

## AN EXTENSION OF THE WELL-KNOWN QUATERNARY SECTION AT GODREVY, ST IVES BAY, WEST CORNWALL: ANALYSIS AND REVIEW



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The well-known section Quaternary section at Godrevy, west Cornwall has been often described during the past half century, however, a further section, about a kilometre to the south is considered for the first time since a brief mention at the beginning of the last century. This 200 m long exposure rests upon a raised shore platform and consists of a basal raised beach and littoral sand, overlain by a local diamict revealing evidence of post-depositional frost disturbance and finally Holocene dune sand. It is proposed that this Strap Rock site be included within the general discussion of the Godrevy section.

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### INTRODUCTION

The well-known Quaternary site at Godrevy on the eastern side of St Ives Bay in West Cornwall (NGR SW 581429) has been frequently described and discussed since De la Beche (1839) and most recently summarised in Campbell *et al.* (1998). The significance of the 800 m north-south section extending from Godrevy Point (NGR SW 579434) to Magow Rocks (NGR SW 582422) has been assessed by geologists with a variety of specialised interests over the past 40 years or so, for example, Hosking and Pisarski (1964) who conducted geochemical analysis of the cements of the basal conglomerate of the raised beach, Stephens (1961) discussed a possible geochronology (Hoxnian) for the raised beach, Moraweicka (1993) examined the palaeokarst/sandrock phenomena at Godrevy, while James (1975) described the decalcified content of the pipes in the sandrock following a cliff collapse. Later, James (2004) discussed the vertically disposed clasts within the upper sections of the head at Godrevy as possible evidence for former permafrost conditions in the area.

The 800 m long Quaternary section at Godrevy between Godrevy Point and Magow Rocks is separated from the new section at Strap Rocks (NGR SW 578416) to the south by the 700 m wide valley of the Red River flowing into St Ives Bay. The main aim of this paper is to describe the sedimentology of the Strap Rock Quaternary sediments through the use of sediment logs and cross-sections in order to compare them with those previously published for the more extensive Godrevy section to the north.

### BACKGROUND

The Quaternary section at Strap Rocks is located at the northern end of Gwithian Towans sand dunes near a life guard hut and slipway (NGR SW 578416). The site may be divided into a 50 m long east-west section at the northern end which then continues north to south via two small coves for a further 50 m

on the western exposure. The Quaternary sediments rest upon an extensive wave moulded shore platform, cut across locally resistant blue slates and intruded vein quartz of the Porthowan Formation. This raised shore platform is c. 6-8 m above Ordnance Datum (O.D.) that is similar in height to a levelled notch (platform/palaeocliff junction) south of Godrevy Point. At Strap Rocks the raised platform extends c. 30 m offshore and is typical of similar extensive morphological features in the area (James, 2001-2002).

Contemporary coastal erosion processes have lead to the formation of fresh, recently eroded vertical cliffs (to the south and east) within the arenaceous turbiditic facies of the Porthowan Formation on either side of the resistant headland which has preserved the Quaternary exposures. Fragments of the local diamict or head may be found at the top of the vertical cliffs and it may be assumed that any evidence for any former platform and palaeocliff has been removed. In places to the east of the northern section, the vertical cliffs appear to be heavily weathered and form a saprolite surface (see Shail, 1989). Within a short distance, the vertical cliffs to the west and south of the Strap Rocks site are replaced by a sand dune coastline, for example, Gwithian and Upton Towans. In contrast, the resistant raised blue slate platform, where well exposed, contains excellent examples of honeycomb weathering typical of this rock type (see Mottershead, 1982) and is comparable with similar structures found at Godrevy about 1.5 km to the north.

