LOW LYING, LATE QUATERNARY, MARINE TERRACES OF CAPE LIPTRAP, AUSTRALIA

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INTRODUCTION

Cape Liptrap presents an interesting problem because it sits on a passive continental margin (see Figure 1 &2 in Gardner, this volume) but displays features that are indicative of a tectonically active region. The predominant tectonic features that are present are uplifted marine terraces and faults. The existence of these features requires a reexamination of the tectonic setting of Cape Liptrap (Figure 1). It is necessary to determine what process is causing uplift and deformation of terraces. Marine terraces form at sea level. They are formed as sand and pebbles abrade a rocky shoreline by wave action. The clasts wear away the rock at sea level and create flat or gently sloping platforms. The specific character of these platforms depends on the rock type that is being eroded, the amount of time that relative sea level remains constant and the force of the wave action that is causing the erosion (Sunamura, 1992; Trenhaile, 1987). Raised terraces were caused by uplift of the land or a drop in sea level or a combination of the two. It is important to determine whether the land level rose or the sea level fell or if it was a combination of both.

There have been several studies of the Cape Liptrap area where researchers in Queensland, New South Wales and South Australia found evidence for a sea level highstand approximately 6000 bp. Evidence for this highstand in Victoria would help to complete

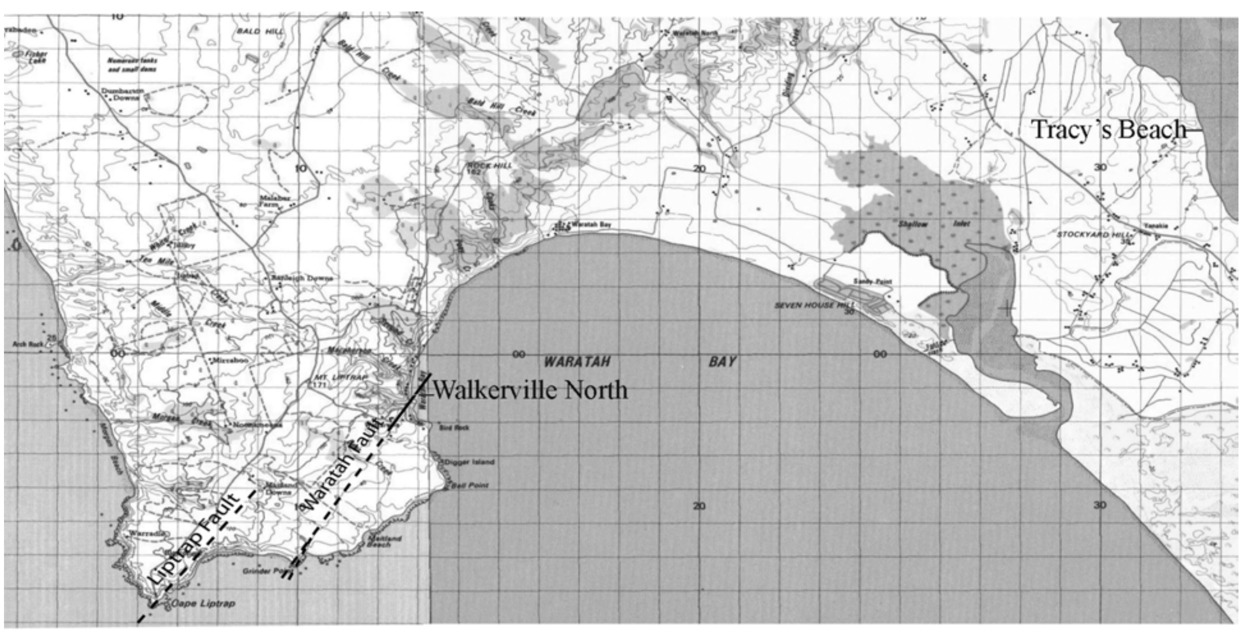

Figure 1. A topographic map of the study area with relevant faults and localities marked.

the picture of (Late Holocene) sea level change around Australia (Flood, 1989; Chappell, 1983; Bourman, 1999; Cann, 2001). Some hypotheses for sea level change along the Australian margin have been proposed such as isostatic rebound of the land or a change in the shape of the geoid (Peltier, 1999), but none have been universally accepted.

