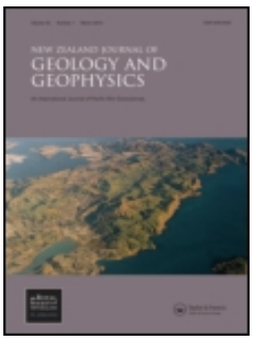

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GEOLOGY OF CASTLEPOINT HEADLAND AND REEF, WAIRARAPA, NEW ZEALAND

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ABSTRACT

Castlepoint contains the youngest known pre-Holocene rocks in coastal Wairarapa. The rocks consist of dominantly mudstone and siltstone of the Opoitian (lower Pliocene) Rangiwhakaoma Formation which is unconformably overlain by fossiliferous sandstone and limestone of the Nukumaruan (Lower Pleistocene) Castlepoint Formation. They are preserved as slivers in the Castlepoint Fault Zone which bounds a large area of graded beds, mapped as the Whakataki Formation of Waitakian to Clifdenian (lower Miocene) age, to the west. Folding is the direct result of movement on the faults in the Castlepoint Fault Zone. Several periods of dextral transcurrent movement have occurred since the Whakataki Formation was deposited.

INTRODUCTION

Castlepoint (Fig. 1), a small holiday settlement on the Wairarapa coast, is 72·5 km (45 miles) by road east of Masterton. It comprises a prominent headland, named the Castle by Captain James Cook, and Reef composed of a sequence of Opoitian and Nukumaruan rocks. Elsewhere on the Wairarapa coast Miocene or Cretaceous rocks are exposed. The Opoitian rocks are dominantly mudstones and are unconformably overlain by Nukumaruan limestone and sandstone beds.

Little geological information has been published on Castlepoint, although numerous fossils have been collected from the Nukumaruan beds over the past 100 years. Hochstetter (Fleming 1959a) described a shore platform south of the Castle and included a sketch by Captain W. M. Smith. McKay (1877) considered the sequence to be conformable and folded into a moderately steep limbed anticline in the west flanked by a syncline, with gently dipping eastern limb, in the east.

McKay (1899) briefly described Castlepoint and the surrounding area. King (1930) mapped the raised marine benches on the Wairarapa coast but did not consider that a number of even crested ridges inland of Castlepoint (Fig. 1) were marine in origin. Powell (1938) described a number of fossils from the Nukumaruan beds.

PHYSIOGRAPHY

The Castle, in the south of the area mapped, is 162 m (535 ft) high, with steep to shear sides and is joined by a narrow ridge to the mainland (Fig. 2). Around its base are numerous large blocks of rock. The Reef, north-east of the Castle, is a low linear feature rising to 50 m (165 ft) above sea level at

D. L. Homer photo

FIG. 1—Aerial view of Castlepoint showing the Castlepoint Fault Zone consisting of the Castle on the left and the Reef on the right. Castlepoint settlement is in the middle distance at the foot of low cleared hills formed on the Whakataki Formation.

its northern end where there is a lighthouse. It is joined to the coast by a sand tombolo, covered at high spring tides, and encloses a small harbour surrounded by narrow benches. Entrance to the harbour is gained through a 165 m (550 ft) gap between the Castle and the Reef. The eastern side of the Reef drops steeply into deep water and, has several narrow, structurally controlled benches. Approximately one quarter and one half way along the Reef from its southern end there are two narrow, low-lying areas that are covered at high tide. Below the lighthouse there is a large cavern in the Reef about 9 m (30 ft) high and partly filled with water at high tide. The cavern can be reached by a narrow entrance on the west side of the Reef and has an opening to the east into which the sea breaks with considerable violence.

STRATIGRAPHY

The Castle and Reef are part of a faulted zone for which the name Castlepoint Fault Zone is proposed. Within the zone two formations, Rangiwhakaoma (Hurupi Group) and Castlepoint, are mapped (Johnson in press). West of the zone is the Whakataki Formation belonging to the Annedale Group (Johnson in press). Overlying all three formations are small areas of unconsolidated sand and poorly consolidated breccia.

