

# Geological Society of New Zealand



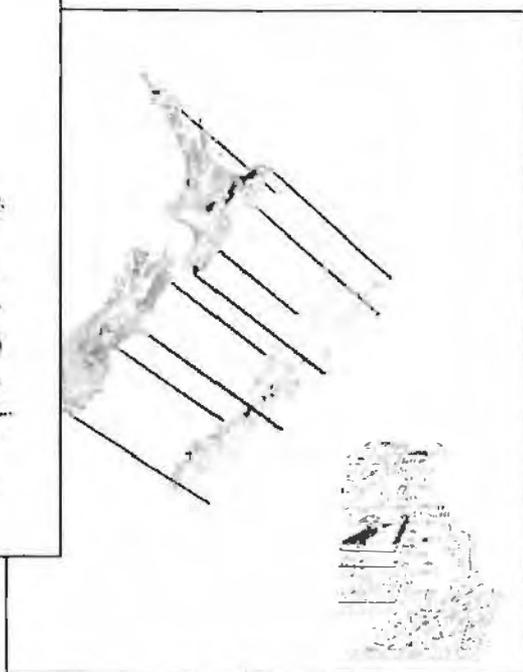
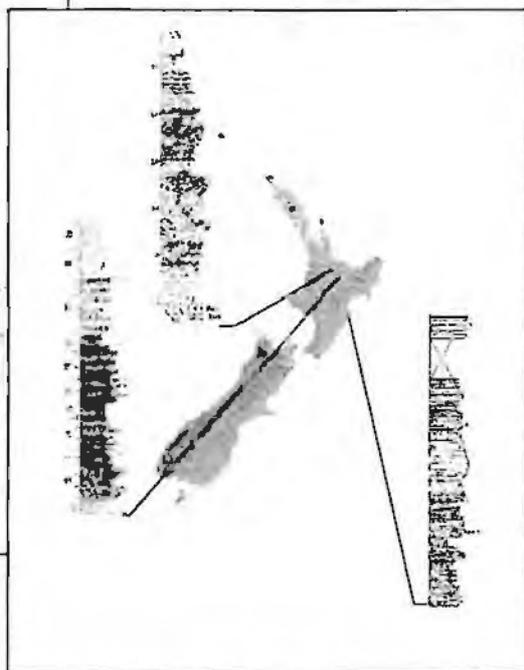
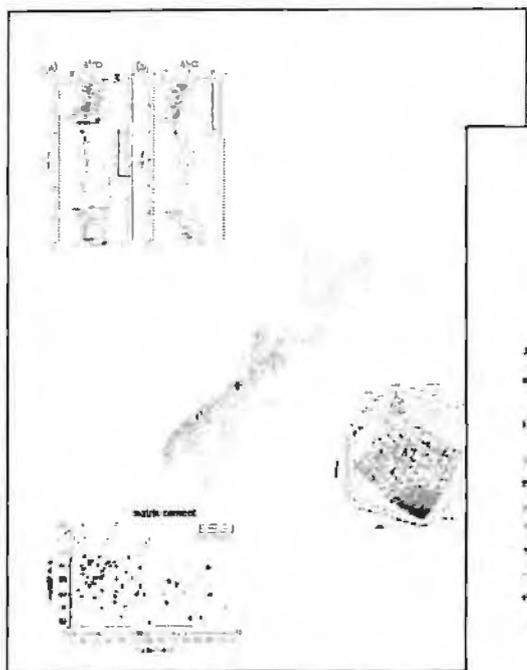
## Annual Conference 2001

27<sup>th</sup> - 29<sup>th</sup> November, Hamilton

### "Advances in Geosciences"



The University of Waikato  
Te Whare Wānanga o Waikato



Fieldtrip Guides

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### *Fieldtrip Guides*

#### *for entire guidebook*

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### *GIS Workshop*

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## Fieldtrip Guides



The  
University  
of Waikato  
Te Whare Wānanga  
o Waikato



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# 2001 CONFERENCE FIELD TRIPS

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### **Acknowledgements**

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The organizing committee is very grateful to all the field trip leaders for their valued contribution to the success and diversity of the 2001 GSNZ annual conference.