The raised shore platform at Strap Rocks is overlain by 3-5 m of Quaternary sediments similar to those found further north at Godrevy. However, those at Godrevy tend to be much thicker in total, for example, 8-10 m near Godrevy Point. The basal, rather weakly cemented conglomerate at Strap Rocks consists of up to 90% well rounded cobbles of slate (occasionally discoid in shape) and vein quartz in a very coarse sand matrix before passing upwards into a quite well sorted medium-coarse sand unit with occasional local pebble lenses. Reid and Flett (1907) described the occasional presence of rounded clasts of granite, elvan,

greenstone and spotted hornfels with the raised beach. No molluscan material was found within the raised beach sediments in this investigation. The contact between the sand unit and the overlying diamict is not always planar and this head unit contains essentially angular local material in a variably clast to matrix supported environment. Stephens (1961) described wedge like structures at this contact further east and north in the Godrevy section.

The average thickness of the overlying diamict is 1.0 m and it locally contains evidence for post-depositional disturbance with vertically disposed angular clasts in the upper sections as described at Godrevy and elsewhere in the county (James, 2004). Finally, the diamict passes upwards into another weakly cemented reddish-brown palaeosol unit before being overlain by c. 0.5-1.0 m of Late Quaternary (Holocene) dune sand.

Further exposures of Late Quaternary raised beach and diamict on the western side of St Ives Bay are limited to embayments around the town of St Ives. Reid and Flett (1907) refer to sections, now very restricted in extent, at Porthgidden Beach (NGR SW 521411) and at the St Ives "Island" (eastern end of Porthmeor Beach, NGR SW 518410). Remnants of a raised shore platform cutting across the igneous metadolerite rockhead, overlain by pebbles of local rock and matrix supported diamict (head) with sharply angular clasts of metadolerite, are found at both sites. St Ives Head or Island is currently linked to the mainland by late Quaternary sediments and was undoubtedly an island during periods of higher sea level. No further exposures of raised beach sediments survive at Porthmeor Beach with local head only being found at Carrick Du (NGR SW 513408) in the west.

Thus the Late Quaternary (Pleistocene) sections in St Ives Bay are limited to the eastern (Godrevy/Strap Rocks) and western (St Ives) extremities and are separated by a substantial sand dune coastline (locally known as "Towans"), the Hayle Estuary (Hayle Bar) and near vertical cliffs, for example, Porthminster Point (NGR SW 524399), together totalling c. 9 km.

## DISCUSSION

There are a number of morphological, lithostratigraphic and sedimentological similarities between the main Godrevy Quaternary exposures between Godrevy Point (GNR SW 579434) and Godrevy Cove near Godrevy steps (GNR SW 581429) and Strap Rocks as well as some distinct differences.

## Geomorphology

The raised shore platform is cut across the local rockhead at both sites at c. 6-8 m O.D. but a distinct platform/palaeocliff junction or notch is locally present at Godrevy. The notch at Strap Rock, possibly because of the highly weathered nature of the raised platform near the junction with the palaeocliff, is therefore much less distinct. At both sites the raised shore platform may be traced for some distance offshore, c. 100 m at Godrevy and 30 m at Strap Rocks. However, the raised platform exposures around St Ives on the western side of St Ives Bay are much less restricted possibly as a result of the greater resistance of the metadolerite to initial formation, compared with the varying weaker facies of the Porthowan Formation on the eastern side of the bay. In addition, exposure to prevailing and dominant winds may also have contributed to these contrasts.

However, a major difference in the characteristics of the geomorphology of Strap Rocks and Godrevy to the north is the availability of cross sections cut into the Strap Rock exposure thereby providing opportunities to trace the raised platform into the palaeocliff on both sides of the headland (Figures 1 and 2). Whereas the sections at Godrevy are almost exclusively strike exposures, the cross sections at Strap Rocks reveal more conclusive evidence for the origin of the overlying Quaternary sediments.

