Sea-level of the Last Glacial Maximum: evidence from the North Western Australia

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The volumes and geographic distribution of the ice during the LGM remains uncertain despite recent progress in understanding the evolution of the large Late Pleistocene ice sheets. Some constraint on the total volumes of ice contained in these ice sheets is provided by observations of past sea levels, but the meaning of such data has remained unclear because of the limitations in the observational record and because of the necessity to correct such data for the isostatic and tectonic displacements of the crust.

Estimates of the sea level during the LGM have remained uncertain and controversial. Nakada and Lambeck (1988) reviewed the limited available data and concluded that, globally, sea levels were some 130 m lower than their present day level. New data from Barbados, however, led to the conclusion that this level may have been about 118 m below present level (Fairbanks 1989, Bard et al., 1990), whilst others have argued that this may have been only about 108 m (Tushingham and Peltier, 1991; ICE-3G) and 106 m (Peltier 1994; ICE-4G). These various estimates of the LGM sea level have major glaciological implications and improved estimates are clearly desirable.

The Australian margin is well suited for studies of sea-level change during the LGM. Firstly, margins are tectonically stable. Second, the continent lies far from the former ice sheets, therefore isostatic corrections, due mainly to the hydro-isostatic effects, are small and not strongly dependent upon the details of the ice-load geometry. Finally, there are wide and shallow shelf areas with depressions where conditions may have been favourable for the preservation of evidence for former and now submerged shoreline positions. The Timor Sea, and Northwest Shelf as well as the Arafura Sea (Fig. 1) provide environments suitable for sea level studies and this area has provided one of the few reliable estimates of sea level for the LGM (van Andel and Veevers 1967; van Andel et al. 1967). The data in this work are based on core and dredge samples from localities in the Timor Sea that may have existed as lagoonal or very shallow coastal environments when sea levels were much lower. Shallow marine molluscs and brackish lagoonal sediments have been identified and radiocarbon dated to determine relative sea levels. These observations have then been combined with the results of glacio-hydro-isostatic modelling to estimate the eustatic sea-level change and, thus the volumes of land-based ice over and above the present-day volumes.

Our observational result clearly showed that the eustatic sea level reached about -115 m. Also, they indicate that the initial melting rate after the LGM was larger than has been reported. These data are in good agreement with other reports from the Timor Sea (van Andel and Veevers, 1967) and the most reliable sea-level observation for this period from Barbados (Fairbanks, 1989; Bard et al., 1990).