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# AN ATTEMPT AT PALEOTEMPERATURE ESTIMATION IN SOUTH CHINA SEA USING TRANSFER FUNCTION*

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Micropaleontological analysis has been widely applied to paleoenvironmental reconstruction[1], and the transfer function (TF) method[2] provides a new means of quantitative paleoenvironmental interpretation of micropaleontological data. As the first attempt in China to quantitatively estimate paleotemperature of sea water, the present article has processed the planktonic foraminiferal data from a piston core (V36-06-3) to reconstruct the history of summer and winter sea surface temperature (SST) in the South China Sea (SCS) over the last 130,000 a. A number of TFs have been developed for various microfossil groups and various oceans, and the TF EP-12E derived by Thompson from 165 samples of surface sediments in the Western Pacific[3] is most suitable to our study on planktonic foraminiferal faunas from the SCS.

Piston core V36-06-3 was recovered by the R. V. Vema, Lamont-Doherty Observatory, in 1979 at 19°00.5′N and 116°05.6′E in the lower continental slope of the SCS, with a depth of 2809 m. The core has a full length of 12.15 m and contains abundant planktonic foraminiferal tests. Sixty-two samples, with an average interval of 20 cm, have been analysed for foraminifera, of which only the tests larger than 149 $\mu$m have been identified and taken into census. An average of 537 specimens has been identified from each of the samples, with a minimum number of 100. The data base comprises the counts of 25 major species. In comparison with the species and morphotypes used by Thompson[3], the sinistrally coiling *Neogloboquadrina pachyderma*, *N. blowi* and *Globorotalia wilesi* are absent in the studied area. As the specimens of *Globigerinoides sacculifer* have not been divided into two groups, forms with or without "sac", their inputs into the computer are arbitrarily taken as 50% for each. Actually, there is no important difference in the contributions of the two types of *G. sacculifer* to the factor assemblages in FP-12E, and the sack-like chamber has been proved to be the final stage of ontogenesis of the species[4]. So, our arbitrary treatment of the data would not bias the result significantly. The age of V36-06-3 is determined both biostratigraphically and isotopi-

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ally[5]. The results are shown in Fig. 1.

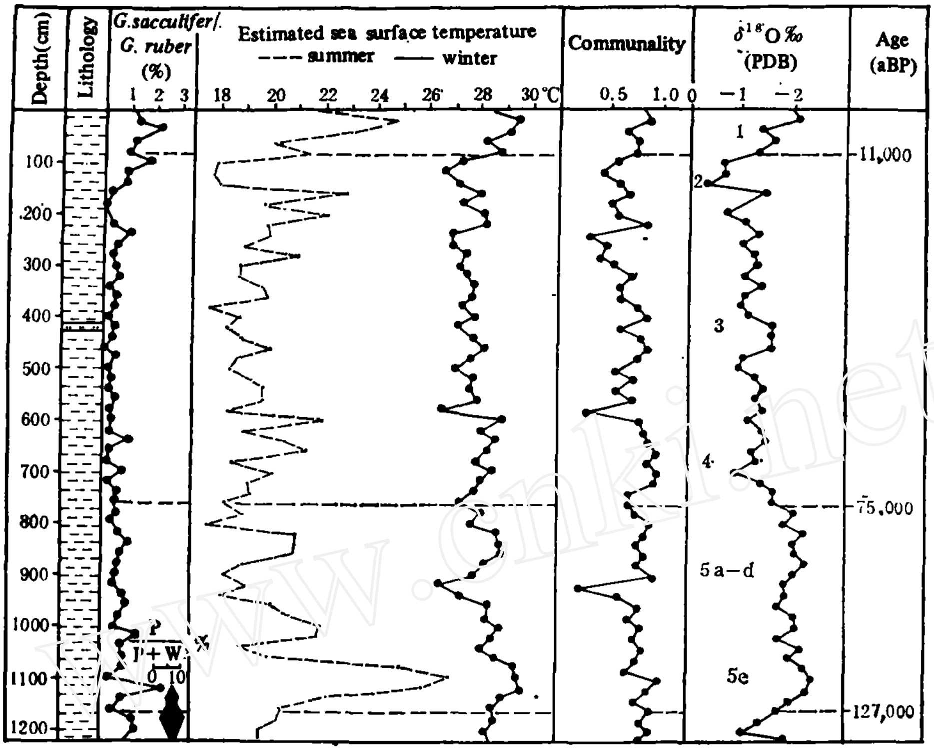

Fig. 1. Paleotemperature curves of Core V36-06-3 recovered from the South China Sea.

