THE GEOLOGY OF KINSALE

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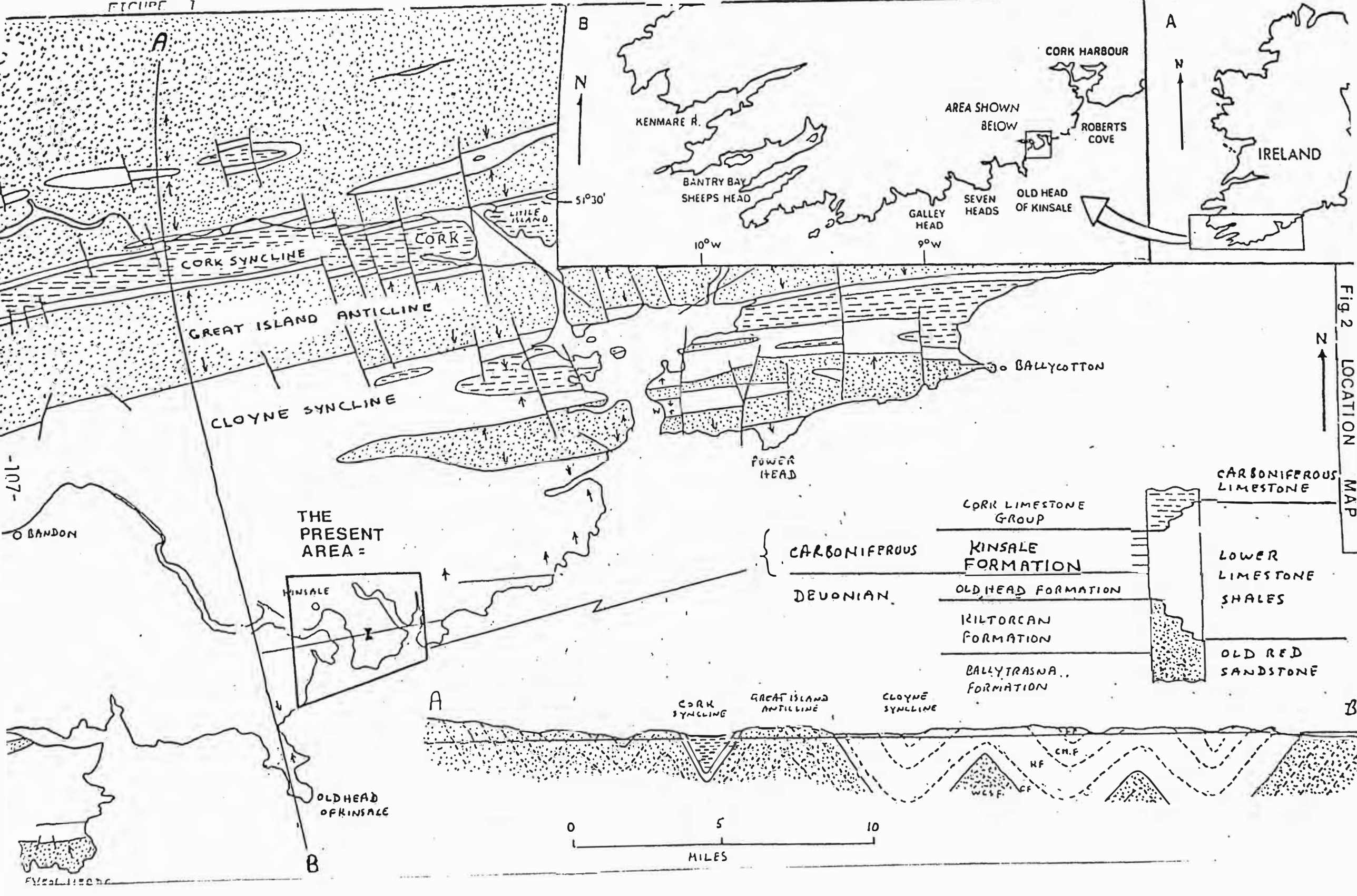
Introduction This is a brief analysis on the geology of the Kinsale area in County Cork as studied during the Summer of 1985. Standard Ordnance Survey (1902) maps with a scale of 1:10580 were used as a base, and geological data collected in the field were plotted onto the base map to produce a map containing only geological data. The area mapped extended in the west from Kinsale town and from the town eastwards to and including the eastern side of Oysterhaven (Fig.1).

