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## ELC\_3: Gin Head (near Tantallon Castle)

### Site information

#### Location and summary description:

Gin Head is a rocky peninsula c. 300 m to the north-west of Tantallon Castle. The rocks exposed in the rock platform at the base of the cliffs are of primary interest: however, access to the site is difficult and dependent on the tides. Fossils, including the jawbone of a Lower Carboniferous tetrapod, ostracods, lungfish toothplates and wood, have been found historically at the site, making it extremely important for understanding Lower Carboniferous fauna.

#### National Grid reference:

Mid-point: [NT 59439 85331]

**Site type:** Natural section; Natural exposure

**Site ownership:** unknown

**Current use:** Open country

**Field surveyors:** Rachael Ellen, David Millward

**Current geological designations:** Firth of Forth SSSI, GCR (Quaternary and Coastal)

**Date visited:** 16th September 2014

**Other designations:** within North Berwick – Dunbar AGLV, Firth of Forth Ramsar

### Site map

(Figure 8) Gin Head (near Tantallon Castle) Location Map. The site boundary has been drawn to include all of the Ballagan Formation bedrock exposure at Gin Head, as well as the intertidal beach at the west of the site. The beach is mapped here as a geologically significant site area, as boulders containing fragments of tetrapods and other Lower Carboniferous fossils have been found here in recent times.

### Site description

#### Background

Gin Head lies 4 km to the east of North Berwick, along an uneven, rocky, tidal coastline. The lower jawbone of a tetrapod was discovered within sedimentary rocks of the Ballagan Formation here in 1977. The time-span from the end of the Devonian to the early Carboniferous represents an important era in the evolution of tetrapods (i.e. limbed vertebrates). During this 20 million year period, known as 'Romer's Gap', tetrapods evolved from aquatic, fish-like creatures into amphibian-like terrestrial forms. Vertebrate fossils had been previously unknown world-wide from this period. However, an increasing number of vertebrate fossils are being found for the first time from sites in south-eastern Scotland from the Ballagan Formation. This area is thus of international significance in the understanding of this critical adaptation in tetrapod evolution from aquatic to terrestrial environments, and is one of only two such areas in the world at present where this can be studied (the other is in Nova Scotia, Canada).

The tetrapod fossils are being investigated by the TW:eed Project (a scientific research collaboration between academic institutes and partners, including the BGS).

## **Sedimentary rocks**

The sedimentary rocks of the uppermost part of the Ballagan Formation are exposed at this site and consist mostly of a fluvial pink-white, medium-grained sandstone with subordinate mica-rich siltstone beds. These rocks contain a range of sedimentary structures; most notably, striking cross-bedding (ELC\_3\_P1), erosional channel sand bodies, desiccation cracks within rare mudstones, and ripples within mudstones and siltstones (ELC\_3\_P2). The strata include a fossiliferous limestone-conglomerate which has yielded tetrapod remains. Whilst this unit was not found in situ at time of site visit, boulders of it were identified near the high tide mark. The fossiliferous rock is composed of clasts of mudstone and sandstone in a carbonate matrix, along with abundant ostracods, bivalves and rarer fossilised wood, gyrocanth spines, lobe-fin fish scales and lungfish toothplates. This rock is interpreted to have been deposited as an accumulation of rock clasts, organic and animal remains at the bottom of a shallow pool set in a fluvial environment.

## **Structural geology**

Excellent examples of deformation bands cutting the sandstones are found across the site, creating minor (cm-scale) displacements across the sequence (ELC\_3\_P3). Larger faults are also present, conspicuous by linear absences of rock across the platform. Some of the smaller fault planes are filled with a clast-supported breccia, containing angular fragments of the surrounding sandstone: it is possible these represent cryptic vents where gas streaming along a fracture has deformed the rock relatively in-situ, rather than related to tectonic deformation.

## **Access and additional information**

The site is accessed only by a rough traverse along slippery intertidal rocks. The site is cut off by the tide and so knowledge of tide times prior to visit is essential. Access to the west is achieved by walking along the A198 (there are no pavements and care should be taken on the road) toward the private road leading to Canty Bay residential houses. The private road leads downhill until a sharp left hand bend, where the road can be exited to the right, for a footpath heading eastward. The path eventually dies out and access by walking along the shingle is possible until the Gin Head promontory. At this point access is restricted to low tide.

