THERMAL STRUCTURE AND VERTICAL MOTION OF INTERSTITIAL WATER IN A 150 M DEEP HOLE DRILLED IN THE BARRIER REEF OF TAHITI

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In order to detail the thermal field and to assess the vertical component of interstitial water flow rate, temperature, salinity and vertical current were measured in a 150 m deep hole drilled on the barrier reef of Tahiti (17°30'S, 150°W). Temperature time series (September 27-October 17, 1994) were obtained from eleven sensors set every 10 m in the well between 10 m and 110m depths. A salinity time series was also measured for the deepest level and the vertical component of the flow was measured at various depths for periods of a few days.

Average temperature in the well was 25.4°C with a standard deviation of 1.5°C. We observed 3 different homogeneous layers separated by sharp changes in the temperature field. Proximity of a heat source and dynamic exchanges between the interstitial system and the ocean were identified as the main forces driving those changes. The first layer corresponding to the first 30 m had average temperature of 27.5°C and formed the surface boundary layer of the barrier reef. The second layer (30-90 m) had an average temperature of 25°C. The third layer (> 100 m) corresponding with the portion of volcanic rocks reached by the drilling had average temperature of 23°C. The time averaged temperature at each level exhibited a higher value (26°C) at 90 m than at neighbour levels (25.4°C at 80 m and 23°C at 100 m), showing that a heat source can generate instabilities at this level in the carbonate platform.

Spectral analysis was performed on the different temperature time series. From top to 100 m depth, the prominent peak in the autospectra is due to the semi-diurnal tidal frequencies. Two less energetic but persistent peaks were observed for the diurnal tidal frequency and for a period of about 6 hours. At 110 m depth, the autospectrum of the temperature looks different. The semi-diurnal tidal signals are smeared with an energetic wide frequency band signal (0.035-0.065 cycles/hour). Non negligible signals in the high frequency band (higher than 0.2 cycles/hour) are also apparent. Large variations are observed between the vertical profiles of the temperature taken in the well at three different times (July 1993, January 1994, February 1994). The largest discrepancies are located in the intermediate layer. The overall standard deviation in this layer is larger than twice those of the two other layers. These observations indicate that the role played by processes of large time scale may be important.

The longest and most reliable time series for the vertical component of the flow rate was recorded at 30 m depth during 4 days (September 21-25, 1994). The mean flow was directed upward with a speed averaging 36 cm/day and a standard deviation of 28 cm/day. Compared to variations in temperature for the same period the flow rate show higher oscillations suggesting that on a short time scale temperature and flow rate are not correlated. Other recordings from December 1993, February ,May and August, 1994 showed flow rate to vary significantly from one level to another but confirmed that the vertical component of the flow rate was dominantly directed upward.

3 abstracts inclus.

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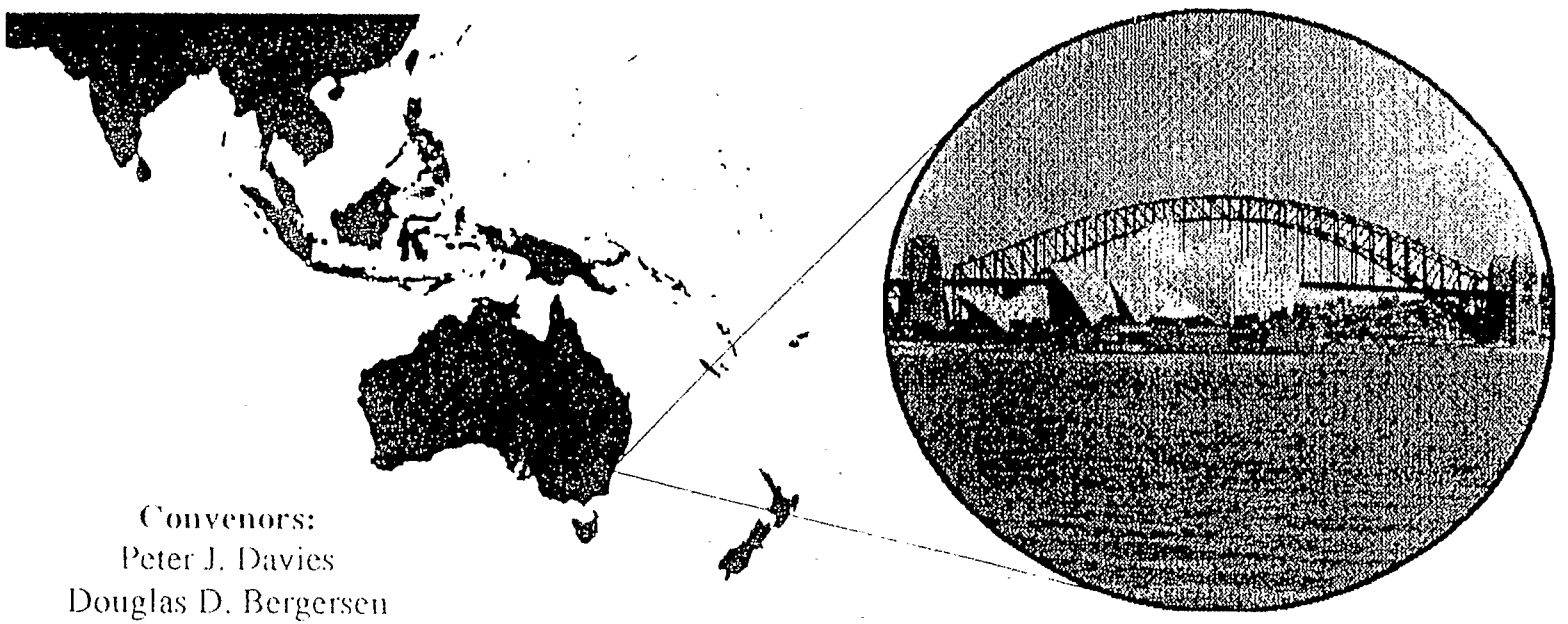

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