## Lithostratigraphy

Again there are clear similarities between both sites with a basal conglomerate overlain by thick units of cobbles and pebbles, marine and aeolian (littoral) sands with occasional pebble lenses, a local diamict (head) and finally post Last Cold Stage dune sands. Occasionally at both sites large boulders underlie the basal conglomerate. However, at the main Godrevy site(s), (erratic) material is located in direct contact with the raised platform, for example, large fine-grained basic igneous boulders. Arguably these may be derived from Cornish basic sills and dykes further north and should be classified as non local rather than as erratics. These non-local igneous boulders are absent from the Strap Rocks site, although, as at the notch near the steps at Godrevy Point, large blocks from the local rockhead may be found in direct contact with the platform at Strap Rocks which are generally indicative of the proximal position of the palaeocliff.

The above descriptions of the Late Pleistocene sedimentary units, that is, the raised beach and the overlying head may be incorporated within the lithostratigraphic models proposed by Scourse (1996) for north and west Cornwall. Thus the widely-distributed raised beach sediments constitute the Godrevy Formation with the overlying slate/vein quartz head making up the Penwith Formation (see figure 6, p. 28, Scourse and Furze, 1999).



Figure 1. South to North 'dip' section at Strap Rocks.



Figure 2. East to West section through the Penwith Formation at Strap Rocks.

## Sedimentology

The rather rare availability of cross sections through the exposures at Strap Rocks reveal a low ridge (1.0 m high) of uncemented rounded clasts (beach pebbles and cobbles) dipping towards the buried fossil cliff c. 5 m further onshore (Figures 1 and 2). Underlying this ridge is a 10-15 cm indurated basal beach conglomerate which is in direct contact with the raised shore platform. This fossil pebble beach is in turn overlain by medium-coarse sands c. 1-1.5 m thick. In some cases pebbles occur in the lower part of this unit.

This unique presence of dip sections through the exposures at Strap Rocks is interpreted as a fossil storm beach barrier which could have impounded a former marsh in front of the low fossil cliff. Hosking and Pisarski (1964), in their explanation for the presence of both manganese and iron oxide cements within the basal raised beach at Godrevy (see their figure 3), suggest the need for a brackish water environment with oxides of manganese and iron derived from the local rockhead being forced to flocculate by the injection of salt water associated with the construction of the raised beach sediments. The Strap Rock section demonstrates this possibility via the dip sections with the basal raised beach being indurated and the upper part of the marine unit remaining uncemented. There is no evidence that the coarse pebble raised beach, cemented or otherwise, consists of anything other than one unitary interglacial unit (probably MIS 5e) (see Bowen *et al.*, 1985).

The c. 1.0 m thick local diamict (head) shows extensive post-depositional disturbance with involutions and examples of vertically inclined local clasts. Such features may be taken as indicative of at least severe frost action and possibly sporadic permafrost conditions within the low angle head terraces which cap the marine deposits (James, 2004). However, there is no evidence of such disturbance within the raised beach deposits as is described elsewhere, for example, Alderney (James and Worsley, 1997) and Northern France (Renouf and James, 2001) suggesting that such cold conditions did not penetrate as deeply at Strap Rocks. Evidence for much deeper permafrost conditions were demonstrated in the Godrevy sections north of the Magow Rocks (James, 2004, figure 2). There is insufficient Late Quaternary sediment to demonstrate such disturbance within the limited sections that survive at St Ives at the western end of the bay.

## CONCLUSION

The discussion of the geological characteristics of the new site at Strap Rocks confirms many sedimentological similarities with the well-known Godrevy exposures 1-2 km to the north on the eastern side of St Ives Bay. In particular the Godrevy Formation, although attenuated at Strap Rocks, can be shown to extend across the Red River to the south (see figure 2, Hosking and Pisarski, 1964, showing the position of the "Old Red River" just north of Strap Rocks). Thus it is proposed that the Strap Rocks section be incorporated with general discussions of the Late Quaternary exposures at Godrevy. Very little remains of any similar age exposures on the western side of St Ives Bay. This brief paper extends our knowledge of the existing Late Quaternary sites on the north coast of Cornwall, i.e. Fistral near Newquay and Trebetherick near Padstow although further work on restricted exposures between St Ives and Porth Nanven near St Just (NGR SW 356309) may offer further information on local similarities and variations within this area of west Cornwall.

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