## **Stratigraphy and rock types**

**Age:** Lower Carboniferous

**Formation:** Ballagan Formation

**Rock type:** Sandstone, siltstone and limestone

## **Assessment of site: access and safety**

**Road access and parking** Park either at Tantallon Castle, or with permission, at the farmstead at Castleton.

**Safety of access** This site is not easily accessible. It must be approached from the west along an intertidal slippery rocky foreshore. Extreme care should be taken when accessing the site, and appropriate footwear worn, and tide tables checked and adhered to. Care should be taken if approaching the site via the A198 – this can be a very busy road and there are no pavements.

**Safety of exposure** The rock exposure itself is an intertidal rock platform, and as such can be slippery underfoot and have deep rock pools. As with all coastal sites, stout footwear should be worn and care taken. There are steep cliffs with loose material. Hard helmets are recommended if working close to the cliff.

**Access** Access along the shore and by coastal footpaths.

**Current condition** The rocks are generally clean from barnacles and seaweed in the upper parts of the exposure, but generally covered nearer the low tide mark.

**Current conflicting activities** None.

**Restricting conditions** Weather and tide: access and exposure are located within the intertidal zone, and access can be very easily cut off if due attention is not paid

**Nature of exposure** Rocky foreshore

## Assessment of site: culture, heritage & economic value

**Historic, archaeological & literary associations** A decommissioned second world war radar station is situated on the cliffs above the site. The deception and jamming operations tested here were key to the success of the D-Day landings in Normandy on 6th June 1944. Tantallon Castle lies to the south-east.

**Aesthetic landscape** Views toward Bass Rock and Tantallon Castle

**History of earth sciences** Recorded find of tetrapod limb in 1977.

**Economic geology** No known association

## Assessment of site: geoscientific merit

	Rarity	Quality	Literature/Collections	Primary interest
Lithostratigraphy				
Sedimentology	Local	Good		
Igneous/Mineral/ Metamorphic Geology				
Structural Geology	Local	Excellent		
Palaeontology	International	Excellent	Day (1928)	X
Geomorphology				

## Site geoscientific value

The site displays a good range of sedimentary rocks and associated structures within Lower Carboniferous strata. The rocks of the Ballagan Formation exposed at this site and at several others in south-eastern Scotland are one of only two areas known in the world where the fossil record within Romer's Gap can be studied to understand a crucial period of Earth's History. This site is therefore of international significance.

Gin Head provides a good example of sedimentary rock structures within Lower Carboniferous rocks, with international palaeontological significance.

## Assessment of site: current site usage

**Community** The site itself is little visited. It is likely only visitors with specialised interest would visit.

**Education** Due to the site's relative inaccessibility, the site would not be recommended for school visits, on-site interpretation nor geo-trails. However, because of its international significance the site should be noted for its research and higher/further education potential.

## Assessment of site: fragility and potential use of the site

**Fragility** Weathering/erosion; sample/fossil collecting; development of coastal defence may affect the geodiversity.

**Potential use** Research, higher/further education

## Geodiversity summary

The site provides good examples of sedimentary rocks originally deposited within a fluvial environment during the early Carboniferous. Dry periods forming small, shallow pools surrounding the fluvial environment preserved a selection of vegetation and animals from the Lower Carboniferous, fossilised within the rock record. The site is of international significance due to recorded findings of tetrapods from this site, which have previously not been found in rocks of this age across the world. The site itself is difficult to access and as such is not suitable for any large number of visitors, but should be given geodiversity status due to its international significance, research, higher and further education potential.

