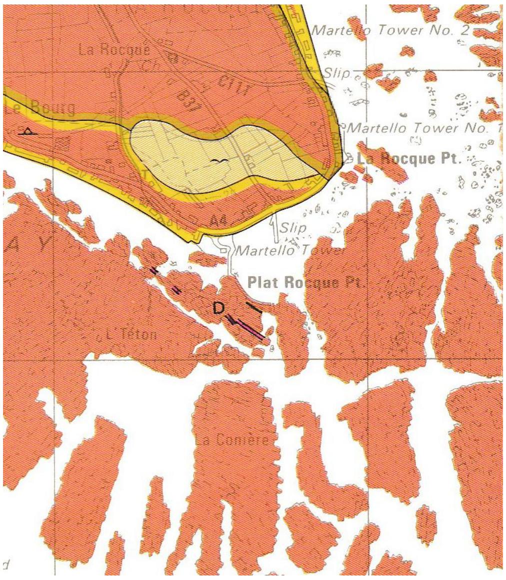
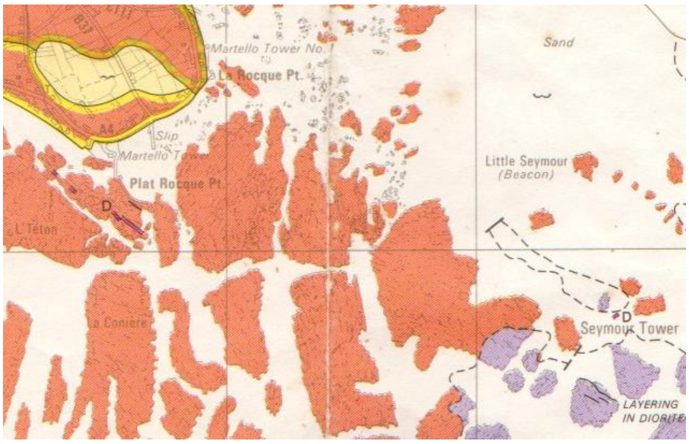
Seymour Tower Trail.

Granites, dykes, Silts (?loess), sands, grits & Mid-tide beach conglomerates.

1. Seymour slipway to Seymour Tower.





Figs. 1 a, b.

Silty clay forms horizontal to sub-horizontal deposits in hollows of various dimensions in the SE granite **(Figs. 1 a, b)** and is the most extensive deposit in the localities examined along and adjacent to the track (not marked) from the first slipway N of La Rocque between Seymour slipway and Seymour Tower, via the Refuge **(Fig. 2).** It varies from grey to yellow-brown in colour and crops out as inliers (‘windows’) in the present day sands and gravels and in the pools of the SE granite wave-cut platform on either side of the white marker track from the slipway to the tower **(Figs. 3, 4, 5).**

Between Seymour slipway and Seymour Tower, this littoral zone or beach area is periodically covered and uncovered by superficial, present day beach sand and grit deposits and so the silty clay appears and disappears, but many have been GPS - plotted by Dr. A. Hill during the last few years (pers. comm.). Standing water pools in the south eastern area may indicate the presence of a more continuous layer underneath the beach sands, grits and pebbles, than at the other localities.

Fig. 2.

Fig. 3.


Fig. 4.


Fig. 5.

2. L'Angliaiche to Le Téton.

Loess? silt, sand, grit and Mid-tide beach deposits.

The following deposits, found by La Société Jersiaise members Paul Chambers and Nick Jouault, are like the grey, but unlike the yellow and brown, clayey silts found by Arthur Hill and later by the author, near the Refuge further north between Seymour slipway and Seymour Tower.
Here, beds of light grey, brown-stained, consolidated silt and sand beds with scattered grit clasts and some quartz and rare flint crop out in the littoral zone SE of La Rocque harbour around the stacks named L'Angliaiche **(Fig. 1, south centre)** and Le Téton **(Fig. 1, centre west).** Above them, a thin outcrop of conglomerate of small to large, angular to rounded pebbles and cobbles in grey sand and silts form a separate outcrop and are thought to be part of a former beach conglomerate in the intertidal zone. In addition, a mica (minette) dyke and a wide quartz dyke, not recorded on the map, also crop out SE of the harbour.
The fine grained, grey-brown beds crop out around the base of L'Angliaiche (Fr. L'Anglaise), and lie on the granite bedrock, lapping around its uneven surface. The thickness is unknown and can't be determined as the base was not seen. In parts of the outcrop there are also brown patches or staining, indicating Fe precipitation between impressions of clasts removed by erosion **(Fig. 6)**. The deposits are uniformly grey, fine-grained silt and fine sand, possibly with some clay. They show polygonal cracks, seemingly dessication cracks of different dimensions, and contain scattered gravel and rare cobbles of granite, quartz, rare flint between impressions of clasts presumably removed by erosion **(Fig. 7)**.