We also greatly appreciate the financial assistance of **Solid Energy North, Kennedy Park Top 10 Accommodation, Environment Waikato, and The University of Waikato Department of Earth Sciences**, which has made these conference field trips possible.

## Field Trip FT5

# Field guide for the upper Temaikan, Heterian and lower Ohauan sequence at Kawhia Harbour

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## INTRODUCTION

Kawhia township is located c. 50 km from Hamilton City. The party will leave the University of Waikato at 7 a.m. and travel southwestwards through the small town of Pirongia, and then westwards over the ranges south of Pirongia Forest Park. A brief stop will be made near the summit for a panoramic view of Kawhia Harbour. On reaching the shores of the harbour the road parallels the well-known Lower Puroan outcrops near Puti Point. Travel time to Kawhia is c. 80 minutes and the boat trip across the harbour takes c. 45 minutes. We will land at Oraka Bay on the east coast of Totara Peninsula and walk eastwards following the coastline. Walking distance around the southern shore of the harbour is c. 5 km, some of it through deep mud, and, allowing time for collecting, will take 5–6 hours. Dry footwear to change into after the excursion, windproofs, sunscreen and a hat are recommended.

## STRUCTURE, STRATIGRAPHY, AND ENVIRONMENT OF DEPOSITION.

The Murihiku rocks of southwest Auckland are gently folded into the broad Kawhia Regional Syncline that extends northwards from near Awakino for c. 140 km to Port Waikato. The synclinal axis (Toe Syncline) strikes northwards across Kawhia harbour just west of its eastern shoreline, then north-north-west to pass just west of Puti Point. The sequence to be examined is located on the western limb of the axial syncline, extends from the eastern side of Totara Peninsula at Oraka Bay eastwards to Kowhai Point, and dips regularly to the east at 30–50°. At Kowhai Point and near the peninsula to the south a zone of tight folding interrupts the regular easterly dip.

Strata to be examined include the upper part of Rengarenga Group (upper Wharetanu Measures) and Kirikiri Group (Oraka Formation, Captain King's Shellbed, Ohineruru Formation, Kiwi Sandstone, Waikutakuta Siltstone, Waikiekie Tuffaceous Sandstone and Kowhai Point Siltstone), and possibly the Takatahi Formation (Ahuahu Group) and Puti Siltstone (Owhiro Group). The formations have been mapped in detail southwards for c. 20 km, and the lower part of the sequence in some detail as far as the Awakino region.

The sequence is rich in fossils, particularly bivalves and belemnites, with less common ammonites and brachiopods. Dinoflagellates and other microfossils are also present. The marine fossil associations indicate that the sequence includes the upper Temaikan to Lower Ohauan local stages (upper Bathonian to Upper Kimmeridgian international stages). Outcrops near Puti Point are Middle Tithonian and the Takatahi Formation is Upper Kimmeridgian and possibly Lower Tithonian. Fossils may be found in most outcrops, but most time will be spent in collecting at Oraka Bay, Heteri Peninsula, and Kowhai Point. Known fossil localities are indicated in Figure 1.

The depositional environment is uncertain, but possibly inner to mid shelf for the lower part of the sequence (Oraka Formation to Ohineruru Formation) and outer shelf to slope for the upper formations (Waikutakuta and Kowhai Point Siltstones). The coarser sediments of the Kiwi and Waikiekie Tuffaceous Sandstones apparently reflect briefer periods of shallow conditions within the upper sequence. Depositional rates for the Heterian,

Ohaun and Puroan sequences have been estimated at 12.5, 42, and 56 cm respectively per 1000 years, and this is reflected by higher biodiversity in the lower and middle Heterian.