The geology of the area consists of the rocks of the Lower Carboniferous - an era of geological time which spanned the period of approximately 360-320 million years ago. The rocks examined belong to the Kinsale Formation, a Formation being a distinct body of sedimentary rocks, broadly similar in geological characteristics such as rock type and depositional environment.

The rocks within the Kinsale formation are sub-divided into three 'Members', the rocks of each member being sufficiently different from one another to be considered separately, but sufficiently similar to be included in the same formation. The Kinsale Formation begins with the mudstone-dominated oldest member - the 'Castle Slate' Member at the bottom, overlain by the sandy 'Narrow Cove' Member, which in turn is overlain by the mudstone-dominated 'Pigs Cove' Member (Fig.2). The rocks noted in the area correlate well with the 'type' or ideal example of the Kinsale Formation which is seen at the Old Head of Kinsale.

However, the Kinsale Formation was found to be thicker (1,600 m thick) in the Kinsale Harbour area from this research, than in the type area on the Old Head of Kinsale. The geology of the area was first considered in the memoir accompanying the original 1"-1 mile Geological Survey of Ireland Sheets 195 and 202. The sequences of rock layers or strata were referred to as Carboniferous Slate - the term slate is inaccurate since the rocks are not slates at all. The strata were deposited in an East-West trending marine basis - the South Munster Basin, that existed in the area during the Carboniferous. Also, a discussion of the stratigraphy (the layers of rock which have accumulated through Geological time) was presented in the Ph.D. thesis of Naylor (1964).

FIGURE 1


A
B
N
KENMARE R.
BANTRY BAY
SHEEPS HEAD
51°30'
10°W
9°W
GALLEY HEAD
SEVEN HEADS
OLD HEAD OF KINSALE
AREA SHOWN BELOW
CORK HARBOUR
ROBERTS COVE
IRELAND
LITTLE ISLAND
CORK
CORK SYNCLINE
GREAT ISLAND ANTICLINE
CLOYNE SYNCLINE
BALLYCOTTON
POWER HEAD
BANDON
THE PRESENT AREA =
KINSALE
OLDHEAD OF KINSALE
CARBONIFEROUS LIMESTONE
CORK LIMESTONE GROUP
CARBONIFEROUS
KINSALE FORMATION
DEVONIAN
OLD HEAD FORMATION
KILTORCAN FORMATION
BALLYTRASNA FORMATION
LOWER LIMESTONE SHALES
OLD RED SANDSTONE
CORK SYNCLINE
GREAT ISLAND ANTICLINE
CLOYNE SYNCLINE
CM.F
KF
WCSF
CF
0
5
10
MILES
Fig. 2 LOCATION MAP
-107-

Topography Most of the area lies below 100 m O.D. The topography is of rolling hills, but is locally quite rugged near the coast. Much of the area is devoted to agricultural use. Many of the coastal slopes are too steep for this and are overgrown with gorse brambles, heather and ferns. The rugged coastline consists of some stretches whose cliffs present excellent but frequently inaccessible exposure of rocks. The area is extensively covered with superficial unconsolidated glacial till. This is largely a clayey till containing angular fragments of sandstone. The till is local in origin and was deposited between 300,000 and 130,000 years ago.

Stratigraphy The study of stratigraphy is the study of the relative ages of the rocks layers or strata. Several techniques have been applied to establish the age of the rocks studied (i.e. can it be established that the rocks under examination are in fact Lower Carboniferous Kinsale Formation at all?). One could just follow the strata, which it is known were deposited one on top of the other, beginning with the oldest layer, and relate the rocks seen to older and younger layers of known age i.e. those below and above the chosen layer. Another technique used is Palynology, whereby the pollen and spores of plants that existed at the time the rocks were deposited are found in the rocks, identified and dated, giving an accurate indication of the age of the strata. Spores found have been useful in indicating that the top part of the youngest or topmost member of the Kinsale Formation has not been found in the area. Palynology has also been used to pinpoint the boundary between the Kinsale Formation and the underlying older Old Head Sandstone Formation.

