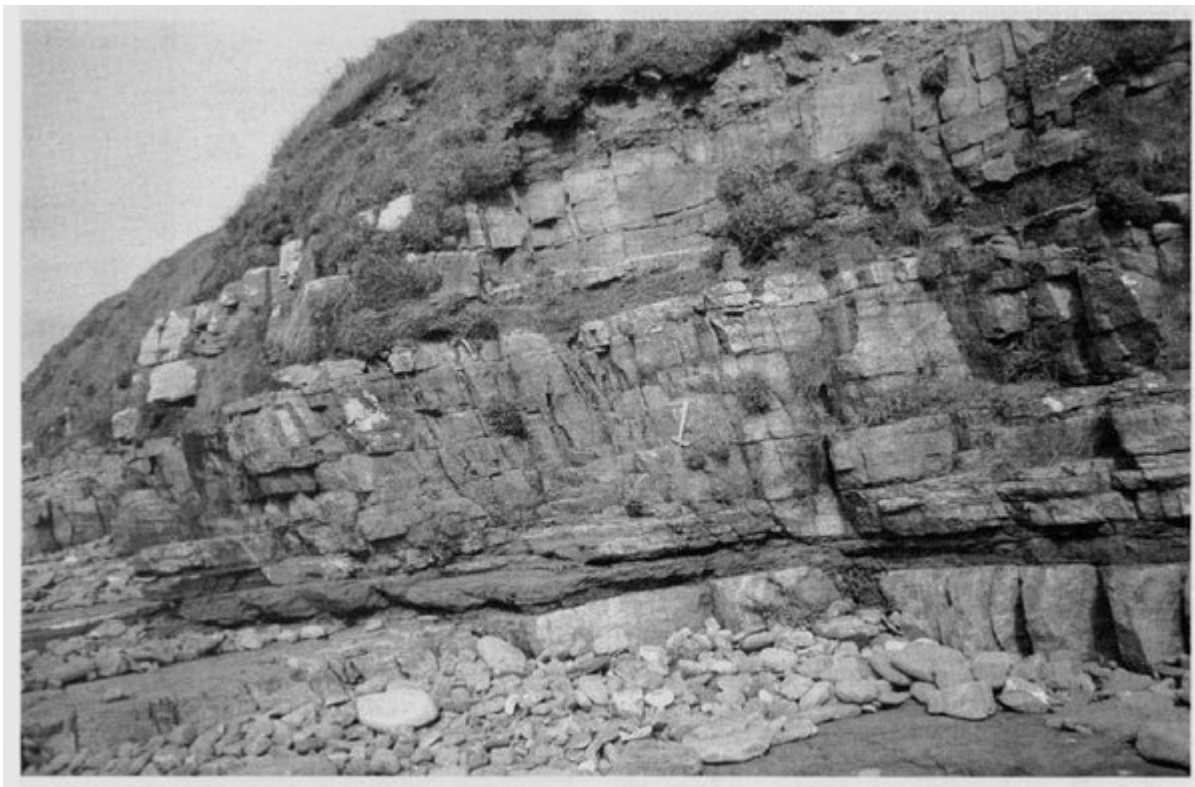
## Conclusions

This site is important as the type section of the Eday Marl Formation. It contains a well-exposed range of the rock types and sedimentary and biogenic structures that characterize this formation. The rocks are interpreted as flood-plain sediments with associated river channel deposits, evaporitic sabkha deposits, pedogenic carbonate (calcrete) horizons and evidence of burrowing by eel-like fish. This represents an environment which is not found elsewhere in the rock record of the Orcadian Basin and is therefore of great significance in palaeo-environmental reconstruction and the overall interpretation of the Mid- to Late Devonian evolution of the Orcadian Basin.

## References



(Figure 2.31) Geological sketch map of the Greenan Nev area. After British Geological Survey (1999).



*(Figure 2.32) Interbedded red marl and sandstone of the Eday Marl formation at Greenan Nev. View towards the north-east. (Photo: E.A. Pickett.)*