Korean Jour. of Petrol. Geol., V. 1, No. 1, p. 63~67, 1993

Foraminifera from shell deposits of the Jindo Island

진도 패각층의 유공충

Ho-Young Lee (이호영)*

Abstract : Foraminiferal assemblages from shell beds of Jindo Island indicate shallow water accumulation under warm to temperate condition near the mouth of a small estuary. 11 species of benthonic Foraminifera belonging to 10 genus have been extracted from 12 samples. Cavarotalia annectens dominates ,accounting for 57 to 90 percent of the total fauna. The foraminiferal assemblages of the shell beds indicates Post-glacial sedimentation.

Key Words : Jindo Island, Foraminifera, Post-glacial

요 약

진도에 분포되는 패각층의 유공충 군집은 온난환경에서 퇴적되었음을 지시한다. 총 12개의 표품에서 10속 11종의 저서성 유공충이 산출되었다. 이중에서 Cavarotalia annectens가 주요종으로 57에서 90퍼센트를 차지한다. 본역의 패각층은 유공충군집으로 보아 홀로세 퇴적물이다.

주요어 : 진도, 유공충, 홀로세

INTRODUCTION

The purpose of the present report is to characterize the Quaternary foraminifera from shell deposits of the Jindo Island, Korea, and to elucidate their paleoecological implications.

Shell deposits occur along the beach of Keumgye-ri, southeastern part of Jindon Island (Fig. 1). Kim (1964) mapped this area and reported occurrence of shell deposits mainly consisting of Ostrea. Micropaleontological works are, however, absent.

SAMPLE MATERIALS AND METHODS

Samples were taken in October,1981,from the shell deposits of the Jindo Island. Shell deposits are aligned parallel to the shoreline; they are divided by a small estuary, thus forming two parallel sets of marine terraces. The distance between the shell deposits is approximately 70 meters. Six samples were taken vertically from each shell deposits, total using 12 samples. The thickness of the shell deposits is 5 meters and 3 meters above the mean seawater level, respectively matching to the surface ground.

Approximately 100 grams of each samples were washed using 63 micron sieve with water and dried in an oven. Subsamples were made using 125, 250 and 500 micron sieves, and then splitted by "quattering" method. If microfossils are abundant, only small fractions are picked. For conveniency in picking 1,400 micron sieve was also used to remove large particles. For each samples more than 300 specimens were picked under the binocular microscope. Percentage of calcium carbonate is measured dissolving the samples in dilute hydrochloric acid.

*P.O. Box 14, Taedok Science Town, KIGAM, Petroleum Geology Division (한국자원연구소 석유지질연구부)

STRATIGRAPHY

According to Kim (1964), the stratigraphic position of the shell deposits are as follows:

Quaternary	Alluvium	Gravel, Sand, Mud
	--Unconformity--	
	Shell Deposits	Mollusc Shell, Skeletal Sand, Gravel
	--Unconformity--	
Cretaceous	Biotite Granite	
	--Intrusion--	
	Feldspar Porphyry	

The shell deposits unconformably overlies the feldspar porphyry and biotite granite of the Cretaceous age and are overlain by alluvium. Most of shell deposits are composed of calcium carbonate mainly responsible for mollusc shells and foraminifers (Table 1). Oysters constitute major part of molluscs, and bivalves such as *Anadara, Pecten,* and *Venus*

