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Stratigraphical Research of the Quaternary Deposits in the Korean Peninsula

Dong Young Lee

韓半島 第四紀 地層의 層序的 考察

李 東 瑛

ABSTRACT

With regard to the Quaternary formations in the Korean Peninsula, very few studies have been done specially from a stratigraphic viewpoint. The alluvial sediments filling in the valleys have often been considered as the only formation of Quaternary age (more precisely of the Holocone) and so the Pleistocene was regarded as an erosional or nondepositional episode. This is apparently evident from a quick look at the general geological maps of the Peninsula, which show a lithological sequence of Mesozoic or Paleozoic substrata immediately overlain by Holocene alluvium. Likewise, the Pleistocene period was described in terms of unconformity in most local or regional stratigraphical successions of the Peninsula.

Recently several different types of Quaternary formation, besides the so-called Holocene alluvium in the valley plain have been found around the Peninsula. They consist of coastal deposits, marine or fluviatile terrace deposits, ancient valley fill deposits or slope deposits. Some parts of the volcanic sediments in Jeju Is. are also known as the Quaternary sequence. Thus the Quaternary deposits in the Peninsula are far more developed than previously known to geologists.

Moreover the importance of Quaternary research became recently apparent in Korea due to the shortage of raw materials and to the policy of an optimum land-use. Advanced constructions and land reclamation have required more precise engineering parameters of loose materials and an estimation of land stability.
This does not imply only the engineering, or the structural properties of the loose

Korea Institute of Energy and Resources (韓國動力資源硏究所)

material, but at the same time the basic study of the sediments from the stratigraphical and environmental viewpoints has been necessary. In this connection, Quaternary outcrops specially along the coastal fringe of the Peninsula have been mapped, profiled and sampled for sedimentological,clay-mineralogical and palaeomagnetic studies. All these results are compiled for the core of the Quaternary stratigraphy of the Peninsula.

要 約

韓半島에 분포하는 第四紀 地層들에 대한 기존의 지질학적 연구는 극히 미소한 편이였으며 계곡이나 평야등지에 분포하는 沖積層들이 第四紀 동안의 유일한 地層으로 대표되어 왔다. 따라서 韓半島의 第四紀 地質時代는 그 대부분이 堆積보다는 浸蝕이 우세하였던 시대로 認識되었으며 기존의 지질도들에 의하면 沖積層의 형성시기를 제외한 第四紀는 不整合으로 표시되었다. 이는 韓半島의 지질과 지형이 第四紀 地層이 형성되어 현재까지 殘存해 있을 수 있는 커다란 堆積盆地를 이루지 못한데 있다. 이와 반면에 現 地形의 산록이나 해안주변등에서는 서로 堆積 환경과 時代를 달리하는 第四紀 地層들이 소규모적이나 수직적으로는 良好한 분포를 보이는 지역들을 발견할 수 있다. 그 대표적인 예로서 동해안의 3개지역(북평, 울진, 포항)과 서해안의 고창지역에서는 砂礫이나 砂質粘土등으로 구성되어 있는 第四紀 地層들이 발달하여 있다. 本 地層들의 분포위치, 堆積相 및 古地磁氣 연구로서 地質時代를 규명하였으며 堆積構造와 粘土광물 분석등을 통하여 이들의 古環境을 해석하여 第四紀 동안 韓半島의 地質史를 규명하였다.

INTRODUCTION

A few previous studies have dealt with the Quaternary geology and geomorphology of the Korean Peninsula. Along the east and west coast of Jeju island, a sandstone of about 10 m thick was first mentioned by KIM, B.K. (1969). He concluded that the foraminiferas contained in this formation were indicative of the Pleistocene age. PARK, Y.A. (1969) studied the sediments of Sinpyenongcheon Marsh on the west coast, including radio-carbon dating of peaty samples taken at the base of the marsh. He drew a submergence curve of the west coast based on a depth-time relationship of the Holocene sea-level rise and concluded that the west coast was submerged at a rate of 1.4 mm over a period of 2700 years up to 4,000 yrs. ago, and then the rate was slowed down to 0.426 mm per year during the last 4,000 years. These rates of submergence led him to the conclusion that the west coast had been submerged for the last 6,520 years due to an eustatic sea-level rise combined with a substantial tectonic downwarping in the Yellow Sea region. KIM, S.W. (1973) studied six marine terrace surfaces along the south-east coast of the Peninsula, occurring from 3 m to 130 m above mean sea-level. He assumed that all these terraces date from the Upper Pleistocene to the Holocene. Radio-carbon dating on two samples allowed him to assume that the Pohang-Yangsan block had been rising at a rate of 1.1 to 1.4 mm per year during the last 12,000 years, disregarding eustatic changes of the sea level. GUILCHER (1976a, b) reviewed the coastal area along the Yellow Sea and the South Sea. He reported blocky gravels on the slope in Geojae Island, interpreting their origin as due to a Pleistocene periglacial environment.