The sequence exposed at the first stop on the southern shore of Oraka Bay includes the upper Wharetanu Measures, Oraka Formation, Captain King's Shellbed, and lower Ohineruru Formation

## Wharetanu Measures

Green weathered outcrops containing plant material but which apparently lack marine fossils occur beneath Oraka Formation at Oraka Bay. They are thought to be terrestrial solely on the absence of marine fossils. Similar green sandstones to the south also lack marine fossils. The Temaikan sequence at Kawhia Harbour is unusual in that it is mostly non-marine, apart from a thin marine band near the middle, and at the very top. Elsewhere in southwest Auckland it is entirely marine.

## Oraka Formation

This consists of a fining upwards sequence of massive medium sandstone, fine sandstone and siltstone, and siltstone, about 75 meters thick. The Temaikan-Heterian boundary is contained within the formation.

**Paleontology.** The fauna includes the bivalve *Retroceramus galoi* (Boehm), first recorded about 20 m above the base of the formation and which marks the base of the Heterian stage. The upper Bathonian fossils *Retroceramus* cf. *patagonicus* and *R. stehni*, first recorded in South America, are also present in the lower part of the Oraka Formation, and can be confused with *R. galoi* and the Ohauan marker *R. haasti*, particularly if incomplete. Also present are *Pleuromya*, *Astarte*, *Pinna*, *Trigonia* and *Indogrammatodon*, the belemnites *Conodicoelites* (middle beds) and small forms of *Belemnopsis annae* (upper beds), and the ammonites *Araucanites*, *Holcophylloceras*, and *Lytoceras*. Some workers maintain that *Idoceras*, a taxon with Mexican affinities is also present; others that the form should be included in *Sulaites*, a Papua New Guinean and Indonesian form. *Sulaites* is preferred here. The brachiopod *Kawhiarhynchia*, and dinoflagellates that may be equivalent to the Australian *Wanaea digitata* zone are also present, suggesting a Callovian age. Ammonite studies currently nearing completion show the presence of the South American genus *Araucanites* that, with the other taxa mentioned, suggest the Oraka Formation ranges in age from late Bathonian to Early Callovian. The formation is much thicker to the south near Awakino.

## Captain King's Shellbed (CKSB)

This is a green-grey highly fossiliferous glauconitic sandstone best exposed in the shore platform above the Oraka Formation. Its distinctive lithology and fossil content have been used to trace the formation southwards to the Awakino region. It seems to be a much condensed Upper Callovian to Middle Oxfordian sequence reflecting very slow deposition.

**Paleontology.** The fauna includes a range of bivalves including *Retroceramus galoi*, *Camptonectes*, *Vaugonia*, *Pleuromya*, and *Astarte*, the brachiopods *Kawhiarhynchia* and *Kutchithyris*, small forms of the belemnite *Belemnopsis annae*, and gastropods. *Malayomaorica malayomaorica* appears in the lower part of CKSB, and marks the base of the Middle Heterian.

## Ohineruru formation

This is composed of 460 m of mostly siltstone with some thin sandstone beds, particularly in the lower part. A concretionary nodular bed 50m above the base contains many belemnites and a 1m concretionary highly fossiliferous bed, the McNaught Shellbed member, is present 100m from the top. The formation crops out in the cliffs and shore platform east of CKSB, on the shore platform to the south, on both sides of Kiwi Bay, and in the northwest face of Heteri Peninsula. The lower part of the formation is more fossiliferous than both the upper part and the overlying siltstone formations, possibly reflecting somewhat shallower water conditions.

**Paleontology.** *Retroceramus galoi* and *Malayomaorica malayomaorica* extend through most of the formation and *Retroceramus* spp., variously known as *R. cf. galoi* and *R. cf. subhaasti*, appear towards the top. This taxon (or taxa) indicates the base of the Upper Heterian. This *Retroceramus* complex, morphologically and stratigraphically transitional between *R. galoi* and *R. haasti* Hochstetter, is poorly known and requires further research. Other bivalves including *Pleuromya*, *Myophorella*, *Astarte*, *Entolium*, *Indogrammatodon* and *Lima* are also present.