Structural Geology Over 300 million years ago, the sediments that make up the Kinsale Formation, along with many other rocks, were deformed by the Variscan Orogeny. An orogeny is a mountain-building phase in geological history caused by massive, slow-moving forces in the earth's crust which deformed ancient sedimentary deposits. Structural geology is the study of these forces and the features they produce.

In the case of the Kinsale area, these forces produced the E-W trending Anticlines and Synclines seen in the area (Fig.3). Such forces also caused the N-S faults seen in the area.

Another structural feature seen in the rocks is cleavage - effectively cracks in the rock which sometimes form distinct patterns

FIGURE 2

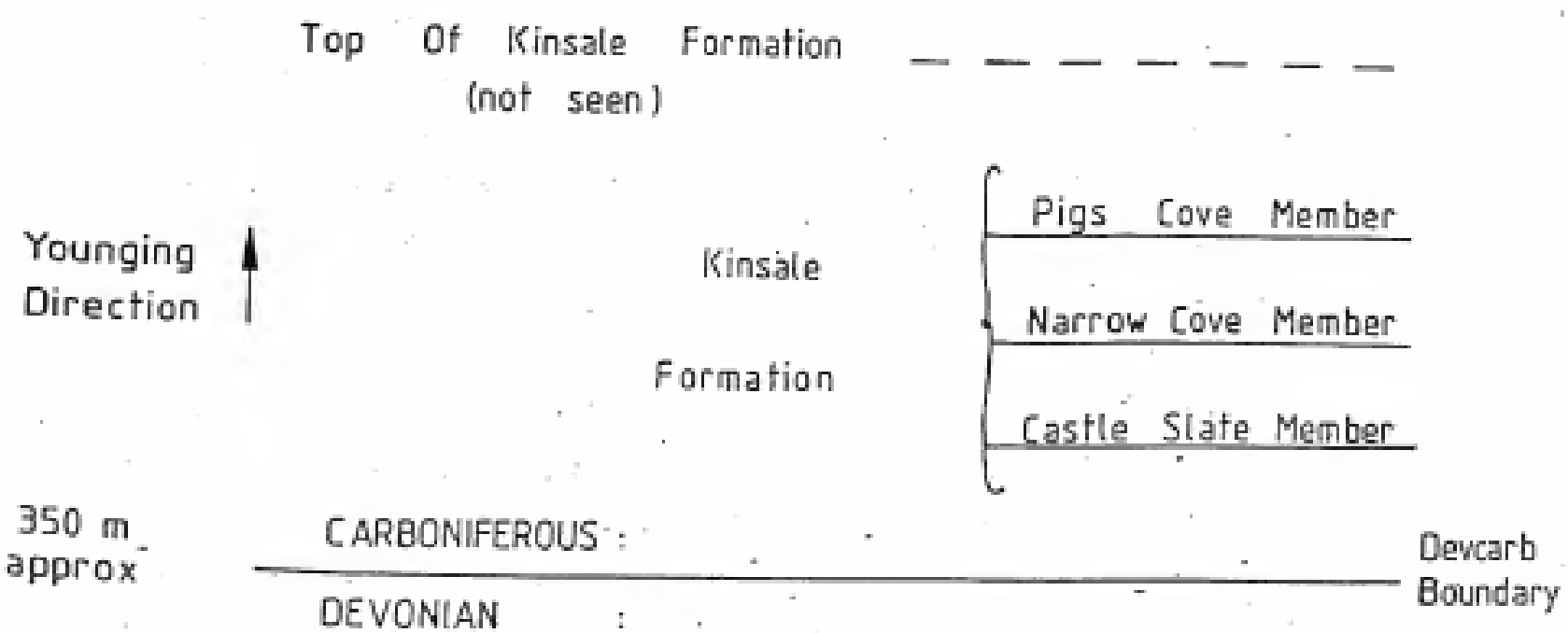
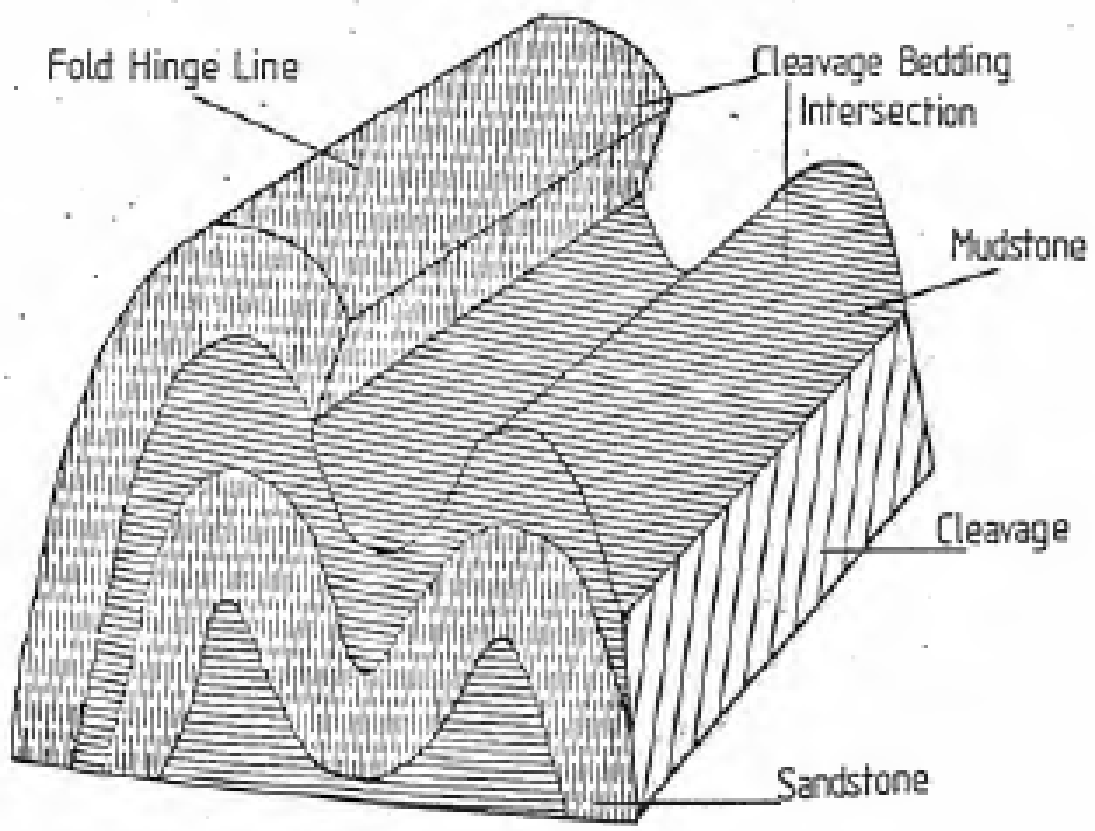