He further stated that such an evidence of periglacial slope development confirms probably the most equatorward occurrence of relict Pleistocene periglacial phenomena at low altitude. OH (1977) reviewed the marine terraces along the east coast from Jang-gikok to Gang-yangri and classified 4 terraces at different levels. JO (1980) identified also three marine terraces on the coast of Yanghanri.

As the Pleistocene deposits in the Peninsula were little mentioned as reviewed above, the first step of this work was to locate the outcrops which were assumed to be of a Pleistocene age. Among several regions, mainly five areas were selected for this study (Fig. 1). Each of these five areas comprised enough outcrops to be able to identify their complete lithostratigraphic units. The areal extension of each unit was large enough to serve as a mapping unit. Each area also showed a specific configuration of the topography and a different lithosequence. Accordingly, the stratigraphic establishment of these five areas was eventually assumed to be representative of all the other Quaternary outcrops in the Peninsula. The areas are:

1. Wolseong area: The marine terraces are successively allocated at five different levels from +3 m to about +90 m along the coast. The terrace deposits and the slope deposits between each successive terrace are profiled in the lower three terraces.
2. Pohang area: Fluviatile deposits overlying the pre-Quaternary substratum are profiled and the landscape evolution since the

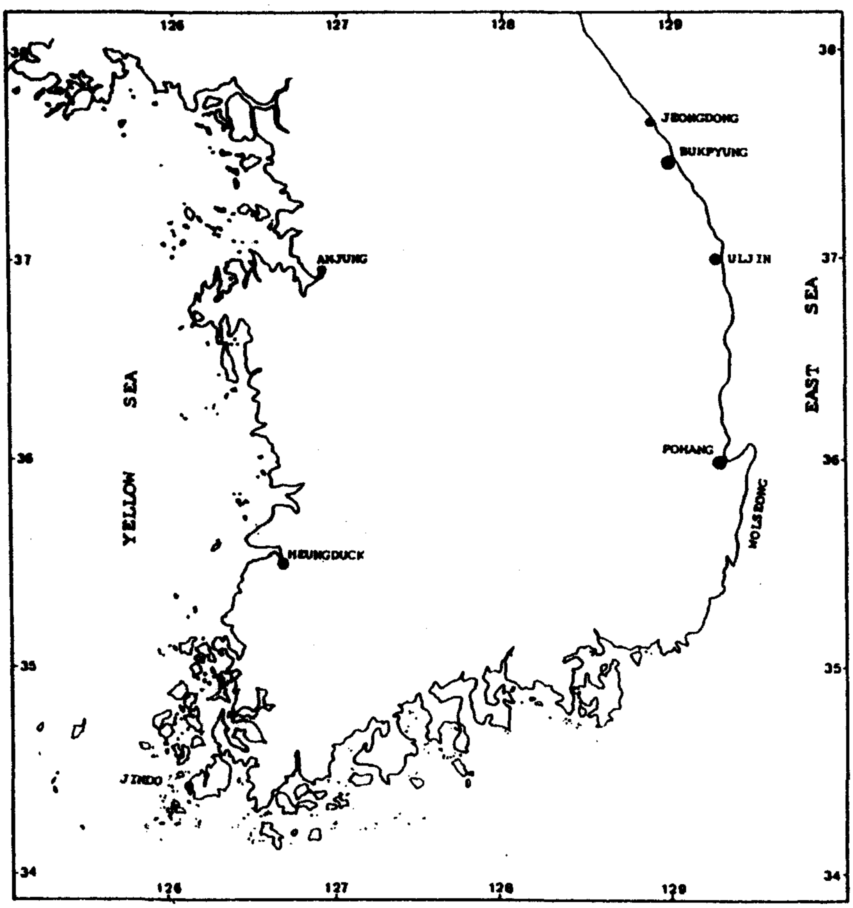

Fig. 1. Location of the Quaternary outcrops cited in this text.

Miocene is analysed for the Pohang basin. The fluviatile terraces are mapped along the Naeong-cheon river and compared stratigraphically with the marine terraces.

3. Uljin area: One distinct gravel mamber surmounts the fluviatile deposits. Periglacial features and fragipan are present in one of the soil deposits.
4. Bukpyung area: The lithological characteristics of the pre-Quaternary and the Pleistocene deposits are clearly discernible. The evolutionary trend of the Bukpyung basin since the Pliocene is also illustrated. Three formations and two members in this area are described separately.
5. Heungduck area: This area shows the unique outcrops of the Pleistocene deposits along the west coast. Two distinctive soil deposits are developed surmounting the fluviatile deposits. The specific environment for kaolinization of clay deposits is reviewed in detail.

