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Coastal Typhoon Deposit in the Hampyung Bay, Southwest Coast of Korea

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The oyster shell bed (more than 47 cm thick) atop the Gaipri Point (granite coastal bluff) in the Hampyung Bay, southwest coast of Korea which is a coastal area of southeastern margin of the Yellow Sea basin has been interpreted as unique typhoon deposit formed at about 3610 yr BP or later. The unconformable boundary between the oyster shell bed by typhoon and the granitic soil horizon of the Gaipri Point is 820 cm high above the mean high-tide water level (MHWL). The ^{14}C age of the oyster shells is 3610±70 yr BP.

INTRODUCTION

A strong storm or typhoon with high sustained winds (over 17-30 m/s) can cause a storm surge along several types of coastline, i.e. long narrowing bays or estuaries, open shorelines, and open wide bays or embayments (sounds). Storm surge (higher sea level) and the strongest winds, which might follow in the direction of typhoon tracks and storm center, would cause flooding, severe wave action, wind transportation and erosion along various types of shoreline.

Along the west coast of Korea Peninsula, where strong and damaging monsoonal summer-season typhoons move generally northeastward and eastward as shown in Figure 1, semi-enclosed tidal basins (bay and sound) and open tidal coastlines are susceptible to large surges and wind erosion and transportation. In particular, the west coast of Korea is well known as typical high-tide-range (more than 5 m) coastline in Asia and the world. Under such dynamic coastal environment, along the western coastal zone of Korea there seems to be a lot of coastal sediments attributable to past typhoon or storms in the time range of early late Holocene. In fact, however, there has been no attempt or report in Korea that describes coastal sediments interpreted as having been laid down by past typhoons.

This short paper that was initially conceived based on a thematic topic "typhoon and storm deposits in relation to rapid coastal changes" in the IGCP 367 meeting in Scotland, 1994 is to describe the total phenomena of typhoons that affected the Korea Peninsula in the period of 1904-1983 (79 years) and a very possible typhoon deposit atop the Gaipri Point (rocky bluff) of the Hamphyung Bay in the southwestern coast of Korea.

OCCURRENCES AND GENERAL MOVING TRACKS OF TYPHOONS IN THE EASTERN ASIA

As shown in Figure 1, it has been analyzed and observed that a possible origin and occurrence of typical monsoon typhoons in the northwestern tropical and subtropic Pacific Ocean would be in the oceanic area between latitudes of 10°C~20°N and longitudes of 137°~148°E, and the initial major moving directions of the typhoons seem to be westward and northwestard and, in turn, around the latitude of 25°N the major moving directions of typhoons seem to be changed northeastward and eastward. Furthermore, it is worthy to note that general major moving directions of typhoons for July, August, September, October and November seem to be different as shown in Figure 1.

FREQUENCY OF TYPHOONS AFFECTING THE KOREAN PENINSULA AND TYPHOON DEPOSIT

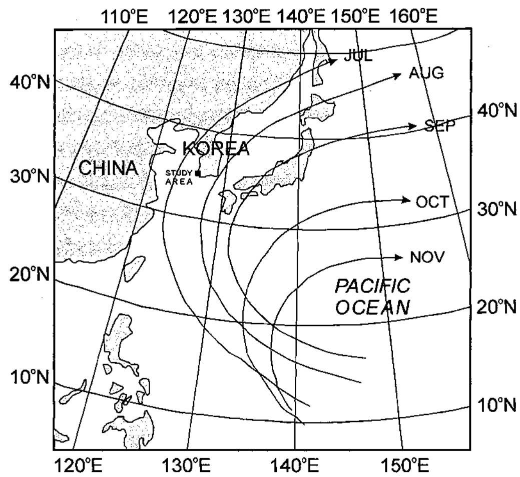

Fig. 1. Major moving directions of typhoons for 5 different months and major occurrence (origin) area of typhoons in the subtropic to tropic northwestern Pacific Ocean. (After KMA, 1984).

