**Supplementary Material**

EVALUATING THE RADIOCARBON RESERVOIR EFFECT IN LAKE KUTUBU PAPUA NEW GUINEA

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Information on the reservoir effect in PNG mainland:

The main geological event that contributed to the formation of limestone in PNG was the deposition of shelf sediments (mainly limestone) in the early Miocene, continuing almost uninterruptedly until the Pliocene (Dow, 1977). At this time, there was a marked attenuation in the supply of terrigenous material reaching the platform, so the sediments without exception are limestone or calcareous mudstone.

The highest occurrence of limestone is in the Papuan Fold Belt (Figure 6 of the main paper). This area was inundated in the early Miocene and shallow-water shelf limestone was deposited throughout the early and middle Miocene (Dow 1977). A major geographical feature of the Papuan Fold Belt is the Darai Plateau, which is an extensive belt of inhospitable karst limestone country developed on thrust sheets of late Eocene to late Miocene Darai Limestone (Sheppard and Cranfield 2012). The limestone in the Papuan Fold Belt (as found in exploration wells) is between 500 and 1500 m thick (Dow 1977). Limestone is thicker near the head of the Gulf of Papua, where over 3350 m of limestone was penetrated by the two Omati exploration wells (Sheppard and Cranfield 2012).

In the northern coast of PNG mainland, a thick package of middle Eocene to Pliocene shallow water limestone overlies chert, argillite and volcaniclastic rocks (Figure 6). The southeast region of mainland PNG consists of tholeiitic basalt with minor pelagic limestone of Late Cretaceous and middle Eocene age (Figure 6). Limestone formation is also known on PNG islands, but we focus our study on mainland PNG.

The Lakes most likely to present a reservoir effect on PNG mainland are:

**Yanamugi Lake:** located in the Markham Valley, this lake has been reported to give ages up to 1,636 years too old when compared with the modern sedimentation surface (Garrett-Jones, 1979) and the modern age of Tibito tephra (Blong et al., 2017a) The most likely factor causing these anomalous results has been reported to be the effect of the surrounding limestone on the water chemistry of the lake, and thus on the isotopic content of the lacustrine organisms. As for Lake Kutubu, sediments and biota of this lake were reported as depleted in 14C with relation to the atmospheric reservoir*.*

***Lake Gwam***: this is a high-altitude lake (3517 m a.s.l.) in Morobe Province. An error term of c. 2800 years has been determined from a comparison of Tibito ash with 210Pb and 14C studies on carbonate-rich whole mud fines in a 2200-year old sequence from Lake Gwam. A manuscript reporting these old carbon reservoir effects for this lake is currently being prepared (M. Prentice and G. Hope pers. comm.).

**Lake Ipea and Sirunki (also known as Kayamanda Swamp):** located in the Kayamanda Valley at 2500 m a.s.l. in the Western Highlands Province. A clay and gravel fan that emerges from the western hills spreads across the valley and cuts the swamp into two sections: the northern part contains Lake Ipea and the southern part contains Sirunki. The Andyoko-Putiti limestone ridge rises very steeply along its southernmost eastern edge (Flenley, 1967; Walker, 1972). Although the description of this area leads to the suspicion of a 14C reservoir occurrence, Oldfield et al. (1980) reported dates that match with tephras in this area: ca. 1405-900 cal BP for the Olgaboli tephra, bracketing the Olgaboli age of ca. 1180–980 cal BP reported by Schneider et al. (2017) and ca.2549-1922 cal BP dates for ash ‘C’, which is likely to be Baglaga tephra (2232 ± 150 cal BP) (Blong et al., 2017b). No evidence of a reservoir effect, therefore, has been reported for Lake Ipea. Detailed dating should be performed in future studies, however, to ensure that the limestone ridge is not affecting different parts of this lake.

Sirunki, in the Western Highlands Province, has an occurrence of limestone in the ridge east of its location. Flenley (1967) reported serious anomalies for 14C dates in this region; among the possible reasons for this anomaly he reported contamination of 14C from nearby limestone.

**Lake Koroba and Lake Haibuga (Haeapugua):** these lakes are in the Tari-Koroba district at an altitude of about 1,500 m a.s.l. Although Miocene limestones are the basal geologic units of this basin, 14C dates on Tibito and Olgaboli Tephras are consistent with a linear interpolation from the 14C dating sequence (Haberle, 1998) in the more recent chronologies established in Blong et al. (2017a) and Schneider et al. (2017) respectively.

**Lake Louise:** is a doline lake in the West Sepik Province, confined within a limestone terrain (Chambers, 1987). No specific study on the reservoireffect in this lake has been conducted, but its limestone formation, including tufa dams in the catchment, suggests that a strong radiocarbon reservoir effect could be expected there.

**Lake Kopiago:** in the northern part of Hela Province, Lake Kopiago is surrounded by limestone (Davies 1983). As far as we are aware no palaeo-environmental studies have been carried out on this lake, but its geological context suggests that it may be subject to the reservoir effect.

**Lake Tebera:** Lake Tebera, as with Lake Kutubu, has been reported in the literature as having one of the highest chemical concentrations among freshwater lakes in PNG (Bayly et al., 1970; Chambers, 1987; Petr, 1985). Both lakes receive water from limestone areas and have high alkalinities (48-94 mg/l CaCO3) (Chambers 1987).

**Lake Wangbin:** is a lake in the Western Province, about 15 km east of the Ok Tedi mine, and close to the Hindenburg Wall, which is in Darai Limestone (Chambers 1987). It is at least partially surrounded by limestone terrain. No specific study on the reservoir effect in this lake has been conducted, but its location suggests that a radiocarbon reservoir effect could be expected there.

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