Fig. 6.


Fig. 7.

The large clasts vary in colour, size and shape, from orange to grey, from 5-10cm, and from sub-angular to elongate. The rock types vary from granite to greywacke and banded diorite **(Fig. 8, 9).**

Fig. 8.

Fig. 9.

Mid-tide beach conglomerate.

Above this horizon, and further away, coarser, grey beds,30-60cm thick, of poorly sorted, well-cemented pebbles and cobbles of varying size and shape, some angular, some long and thin with rounded edges **(Fig. 10),** and others, wedge shaped with rounded edges in a finer, grey matrix **(Fig. 11).** One part of the outcrop consists of a thin wedge of finer grey sediments overlain by a wedge of a coarser purple-coloured finer pebble bed under a granite boulder **(Fig. 12)**, and another part consists of a large granite boulder lying in, and surrounded by the finer sediment which has been compressed around it **(Fig. 13)**. The large pebbles and cobbles vary in colour from orange to grey and brown, in size from pebbles and cobbles, 10-15cm across, to small boulders, in shape from sub-circular pebbles to elongate and triangular large cobbles, and in rock type from orange, medium crystalline granite to greywacke and possibly maroon-brown rhyolite. Varying degrees of rounding and sphericity are also seen, from angular to sub-rounded and rounded, with low in the larger clasts to high sphericity in the pebbles. The smaller pebbles are often grain-on-grain supported in contrast to the larger ones which are often matrix-supported.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

Further west across expanses of sand and small lagoons, is Le Téton, the highest part of a mass of low reefs and stacks SW of La Rocque harbour. A different deposit crops out between the reefs and low stacks. It is much thicker, with c. 1.5 - 2m showing above the general beach level and comprises a grey, compact, silty sand with grit-sized clasts in parts and larger pebbles in others **(Fig. 14).**

Fig. 14.

Fig. 15.

They are all matrix supported and horizontal planes within the matrix make it appear thinly bedded in the lower part at the landward end of the outcrop **(Fig. 15).** The weathered surfaces are also uneven possibly due to weathering and/or shallow erosion along drying cracks. Their surfaces also exhibit a patchy brown iron staining. The outcrop becomes more uniform along the exposure, where the clasts become larger but still scattered within the enclosing sands and silts **(Fig. 16)**. Continuing along the outcrop, it becomes thicker and is exposed below a covering of cobbles and boulders rising to a form the base of a boulder-strewn col between two stacks **(Fig. 17)**.

Fig. 16.

Fig. 17.

To add to the variety of this area, there are two dykes, shown to the author by Paul Chambers, which outcrop near L'Angliaiche, both unrecorded on the IGS map. One is made of white quartz c. 1m-1.5m wide, and strikes c. WNW cropping out in the low cliff face of a small stack further west **(Fig. to follow).**

The second is a mica lamprophyre (minette) dyke, 1-1.5m wide, striking c. NNE. It crops out in a shallow gully eroded along it, and varies in colour from brown to grey and **(Figs. 18, 19).** It also varies in shape and thickness and large brown to bronze biotite micas are easily visible and often give it a cleaved appearance **(Figs. 20, 21**; photos by Paul Chambers**)**.


Fig. 18.


Fig. 19.


Fig. 20.


Fig. 21.

3. North Le Hurel Slipway & recently exposed littoral clayey silts, sands & grits.

A further 500m north of the Seymour slipway, **within 50m south of Le Hurel slipway**, a longer outcrop of brown to yellow clayey silts was recently revealed at a higher elevation and occurs at the start of, and below, the high spring tide bank of pebbles against the sea wall **(Fig. 22)** reported by Dr. Paul Chambers (Dec. '09, pers. comm.).


Fig. 22.

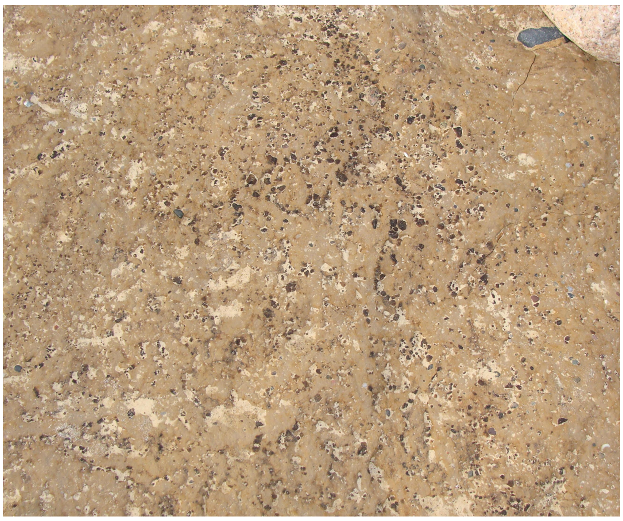


Fig. 23.

