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PROVISIONAL CHRONOLOGY OF A LATE QUATERNARY CORE FROM LAKE WAIKARE, NORTH ISLAND, NEW ZEALAND

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ABSTRACT

Lake Waikare is a shallow (< 2 m), 34.4 km² riverine lake near Hamilton,

North Island, New Zealand (175° 12' S, 37° 24' E). A c. 12.5 m long (corrected depth) sediment core taken from the lake in 1990 comprises mainly green-grey lacustrine clays with interbedded layers of peat, brownish clays, occasional fluvial sandy layers, and several thin tephra deposits. Lake sediment at the base of the core has been dated at 26 000 ± 1600 years BP (old half life basis) using the C-14 method; charcoal fragments at c. 11.7 m depth were dated at 17 300 ± 400 years BP; and a tephra layer at c. 8.5 m depth has been provisionally identified, using major element composition of glass, as the Rerewhakaaitu Tephra with an age of 14 700 ± 110 years BP. These ages accord with previous work in the area.

Озеро Вайкаре является мелким (<2 м), речным озером площадью 34,4 км² недалеко от города Гамильтон, остров Северный, Новая Зеландия (175° 12' Ю, 37° 24' В). Керн отложения длиной 12,5 м (поправленная глубина), которого брали в озере в 1990 г. состоит в основном из зелено-серых озерных глин с напластованием слоев из торфа, бурых глин, с редкими слоями из речного песка и некоторыми тонкими месторождениями тефры. Озерное отложение в базисе керна восходит к 26000 ± 1600 лет ВР (до настоящего времени используя метод С-14; древесно-угольные обломки на глубине 11.7 м датировались в 17300 ± 400 лет ВР (до настоящего времени); предварительно определили также слой тефры на глубине 8,5 м, используя при этом главный состав элементов стекла, как тефру Реревакааиту с возрастом 14700 ± 110 лет ВР. Эти определения возраста соответствуют прежним работам на этой территории.

Lake Waikare ist ein seichter (< 2 m tief) Fließwassersee nahe Hamilton, Nordinsel, Neuseeland (175° 12' S, 37° 24' O); seine Fläche beträgt 34,4 km².

Eine Sedimentkernprobe (Länge 12,5 m, korrigierte Tiefe), die dem See 1990 entnommen wurde, umfaßt hauptsächlich graugrünen Seelehm mit eingelagerten Schichten aus Torf, bräunlichem Lehm, gelegentliche Flußsandschichten sowie einige dünne Tephersedimente. Die Seesedimente am Boden der Kernprobe wurden mit Hilfe der C-14-Methode auf 26.000 +/- 1.600 Jahre vor unserer Zeit (BP) datiert; Holzkohlefragmente in einer Tiefe von ca. 11,7 m wurden auf 17.300 +/- 400 Jahre BP datiert. Eine Tephraschicht in einer Tiefe von ca. 8,5 m wurde vorläufig entsprechend der Zusammensetzung der Hauptelemente von Glas als Rerewhakaaitu-Tephra (Alter 14.700 +/- 110 Jahre BP) identifiziert. Diese Altersangaben entsprechen der auf diesem Gebiet geleisteten Arbeit.

Le lac Waikare est un lac peu profond (inférieur à 2 m) avec une surface de 34,4 km² près de Hamilton, North Island, Nouvelle Zéland (175° 12'S, 37° 24' E). Une carotte de 12,5 m de long (profondeur corrigée) prise dans ce lac en 1990 comprend avant tout de l'argile lacustre vert-gris avec des couches de tourbe, des argiles bruns et quelques couches de sables fluviatiles ainsi que certains minces dépôts de tephra. Les sédiments du lac au fond de la carotte ont été datés avec 26 000 +/- 1 600 ans (ancienne base de demi-vie) en utilisant la méthode C14, de fragments de charbon de bois à 11,7 m de profondeur ont été datés de 17 300 +/- 400 ans; et la couche de tephra à 8,5 m de profondeur a été identifiée, en utilisant des éléments majeurs de verre, comme Rerewhakaaitu Tephra avec un âge de 14 700 +/- 110 ans. Ces âges s'accordent avec d'autres travaux entrepris auparavant dans la région.