$\delta^{18}O$ represents the isotope mesurements of *G. sacculifer*; P/(P+W) means the percentage of pink-pigmented tests of *G. ruber* to the total population of the same species.

The confidence of the winter and summer SST curves yielded by the TF technique can be evaluated in three aspects. (i) The average communality of 62 samples is 0.72, i.e. 85% of the original information is accounted for by the TF. (ii) The range of the estimated winter and summer SST (17.6—27.0°C and 26.5—29.6°C, correspondingly) falls in the temperature range in which the FP-12E can provide statistically accurate results. And (iii) the estimated SST values of the core top sample (2 cm from the top) are 21.9°C for winter and 28.6°C for summer, while the present winter and summer SST are 23.7°C and 28.8°C at the site of V36-06-3. The estimated values match well with the observed present values and both differences are within the standard errors of estimation of FP-12E. Obviously, the results of the calculation are provided with high confidence.

As shown in Fig. 1, the studied area has witnessed considerable changes in SST during the last 130,000 a, with the difference between the neighbouring peaks and valleys on the SST curves being 1.5—2.8°C for summer and 4.0—8.3°C for winter. The maximum temperature difference occurs between the glacial and interglacial stages when the oxygen isotope stage 2 (glacial) and stage 5 (interglacial) are compared with each other. The summer SST difference is 3.0°C, and that of winter reaches 9.1°C. Such unusually high temperature difference far exceeds those in the western tropical Pacific. The SST difference between the glacial/interglacial is very small in the low latitudinal zones of the western Pacific, as well as other oceans, usually falling in the range of standard errors of estimation. A remarkable temperature difference occurs only in the temperate zone. As summarized by Thompson, the SST drops only by 2℃ in tropics and by 1℃ (or even less) in subtropics in the western Pacific in glacial stages, while a 5℃ decrease may be found in the temperate zone[3]. Since Core V36-06-3 has been taken from a sea area near the tropics (19°N), the considerable difference in temperature between glacial and interglacial must be attributed to the changes in paleocirculation pattern. The sea water exchanges, for example, between the SCS and the western Pacific through the Bashi Channel as the main passage were hindered during the lower sea level intervals in glacial stages. Consequently, the entry of the warm tropical Pacific waters into the SCS, which is driven by the NE wind in winter was obstructed. On the other hand, the influence of cooler water masses on the SCS must have been strengthened due to the equatorward shift of the climatic zones and the polar front. However, furthur studies and analyses of more cores are needed before a definite conclusion can be drawn.

Another conspicuous feature of the paleotemperature curves of V36-06-3 is the remarkable seasonal variation between winter and summer SST. In the tropical western Pacific, for example, the seasonal SST difference does not exceed 3.4℃ for the interglacial (oxygen isotope stage 5e) and ranges from 1.3℃ to 4.4℃ for the glacial (oxygen isotope stage 2), while in the SCS the seasonal SST difference is estimated at 2.2℃ for the interglacial and can be as high as 8.8℃ for the glacial, similar to the seasonality of the area at 28°N in the western Pacific[3]. Such an anomaly in the seasonality of the studied area must be, again, related to the changes in paleocirculation pattern. Along with the obstruction of water exchange through the Bashi Channel, the influence of the Pacific tropical-subtropical water masses decreased whereas that of the continental runoff and climate increased. Both factors would inevitably contribute to the intensification of the seasonality during glacial stages.

There also exists a quite good correlation between the estimated SST curves and the $\delta^{18}O$ curve in Core V36-06-3. For the intervals where the correlation is reduced, the communality values also decrease, suggesting a relatively low quality of the estimated SST due to some unknown no-analog conditions. A similar positive correlation between estimated SST curves and $\delta^{18}O$ curves has been observed also in the Atlantic and other sea areas and, hence, is of global significance[6].

Thus, it is concluded that the general trend of SST fluctuations in the northern SCS is the same as that in the western Pacific and, furthermore, the world oceans. Only the glacial/interglacial SST difference and the seasonality during the glacial stages are much more significant than those in the ocean with the corresponding latitude. As discussed above, the reduction of water exchange with the open ocean, the changes in the circulation pattern and the increase of the continental influence during the glacial stages are the main characteristics of the SCS, which marks the difference of this marginal sea from the open ocean.

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