*Belemnopsis stevensi* first appears in outcrops on the western side of Heteri

Peninsula, accompanied by rare *Belemnopsis kiwiensis*, *Belemnopsis* sp.B and *Belemnopsis* sp. Another rare form, *Belemnopsis* sp. D, occurs at a similar horizon in outcrops on Whakapirau Road c. 4 km to the south. *Phylloceras*, *Calliphylloceras*, *Lytoceras* (including very large forms), and *Sulaites* are present, and *Parabolicseras* makes its first appearance near the base of the formation. Ammonites indicate a Late Oxfordian to Early Kimmeridgian age. Dinoflagellates from the lower part of the formation suggest an Oxfordian age, and, from higher in the formation, Kimmeridgian.

## Kiwi Sandstone

This formation consists of 40m of alternating sandstone and siltstone, conglomerate, and, at the top, coarse sandstone with siltstone beds and pebbles. Abundant fossils, carbonaceous material, and fossil wood, occur near the base. It is well exposed in the northwest face of Heteri Peninsula.

**Paleontology.** *Retroceramus* spp., *Malayomaorica malyomaorica*, *Sulaites*, and *Belemnopsis stevensi*.

## Waikutakuta Siltstone

Composed of 130 m of blue-grey muddy siltstone, with thin white silty sandstones and concretionary beds more common in the lower part. It forms most of the northern face of Heteri Peninsula.

**Paleontology.** The *Retroceramus cf. galoi* cf. *subhaasti* complex that appears at the top of the Ohineruru Formation continues through the Waikutakuta Siltstone. *Indogrammatodon*, *Malayomaorica malayomaorica* and *Lima* are also present. *Lytoceras* and *Parabolicseras* are present but not common, and *Parabolicseras*, in particular, is usually found as partial impressions. *Belemnopsis stevensi* extends throughout the formation, and *Belemnopsis keari* appears in the top half. *Belemnopsis annae*, *B. stevensi*, and *B. keari* share ontogenetic characteristics, and immature forms can be confused. Adults are more easily recognised.

## Waikiekie Tuffaceous Sandstone

12 m of coarse to medium sandstone with tuffaceous horizons and siltstone pebbles make up this formation. Carbonaceous material is common throughout. Mudstone appears in the top of the formation to the south on Whakapirau Road. It forms the northeast headland of Heteri Peninsula.

**Paleontology.** No marine fossils are known from the coastal outcrop. *Retroceramus haasti* and *R. cf. subhaasti* extend throughout the formation in outcrops to the south, and *Phylloceras* is present at the top. The first appearance of *Retroceramus haasti* marks the base of the Ohauan stage (and Lower Ohauan substage), which are therefore located close to the base of the Waikiekie Tuffaceous Sandstone.

## Kowai Point Siltstone

This consists of c. 700 m of siltstone with thin pale coloured tuffaceous bands, concretionary horizons, and thin sandstones. The lower 150m, poorly exposed in the shore platform east of Heteri Peninsula, consists of well-bedded siltstone and some thin sandstones. The middle part, 375 m thick, consists mostly of siltstone with thin tuffaceous beds, and thin graded and cross-bedded sandstones. Several tight folds are present in the shore platform at the northern end of the peninsula east of Heteri, and in the shore platform at Kowhai Point, and are represented by opposing dips along the western shore of Kowhai Point peninsula. At least five tightly folded anticlines are present. They strike east of north, plunge northwards at c. 20°, and the limbs dip at between 45

and 90°. The upper c. 150 m of the formation is mostly unexposed along the shore but is represented to the south by alternating siltstones and sandstones, with sandstones becoming more common towards the top.