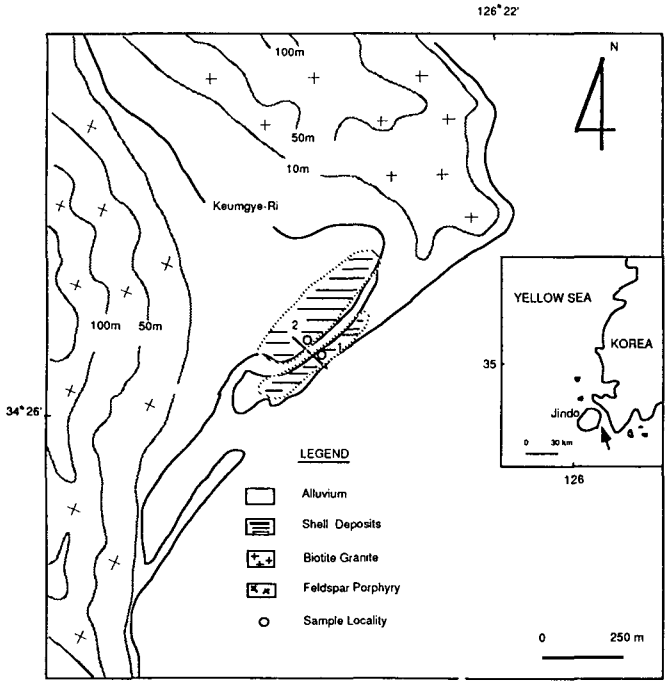

Fig. 1. Map showing sample sites.

Table 1. Sediment texture and percentage of calcium carbonate

Locality no.	Sample no.	Elevation above s.l. (m)	Size of sediment <500 μ (%)	Size of sediment >500 μ (%)	$CaCO_3$ (%)
1	102	2.8	20	80	95
	105	2.5	27	73	92
	110	2	22	78	97
	115	1.5	2	98	99
	120	1	2	98	98
	130	0	21	79	91
2	200	5	2	98	96
	210	4	2	98	95
	220	3	2	98	98
	230	2	8	92	91
	240	1	23	77	93
	250	0	52	48	87

etc. and ornamented gastropods constitute minor proportions of mollusc shells.

Besides molluscs, bryozoan fragments and echinoderm spines also occur. Shell beds consist of disarticulated small valves, fragmentary shells and minor proportions of pebbles in matrix of coarse skeletal sands. In general, shells are distributed in planar fashion, forming large-scale cross-stratification. Most shell fragments and skeletal sands are similarly aligned and help enhance laminations. In locality 2, shell deposits show about 5 meter thickness above sea level. Sample number 250 was taken at the bottom of the cliff in a watercourse and sample number 200 was taken at the top.

Table 1 shows approximate elevation, size of sediments and percentage of calcium carbonate.

OCCURRENCE OF FORAMINIFERA

11 species of benthonic foraminifers are occurred from the treated samples. They are as follows in decreasing order of abundance;

Cavarotalia annectens (Parker and Jones)
Elphidium advenum (Cushman)
Asterorotalia concinna (Millett)
Elphidium crispum (Linnaeus)
Buccella frigida (Cushman)
Rosalina globularis d'Orbigny
Cibicides lobatulus (Walker and Jacob)
Chrysalidinella dimorpha (Brady)
Siphogenerina raphanus (Parker and Jones)
Lenticulina thalmanni (Hessland)
Bolivina subaenariensis Cushman

Among these species, *Cavarotalia annectens* is the most dominant species, composing 57 to 90 percent of the total foraminiferal fauna (Table 2). Next to *Cavarotalia annectens, Elphidium advenum* accounts for 6 to 38 percent. These two species constitute 94 to 97 percent of the total fauna. *Asterorotalia concinna* and *Elphidium crispum* occur commonly, *Buccella frigida* and *Rosalina globularis* are less common, and *Cibicides lobatulus, Chrysalidinella dimorpha, Siphogenerina raphanus, Lenticulina thalmanni* and *Bolivina subaenariensis* are rare.