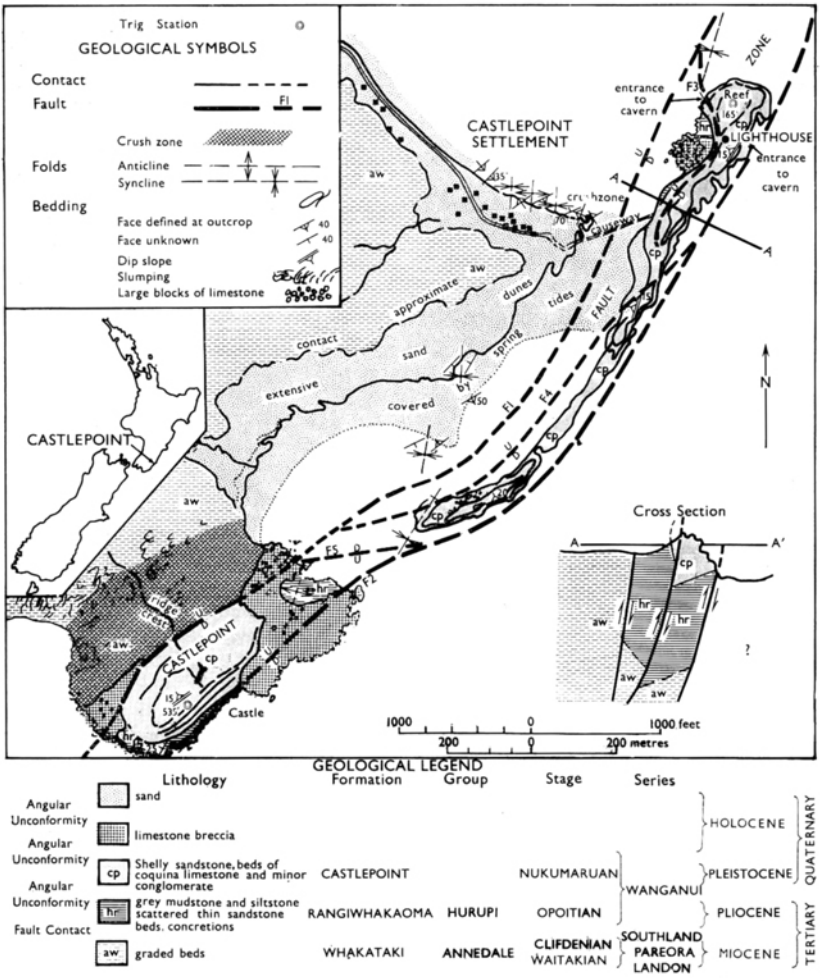

FIG. 2—Geological map of Castlepoint

Whakataki Formation

The Whakataki Formation consists of a thick sequence of graded beds. The beds are less than 0·3 m (1 ft) thick and grade from grit or sandstone at the base to mudstone at the top. The sandier part of the beds are commonly laminated and convolute bedded. Outside the area mapped, flute casts are commonly abundant at the base of individual beds and indicate that sea-floor currents flowed from the south and east. In the area mapped the formation is crushed and folded into numerous small folds but further west it dips between 30° and 70° WNW. Its age, based on foraminifera, is Waitakian to Clifdenian (lower Miocene) (Johnston in press).

Rangiwhakaoma Formation

Fine-grained beds at Castlepoint, mapped as Opoiti Series by Ongley (1935), were mapped as Rangiwhakaoma Formation by Johnston (in press). The formation takes its name from the Maori name for Castlepoint and the type section is on the south-east side of the Castle.

The formation consists of poorly-bedded mudstone and siltstone with scattered sandstone beds and concretions. In the north it crops out on the west side of the Reef, the best exposures being below high-water mark immediately to the north of a causeway across the tombolo (Fig. 3). The beds dip vertically except immediately west of the lighthouse where they are slightly overturned. In the south the formation crops out at the base of the Castle. On the south-east side of the Castle the formation dips 25° WNW whereas on the north side it is folded into several steep folds. Nowhere in the Castlepoint Fault Zone is a contact with the underlying rocks exposed but it is inferred that the formation is unconformable upon the Whakataki Formation. The total thickness of the formation exposed is about 15 m (50 ft).