**Paleontology.** *Retroceramus haasti* and *Malayomaorica malayomaorica* extend throughout the formation but are rare or absent in the overlying Takatahi Formation, probably a function of facies control. *Retroceramus* cf. *subhaasti* is said to extend part way into the formation and occasional *Nucula* are present. Cephalopods are less common than in the underlying siltstones. Small belemnites (*Belemnopsis* and *Dicoelites*) may be found loose at the base of the beach, but are difficult to find *in situ*. Phylloceratid ammonites (*Phylloceras*, *Holcophylloceras*, *Ptychophylloceras*) are present, together with *Kossmatia* and *Pachysphinctes*, but none is common. *Belemnopsis stevensi* extends through much of the *Retroceramus haasti* zone in the Port Waikato region, and *B. keari* may also extend into it in the same region, but neither is recorded from the lower Kowhai Point Siltstone at Kawhia. Kowhai Point is of historical interest as Ferdinand von Hochstetter visited the outcrops in 1859, and collected the first ammonites found in New Zealand. Time permitting we will briefly examine the Takatahi Formation (east of Kowhai Point) and the middle part of the Lower Puti Siltstone (northern shore of the harbour).

## Takatahi Formation

Takatahi Formation is well exposed at Nathan Point. It includes Takatahi Conglomerate, Hekopo Mudstone, and Nathan Sandstone Members, and is the lower of the two formations that together make up the Ahuahu Group. It contains *Belemnopsis trechmanni*, near the base, indicating the base of the Upper Ohauan substage. The Middle Ohauan is an interval zone between *R. haasti* and *B. trechmanni*. Rare *Kossmatia* also occur in the Takatahi Formation.