The entire foraminiferal fauna consists of hyaline benthic species. Agglutinated taxa are absent; some are destroyed by current action during transport and/or post-deposition. All

Table 2. Species distribution in percentages (samples greater than 125 micron)

Sample no.	Cavarotalia annectens	Asterorotalia concinna	Elphidium advenum	Elphidium crispum	Buccella frigida	Rosalina globularis	Cibicides lobatulus	Chrysalidinella dimorpha	Siphogenerina raphana	Lenticulina thalmanni
102	77.9	4.6	16.4		0.4	0.2	0.2	0.2		
105	90.0	1.5	6.2	1.5	0.2	0.4	0.1		0.1	
110	78.9	1.3	16.7	1.0	1.3	0.3	0.2	0.2	0.2	
115	77.9	1.5	18.4	1.6	0.3	0.2				0.1
120	84.5	2.1	11.8	0.6	0.4	0.4				
130	81.4	1.9	15.1	0.7	0.7	0.2				
200	75.2	1.0	20.7	1.4	0.4	0.8	0.1	0.2	0.2	
210	82.3	1.2	14.1	1.2	1.0	0.3				
220	56.5	1.4	38.0	2.4	1.0	0.7				
230	78.8	1.9	18.4	0.3		0.3	0.3			
240	76.1	0.5	19.5	1.5	1.0	1.3				
250	64.9	2.2	29.0	1.3	1.1	1.1				

Table 3. Foraminiferal abundance of samples per 100 grams

Sample no.	Fractions (μm)	*C. annectens*	*A. concinna*	*E. advenum*	*E. crispum*	*B. frigida*	*R. globularis*	*C. lobatulus*	*C. dimorpha*	*S. raphanus*	*L. thalmanni*	*B. subaenariensis*
102	>500	237	7									
	500~250	126	1	7		2	1	1	1			
	250~125	11	14	72								
105	>500	803	15		1							
	500~250	998	15	72	29	2	8	2		3	1	
	250~125	44		55		3						
110	>500	355	5									
	500~250	102	3	12	6	3	1		1			
	250~125	26		90		5	1	1		1		
115	>500	44	1									
	500~250	708	11	85	16		2				1	
	250125	25	3	98		3						
120	>500	165	7				1					
	500~250	216	2	11	3		1					
	250~125	13	1	44		2						
130	>500	285	9									
	500~250	158	1	16	3	1						
	250~125	16	1	69	1	3	1					
200	>500	75	4									
	500~250	657	5	64	13	1	8	1	2			
	250~125	46	1	150	2	3				2		
	125>	8		3								1
210	>500	320	4				1					
	500~250	152	2	7	4	2	1					
	250~125	21	1	78	3	4						
	125>	6		1								1
220	>500	17	1									
	500~250	135	2	40	7	2	2					
	250~125	13	1	71		1						
	125>	3		8								
230	>500	143	3									
	500~250	122	4	14	1		1					
	250~125	17		52				1				
	125>	3		8								
240	>500	150	1				2					
	500~250	138	1	33	6	1	3					
	250~125	12		44		3						
	125>	7		4								
250	>500	137	5				1					
	500~250	154	4	88	3	2	3					
	250~125	9	1	46	3	3	1					
	125>	8		1								

The samples contain abundant Foraminifera, from 5 to 205 specimens per gram. The minimum-maximum number of species per sample ranges from 6 to 10.

Faunal diversity (Walton, 1964) is low, ranging from 2 to 3. The low faunal diversity may indicate extreme ecological conditions during deposition of these sediments. Similarity index (Murray, 1973) between the samples from locality 1 and 2 shows 90 percent similarity, which is nearly identical.

As shown in Table 3 only rotaliids (*Cavarotalia annectens* and *Asterorotalia concinna*) occur in sample fractions larger than 500 microns, except one specimen of *Elphidium crispum* from sample 105 and a few specimens of *Rosalina globularis* from samples 120, 210, 240 and 250. Most of species are confined between 500 microns and 125 microns size fractions except for *Bolivina subaenariensis* from sample 200 and 210, which occurs in less than 125 microns size fraction. Table 3 shows species distribution of each sample in percent. Ostracodes also occur forming minor proportions among calcareous microfossils.