The only macrofossils, collected by J. Marwick and M. Ongley, are *Waitara* n.sp. (N159/f486)†, from the south side of the Castle, and *?Marshallena* aff. *austrotonoides* Powell (N159/f487) from the north-east side of the Castle. Foraminifera are abundant, Opoitian (lower Pliocene) in age, and indicate the formation was deposited in an outer shelf, or possibly deeper environment (G. H. Scott pers. comm.).

Castlepoint Formation

Shelly limestone and calcareous sandstone cropping out at Castlepoint were called the Castle Point Beds by McKay (1877). Fleming (1959b) stated that the beds were "typically exposed on Castlepoint Reef". They were mapped as the Te Aute Series by Ongley (1935).

The formation consists of about 65% of well-bedded grey calcareous sandstone, with minor conglomerates. Interbedded with the sandstone beds are beds of light grey, porous coquina limestone. The formation contains numerous comminuted shell fragments and a relatively small number of complete shells. On the south-east face of the Castle a 136 m (450 ft) section contains five clear erosional breaks while on the ESE side of the Reef the section is 45 m (150 ft) thick and contains three erosional breaks. Above each erosional break, which is considered to represent only a small amount of time, there are commonly thin conglomerates containing subrounded to subangular pebbles and cobbles of older rocks, including concretions. Many of the cobbles and concretions have been extensively bored by pholad bivalves. Beneath the breaks are filled channels (Fig. 4) showing the formation is not overturned on the Castle and east side of the Reef. The uppermost erosional break on the Castle truncates a 9 m (30 ft) thick sequence cross-bedded in a simple manner with an apparent dip to the north-east.

†Sheet and fossil record number.

FIG. 3—Disconformity between the Rangiwhakaoma Formation (right) and the overlying Castlepoint Formation exposed north of the causeway to the Reef.

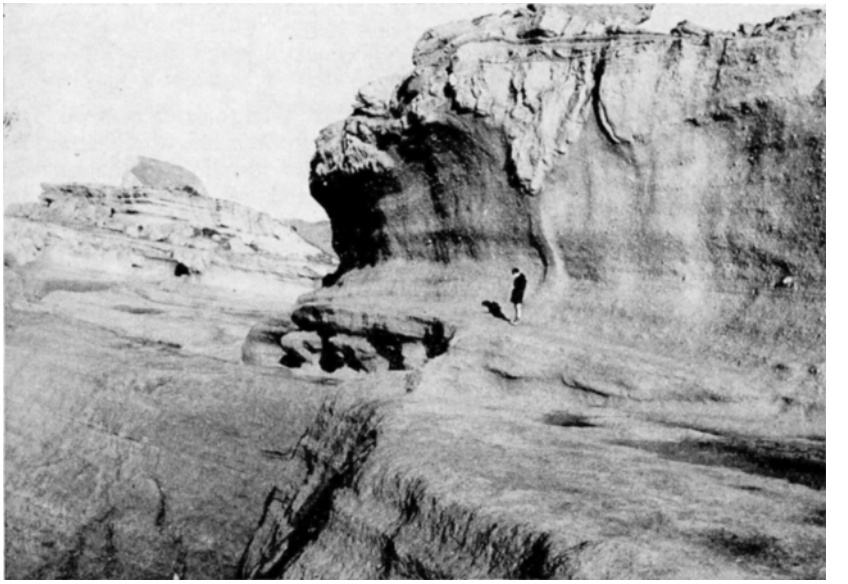

FIG. 4—Irregular contact between limestone bed and underlying pebbly sandstone, Castlepoint Formation, east side of Reef.

According to A. G. Beu (pers. comm.) the most common macrofossils in the formation are: *Glycymeris* (*Grandaxinea*) *wairarapaensis* Powell, *Chlamys delicatula* (Hutton), *Phialopecten triphooki* (Zittel), *Mesopeplum convexum* (Quoy & Gaimard), *Venericardia purpurata* (Deshayes), *Dosina creba* (Hutton), *Neothyris* n.sp. The age of the formation, based on the above fossils, is Nukumaruan (Lower Pleistocene).