Il Lago Waikare è un lago poco profondo (prof.: < 2 m) simile a un fiume, vicino ad Hamilton, North Island, in Nuova Zelanda (175° 12' S, 37° 24' O): la sua superficie è di 34,4 km².

Una carota di sedimento lunga 12,5 m (profondità corretta), che è stata prelevata dal lago nel 1990, comprende principalmente argilla lacustre grigioverde con strati interstratificati di torba, argilla brunastra, occasionali strati di sabbia fluviale e alcuni sottili sedimenti di tefra. I sedimenti lacustri nel fondo della carota sono stati datati con il metodo del carbonio 14 a 26.000 ± 1.600 anni fa; i frammenti di carbone di legna ad una profondità di ca. 11,7 m sono stati datati a 17.300 ± 400 anni. Uno strato di tefra ad una profondità di ca. 8,5 m è stato identificato, per il momento, usando la composizione degli elementi principali del vetro, in quanto tefra Rerewhakaaitu (età 14.700 ± 110 anni). Questi dati concernenti l'età concordano con gli studi precedenti effettuati in questa zona.

LOCATION, MORPHOMETRY, AND CATCHMENT GEOLOGY OF LAKE WAIKARE

Lake Waikare is situated near Hamilton in the Lower Waikato Lowland of the Waikato region, North Island, New Zealand (Fig. 1A). With an area of 34.4 km², it is the 19th largest lake in New Zealand, and has a maximum length of 10.0 km and maximum width of 6.0 km (Lowe & Green 1987a). It is very shallow, having a maximum depth of about 1.6 m, and occurs at an altitude of 9 m above sea level (Lowe & Green 1987a). Lake Waikare is classed as a riverine lake by Lowe & Green (1987b).

The lake is bounded by uplifted greywacke ranges of Mesozoic age on its eastern shores (Fig. 1B). The rest of the lake is surrounded largely by alluvium

of Quaternary age and extensive deposits of Holocene peats (Fig. 1B; McGlone et al 1984).

CORING SITE AND OPERATION

The coring site location is shown in Fig. 1B at approximately 175° 12'S, 37° 24'E (grid reference approx. S13/164045 on the 1:50 000 topographical map series NZMS 260). The core was obtained in March 1990 by Brown Bros (NZ) drilling engineers under the supervision of Prof. Horie using a Gemco Model HP7 hydraulic drilling rig mounted on a 6m-long aluminium cateraman fitted with stabilising spuds. The core, 75 mm in diameter, was obtained in sections using an (non-rotating) open ended barrel with hardened steel cutters or with a triple tube core barrel with inner split tubes. The core obtained was extruded into PVC tubes, taped up, and stored in a cool store at 3°C.

CORE STRATIGRAPHY AND CHRONOLOGY

The core, approx. 12.5m long (corrected depth; apparent depth was 21m), comprises mainly green-grey lacustrine clay with interbedded layers of peats (some with wood), brown clays, and occasional sandy layers including several tephra deposits. The base of the core is marked by blue-grey sand deposits with pebbles and shell fragments.

Two samples, numbered "14B" and "15", were submitted for radiocarbon dating using Quantulus liquid scintillation spectrometry at the University of Waikato Radiocarbon Dating Laboratory (symbol Wk; Hogg et al. 1987). Sample 14B (Wk-1627) comprised charcoal washed from Core No.14 (at c.11.7 m corrected depth; apparent depth 19.5m) and returned a conventional radiocarbon age (old half life basis) of $17\ 300 \pm 400$ years BP. Sample 15 (Wk-1628) comprised brownish lake sediment from Core No.15 (at c.12.5 m corrected depth; apparent depth 21m) and returned a conventional radiocarbon age (old half life basis) of $26\ 000 \pm 1600$ years BP.

