Jersey Geology Topics

Illustrated Notes on Recent Studies.

La Bonne Nuit Trail.

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La Bonne Nuit Trail.

La Bonne Nuit Raised Beaches Revealed.

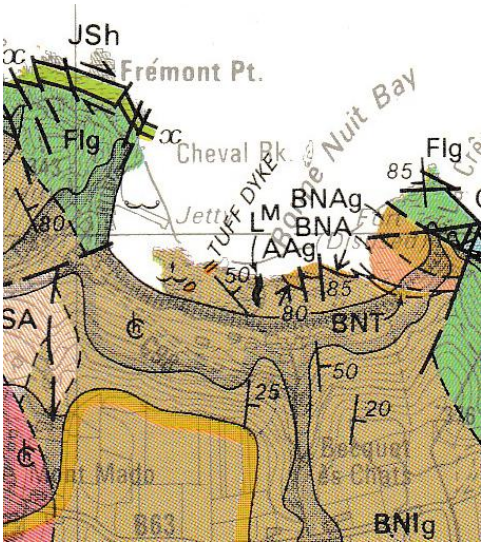

Fig. 1.

At Bonne Nuit, the raised beach deposits are exposed in the cliffs above the beach rocks of the bay (**Fig. 1.** IGS 1:25,000, 1982) on the north coast of Jersey in the parish of Trinity. The bedrock was examined in 2005 as part of a study of Dr. Mourant's work on the spherulitic rhyolites. They were found to be ignimbrites with possible spherulites and flattened pumice textures **(Figs. 2, 3).**

Fig. 2.

Fig. 3.

and agglomerate sections overlain by tuff, andesite and agglomerate at the eastern end of the bay as described by Bishop & Bisson (1989).

The raised beach deposits in the cliff section at the back of Bonne Nuit Bay **(Figs. 4, 5)** are a striking example of the effects of sea level rise and fall during the later stages of the last ice age, and rank with other striking ones seen by the author at Portelet Bay and on the west side of Noirmont south of La Cotte de St. Brelade.

Fig. 4.

Fig. 5.

They were not examined in this cliff section however, until later visits with J. Sonnex during her UCL Birkbeck Honours dissertation studies in 2009 and with Dr. Martin Bates (UW Lampeter) during his Quaternary geoarchaeology studies of La Cotte de St. Brelade in 2010. The cliff section is very well exposed and reveals a thick sequence of Pleistocene deposits with a fine cross section and stratigraphic sequence of raised beach, loess and head facies.

From the slipway at the western end of the bay by the jetty, and from the eastern end of the beach wall it was found that within the beach and the cliff, **there are three raised beach pebble beds** exposed representing former sea levels, two in the present day beach and one in the cliffs at the back of the beach.

The first or lowest exposure is of a ferruginous, pebble and coarse sand deposit at c. mid-tide level.
The second, next highest, exposures are of rounded pebbles in a brown to green, silty clay matrix (not sampled) almost hidden below the boulders approximately half way up the present beach.
The third, is higher again, and occurs in the lowest part of a sequence of various yellow-brown silty clays, possible loess, and head, and seems to be a strand of pebbles which are matrix-supported, near the base of the cliffs at the back of the beach; this is possibly the 8m raised beach.

The first raised beach deposit crops out in the lower part of the present day Bonne Nuit beach and lies on bedrock and underneath the present large boulders.

Fig. 6.

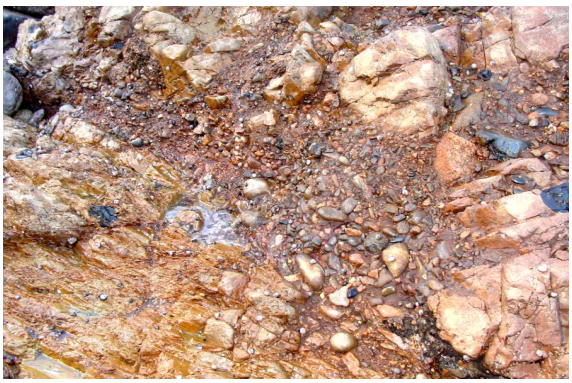

Fig. 7.