Methods

Coastal areas around Cape Liptrap were accessed by car and foot. Some coastal sections were inaccessible due to land ownership, trails and the possibility of becoming stranded by a rising tide. Some elevation data for marine terraces were collected with a Trimble Pro-XRS GPS receiver with real time differential correction, which has good horizontal accuracy but is less accurate when measuring elevation (~1m. Most elevation data were obtained with a 1.8 meter long staff marked in 5-centimeter increments and was approximately. A hand level was used to aid in determining elevation. In general, elevation was measured relative to the same feature on the modern coastline, i.e. modern inner edge to paleo-inner edge of marine terraces. In cases where it was not possible to use the stick and hand level method trigonometry was used, a distance was measured on the ground and the angle between the horizontal and the feature was measured using a Brunton compass taking into account the height of the person taking the measurement. When an inner edge was being measured the composition of the deposits was recorded. It was often the case that the inner edge deposits were made up of mostly rounded to well rounded quartz clasts. These clasts ranged in sized from 20 cm to gravel sized. A quartz cobble was taken from Walkerville North (cosmogenic dating results are still pending). Sediment was taken from marine terrace at Tracy's beach in order to extract an Optically Stimulated Luminescence (OSL) age to constrain the age of the formation of the paleo inner edge. This technique yielded an age of 125 ka at an elevation of 2.1m above present sea level. At Bird Rock a sample of relic fossil barnacles occurring 2.18 m above present sea level was taken for an accelerated mass spectrometry ^{14}C radiometric age which yielded an age of 5,570 +/- 40 yBP. The relic barnacles were determined to have been alive when relative sea level was 2.18 m higher than it is at present. Such disparate ages occurring at similar elevations reveals deformation of the terraces over approximately 20 kilometers with the east side down.

The ESRI Geographic Information System (GIS) software package ArcGIS was used to plot GPS positions that were taken in the field. The measurements that were taken without the GPS receiver were plotted on 1:50,000 maps

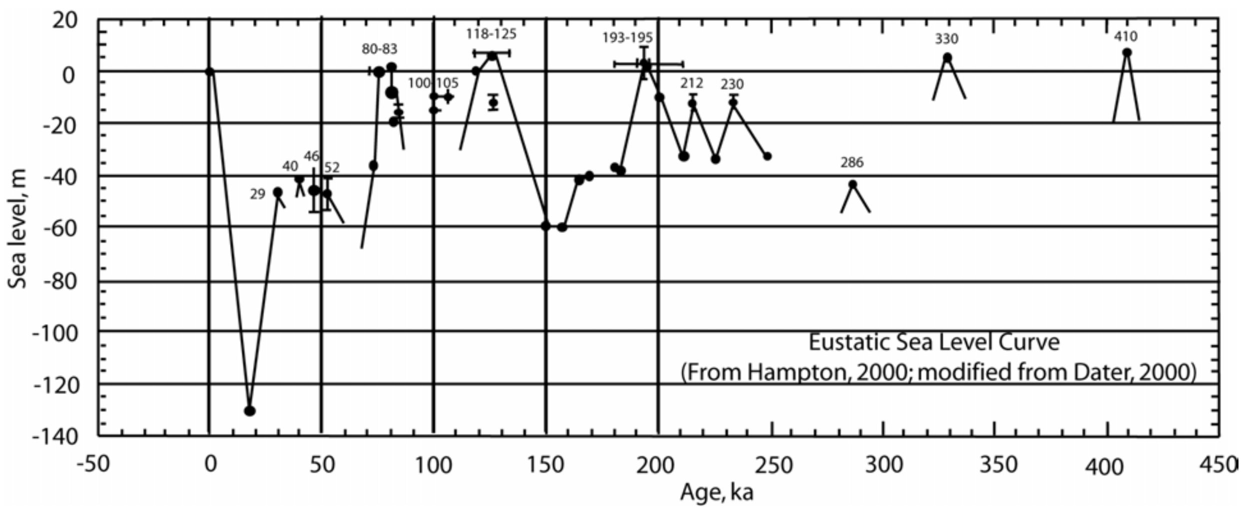

Figure 3. The sea level curve used to determine the elevation of sea level in the past.

and then Australian Map Grid coordinates were assigned to the points using a Gerber Variable Scale which allows any distance to be divided equally into any amount of divisions. These points were then also put on to the maps with their corresponding elevations. The points were projected onto a single line around the coast and these were graphed. Each terrace was plotted separately and a line was fit to the data. (Figure 2) it showed a general warping of the terraces near the Waratah Fault where it outcrops at Walkerville North and at the inferred fault that runs through the southern most point of Cape Liptrap. The projections of the terraces were then compared to a sea level curve to determine the relative height of sea level at the ages determined for each terrace (Figure 3). It was found that relative sea level at125 ka was approximately 6 m higher than it is currently. The sea level highstand recorded around Australia at approximately 6000 BP is not recorded in the sea level curves used because these curves are global and do not represent local subsidence or isotasy around Australia.

