<u>**EXTENDED ABSTRACT**</u>

TIMING AND CAUSES OF LATE QUATERNARY EROSION EVENTS IN LOWLAND AND MID-ALTITUDE TASMANIA[1]

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Aim

Although the effects of periglacial climate on erosion and deposition in lowland and mid-altitude Tasmania has long been recognised (Colhoun 2002) the chronology of the erosion and deposition events is not well known. In this paper we review and summarise previous work on lowland and mid-altitude climate change and erosion, present new dates for aeolian, fluvial and colluvial deposits, and discuss the factors that caused erosion.

Climate change deductions from vegetation change

Excavations at Tullarbardine (230 m altitude and present mean annual rainfall of 2000–2500 mm) in the Mackintosh catchment of northwest Tasmania revealed swamp and lake sediments that recorded regional and local vegetation changes over a period from >43.8 ka BP to the present (Colhoun and van de Geer 1986); the presence of locally-derived pollen of *Isoëtes* (a genus which lives in shallow water) was particularly useful because it enabled periods of high and low lake levels to be defined. From before 43.8 ka BP to about 25 ka BP cool but humid interstadial conditions prevailed. The vegetation was largely alpine and subalpine, with some rainforest taxa. This interstadial (later named the Middle Margaret Interstadial by Colhoun and Fitzsimons (1990)) included a period of wetter conditions and open-water favouring *Isoëtes*. Maximum dryness occurred at about 21.3 ka BP and an average temperature decline of 6.5^{o}C lower than at present during the Last Glacial maximum (Colhoun 1985b) was inferred. Before 11.7 ka BP there were brief periods of high lake level interpreted to be the result of deglaciation (snow and ice melt) and shortly after 11.1 ka BP rainforest re-established and prevailed throught the Holocene. No significant erosion events were recorded among the dated layers: till, sands and gravels (probably glacial outwash) near the base of the exposed section were dated >43.8 ka BP and probably belonged to the penultimate glaciation (130–200 ka BP) (Colhoun and van de Geer 1986). Although charcoal occurred intermittently throughout the analysed profile, the authors explained pre-Holocene vegetation variation solely by climatic factors although they agreed with (Kirkpatrick 1977) that Holocene and present vegetation cover had probably been influenced by Aboriginal and European burning.

The change to warmer, humid conditions and vegetation similar to the present interglacial vegetation occurred at about 11.2 ka BP at Lake St Clair (737 m altitude) (Hope et al. 2000) but there was a c. 7 ka period of grass and herb dominance in the preceding deglaciation phase both at Lake St Clair (Hope et al. 2000), and Ooze Lake (Macphail and Colhoun 1985) and Henty Bridge (Colhoun 1985c). Palynological evidence, together with sand dunes dated to 15.7 ka BP and after 19.8 ka BP in eastern Tasmania (Colhoun 1977, 1985a) supports the hypothesis that there was a change to drier conditions at the end of the the Last Glacial stage, with maximum aridity peaking at about 17–13 ka BP (Hope et al. 2000). However, it is noted that the development of grasses (Poaceae) at Lake St Clair coincides with sediments containing abundant

[1] McIntosh, P.D.; Price, D.M. (2006). Timing and causes of late Quaternary erosion events in lowland and mid-altitude Tasmania. Pp. 18–21 in: Legacy of an Ice Age. Abstracts of Conference Proceedings, Mungo Lodge, Lake Mungo, 6–9 September 2006.

charcoal, so fire-induced vegetation change (resulting from natural or aboriginal burning) in a dry climate must also be considered a possibility. At Pipe Clay Lagoon in southeast Tasmania Colhoun (1977) described a sequence of organic-rich freshwater sands overlain by laminated organic-rich sands in which pollen analysis indicated a change of vegetation from eucalypt forest to eucalypt ‘savannah’ during the period 25–20 ka BP. Colhoun (1977) remarked that "the vegetation change may be a response to colder and drier climatic condition in southeastern Tasmania as the ice sheets developed in central and western Tasmania." Thus in the southeast the onset of dry conditions appears to have been earlier than in central and western Tasmania.

Fan alluvium

Clark et al. (2006) dated alluvial deposts bisected by the Edgar Fault at Scotts Peak Dam in southern Tasmania by optically stimulated luminescence (OSL) methods to between 34 and 21 ka BP (mean age 27.8 ka BP) and attributed the erosion to the removal of stabilising vegetation. The authors did not discuss how the vegetation might be removed at altitudes of c. 1000 m, but extreme drought or fires must be the likely causes.

Colhoun and Goede (1979) dated charcoal in fan deposits at Blakes Opening in the middle Huon Valley in southern Tasmania to 27.4 and 29.3 ka BP and suggested that the fan alluvium accumulated during the later part of the Last Glacial Stage "when the effects of strong fluvial action, accentuated by snowmelt, eroded the till and the stratified drift deposits". Recent re-dating of the Blakes Opening deposits (in this paper) indicates that the deposit dated to 27.4 ka BP was older (>50 ka BP) than measured by Colhoun and Goede (1979) and a new date of 38.5 ka BP was obtained for fan alluvium in another part of the section. It appears that at this site fan accumulation may have occurred intermittently since the Last Interglacial.

That hillside deposits continued to erode into the late Last Glacial is evident from a date of 13.87 ka BP obtained for quartzite slope deposits at Hardstaff Creek in northwestern Tasmania and a date of 14.2 ka BP for charcoal in an A horizon overlain by solifluction deposits at 500 m in the Florentine Valley (Colhoun 2002).