They are light brown-yellow in colour, similar to some of the clayey silts further south near Seymour Tower, and seem to be the clay-silt with sand and grit variety, but in part with some black, possible carbon pieces **(Fig. 23);** more details will follow after examination by Dr. Chambers and Robert Waterhouse who also visited the exposure.

Fig. 24. **Fig. 25.**

Pebbles resting on the surface seem to be sites of incipient pot-holing but in one case swirl marks occur in the sediments around a pebble clast **(Fig. 24)**, while nearby, possible relict dessication cracks (first photographed by Dr. Chambers) stand out as light coloured lines within the yellow-brown background **(Fig. 25).**

Addenda.

1. Rozel Conglomerate.

A small mass of conglomerate **(Fig. 26 a, b)** occurs among the granites and diorites of the wave-cut platform south-east of La Rocque Point and south of the Refuge Tower about half way to Seymour Tower on the SE coast of Jersey.

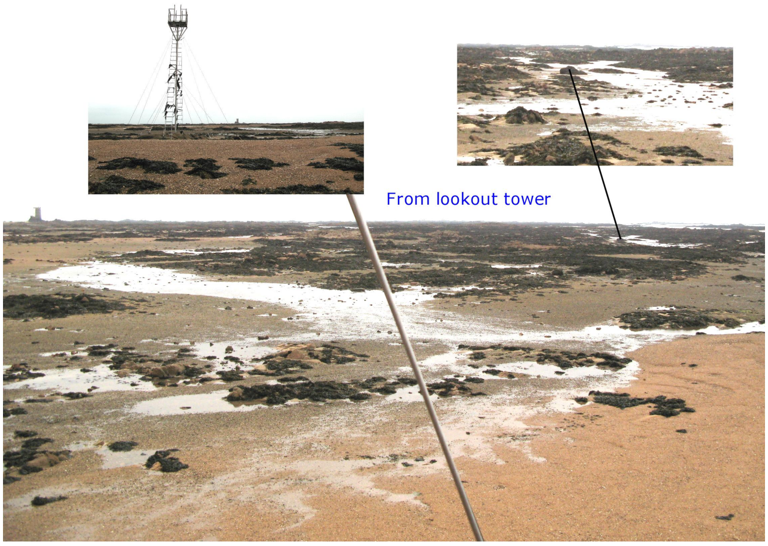


Fig. 26 a, b.

In appearance it looks like an outlier of the Rozel Conglomerate which crops out c. 7 - 8 km to the north on the NE corner of the island. Does this exposure of conglomerate represent an outcrop, an outlier of the Rozel Conglomerate Formation, a megalith or a boulder somehow transported here and abandoned deliberately (to save a vessel from foundering?), or by accident? (Nichols, 2013, p. 81).

2. Quartz & aplite dykes.

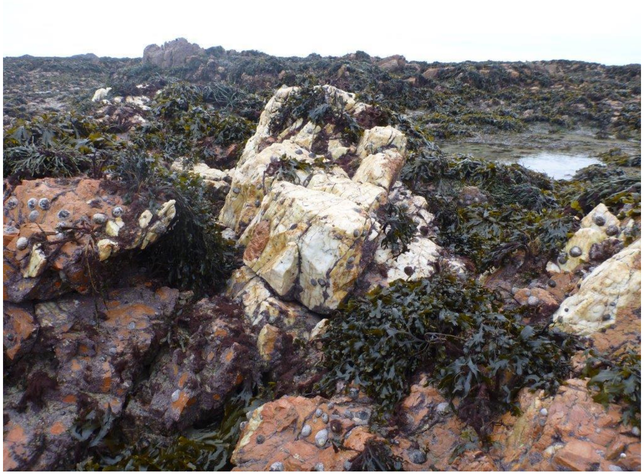


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Fig. 27 a, b, c

Along this trail, southeast of the Refuge, there are several quartz dykes and enclaves composed of massive quartz crystals, together with aplite dykes in the granite of the wave-cut platform **(Fig. 27 a, b)**, also found by Dr. Chambers. They may be associated with the formation of the nearby quartz pegmatite areas **(Fig. 27 c)** which formed as the granite crystallised, but post-date their formation.