PALEOENVIRONMENT AND CORRELATION

Walton (1964) introduced two concepts of faunal dominance and faunal diversity as measures for foraminiferal ecology. The former refers to the percent occurrence of the most frequent species in a foraminiferal population, whereas

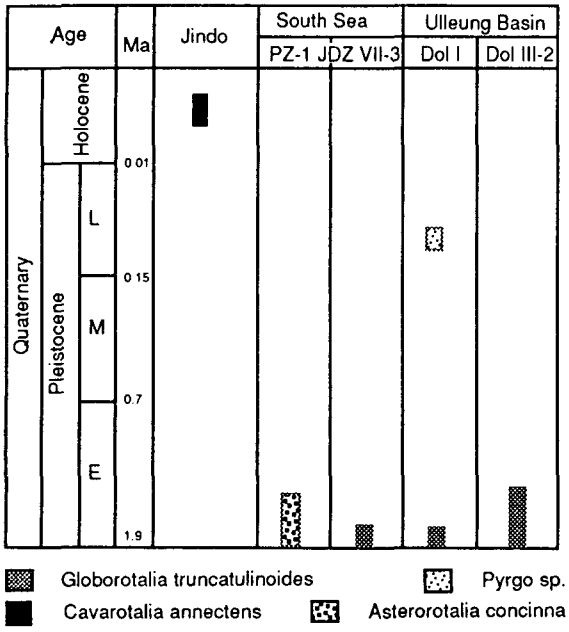

Fig. 2. Quaternary marine transgression scheme of Korean shelf.

the latter is meant by the number of ranked species of a counted assemblage of which cumulative percentage accounts for 95 percent of the total fauna.

In the samples, the faunal dominance averages 77, the faunal diversity is 2. Foraminiferal assemblage from shell deposits of the Jindo Island indicates shallow and brackish environments. This condition limits the reproduction ability in many species; relatively few species are adapted to such environmental conditions, hence diversity is low.

The large number of specimens per grams of sediments on the other hand, may have been caused by relatively high flood episode, although low sedimentation rate cannot be excluded.

The sediment characteristics are considered to be of great ecological importance to the foraminiferal infauna (directly) as well as to the epifauna (indirectly *via* substratum type). Some foraminifers such as *Cibicides lobatulus* and *Rosalina globularis* are known to sessile habitat at least during the part of their ontogeny to shells or coarse sand. The sands are well sorted, representing high-energy unstable conditions. In such sediments the faunas may represent a thanatocoenoses i.e. a death assemblage due to removal of certain species through current activity. Coarse sediments bear vagrant benthos such as *Elphidium* and *Ammonia*, i.e. free to move about on the substrates. As they often do not represent the original assemblage which lived at or near the site, mixing of the fauna from other environments may happen. According to Phleger (1960), and Murray (1973) following categories are safely made, that is;

Warm species : *Cavarotalia annectens, Asterorotalia concinna, Elphidium crispum, Chrysalidinella dimorpha,* and *Siphogenerina raphana.*

Warm and cold species : *Elphidium advena, Rosalina globularis, Lenticulina thalmanni,* and *Cibicides lobatulus.*

Cold species : *Buccella frigida, Bolivina subaenariensis.*

Thus the majority of foraminiferal assemblages indicate warm to temperate environments.

In the shell deposits of Jindo Island, the foraminiferal assemblages have much in common with that of Birkelse Postglacial *Littorina* deposits, north of Denmark. Feyling-Hanssen *et al.* (1971) records *Ammonia batava* accounting for 45 to 64 percent of the total foraminiferal fauna; *Elphidium clavatum,* constitutes up to 30 percent. Boring samples at Lokken, in the northern Denmark are dominated by two species like *Ammonia* and *Proelphidium anglicum,* which account for 33 to 94 percent, 49 to 94 percent, of the total fauna from each boring sample (Knudsen, 1971).