1) Typhoon frequency

Table 1 shows statistic data of typhoons affecting the Korean Peninsular. Tobal of 247 typhoons for 79 years from 1904 to 1983 would be easily outlined. It is further understood that typhoons occur with greatest frequency in July to September. It is very much meaningful and worthy to understand that the major frequency of typhoons in each major months (June to September) might be grouped by the period of 10 day-unit, i.e. the 1st-10 day, the 2nd-10 day and the 3rd-10 day. Based on such statistical data, the following diagram (Fig. 2) can be drawn as showing occurrence numbers of typhoon by 10 day in each month. Among 247 typhoons for 79 years, the period of 3rd-10 day in August seems to have the most frequent numbers of typhoons, that is, 36 occurrence numbers of typhoon.

In addition to Figure 2, graphic representation of typhoon tracks would be much meaningful for a better understanding of typhoon moving direction and affecting range of typhoon. In this connection, three graphic representations of typhoon tracks, that is, typhoon tracks in the 3rd-10 day in June, August

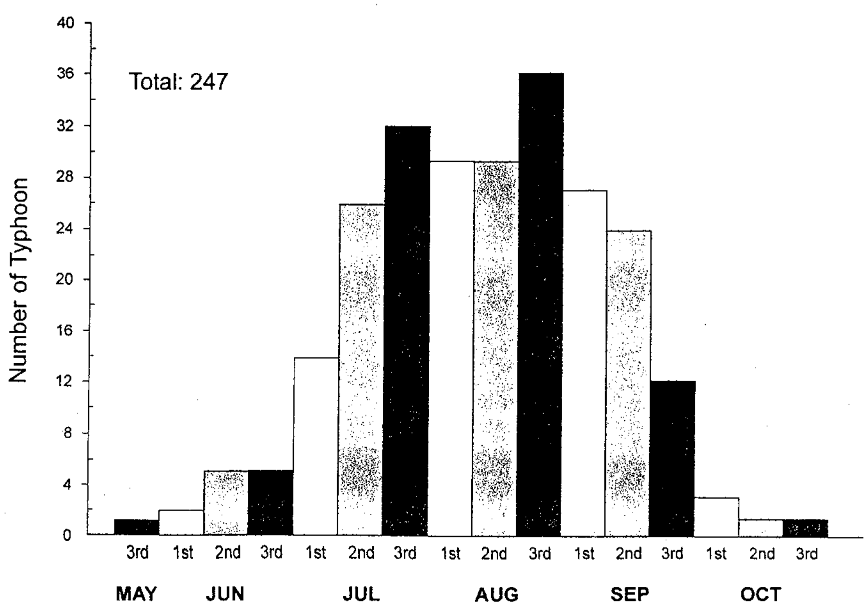

Fig. 2. Number of typhoon by 10 day in each major month for seventy nine years (1904-1983). (After KMA, 1984)

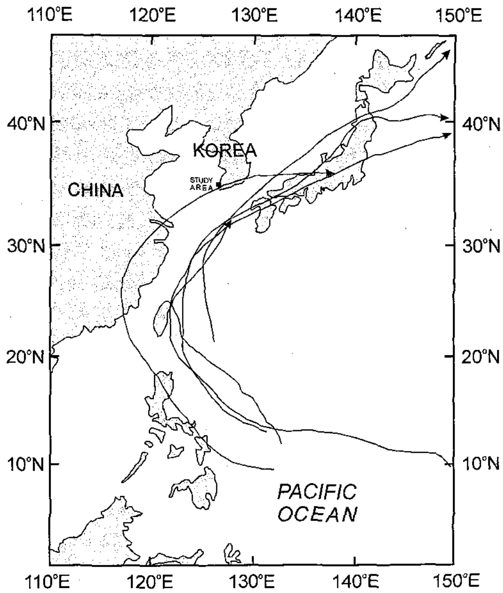

Fig. 3. Typhoon tracks during the 3rd 10 days in June for 79 years (1904-1983). (After KMA, 1984).