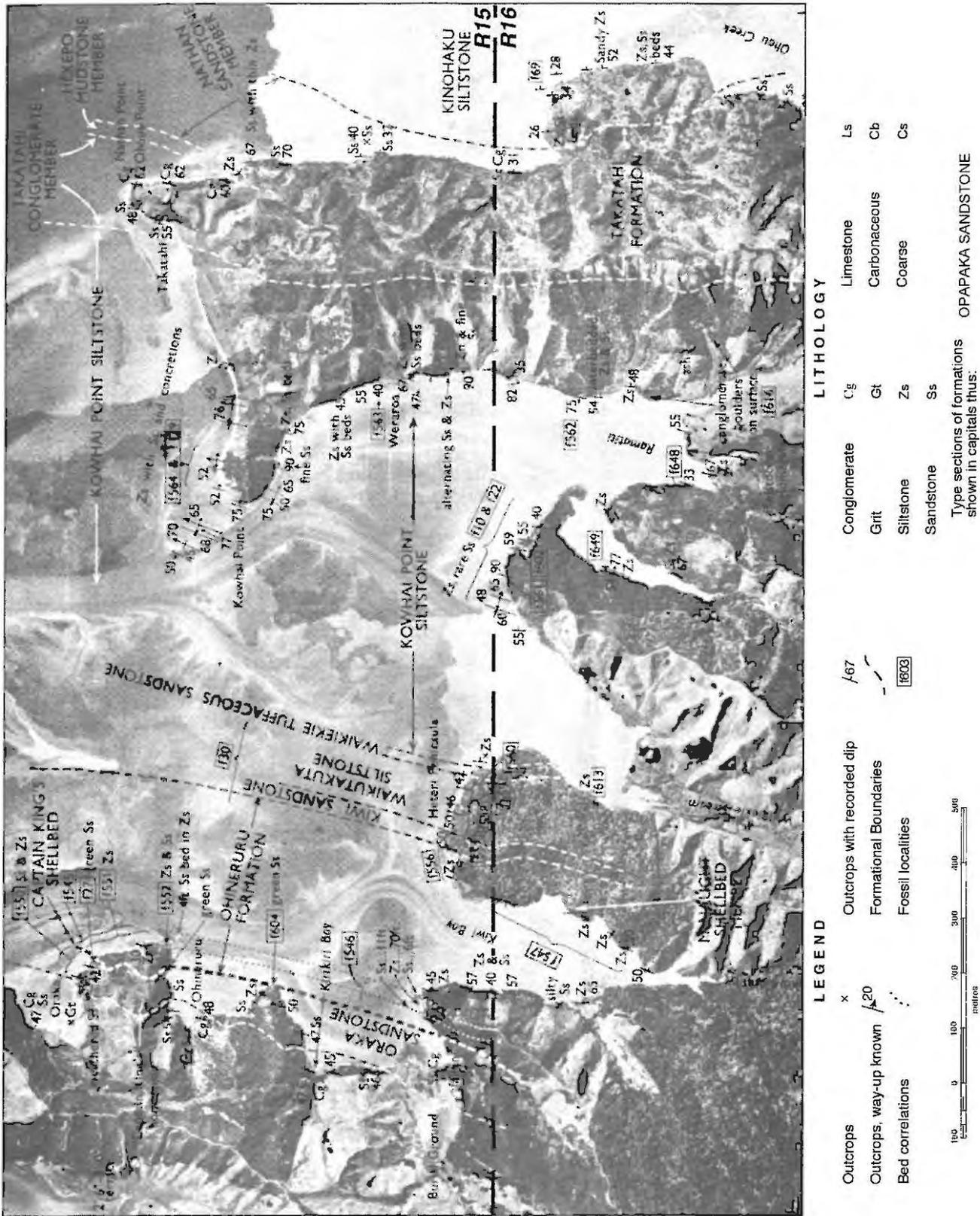
## Lower Puti Siltstone

This formation is the upper of two that together make up Owhiro Group. It is at least 750m thick on the western limb of Toe Syncline and well exposed near Puti Point. The lower c. 350m is incompletely exposed, but probably consists mainly of blue-grey siltstone with thin sandstones and tuffaceous beds. The middle 15 m, well exposed at Puti Point, consists of blue-grey siltstone with prominent concretionary beds and tuffaceous horizons, and the upper 300m plus is made up of blue-grey concretionary siltstone.

**Paleontology.** Puti Siltstone differs from the Ohineruru, Waikutakuta and Kowhai Point Siltstones in its relatively sparse benthic fauna. Quite a number of taxa are present at Puti Point including *Malayomaorica* aff. *misolica* (first appearance), *Retroceramus* aff. *everesti*, *Paleonucula*, *Nuculana*, gastropods and annelids, but individual specimens are not common. The remains of pelagic forms are more easily found. Three belemnites are present. *Hibolithes arkelli* appears near the base of Owhiro Group, and extends up to the horizon of Puti Point, where it is replaced by *Hibolithes marwicki* and *H. mangaoraensis*. *H. marwicki* is most abundant in the lower part of its range but is still present in outcrops on the eastern side of Motutarakatoa Peninsula west of Puti Point. *H. mangaoraensis* is rare at first, becomes fairly common at Motutarakatoa Peninsula, and extends into higher beds. Ammonites are not uncommon, but these days are rarely found because the beds are very accessible and regularly collected. *Aulacosphinctoides*, *Kossmatia*, *Uhligites*, *Lytoceras* and phylloceratids are all present.

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**Figure 1.** Geology within the Upper TeMaikan to Ohauan (Upper Bathonian to Upper Kimmeridgian) sequence at Kawhia Harbour. Boundary between sheets R15 and R16, NZMS 260 1:50 000 indicated. Fossil record numbers are pre-metric; to metricate, prefix numbers within R15 with "8", and those within R16 with "6" (e.g. f550 becomes R15/f8550, and f547 becomes R16/f6547). Map modified from Fleming & Kear 1960, map 3.