It is a brown, well-cemented ferruginous pebble deposit with laminated coarse sand layers which lies on and against the bedrock c.10 - 15m from the end of the sea wall and c. 40m down beach **(Figs. 6, 7)**.

In December 2012, a striking view of the deposit was obtained as present day backwash had removed the beach shingle and a more extensive outcrop was revealed which showed a thicker

deposit, c.1m of the conglomerate lapping around prominent parts of the uneven eroded, surface of the rhyolite bed rock.

The deposit is unsorted and the pebbles vary in size. They are well rounded but of low sphericity and are grain-on grain as well as matrix supported. They consist of a mixture of local rocks, eg. the underlying ignimbrite but also of grey shale or dolerite pebbles (not sampled) and some larger, c. 10-15 cm rounded quartz pebbles. The laminated (bedded) coarse sandstone and fine grit parts of the sequence form lenses of varying thickness, shape and extent between the poorly sorted pebble intervals.

This deposit was the lowest deposit found and seems to occur lower down the beach (no levelling was done) below the second type of which no previous description has yet been found but it may not have been exposed in 1978 (Keen, 1978)..

This well cemented ferruginous conglomerate is assumed to be the one described by Mourant (1933, p. 59) as “a hard ferruginous conglomerate” and “a cemented ancient beach deposit” (Mourant, 1935, p. 489). It is also described by Keen (1978, p. 9) as the only beach gravel to be seen and is " a coarse, iron-cemented, sandy shingle....attached to the rock platform” 45m seaward of the modern cliffs. Mourant (1935, op. cit.) thought that the deposit "may belong of the **25ft.** raised beach” but that it is possible it may “represent a distinct horizon”. It was also described by Bishop & Bisson (1989, p. 85-86) in the 8m beach descriptions as ‘beach gravel strongly cemented by ferruginous minerals’

Fig. 8.

Fig. 9.

The second raised beach deposit is thought to form a separate deposit because the outcrops are exposed in several places slightly higher up the beach between 10 - 20m further east (again no levelling was done), that is, part way between the ferruginous well-cemented deposit and the cliff deposits.

These deposits are similar to each other and are at the same elevation. They are exposed in cavities under large boulders as if having been eroded away as the boulders were undercut by wave action. In contrast to the red-brown ferruginous conglomerate, they are non-ferruginous and semi-indurated pebble deposits seemingly in a dark grey-brown soil-like, sandy clay groundmass (not sampled due to difficult access). They are often green-coloured due to a thin covering film of algae **(Figs. 8 & 9).** Given the seemingly different elevations between the two different beach gravel/pebble conglomerates and their position below of the strand line of pebbles in the superficial deposits of the cliff, are they each separate deposits, or are they parts of the same 8m beach deposit which have formed under differential physico-chemical weathering and lithification conditions due to either their different positions in the beach, or to those different conditions prevailing at different times?

The third raised beach deposit (8m) crops out in the cliff sequence as a well-exposed, excellent outcrop of a thin strand line of rounded pebbles just above the base, with interbedded yellow, silty clays (some laminated), other thin strands of raised beach pebbles and gravel and glacial head layers **(Fig. 10)**.

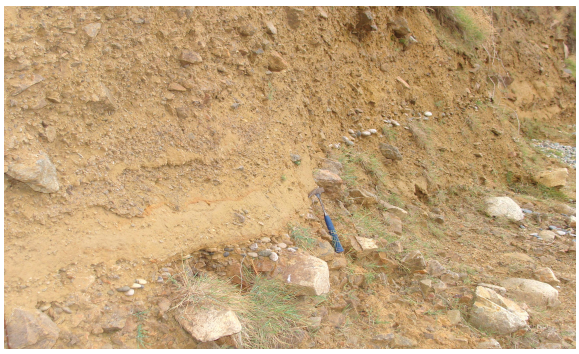

Fig. 10.

Fig. 11.