FIGURE 3



reflecting changes in the physical properties of the rock.

Such features as cleavage and joints were caused by forces that were operative during deformation, which acted to contract the rock in one direction and expand it in another direction. Joints are another form of break in the rock which are seen in the area. A more major or dominant set of 'master' joints run North-South, perpendicular to the fold hinge lines and are seen throughout the area.

A second set of joints - a 'conjugate' set is encountered at Kinsale in the West of the area but absent at Oysterhaven in the East of the area.

Sedimentology In general, sedimentology is the study of the substances the rock is physically made up of. It refers to rocks produced by sedimentary deposition of material. A sedimentary rock type, i.e. a lithology, is dependant on the composition of material making up the rock. In a sense sedimentology is a sort of 'history' of the rock.

Apart from the study of the material content of the rock, sedimentology also deals with the features that are seen in the rocks either within the beds or layers of rock or on the surfaces between the beds - known as bedding planes.

The 'Castle Slate' Member occurs in the West of the area and makes up the core of the Courtaparteen anticline (Fig.4). At most, it is the youngest member of the Kinsale Formation the top 40 m are visible here. The rock types are largely mudstones with streaks of silt, the silt being a coarse material and lighter in colour. Some material possibly containing calcium is seen near the top of the Castle Slate Member. Some fire-grained sandstones do occur, however. Wave ripples are common on both sandstone and mudstone bedding planes.