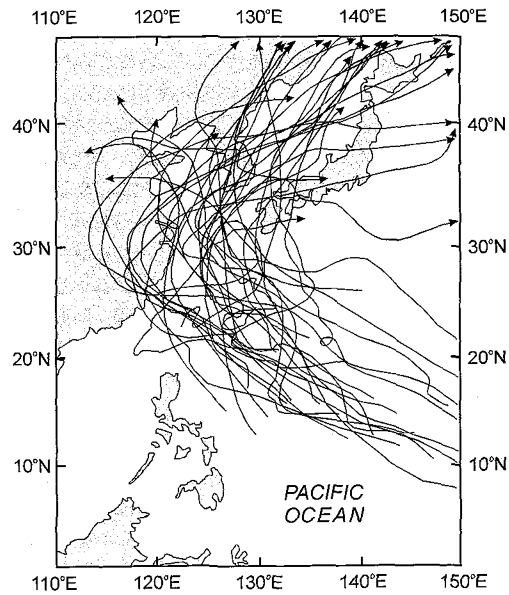

Fig. 4. Typhoon tracks during the 3rd 10 days in August for 79 years (1904-1983). (After KMA, 1984)

and October are shown in Figures 3, 4 and 5, respectively.

2) *Oyster shell deposit as proxy typhoon record*

The recognition of coastal clastic and/or shell sediments atop the coastal bluff or high morphologic terrain, which might be attributable to past typhoon shall be very essential if one wants to try to distinguish these sediments from those deposited by former strong typhoon or superelevated storm surge and long-term changes (higher stand) in relative sea level.

As shown in Figure 6, the overall distinct geometry of oyster shell deposit and shell deposit altitude above mean high tide level seem to be significant for accounts of episodic strong typhoon record associated with extremely strong wind that could transport oyster shells from nearby intertidal flat. The oyster shell bed with more than 47 cm thickness overlies the granitic soil profile (Bt horizon). The unconformable boundary between overlying oyster shell bed and underlying soils on the granite bluff is 820 cm high above the mean high tide level. The shells are 100% of oyster shells as shown in Figure 7 and 8. Most abundant lengths of the oyster shells are 5 to 6 cm and most dominant weights of each shell are 5 to 10 g (Fig. 8). Such statistics are carried out by counting 120

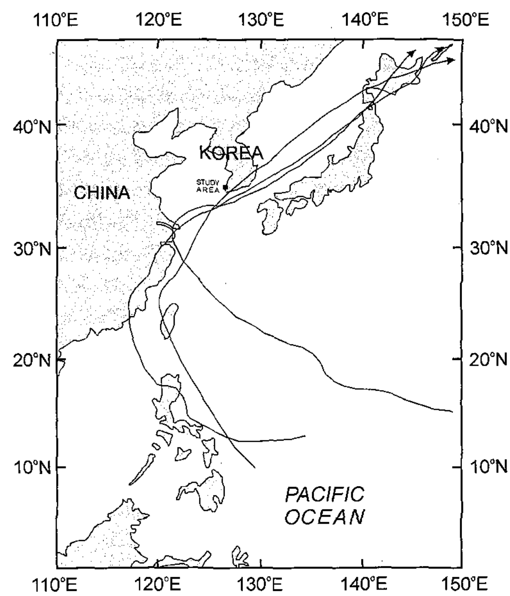

Fig. 5. Typhoon tracks during the 3rd 10 days in October for 79 years (1904-1983). (After KMA, 1984).

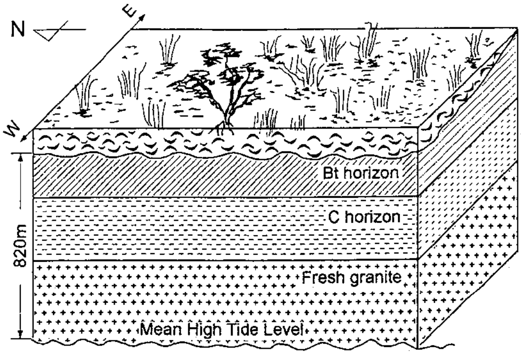

Fig. 6. Diagram showing geometry of oyster shell deposit atop the rocky point bluff in the Hampyung Bay. Note orientation of the oyster shell deposit geometry indicating the thickest thickness to the west and the thinnest to the east.

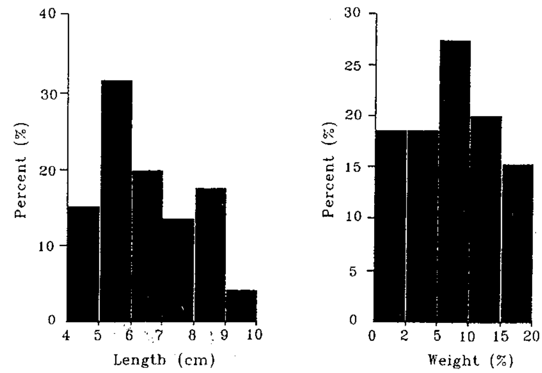

Fig. 8. Statistic data showing the length (long diameter) and weight of 120 oyster shells taken from the shell deposit investigated.