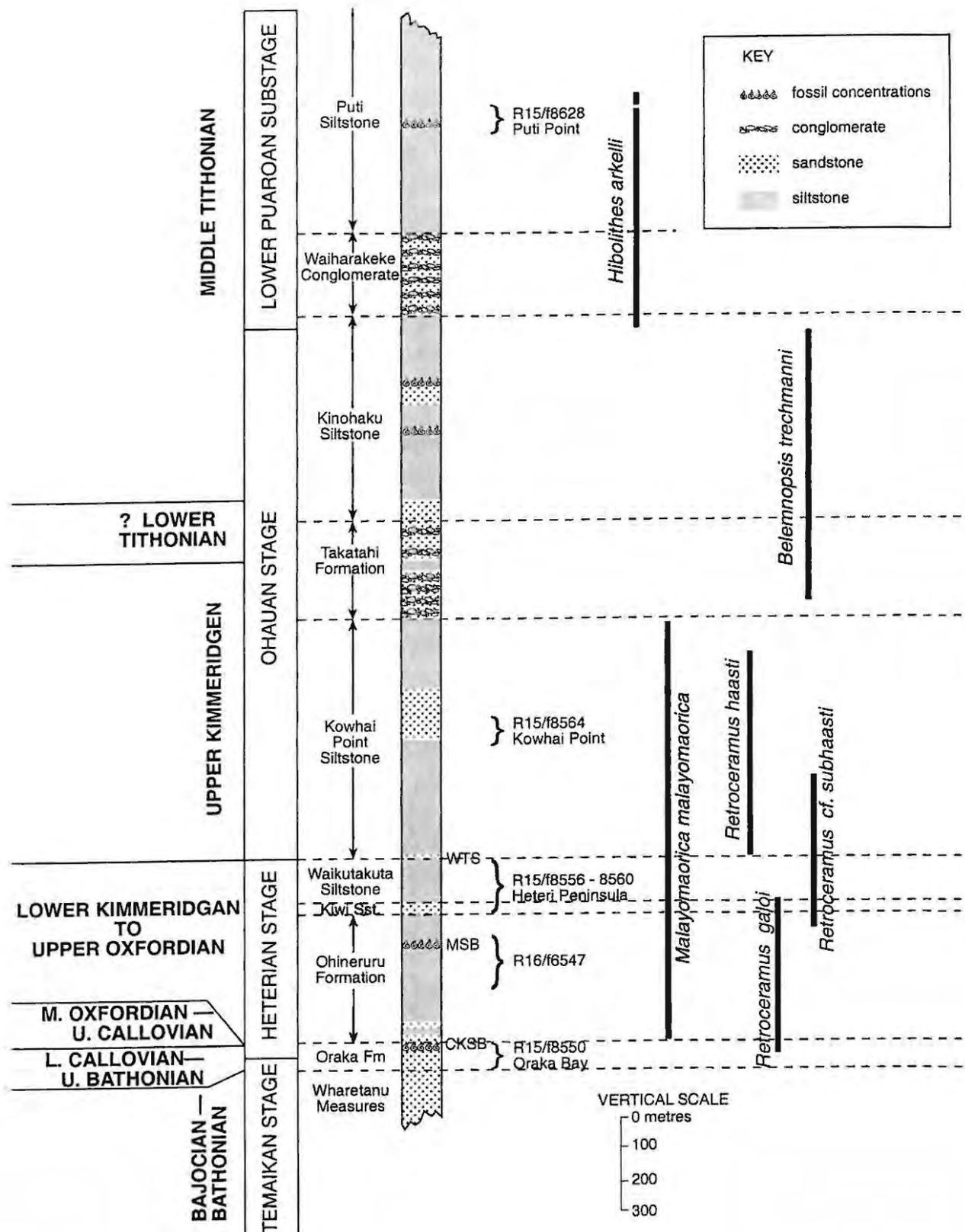


Figure 2. Stratigraphic column for Upper Temaikan to Lower Puroan sequence at Kawhia Harbour. WTS = Waikiekie Tuffaceous Sandstone; MSB = McNaught Shellbed; CKSB = Captain King's Shellbed. Fossil record numbers indicate levels of significant biostratigraphic interest. The stratigraphic range of marker taxa that indicate the bases of New Zealand stages and substages are indicated. *Retroceramus galoi* (base of Heterian stage and Lower Heterian substage); *Malayomaorica malayomaorica* (base of Middle Heterian substage); *Retroceramus cf. subhaasti* (base of Upper Heterian substage); *Retroceramus haasti* (base of Ohauan stage and Lower Ohauan substage); *Belemnopsis trechmanni* (base of Upper Ohauan substage); *Hibolithes arkelli* (base of Puroan stage and Lower Puroan substage): The middle Ohauan substage is an interval zone between the last appearance of *R. haasti* and the first appearance of *Belemnopsis trechmanni*. Column modified from Fleming & Kear 1960, fig. 4.