Depositional Environment It is thought that the depositional environment of the sediments of the 'Castle Slate' Member was the underwater slopes, on the seaward side of the delta of an ancient river, or possibly the continental shelf in front of such a delta slope. The rocks of this Member grow more fine-grained to the south, as the rock type changes from rocks representing a river-dominated coastal environment south to shoreline features such as sand bars, and further southwards to fine-grained muddy sediments that were clearly deposited in an open bay. The thickest sediments were deposited in an open bay - such great thicknesses were being poured into the bay area.

because the area was apparently sinking at the time. The sinking or subsidence actively occurred at the same time as the deposition of the sediments was taking place.

Interestingly, the 'Castle Slate' Member shows increased wave influence compared to earlier Devonian era deltas. Clearly, a more open marine geography existed at the time the Castle Slate Member was deposited.

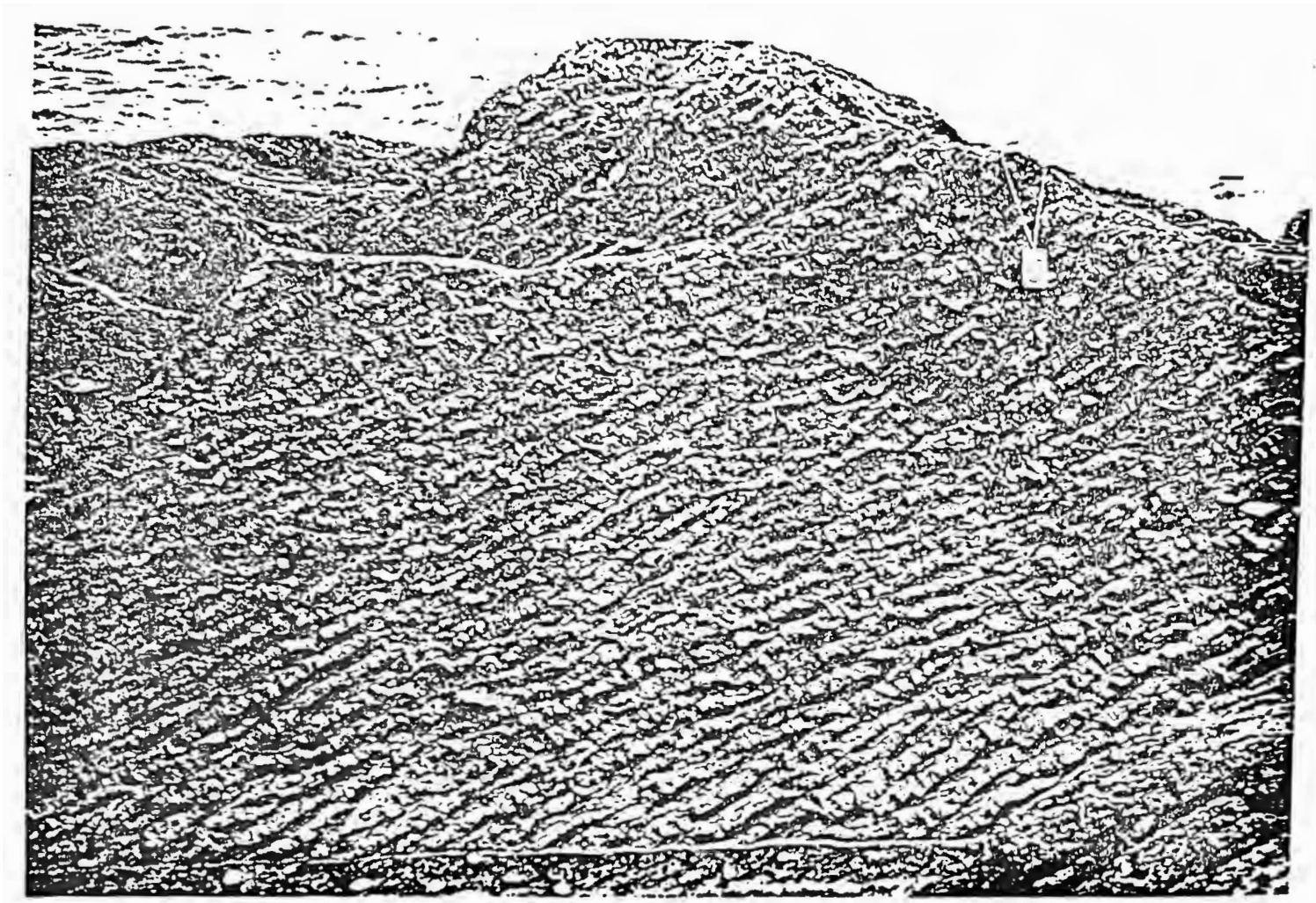
Sedimentology The sedimentology of this Member is characterised by several different rock types. Each has a different proportion of sand:mud. The rock types are classified into two main groups in order of increasing sand content and increasing energy of environment of deposition:

1. Streaked mudstones
   - (a) Silt-streaked mudstones] increasing sand content
   - (b) Sand-streaked mudstones]
2. Lenticular Beds
   - (a) Linsen beds
   - (b) Parallel laminated sandstone
   - (c) Large scale structured sandstones

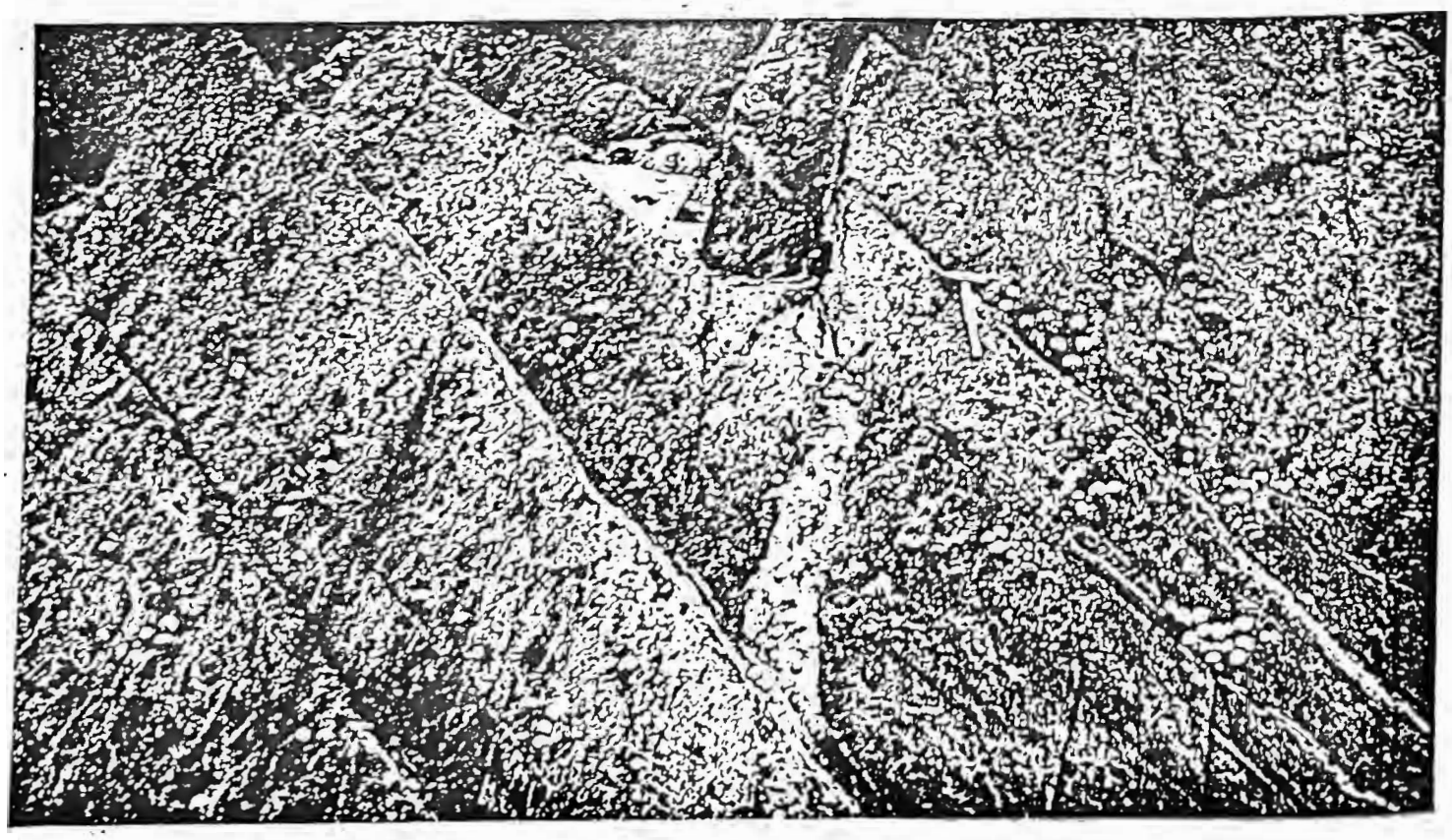
Wave Generated Structures The most obvious features formed by wave action seen in the Narrow Cove Member are wave ripples (Plate 1). These are preserved everywhere on the top surface of beds of rock i.e. the bedding planes. These wave ripples are very significant. They are exactly the same as ripples that are seen on the sand at the seashore today and have been formed in exactly the same way. As such they are very useful indicators of depositional environment.