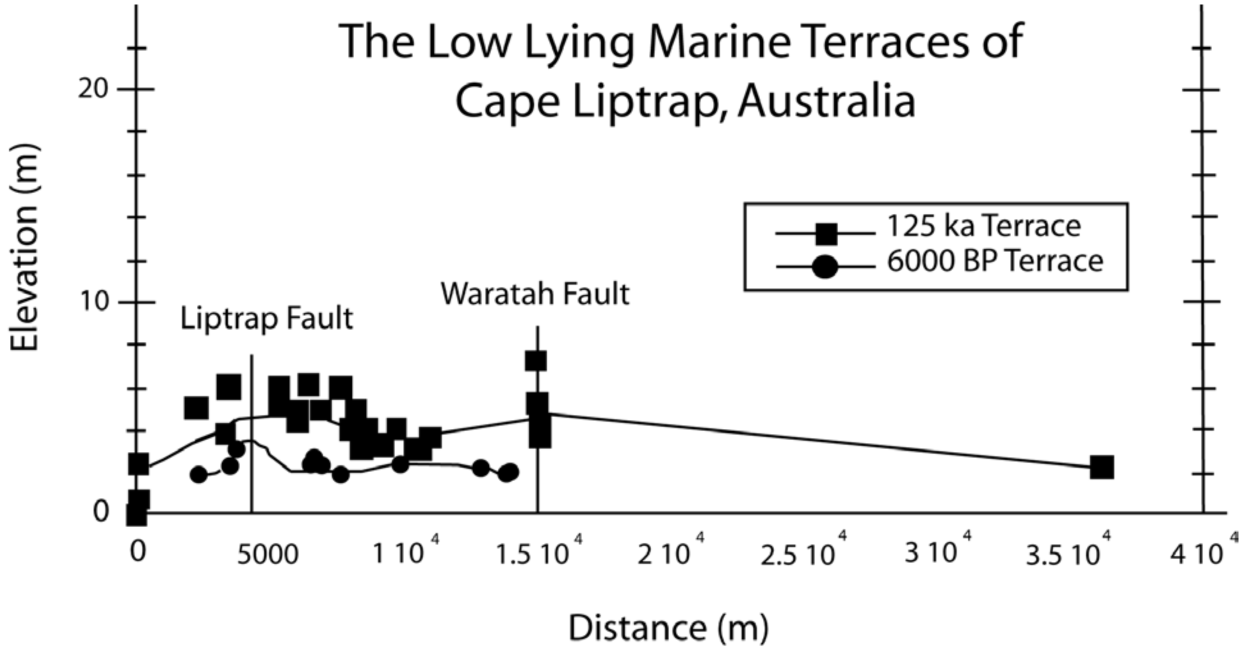

Figure 2. A graph of the terraces plotted by projected distance and elevation in meters.

CONCLUSIONS

The two low lying raised marine terraces of Cape Liptrap present evidence for recent tectonic deformation on the Australian passive Margin. The oldest terrace (terrace 1) was formed 125 ka and the youngest terrace (terrace 2) was formed a 5,570 +/- 40 yBP. 125 ka ago sea level was approximately 6 meters higher than it is today. The terrace that formed at that time must have been level at +6m. Presently, that terrace can be observed at 7.25 m and 2.1m. This deformation is centered around the Waratah Fault creating a gentle anticline, which is causing subsidence in most areas because this terrace is generally found around 4m. The deformation caused by the fault is more exaggerated in the northeast part of Cape Liptrap. On the Yanakie isthmus subsidence is apparent as the 125ka terrace is found at 2.1m above sea level, meaning that the area has subsided 2.9m from 125ka.

The terrace that was given an isotopic date of 5,570 +/-40 yBP was generally found at 2 meters above sea level. Near the Liptrap Fault it was found at a little over 3 meters above sea level revealing deformation in the area. There is evidence from many locations around Australia for a ~2m sea level highstand at approximately 6,000 BP indicating that there has been little deformation of this terrace on Cape Liptap. This terrace was not observed on the Yanakie Isthmus and it can be inferred that if the terrace was formed in the area during the 6000 BP highstand it would now be submerged. The extent of this submersion could show the temporal extent of deformation by the Waratah Fault before and after the 6000 BP highstand.

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