

## An 8000-Year Record of Typhoons in the Northern South China Sea

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Tropical cyclones in the north-western Pacific are referred to as typhoons. We have attempted to reconstruct the record of typhoons over the past 8,000 years based on the study of inner continental shelf boreholes, archaeological, historical and instrumental records. Our study area is the Pearl River Estuary a subtropical region in the northern South China Sea.

### Late Holocene Increase in Storm Beds

Six cores from seabed depths ranging from 3.8–26.2 m were studied to identify storm beds formed by Holocene typhoons. The Holocene-Pleistocene boundary in these cores was radiocarbon dated at about 8,100 yr BP (Yim, 1999). Two types of storm beds were found. First, siliciclastics-dominated beds mainly of fluvial and/or beach sands occurring in shallow water, and second, bioclastics-dominated beds formed by the resuspension of sea-floor sediment occurring in deeper water. The latter is found to possess a higher diversity of foraminifers compared to non-storm beds due to mixing of estuarine sediments and open shelf sediments during typhoons (Huang and Yim, 1997). The maximum number of storm beds found in the cores studied is seventeen (Figure 1a) representing an average of just over two typhoons per thousand years. Storm beds are relatively rare during 6,000–8,000 yr BP. This is a period of rapid change from temperate to subtropical conditions as indicated by palynological data and rapid sea-level rise of 1 cm/yr as determined from sea-level curves (Yim, 1986). Since 6,000 yr BP, with the establishment of the present subtropical climate, the frequency of typhoons has increased. However the number of radiocarbon dates is insufficient to distinguish between the ages of the storm beds in the cores. The Late Holocene (ca. 3,000