A tephra layer recorded in the core at about 6 m corrected depth was not analysed by us, but we did analyse another tephra layer sampled at c. 8.5 m corrected depth. This sample, numbered "10", was obtained from Core No.10, and was provisionally identified as a correlative of the rhyolitic Rerewhakaaitu Tephra Formation, derived from the Okataina volcano, and is well-dated elsewhere at $14\ 700 \pm 110$ conventional radiocarbon years BP (Froggatt & Lowe 1990). The sample contained quartz, plagioclase, sparse pumice fragments and glass shards, and corroded calcic hornblende and traces of clinopyroxene (probably augite). The glass shards were analysed by electron microprobe by Dr. P. C. Froggatt

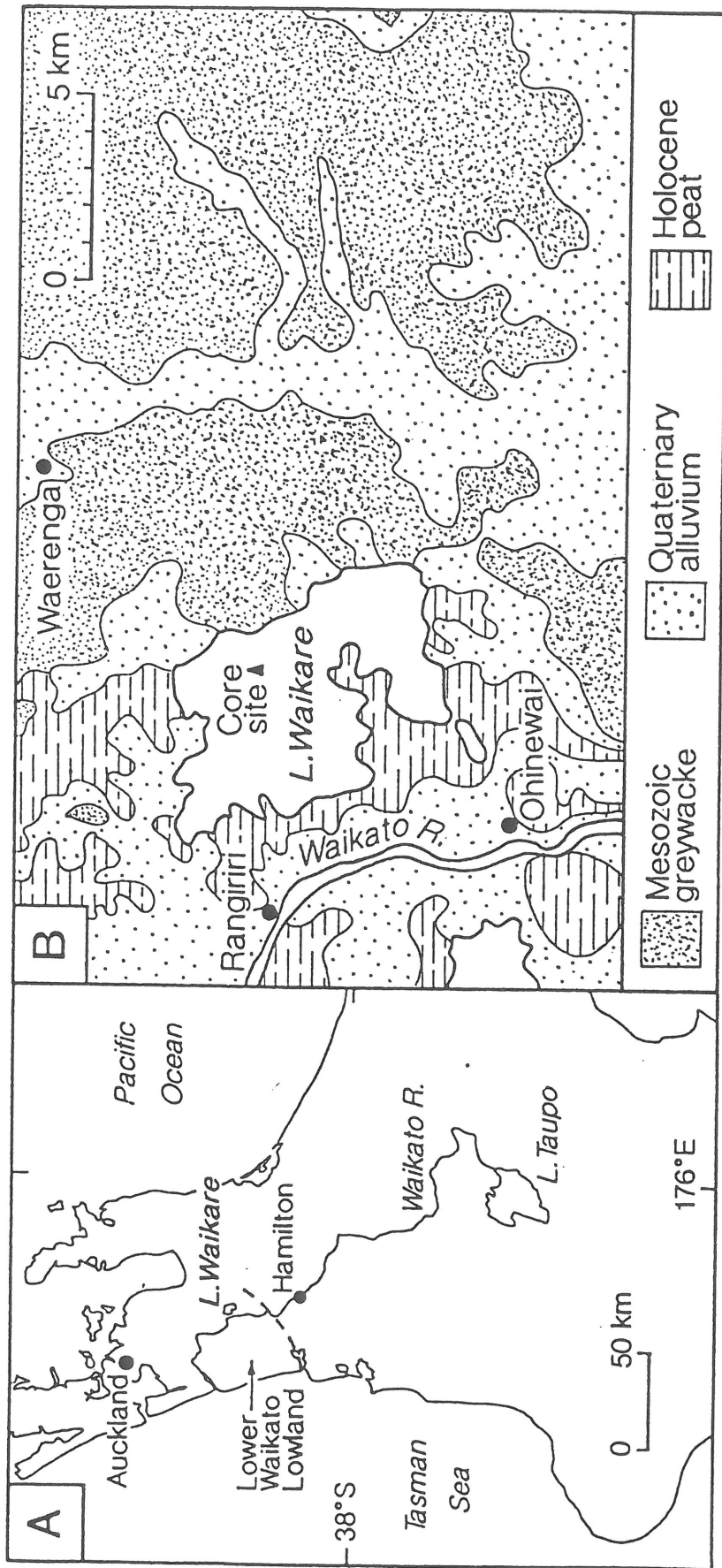


Fig. 1 A. Location of Lake Waikare in North Island, New Zealand. B. Generalised geological map of the Lake Waikare area (after McGlone et al. 1984, p. 234).