Granitic fan alluvium at 370 m altitude at Rayners Hill in northeast Tasmania was ^{14}C dated to 28.2 ka BP (this paper) indicating burning and erosion at this time. New work has ^{14}C dated colluvium at 430 m altitude and fan alluvium at 340 m altitude at two sites near Maydena in the Tyenna catchment in Southern tasmania.The Maydena sites showed that there were erosion events at >42 ka BP, 24.8 ka BP and 12.3 ka BP.

Aeolian deposits

Sand dunes in eastern Tasmania were dated to 15.7 ka BP and after 19.8 ka BP by Colhoun (1977, 1985a). Thermoluminescence (TL) dating of the quartz component of one of the west-northwest-trending Ainslie linear dunes on the coastal plains of northeast Tasmania by Duller and Augustinus (1997) showed it was initially deposited at 44 ka BP, was mobile again at 30 ka BP and was reworked again after European settlement. Another dune intersected by the Waterhouse Road was dated at 29 ka BP. Duller and Augustinus (1997) remarked that "it is interesting to note that none of the samples analysed from northeast Tasmania in this paper indicate aeolian activity during the last glacial maximum, but instead they imply that the earlier part of the last glaciation was more conducive to dune formation."

An 4 m-thick isolated dune south of the Waterhouse Road and the Ainslie linear dune system in northeast Tasmania was dated by TL methods (this paper) and six dates in one profile indicated dune initiation before 29 ka BP and stabilisation after 14.5 ka BP. A prominent palaeosol (podzol) between 1.98 m and 4 m depth occurred below a layer dated 15.9 ka BP indicating that podzolisation processes occurred during the Last Glacial.The observations by Duller and Augustinus (1997) and in this paper of active dune accumulation from 29 ka BP onwards appear to conflict with the deductions of Harrison (1993), who, in his study of precipitation rates based on Australian lake levels, concluded that between 30 and 24 ka BP conditions were on average wetter than today rather than drier. The mainland drying trend began about 26 ka BP (illustrated in particular by the declining Willandra Lakes levels (Bowler 1981)), and peaked by 20 ka BP when conditions were generally drier than at present. However, Harrison's 1993 paper did not look closely at regional variations and the Tasmanian climate trend may have differred from the trends on the mainland. That a podzol profile was formed before 16 ka BP may indicate that in northeast Tasmania dune accumulation (dry) phases were interspersed with podzolising (wet) phases.

A 7 m thick loess-like aeolian deposit in a gully at 250 m altitude in a gully near Cygnet, downwind (east) of the Huon River floodplain was dated by TL methods to 25.3–31.8 ka BP (the mean of six dates was 28 ka BP) (McIntosh et al. 2004). These authors pointed out that the date obtained for these unusually thick aeolian deposits approximately coincided with the date of the first arrival of man in the Huon River catchment 28–29 ka BP (Cosgrove 1995) and suggested that human-lit fires aided by dry windy conditions may have caused erosion within the catchment.

Summary

When all dates for erosion events on lowland and mid-altitude Tasmania are plotted there is a marked peak of erosion events at c. 28 ka BP (Figure 1). Thus the Tasmania record seems to indicate that erosion was at its maximum at the beginning of the dry period that followed the end of the Margaret Interstadial, rather than at the peak of the Last Glacial c. 20–18 ka BP. The severity of the 28 ka BP event is demonstrated by the 7 m of aeolian sediments that have accumulated in a gully at Cradoc, in the lower Huon River catchment, which McIntosh et al. (2004) speculated might have partly resulted from erosion following fires as the first aboriginal populations settled in the Huon Valley. In Tasmania in general it appears likely that the drier post-interstadial climate favoured spread of fires, and that the arrival of human populations known to have used fires as a vegetation management tool at around 35 ka BP (Cosgrove et al. 1990; Cosgrove 1995) is likely to have increased fire frequency.

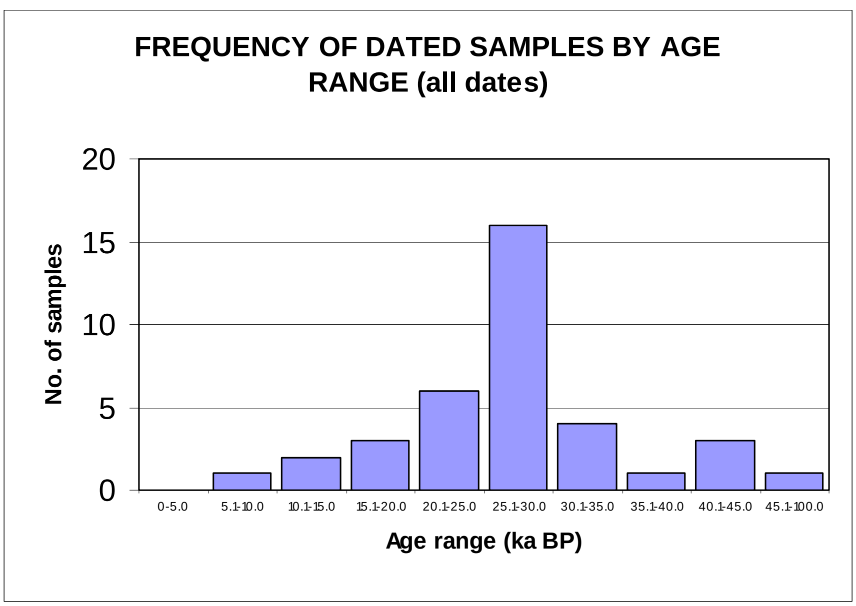

Figure 1. Frequency distribution of dated samples indicating erosion in Tasmania, by age range.

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