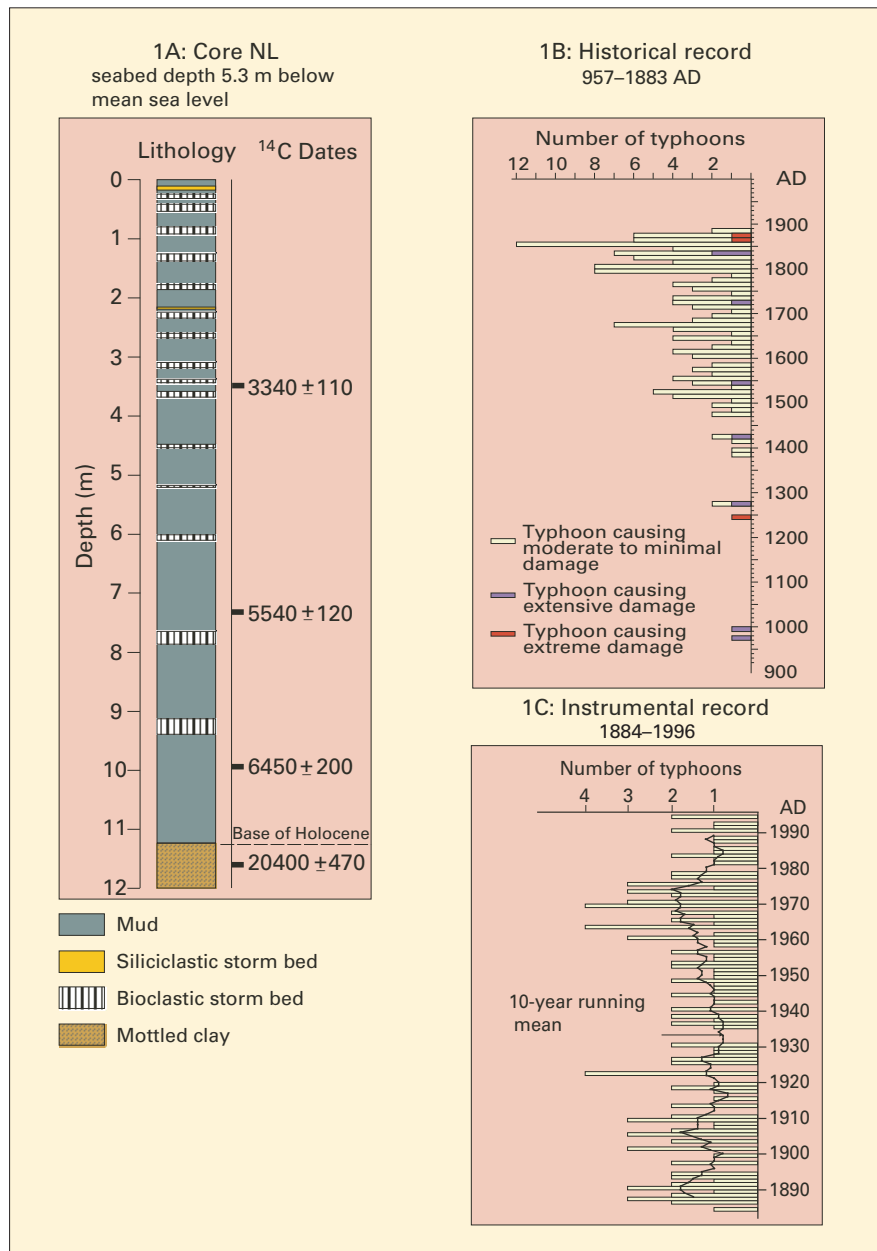


Fig. 1a: Holocene record of storm beds from Core NL (located in 2). 1b: Historical record of typhoons from 957–1883 AD. 1c: Instrumental record of typhoons from 1884–1996.

yr BP onwards) is found to show a even higher frequency of typhoons compared to the Middle Holocene.

### Increase in Typhoons Since 1500 AD

Historical documentation of typhoons is available in southern China for more than one millennium mainly in the form of county chronicles (Huang, 2000). Our examination of these documents during the period 957–1883 AD (67–993

yr BP) has revealed 160 typhoons. Based on the number of counties affected, the damage to crops and dwellings, and the death toll, these typhoons are classified into three categories (Table 1). The three most disastrous typhoons occurred in 1245, 1862 and 1874 AD. These have all resulted in death tolls exceeding 10,000 and the flooding of a total land area exceeding 15,000 km<sup>2</sup>. The frequency of typhoons during the period 957–1883 AD is shown in