Fig. 7. Oyster shells taken from the typhoon deposit investigated. Note that most of shells are not brocken.

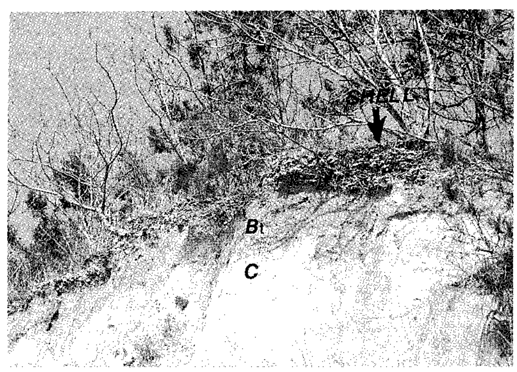

Fig. 9. Field photography showing the upper part of rocky point bluff and overlying typhoon deposit (oyster shell bed), on which trees and grasses are growing. Note Bt and C soil horizon of granite outcrop(bluff).

shells taken from the shell deposit atop the rocky bluff in the study area. It is worthy and necessary to know that the ^{14}C age of these oyster shells is 3610 ± 70 yr BP. As shown Figure 9, pine trees and grasses are growing on the shell deposits suggesting rather long period of vegetation and related soil forming processes.

DISCUSSION

Reference work concerned about past typhoon deposits and typhoon sedimentation along coastal zones, Korea and other parts of Asia and world shows that such references are very rare even though past storm deposits and tsunami sedimentation (Lamb, H.H., 1988, Kowalik, Z., 1984, Dawson, A.G. et al., 1995) have been reported rather freguently in the other parts of the world.

Are there questions concerning the past typhoon shell deposit described and reported in this paper? How can we recognize it as typhoon deposit?

In the first place, long term (at least 30 years) records for typhoon occurrences and tracks affecting the coastal zone, southwestern coast of Korea, i.e. southeastern coasts of the Yellow Sea would be one of very necessary considerations for the oyster shell deposit atop the rocky bluff to be described as past typhoon deposit, because the present oceanographic conditions and sea level including tidal range might already be the same as those in the period of 4500 yr BP or so (Park, 1996). Naturally, Figures 2, 3, 4 and 5 should be interpreted as very plausible meteorologic conditions since 4500 yr BP, and such past meteorologic conditions might make and/or leave possible past records of typhoon occurrences as coastal deposits, i.e. the oyster shell deposit described in this paper.

The fact that the oyster shell deposit reported in this paper overlies the soil horizons (Bt and C) of granite cliff directly as shown in Figure 9 should be considered as unusual coastal sedimentation. How do we consider it as unusual sedimentation? As shown in Figure 6, the altitude of the oyster shell bed is 820 cm high above the mean high tide level (MHWL). The question is whether the superelevation of water associated with strong storm and typhoon could reach up to more than 820 cm high above the MHWL or not. The point is whether or not storm surge-superelevation of water associated with typhoon might deposite the oyster shells. However, the most of these oyster shell sedimentation as shown in Figure 6 and 9 seems to be carried by strong winds associated with strong typhoon, which might be strong enough to transport shells selectively out of intertidal muddy flat. In fact two improbable explanations on the sedimentation of oyster shell deposit atop the granite cliff could be; 1) the higher sea level than the present, i.e. at least 820 cm higher sea level at the time of ca. 3600 BP, and 2) shell mound by ancient early man. These two explanations shall not be supported by many proper Quaternary geoscientists and/or archeologists who are well experienced and of analytic thinking on those field data described in the Hampyung Bay, southwest coast of Korea.

In short, it is reported that the oyster shell bed with more than 47 cm thickness atop the Gaipri Point (granite cliff) in the Hampyung Bay, southwest coast of Korea seems certainly to be a typhoon deposit during ca. 3600 BP or later.

ACKNOWLEDGMENTS

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