phosphate is bound in relict detrital gains of phosphorite. These were derived in the late Tertiary, or during low sea level times in the Pleistocene, by mechanical reworking of diatomaceous muds (north of Walvis Bay) or by the erosion of previously existing phosphorite (throughout the area). The lack of widespread modern phosphorite formation signifies a wide difference in environmental conditions between the present time and the early to middle Tertiary (when phosphorite formation predominated locally).

The rich relict phosphate deposit near Walvis Bay is probably about 0.5 m thick and may constitute a reserve of some 4×10^9 t P_2O_5. The grade of the deposit could be beneficiated by screening and its potential lies in its situation 700 miles nearer to Walvis Bay than the nearest land deposits of comparable grade at Saldanha Bay. As the phosphatic fraction of the sediments south of Lüderitz is not likely to be >16% P_2O_5, the average for local source rocks[6], the southern deposits have no immediate economic interest.

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Received October 30, 1972; revised February 12, 1973.

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Tidal Resonance in the Coral Sea

THE "age of the tide" is a measure of the time lag between new or full Moon and the following spring tide. In the Coral Sea, the age of the tide is negative[1]. This behaviour is rare in the ocean. In terms of the tidal response function this means that there is a negative phase change in the $\bar{R}_2^2$ (ω) response function[2], between the frequencies of the dominant M_2 and S_2 constituents.

Suspecting that this may be the consequence of a resonance, I have tried fitting a response function of the form

$$\bar{R}_2^2(\omega) = A + B\omega + C/(\omega - D)$$

to the harmonic constants for Cairns[3]. The first two terms correspond to the background and the third term to the resonance. Only two terms were used for the background to reduce the number of free variables. I estimated the complex variables A to D by minimizing the expression

$$\sum_j (|h_j - \bar{R}_2^2(\omega_j) e_j|)^2$$

where h_j is the complex harmonic constant relative to Greenwich, for the semi-diurnal constituent with angular velocity ω_j and equilibrium amplitude e_j (ref. 4).

The function obtained in this manner is shown in Fig. 1. The data points are the values of the response functions at the twelve constituent frequencies calculated from the relation,

$$\bar{R}_2^2(\omega_j) = h_j/e_j$$

The error bars indicate the expected standard deviation due to noise in the original record[5]. For the constituents N_2, M_2, S_2 and K_2 the s.d. is less than the radius at the data points.

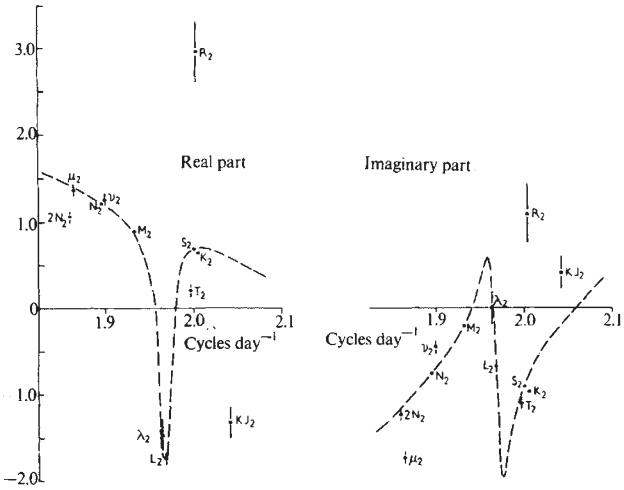

Fig. 1 Real and imaginary part of the R_2^2 (ω) tidal response function at Cairns (16° 55′ S, 145° 47′ E), showing the influence of a resonance in the Coral Sea.

The coordinate of the resonance is 1.969–*i* 0.009 cycles day^{-1} with an expected s.d. in both coordinates of 0.003. The imaginary part corresponds to a decay time of 18 days.

Initially it also seemed possible that the large phase differences might be due to the radiational tide[2,6], but this would have meant that the radiational component of S_2 was much larger than its normal value of about 20% of the gravitational component. Further, the data of Fig. 1 show that the resonance hypothesis is supported by the behaviour of the L_2 and λ_2 constituents, which would not be affected by the radiational tide.

The existence of the resonance is also confirmed by calculations using harmonic constants for Cooktown[3] and Port Moresby[7]. But in these cases the fit to the harmonic constants is not as good as it is by Cairns. Non-linear interactions may, however, introduce an error of up to 25% in the L_2 constituent at Cairns.

If the resonance is an oceanic resonance and is not due to the movement of nearby land masses[8,9], then I believe this to be the first time an oceanic resonance has been observed lying within a tidal band. A fuller discussion of the method and of its errors will be published later.

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Received January 30, 1973.

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