3. Other Mid-tide conglomerates.

Fig. 28 a, b.

The mid-tide conglomerates lie above the orange to grey, clayey silts and fine sand but they also contain large angular granite boulders **(Fig. 28 a, b),** leading to a puzzling depositional history, and an inter-glacial age rather than a more recent post-glacial (Holocene) date.

4. Erratics.

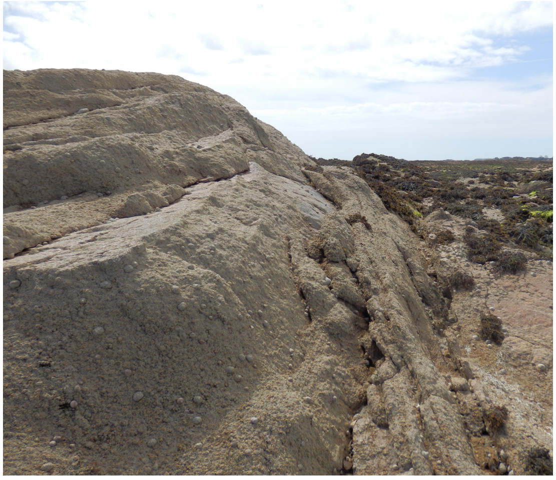

Fig. 29 a, b.

Further on towards the harbour, large boulders of diorite, a local outcrop rock type **(Fig. 29 a, b)** were also found, but not in situ, and were thought to be possible erratics but their mode of transport is still under discussion.

Brief geological history and possible correlations.

These above deposits, clay-silts and beach conglomerates in the littoral zone, lie in a similar position to those recorded from St. Brelade's Bay, La Cotte de St. Brelade – Le Fret Point, La Greve d'Azette, Seymour Tower – Refuge, Le Hurel, St. Catherine's Bay (south) and Bonne Nuit Bay.

They occur as three types of deposit, eg. semi-indurated, yellow to blue-grey and brown clayey silts (St. Brelade's Bay, Seymour Tower-Refuge); indurated, grey, yellow-brown, silts, sands, grits and pebbles (Le Hurel, St. Catherine's Bay south); and well-cemented, sometimes ferruginous conglomerates (La Cotte de St. Brelade – Le Fret Point, Bonne Nuit Bay).

The vari-coloured clayey silts are thought to be reworked loess, quite distinct from the loess above the 8m raised beaches in the cliff sections at the back of some of the bays.
The supposed reworked loess has not been analysed or examined for pollen so its redistribution mode, aeolian or fluvial/marine has not been determined.
The sandy grit and pebble beds may be a mixture of reworked loess and water-laid deposits of limited transport duration.
The well-cemented conglomerates (Mourant, 1933, p.59;1935, p.489; Keene, 1978b, p.79; Bishop & Bisson, 1989, p. 85-86), quite distinct from the raised beaches in the cliffs, seem to represent former beach pebble-strand line deposits ('not so-raised beach levels') formed during the Holocene as the sea level rose, with time for cementation which prevented their erosion during subsequent transgression to present levels.

Time intervals and their climatic variations have been established for the Holocene, above the Late Glacial of the Pleistocene, based on the Pollen Zones of Goodwin (1940), and the Pollen Assemblage Biozones & Radiocarbon **start dates (bp)** of Hibbert, Switsur & West (1971), in Jones et al (1990).
These are shown below and may be used to infer the conditions under which the sediments under discussion were deposited.

Pleistocene & Holocene subdivisions. (Jones, Keane, Birnie & Waton. 1990, p. 3.)

Interglacial		**Holocene. Flandrian (Chronozones, West, 1970).**	
Sub-Atlantic;	cold & wet.	VIII (Oak-Alder)	
Sub-Boreal;	warm & dry.	VIIb	5010 +/- 80 bp
Atlantic;	warm & wet.	VIIa (Oak, Elm, Alder)	7107+/- 120.
Boreal;	warm & dry.	VIc (Pine, Hazel, Elm)	8196+/- 150
		VIb (Hazel, Pine)	8880+/- 170
		VIa	
		V (Birch, Pine, Hazel)	9798+/- 200.
Pre –Boreal	sub-arctic	IV (Birch, Pine & Juniper)	c. 10,250.
Late Glacial		**Pleistocene. Devensian (Weichselian; Late Glacial).**	
Younger Dryas;	sub-arctic.		10,850.
Allerød oscillation;	warmer.		11,850.
Older Dryas;	sub-arctic.		12,050.
Bølling osc.	**rapid warming; sea level rise 100m**		**12,450. Recent O isotope 14,600-14,100**
Oldest Dryas;	arctic.		15,000.
NB. Preceding Interglacial		**130, 000 - 115, 000 Ipswichian (Eemian)**	

Discussion.