The ripples are symmetrical in cross-section i.e.

PLATE ONE



Wave ripples showing characteristic features



Characteristic joints in a sandstone unit.

which tells us that they were created by wave action in a nearshore environment. If they were current direction i.e.

it is more likely that they would have been formed by a current from one consistent direction. Occasionally, however, waves in the nearshore environment can produce assymmetrical ripples.

Lithotypes This Member displays the widest variety of lithotypes i.e. rock types of the three Members of the Kinsale Formation. The two main groups of rock types can be subdivided into 8 types of rock. In order of increasing sand content these are:

1. Parallel-laminated silt-streaked mudstone
2. Parallel-laminated sand-streaked mudstone
3. Parallel and cross-laminated sand-streaked mudstones
4. Linsen
5. Flaser
6. Wave-knitted sandstone
7. Uni-directional cross-laminated sandstones
8. Evenly laminated sandstone

Depositional Environment The mudstones were deposited in a quiet marine environment. The mud settled from suspension in the water during calm weather. Thin silt and acid layers represent storm-deposits, deposited during rough weather. The more sand-rich rocks e.g. types 3,4,5 above, were deposited in progressively higher-energy environments i.e. in a coastal zone where waves were operative. The pure sandstones i.e. 6,7,8 above, were generated under conditions of moderate, continuous wave action.

Palaeogeography The Narrow Cove Member represents a period when the depth of water in the South Munster Basin was becoming shallow. The sandier parts reflect a depositional platform at the front part of an ancient delta pouring sediment into the basin.