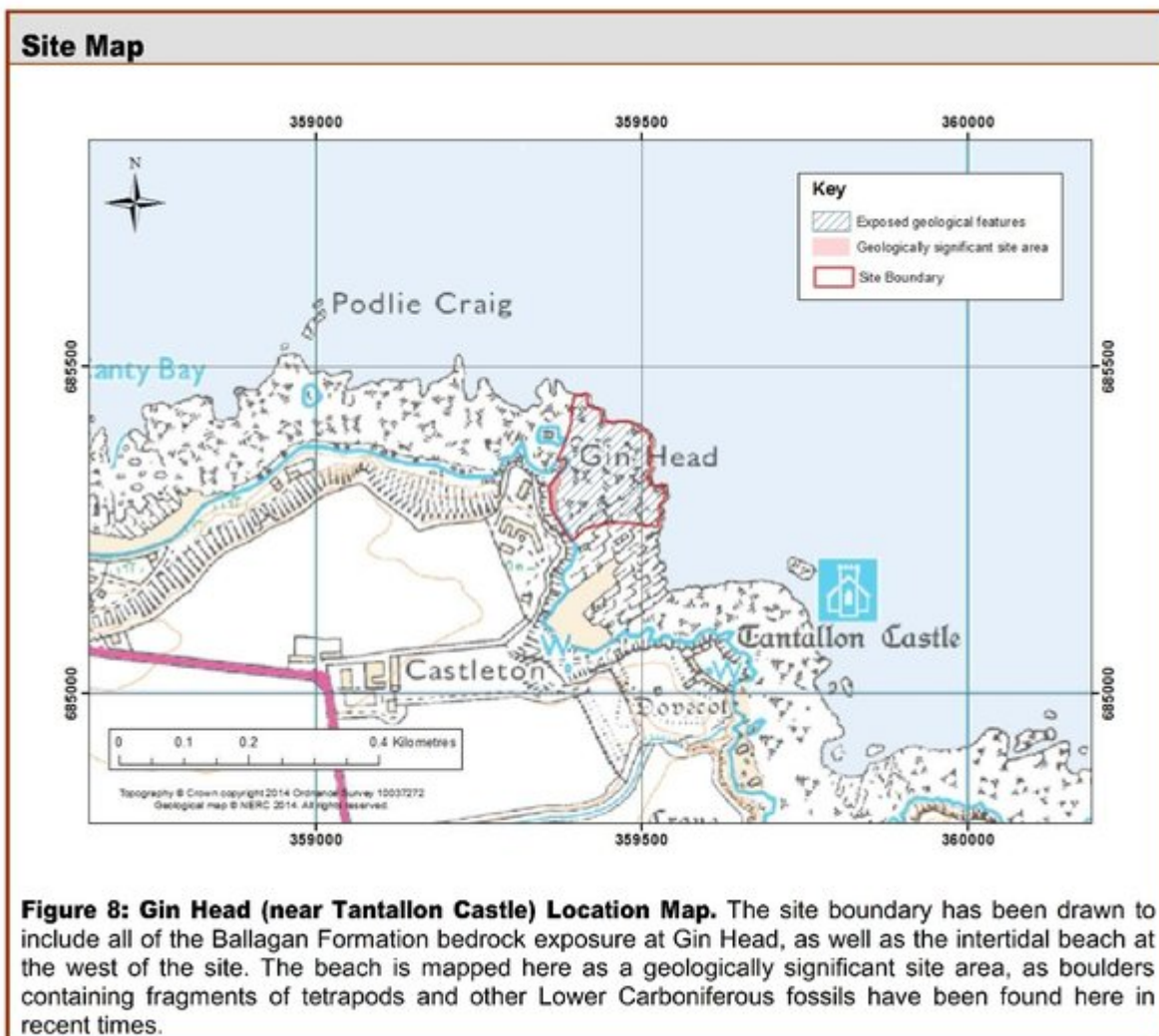
## Site photos

(ELC\_3\_P1) Trough cross-bedding developed within fluvial sandstones of the Ballagan Formation. Note the sub-horizontal bedding in the foreground is truncated by the cross-bedded layer, suggesting the cross-bedding developed within a river channel that actively eroded earlier deposits. Photo looking toward the north-east. © BGS, NERC.

(ELC\_3\_P2) Ripple lamination within sandstone and siltstone lithologies across the site are common. This photo shows a cross-section through a rippled sequence of siltstones. © BGS, NERC.

(ELC\_3\_P3) Deformation bands (linear bands produced by faulting, composed of crushed quartz grains with a component of displacement) cross cut sedimentary layering across much of the site. These bands are associated with cm-scale displacements, and deformation (folding or buckling) of the sedimentary layering. © BGS, NERC.

## References



(Figure 8) Gin Head (near Tantallon Castle) Location Map. The site boundary has been drawn to include all of the Ballagan Formation bedrock exposure at Gin Head, as well as the intertidal beach at the west of the site. The beach is mapped here as a geologically significant site area, as boulders containing fragments of tetrapods and other Lower Carboniferous fossils have been found here in recent times.



(ELC\_3\_P1) Trough cross-bedding developed within fluvial sandstones of the Ballagan Formation. Note the sub-horizontal bedding in the foreground is truncated by the cross-bedded layer, suggesting the cross-bedding developed within a river channel that actively eroded earlier deposits. Photo looking toward the north-east. © BGS, NERC.





*(ELC\_3\_P2) Ripple lamination within sandstone and siltstone lithologies across the site are common. This photo shows a cross-section through a rippled sequence of siltstones. © BGS, NERC.*



*(ELC\_3\_P3) Deformation bands (linear bands produced by faulting, composed of crushed quartz grains with a component of displacement) cross cut sedimentary layering across much of the site. These bands are associated with cm-scale displacements, and deformation (folding or buckling) of the sedimentary layering. © BGS, NERC.*