The section exhibits well-sorted intervals alternating with intervals containing scattered large angular blocks all along the back of Bonne Nuit Bay. The pebbles are well rounded but of variable sphericity, some being oval, and are poorly sorted, that is, they are matrix-supported being surrounded by brown-yellow clay-silt, and rarely show grain-on-grain structure **(Fig. 11).**

The strand-like appearance is not uniform along the outcrop and variation in the form of the raised beach deposits occurs at the eastern end of the cliff where one can descend from the cliff top beyond Le Cheval Roc via a steep path to the eastern end of the beach. For example, there are gully accumulations **(Fig. 12)** of pebbles and silt lenses from possible lagoon/pool **(Fig. 13)** which lie below pebble deposits & head along this part of the outcrop.

Fig. 12.

Fig. 13.

Above the raised beach and possible lagoonal deposits, beds of glacial head occur between a dipping, lower laminated silt (base) and a grey silt bed which cuts across it**;** some of these intervals show wedging or thinning **(Fig. 14)** where a mid-section, pale grey bed, c. 30cm thick provides a good marker half way along the bay. Some layers seem to be truncated by overlying beds **(Fig. 15).**

Fig. 14.

Fig. 15.

Fig. 16.

The whole sequence seems to represent periods of marine advance (pebble strand); lagoon-pool conditions; fluvial deposition, for example, the apparent cross-bedded part; followed by later glacial head formation (gelifluction deposit) and some thin loess (aeolian) deposits. The raised beach deposits have also been described by Bishop & Bisson (1989, p. 83) who also interpreted the head deposits as forming under variable conditions (op. cit. pp. 85 - 88).

Summary.

The possibility that the three pebble deposits represent three former sea levels and three distinct beaches was raised by Arthur Mourant when he stated that the ferruginous deposit which crops out “at a little above mean tide level…..may belong to the 25ft. raised beach but it is possible that they represent a distinct horizon” (Mourant, 1935, p. 489).

This raises the question that given their elevations above the Fe deposit, are the other pebble deposits also distinct horizons, therefore representing pauses in sea level rise below 25ft.(8m), separated by periods of deposition under sub-aerial conditions. The well-cemented ferruginous deposit seems to be much older, with time allowed for possible oxidation and lithification to occur. The type of iron is not named, nor have the conditions of formation been discussed, that is, is it an example of subaerial or shallow depth diagenetic ferruginisation, or of leaching and precipitation of an Fe-rich leachate by ground water as in the present cliff **(Fig. 16),** but within a since-eroded superficial deposit? The intermediate level deposit is much less indurated as are the pebble deposits at the base of the cliffs.
They could also represent parts of a diachronous deposit with three periods of still-stand to permit beach formation, and therefore the lower two are evidence of earlier raised beaches than the 8m one.

Brief Geological History.

In this part of Jersey, after the volcanic episodes which produced the rhyolites and ignimbrites (St. John's Rhyolite Formation) and the overlying spherulitic, flow-banded rhyolites (Bouley Rhyolite Formation), the intrusion of the NW Granite (or Igneous Complex) occurred and was followed by uplift and erosion to produce the Rozel Conglomerate Formation.
There then seems to have been a long period of weathering and erosion, deposition of Tertiary Eocene limestones around us and then several regressions and transgressions during the Pleistocene glacial and interglacial periods which produced interbedded loess, head and raised beach deposits respectively.

The raised beach deposits of Bonne Nuit Bay are varied and seem to represent a variety of conditions, not always seen in other deposits around the island. The variations in the deposits south of La Cotte de St. Brelade seem to bear comparison with the ones described above starting with a lower, well-cemented former beach shingle. The sequence of raised beach, loess and head is thought to represent the change from interglacial to glacial conditions with the advance and retreat of the sea, but also may have been combined with the rise and fall of the land due to partial isostatic rebound.
The ferruginous cement of the lowest raised beach could have formed from iron transported in solution by sea water or groundwater; the nearest sources of iron being the underlying volcanic bedrock and the overlying head and loess. It was then possibly oxidised under sub-aerial conditions to form the present very well cemented ferruginous beach deposit seemingly before the deposition of the upper raised beaches.

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