FIGURE 4

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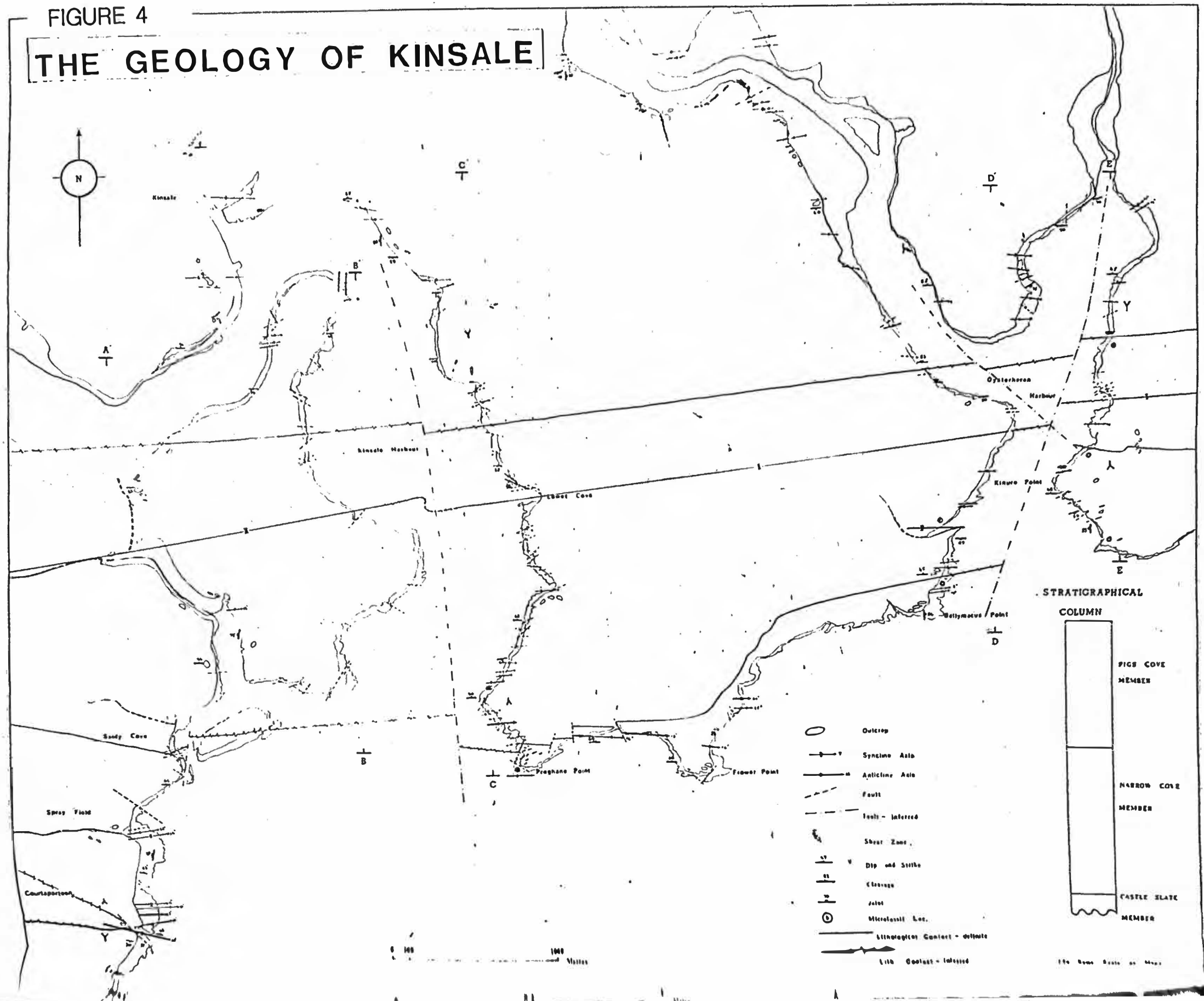

Pigs Cove Member

Sedimentology This Member consists mainly of medium-grained grey laminated and linsen mudrocks. It also exhibits frequent layers of small sand-rich nodules. In some areas whole beds of rock consist almost entirely of nodules. The nodules are very hard, due to a high silica content, and stand out from the soft weather-pitted mudstone beds.

The base of the Pigs Cove member shows significant differences from the main bulk of the Member. The dark grey mudstone changes over to a lighter-coloured, more sand-rich lithology. In places mudstone and sandstone are interbedded. The contact between the Pigs Cove member and the Narrow Cove Member is clearly seen at Sandy Cove in the west of the area (Fig.4), and also on the eastern side of Kinsale harbour approx. 300 m south of Charles Fort. Here the first thick green sandstone layer is taken as the boundary between the two Members. Wave ripples are seen throughout the Pigs Cove member, being well preserved on the bedding planes.

Depositional Environment The mud-rich Pigs Cove Member was deposited at some depth in a marine environment, ranging from just below to just above wave base. Such sandstones as are seen probably originated from sandy material whirled up into suspension by wave turbulence near the shore during storm activity. The sand whirled up was then carried by offshore currents into the deep water in front of the delta. In general, the Pigs Cove Member accumulated on a fairly shallow marine shelf in front of an ancient delta.

Quaternary During the greater Cork-Kerry Glaciation which took place during the Munsterian period 300,000-130,000, (Mitchell,1986 p.39) ice advanced from the Cork-Kerry mountain area, eastwards as far as Ballycotton (Mitchell,1986). At Courtmacsherry Bay, near Kinsale, the deposits have been studied. The boulder clay is clearly local, of Munsterian age, deposited by ice moving east from the mountains. It seems that local foci of glaciation in highland areas near the Cork/Kerry border spread east and laid down the glacial till seen on the coast in the Kinsale area. This till is relatively fine-grained, but containing angular blocks of sandstone. Deposits up to several metres thick have been exposed by coastal erosion in many places throughout the area.

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