The various sediments occur midway between present day half-tide and MHWS levels lying unconformably on bedrock.

It is hoped that the period (s) of conglomerate and the possible redistributed loess deposition can be determined from the above climatic table, if not during one interval, then perhaps within a range of intervals.

Starting at the base, it is the thought the following is a possible sequence of conditions for our region.

From c. 130,000 – 115,000 years ago in the Pleistocene, during the last interglacial (Ipswichian (Eemian)), the sea bed around us, of Eocene limestone and Lower Palaeozoic rocks near Normandy and Les Minquiers, was covered by the **sea which deposited the 8m raised beach.**

Then, about 115,000 years ago, a late glacial period started (the Devensian (Weichselian)) and the sea regressed leaving us in a cold tundra type environment during the **Oldest Dryas** (a species of the Rosaecae arctic type of vegetation, with leaves similar to those of the oak).

During this time, the bedrock types would have been weathered physically by freeze-thaw and mass-wasting via solifluction and gelifluction, to produce layers of angular fragments comparable to head deposits and there would have been little or no deposition from rivers. **Much airborne loess** was probably deposited on and around the island during this time (Bishop & Bisson, 1989. p. 82).
NB. Check c.100, 000 yr gap; Devensian start, c.16, 000bp (Jones et al. 1990,Table 1. p. 3).

This was followed between 14,000-12,000 years, by a rapid warming and transgression, the **Bølling oscillation** (named from Bølling Lake peat sequence in Jutland; pollen zone 1b), when the sea level rose 100m.
This level has been identified as still some distance offshore on maps by Lambeck (1995, p. 445).

Beach pebbles and gravels of the mixed rock types, (limestones, greywackes and quartz sandstones) would have formed at this level, while Temperate hardwood and softwood forests occurred on land between 29° - 41°N as the soil horizons developed, and streams and rivers would have increased flow and deposition onto the coastal areas and sea bed. The limestones would have been chemically weathered by solution.

From c.12,000 – 10,000 there was a colder, sub-arctic period again, the **Older Dryas,** followed by a warmer period, the **Allerød oscillation** (named after the municipality of Allerød in Denmark; pollen zone II , mixed evergreen and deciduous), with present day-like temperatures, then followed by another colder, sub-arctic period, the **Younger Dryas.**
It is assumed that the sea-level fluctuated during these oscillations and that weathering and erosion of the bedrock occurred in similar relative ways, with more stream deposition during the warmer period, to give a relatively similar alternating sequence of sand silt and clay sediments.

It is thought that the deposits examined could not have formed during this upper part of the Pleistocene, even though there would have been both terrestrial and marine redistribution, subsequent sea-level rise during the Holocene (Recent) would have eroded them.

From 10,000 years ago to the present (Holocene (Recent)), starting with the **Pre-Boreal,** a sub-arctic period (? a continuation of the Younger Dryas), the climate became **Boreal,** gradually warmer and drier**;** then **Atlantic,** warmer and wetter**; and lastly Sub-Boreal,** warmer and drier again, until c. 5000 years ago. Sea temperatures were also rising with different flora and fauna appearing, while on land, different vegetation types were colonising the area.

NB. It was during the **Atlantic** period that the **peat beds** were deposited.

This is also the date (c. 7,000 bp / 5,000BC) generally given for our low-lying plateau areas and crags to have become islands and reefs.

Consequently, it is in this interval, possibly at the end of the warm and dry **Sub-Boreal** period**,** that the climatic conditions existed for the formation of the **cemented beach conglomerates** and their part ferruginisation with the Fe being provided (because of the temperature and humidity conditions), at a relevant sea-level height in the present day intertidal zone, comparable elsewhere (see below).

It is also possible that the warmth and dryness created an arid enough environment for aeolian action to redeposit the loess. One assumption is that, as the land surface was soil-covered, the cliff deposits and stream bank deposits were the source of the loess and that it was re-deposited by wind action. An alternative assumption is that streams transported it to the sea where longshore drift redistributed it in hollows and protected areas of the bedrock.

Subsequently, until today, the climate became colder and wetter and is now called the **Sub-Atlantic!**

The identification of the floral changes through pollen analysis has been done, but a palynologist is still needed to examine and date the shoreline sediments described above, and more importantly, to examine the core sediments across the adjacent channel, La Déroute.

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Ralph Nichols. 2013.