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A late glacial to present diatom record from Lake Euramoo, wet tropics of Queensland, Australia

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Abstract

A new diatom record from Lake Euramoo on the Atherton Tableland, north Queensland, Australia is used to assess regional climate change and variability and their links to forcing at a local to global scale. The major factor driving diatom composition in the approximately fifteen thousand-year record appears to be regional moisture availability. Patterns of diatom preservation and other indicators, particularly sediment organic content, suggest that permanent deep water formed at the site from ca. 15,000 cal. yr BP. However, between 13,800 and 11,500 cal. yr BP, there was a notable phase of lower lake levels and effective precipitation. The timing and duration of this phase does not correspond to large-scale climate phenomena such as the Antarctic Cold Reversal or the Younger Dryas and supports emerging evidence for a variable climate regime in the south-west Pacific during the late glacial transition.

The Early to Mid Holocene record is one of remarkable stability with 5000 years of sustained dominance by the planktonic diatom *Aulacoseira ambigua*. Conversely, the Mid to Late Holocene record is marked by distinct diatom variability superimposed on a series of sustained shifts in composition. Accentuated Late Holocene climate variability may aid in explaining intensified land use in indigenous populations and also suggests that Europeans may have arrived in the landscape at the time it was most vulnerable to perturbation.

Keywords: Pleistocene; Holocene; Tropical; Palaeolimnology; Climate; Lake level

1. Introduction

The Late Quaternary history of the humid fringe of Australia in general, and of north-east Queensland in particular, is dominated by records derived from pollen analysis of lakes and swamps (Kershaw and Nanson, 1993). These records have provided an invaluable insight into regional and global scale climate change and variability (Kershaw, 1974, Turney et al., 2004), the nature and timing of human occupation (Kershaw, 1986) and the development and dynamics of rainforest vegetation (Walker and Chen, 1987; Haberle, 2005). While such records are of immense value, the nature of (dryland) vegetation response to external forcing means that it may take decades to centuries for pollen records to reach equilibrium with climate (Walker and Chen, 1987). Such outcomes are problematic when issues such as centennial scale climate variability or inter-hemispheric climate linkages are assessed. A variety of

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other proxies exist which are capable of examining such issues (e.g. tree rings or coral banding). These are characterised by substantial environmental sensitivity and both high temporal resolution and precision (e.g. Hendy et al., 2002). However, such records are often limited in temporal and/or spatial extent, particularly in the Australasian region (see Fig. 1a in Mann et al., 1998).

In this context, we present a new diatom record covering approximately the last 15,000 years from Lake Euramoo in north-east Queensland. Due to their short life cycles and sensitivity to a variety of climate-related water quality and aquatic habitat characteristics, diatoms are increasingly being utilised as indicators of Quaternary climate change and variability (Smol and Cumming, 2000). In Australia, despite a long recognition of the sensitivity of diatoms to their environment (Reid et al., 1995), which has included the development of a number of water quality transfer functions (e.g. Gell, 1997; Tibby et al., 2003; Tibby, 2004) and some of the earliest efforts at quantitative environmental reconstructions (Tudor, 1973) there has been a general paucity of Late Quaternary diatom records. Indeed, there are very few records with any Pleistocene antiquity (Bradbury, 1986, Tibby et al., 2006; Turney et al., 2006), with only Tibby et al. (2006) providing data from the last glacial maximum through the Holocene. This and other records from western Victorian crater lakes (Tudor, 1973; Gell et al., 1994; Tibby et al., 2006) appear to be the only Australian diatom records that cover the entire Holocene.

2. Study site

Lake Euramoo (718 m above sea level, 17°10′S, 146°38′E, Fig. 1) is one of a small number lakes formed in Late Quaternary volcanic craters on the Atherton Tableland, an uplifted Tertiary region which has peaks rising to over 1500 m. The site lies near the western margin of wet tropical rainforest, although vegetation within the crater has been substantially modified by human agency (Kershaw, 1970; Haberle et al., 2006). Rainfall at the site is estimated to be ~1500 mm per annum, with the majority (60%) falling predominantly between January and March. The lake is warm monomictic, with a water depth averaging around 20 m in the southern basin and 16 m in the northern basin, though there are seasonal fluctuations in water depth of between 2 and 3 m (Timms, 1976). Lake Euramoo is very fresh (31 parts per million salt) and slightly acidic (with a mean pH measured in 1973–1974 of 6.31, Russell, 1987). Extensive (>30 m wide) marginal fixed and floating root mat vegetation is found around the Lake, particularly in the southern basin (Kershaw, 1979).

3. Methods

Coring, sampling and dating methods are detailed in Haberle (2005) and Haberle et al. (2006) and are briefly summarised here. Cores were raised from a water depth of 16 m in the centre of the northern basin of Lake Euramoo in 1999. A clear plastic piston corer was used

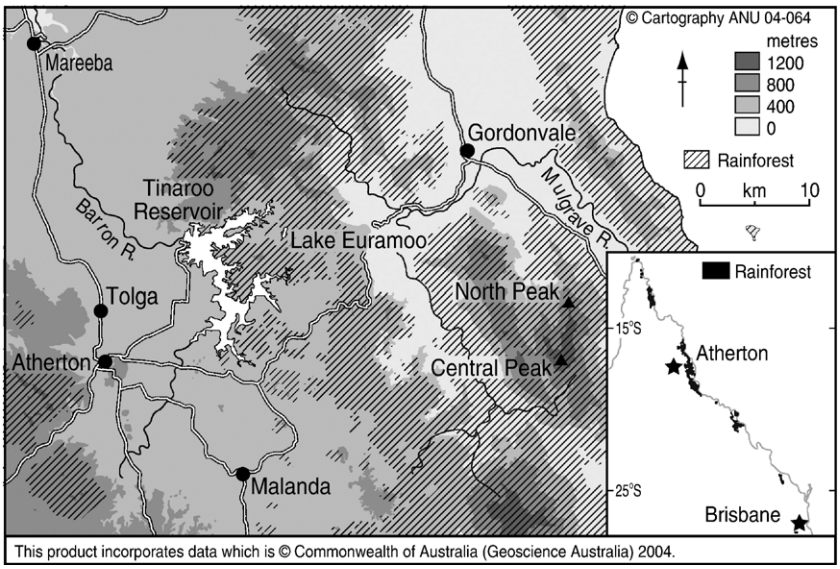

Fig. 1. Location of Lake Euramoo, distribution of rainforest in the north-east Queensland region and generalised topography (from Haberle, 2005).