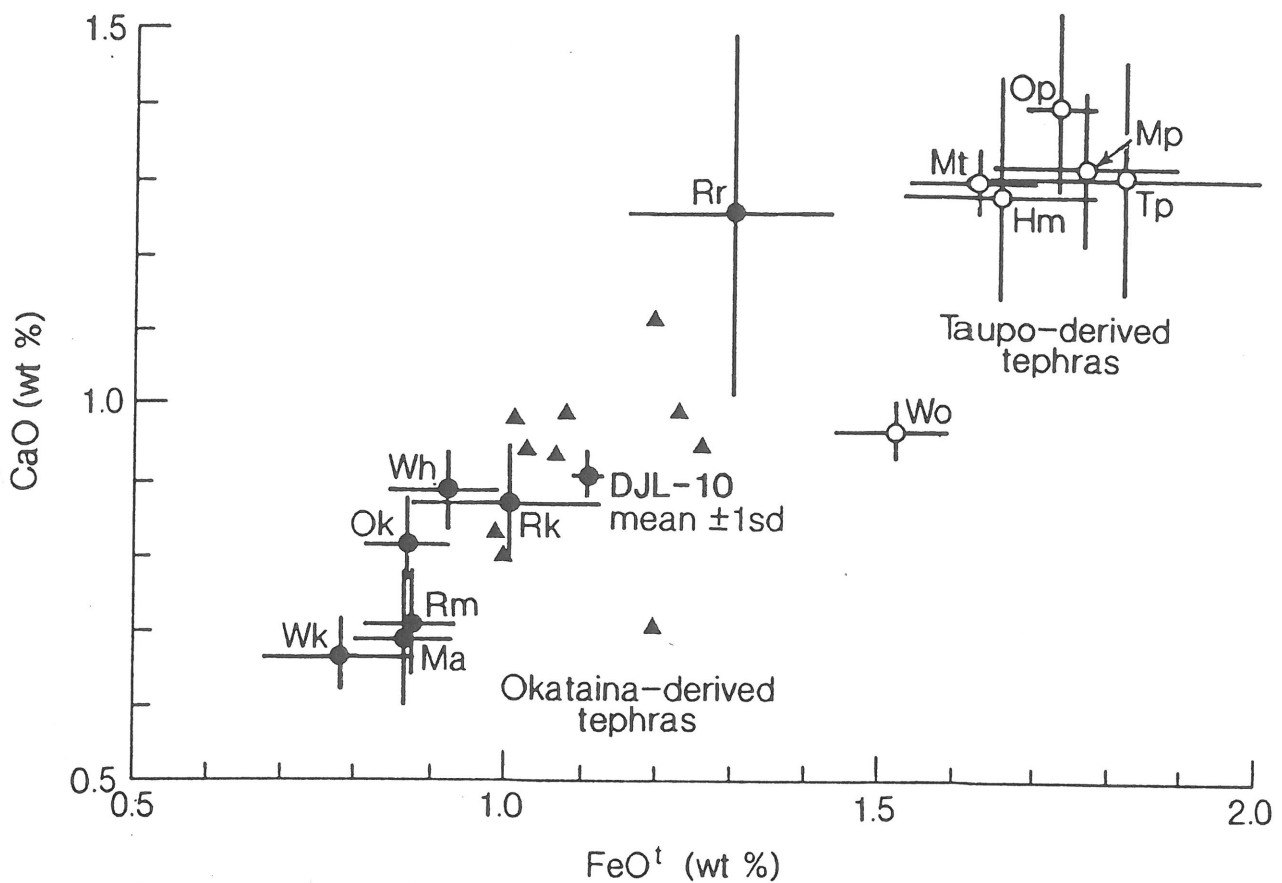


Fig. 2 CaO vs FeO (total iron) in glass in post-20 000 year old tephras derived from the Taupo (open circles) or Okataina (closed circles) volcanoes, and sample 10 from Lake Waikare (DJL-10; triangles are individual analyses). Bars are ± 1 S.D. of mean values. Tephra names: Tp, Taupo; Mp, Mapara; Wo, Whakaipo; Hm, Hinemaiaia; Mt, Motutere; Op, Opepe; Wk, Whakatane; Ma, Mamaku; Rm, Rotoma; Wh, Waiohau; Rr, Rotorua; Rk, Rerewhakaaitu; Ok, Okareka. After Lowe (1988b).

(Victoria Univ. Wellington) for major elements (Table 1). These analyses showed a good match with previously published analyses of this tephra in the Waikato

Table 1 Electron microprobe analyses of glass shards (normalised to 100 %)

	DJL-10 (L. Waikare)	Rerewhakaaitu Tephra	
		Waikato ¹	All ²
SiO ₂	78.06 (0.48)	78.34 (0.41)	78.17 (1.83)
Al ₂ O ₃	12.20 (0.20)	12.41 (0.18)	12.43 (0.31)
TiO ₂	0.13 (0.04)	0.14 (0.04)	0.11 (0.04)
FeO [*]	1.11 (0.11)	1.00 (0.13)	0.97 (0.18)
MgO	0.09 (0.02)	0.13 (0.03)	0.10 (0.04)
CaO	0.92 (0.13)	0.88 (0.07)	0.85 (0.09)
Ma ₂ O	3.37 (0.16)	3.42 (0.34)	3.69 (0.30)
K ₂ O	3.90 (0.23)	3.56 (0.34)	3.66 (0.44)
Cl	0.21 (0.04)	0.12 (0.03)	n.a.
Water ⁺	2.81 (1.60)	3.38 (2.12)	3.15 (2.16)
n	10	12	73

n.a., not available; n, number of analyses in mean \pm 1 S. D.

1 From Lowe (1988a)

2 After Stokes et al. (1991)

* Total Fe as FeO

+ By difference

region (Lowe 1988a, b).

A comparison between sample 10 analyses with those of Rerewhakaaitu Tephra published in Stokes et al. (1991) gave a similarity coefficient of 0.93, indicating close similarity (see also Fig.2).

Several other layers sampled in the core as possible tephra layers (sample numbers 9, 14C, 14D) were analysed but interpreted to be fluvial layers.

DISCUSSION

The ages obtained indicate that the core spans about 26 000 years, and that the sediments are likely to thus represent glacial (oxygen isotope stage 2) and interglacial (Holocene) conditions. The radiocarbon and tephrochronological dates accord with the sequence of dates obtained by McGlone et al. (1984) in their study of Holocene and Late Pleistocene peats at Ohinewai adjacent to Lake

Waikare (Fig. 1B). They found that lacustrine mud was deposited in a proto-Lake Waikare from c. 20 000 to 7000 years ago, and that open shrubland-grassland vegetation was dominant for at least a portion of this time. Peat deposits formed around 7000 years ago when forest dominated the landscape. A more detailed record of paleoclimate and paleovegetation for the Waikato region since c. 18 000 years ago is given by Newnham et al. (1989).

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