Abundant shallow-water fossils, cross bedding and erosion intervals of minor importance show that the formation was deposited in very shallow water, in which there was considerable transportation, erosion and by-passing of sediment, and breaking up of shell material.

The formation rests with angular unconformity on the Rangiwhakaoma Formation on the south side of the Castle. The difference in the angle of dip between the two formations is about 12°. A similar unconformity, although not exposed, is indicated on the north side of the Castle with the gently west-dipping Castlepoint Formation overlying steeply folded beds of the Rangiwhakaoma Formation. Where the causeway joins the Reef the contact is a disconformity (Fig. 3).

The formation was formerly correlated with the Waitotaran Te Aute limestone of Hawkes Bay (Ongley 1935) and is the same age as the coquina limestone of Hawkes Bay (Petane limestone) and of southern Wairarapa.

Late Quaternary

Remnants of dissected marine benches at about 80 m (270 ft), 120 m (400 ft) and possibly 165 m (550 ft) above sea level are present west of the area mapped (Fig. 1) indicating uplift at a rapid rate.

Holocene Deposits

Areas of sand unconformably overlie older rocks in the area mapped. The most extensive area is on the hillside west of the Reef where sand has accumulated after being blown from the beaches surrounding the harbour (Fig. 2). Moa remains are found in the sand and have been described by Brodie (1950).

On the Reef west of the lighthouse and on the north-east side of the Castle (Fig. 1) there are areas of poorly consolidated breccia, of probable early Holocene age, largely derived from the Castlepoint Formation. Locally on the north end of the Reef there are areas of unconsolidated richly fossiliferous debris overlying and derived from the Castlepoint Formation.

STRUCTURE

Folds

In the Whakataki Formation, increasing in number and intensity towards the Castlepoint Fault Zone, are numerous small folds. Most are inferred from opposing dips, but south of the area mapped several folds are completely

exposed on a rock platform. From the difference in dip and strike of each limb of the folds near the Castlepoint Fault Zone, it is inferred that the folds plunge southwards.

In the Castlepoint Fault Zone an asymmetrical syncline is exposed on the northern end of the reef. The syncline, faulted along part of its axis, strikes NNE and has a gently-dipping eastern limb and a vertical to overturned western limb. At the south-east end of the reef a small shallow syncline, striking about NNE is exposed. From the shallowing of dips on the northern end of the reef a similar fold is inferred to exist to the north-west of the Reef. Immediately south-west of the lighthouse poorly-exposed, complex, but small-scale folding in the basal beds of the Castlepoint Formation can be seen.

Faults

The Castlepoint Fault Zone (Fig. 2) is bounded by Fault 1 in the west and an inferred fault (Fault 2) in the east. Within the zone three faults (Faults 3, 4 and 5) have been mapped. Apparent directions of downthrow, where known, are shown on Fig. 2.

Fault 1 consists of a belt of crushed rock up to 200 m (650 ft) wide and along which widespread slumping has taken place. Fault 2 is inferred from the straight eastern side of the Reef and the Castle, and the presence of deep water east of the Castlepoint Fault Zone. It is inferred that soft rocks were faulted against the more resistant rocks in the Castlepoint Fault Zone and have now been removed by erosion to form a fault-line scarp. The direction of downthrow is not known. Fault 3 is exposed only on the north end of the Reef and separates the steeply dipping west limb from the gently dipping east limb of the NNE-striking syncline. The fault plane exposed in the Castlepoint Formation is a sharp vertical or steeply-dipping break with no fault pug. Fault 4 is represented by a belt of broken limestone on the Reef. The base of the Castlepoint Formation is about 15 m (50 ft) above sea level on the Castle whereas it is below sea level on the south-east end of the Reef. It is therefore inferred that a fault (F5) of similar strike to fault 4 separates the Castle from the Reef.

TECTONICS

All the folds measured in the Whakataki Formation and Castlepoint Fault Zone strike approximately north and make an angle of approximately 45° with the strike of the fault zone. In the Whakataki Formation, folds increase in number towards the Castlepoint Fault Zone. Assuming the folds were formed by compressive stresses it is likely that faulting has been dextral transcurrent. Within the fault zone folding took place prior to the deposition of the Castlepoint Formation and at several times after the formation was deposited.

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