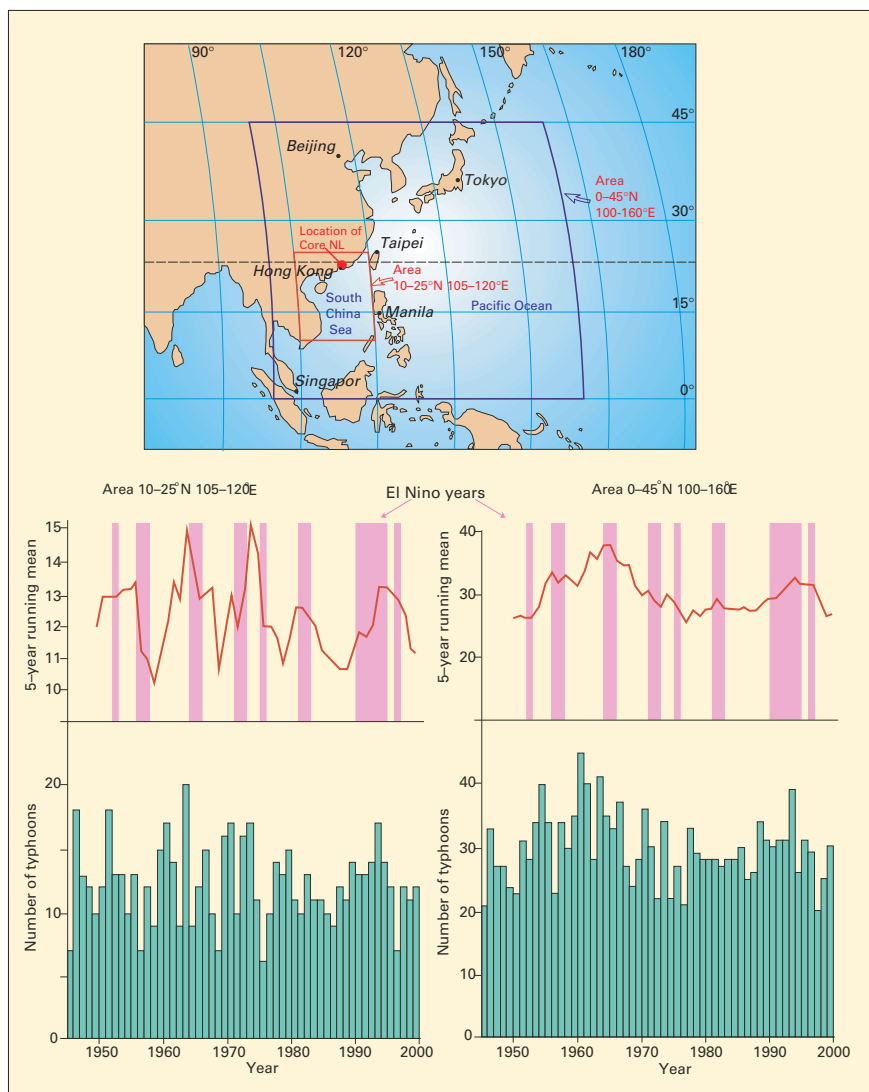


Fig. 2. Frequency of typhoons in the South China Sea and the northwestern Pacific in the two areas 10–25°N 105–120°E and 0–45°N 100–160°E during 1946–2000. Based on data collected by the Hong Kong Observatory.

Figure 1b. In this record, the number of typhoons increased sharply after 1500 AD. Although this increase is possibly related to greater typhoon damage through population growth in the region, the fall in frequency of typhoons during the Little Ice Age (ca. 16th to early 19th century) and the subsequent rise indicates that frequency of typhoons in this record is likely to be linked to climatic factors rather than to population growth.

The instrumental record of typhoons of the Hong Kong Obser-

vatory for the period 1884–1996 AD was analysed. A total of 132 were found to pass within a 150-km radius of central Hong Kong with an average frequency of ca. 1.2 times/yr. The typhoon frequency shows a period of maximum activity between 1960 and 1970 (Figure 1c). The instrumental record of typhoons frequency in the South China Sea and the northwestern Pacific during 1946–2000 is shown in Figure 2. During this period, typhoons entered the South China Sea, about 12 times per year. The

Category	No. of countries affected	Damage	No. of typhoons
I	<4	Moderate to minimal damage to crops and dwellings; death toll < 100	149
II	5–8	Extensive damage to crops and dwellings; death toll between 100–1000	8
III	>8	Extreme damage to crops and dwellings; death toll of above 10 000	3

Table 1. Classification of typhoons in the Pearl River Delta region based on historical records from 957 to 1883 AD.

5-year running mean shows a decadal cyclicity with lower typhoon frequencies associated with the occurrence of El Niño years. Looking at the entire northwestern Pacific region, shows a weak peak in typhoon activity for the period 1954–1969.

## Conclusions

In comparison to the modern instrumental record, it seems likely that shelf cores record less than 5% of typhoons. This incompleteness of the record is mainly due to post-depositional reworking. Coral palaeoclimatology may be helpful in providing the missing record if they possess a long history of growth.

## REFERENCES

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For full references please consult: [www.pages-igbp.org/products/newsletter/ref20012.html](http://www.pages-igbp.org/products/newsletter/ref20012.html)

## New Ice Core Database

A partnership between the Antarctic Glaciological Data Centre (funded by NSF), the World Data Centre for Paleoclimatology and the International Ice Core Data Cooperative had lead to the creation of a new Ice Core Data Gateway which utilizes a website (<http://www.ngdc.noaa.gov/paleo/icgate.html>) to increase the visibility (and use) of many data sets, greater access to data across scientific disciplines and an organized, long-term data archive.