There are some dates concerning the age of *Littorina* deposits in Lokken area, showing ages from 5,115± 135 to 3,365 ± 100 years B.P. Elsewhere in Vensyssel marine deposits from the *Littorina* transgression occurred at 6,330 to 550 years B.P. (Feyling-Hanssen *et al.*, 1971). Deposition of these sediments took place during Atlantic and Subboreal times. The absolute age of the Jindo shell sediments is reported as about 2,300 years old (Park and Chung, in Park, 1975). According to Wang *et al.* (1985), Ammonia transgression also occured in East China during Holocene.

Timing of Quaternary marine transgression scheme is made on Korean continental shelf (Fig. 2). In PZ-1 Well (core interval from 180 to 350 m), abundant *Asterorotalia concinna* and *Asterorotalia multispinosa* occur, which probably indicate Early Quaternary. In top of JDZ VII-3 Well (core interval from 470 to 550 m), occurs *Globorotalia truncatulinoides,* which indicates Pliocene/Pleistocene boundary. In Dolgorae I Well, *Pyrgo*-abundant interval, between 340 to 380m is strongly indicative of the Late Pleistocene warm transgression in the region. In Dolgorae III-2 Well, however, climatic fluctuation of Early Pleistocene is well represented in planktonic foraminiferal fauna.

CONCLUSIONS

1. The shell deposits of the Jindo Island, Korea shows high content of calcium carbonate mainly composed of molluscs and foraminifers.

2. The shell deposits unconformably overly feldspar porphyry and biotite granite of the Cretaceous age and are, in turn, overlain by alluvium composed of gravels, sands and muds. Shell deposits show size sorting and cross-stratification.

3. 11 species of benthonic Foraminifera belonging to 10 genus have been extracted. The foraminiferal assemblages are dominated by *Cavarotalia annectens* and *Elphidium advenum.* These two species constitute 94 to 97 percent of the total fauna.

4. The high faunal dominance and low diversity reveal extreme ecologic conditions, such as shallow water and possibly reduced salinity. Most species indicate warm to temperate environments. These shell deposits are tentatively correlated with the Holocene *Littorina* deposits of Denmark and *Ammonia* transgression of East China.

REFERENCES

Feyling-Hanssen, R.W., Jorgensen, J.A., Knudsen, K.L. and Andersen, A.L., 1971, Late Quaternary Foraminifera from Vendsyssel, Denmark and Sandnes, Norway. *Bulletin of the Geological Society of Denmark,* 21, 67-317.

Kim S.W., 1964, Report on the Limestone Deposits in the Claim No.85, Jindo Quadrangle. *Bulletin of the Geological Survey of Korea,* 7, 121-134.

Knudsen, K.L., 1971, Late Quaternary Foraminifera from the Lokken Area. In:Feyling-Hanssen R.W. *et al.* (editors), Late Quaternary Foraminifera from Vendsyssel, Denmark and Sandnes, Norway. *Bulletin of the Geological Society of Denmark,* 21, pt. 2-3, Copenhagen, 130-158.

Murray, J.W., 1973, Distribution and Ecology of Living Benthic Foraminiferids. *Heineman Educational Books,* 274p.

Park, Y.A., 1975, The Carbonate Beach Sediments along the Geumgeri Coast, Jin Island, Korea. *The Journal of the Oceanological Society of Korea,* 10, 45-50.

Phleger, F.B., 1960, Ecology and Distribution of Recent Foraminifera. *Johns Hopkins Press.* Baltimore. 297p.

Walton, W.R., 1964, Recent Foraminiferal Ecology and Paleoecology. In: Imbrie, J and Newell, N.D. (editors), Approaches to Paleoecology, New York, *Wiley and Sons,* 151-239.

Wang, P., Min, Q., Bian, Y. and Cheng, X., 1985, On Micropaleontology and Stratigraphy of Quaternary Marine Transgression in East China. In: Wang P. (editor), Marine Micropaleontology of China, *China Ocean Press,* 265-284.

Manuscript received November 17, 1993