PRE-QUATERNARY DEPOSITS

Tertiary deposits in the Korean Peninsula outcrop in the Bukpyung and the Pohang Basins. Although these areas were often the subject of previous studies (TATEIWA, 1924, UM et al., 1964, KIM, 1965 and YOON, 1975), the evolution of the basin morphology related with the depositional episodes remained skeptical. The Pohang basin comprises the Yeonil Group subdivided into six different formations. Each of these formations represents the specific lithology related with the changes of the palaeoenvironment and basin morphology (Table 1). The lowest sequence of Middle Miocene age shows very coarse gravelly deposits formed on a subdued erosional surface of the Cretaceous substratum. A gradual change of the palaeoclimate from very dry and warm into warm and humid, provoked the stream flood deposits, while endogenic subsidence caused transgression in the 2nd and the 3rd sequences. The 4th and the 5th sequences represent entirely marine sediments with different lithofacies as organic rich black mudstone in the former sequence and whitish grey mudstone in the latter. The last sequence (Yonam Formation) of the Pliocene was formed in regression, possibly due to a climtic cause. On these gently inclined Tertiary outcrops, an almost horizontal geomorphic surface is developed at +200 m +100 m, +80 m, and +50 m. The surface of +200 m represents the highest depositional level of the Miocene where tectonic influences are excluded. This level had been gradually lowered down to about +100 m by the end of the Pliocene. The marine platform along the Jeongdong coast, developped at the level of +90 m can be likewise interpreted to be of Pliocene age.

The Bukpyung Basin comprises the Tertiary sediments of lignite-bearing mudstone (Bukpyung Formation) (LIM & CHOI, 1982). Its lithofacies is different from the Yeonil Group as it consists of serveral types of sediments such as channel fills, beach, and also lagoonal deposits, all indicating a temperate climate (Fig. 2). The palaeomagnetic investigation yields all negative polarities throughout the formation, which infers its age older then the lower limit of the Gauss magnetozone.

LOWER PLEISTOCENE

The first problem is to define the Plio-Pleistocene boundary. Although several lithological successions overlie the Tertiary substratum, no continuous deposition throughout the boundary has been found. However there are several significant differences in litho-facies between the Pliocene and the Pleistocene. A very loose, ironified and highly weathered graveliferous lithofacies is representative of the Lower Pleistocene. As it

Table 1. Simplified geological and geomorphological evolutionary trends of the POHANG BASIN since the Miocene.

CHRONOSTRATIGRAPHY			LITHOSTRATIGRAHPIC UNITS	LITHOLOGY	DEPOSITIONAL ENVIRONMENT	DEPOSITIONAL PROCESS	GEOMORPHIC PROCESS	MORPHO-STRATIGRAPHIC LEVEL Dep.	MORPHO-STRATIGRAPHIC LEVEL Ero.	CLIMATE	TECTONIC HISTORY
QUATERNARY	HOLOCENE			gravel, sand and silty clay	valley fill	stream flood	valley fill / valley cut	5		humid (monsoonal) vegetated	tectono-, and climato-geomorphic elements, even if any present along the coast, are mostly concealed and dominated by the eustatic sea-level changes
	PLEISTOCENE	Upp.		gravel	valley fill	stream flood	valley fill (terrace) / valley cut	10		humid vegetated	
		Mid.	JUNGDAN FORM.	gravel and coarse sand	valley fill or alluvial fan	debris flow or stream flood	valley fill (terrace) / valley cut	40		humid less vegetated	
		Low.	GOEDONG FORM.	gravel and sandy silt	valley fill or alluvial fan	stream flood and alluvial fan	valley fill (terrace) / valley cut	55	50	dry less vegetated	
TERTIARY	PLIOCENE		YONAM FORM.	sand, sandy silt or silty clay	shallow marine to non-marine following regression of sea		coastal slope denuation following regression of the sea	95	80	dry, warm less vegetated	
	MIOCENE	Upp.	DUHO FORM.	↑ sandy silt silty clay sandy silt	↑ bay open sea bay		continuous changes in the coastal form, embayment toward the present Pohang plain	105	100	very dry, warm less vegetated	= minor fault; subsidence of Pohang basin (shifting eastwards and decrease of the subsidence rate)
		Mid.	IDONG FORM.	↑ sandy silt silty clay fine sand	↑ bay open sea shallow marine		changes of the type of the coastline, from straight to bay type	140		dry (gypsum), warm; decrease of pluviosity	
			HEUNGHAE FORM	fine sand or sandy silt	shallow marine		main river system and tributaries (Hyungsang and Heunghae rivers)	200		humid, vegetated (grass and trees)	
			HAKRIM FORM.	sand or sandy silt	mid to distal fan local marine transgression	sheet flood or stream flood	rivulets along the depositional surface of the CHEONBUK Form..	200<		dry, warm; increase of pluviosity	= Pohang basalt 13.9 my fault
		Early Mid.	CHEONBUK FORM.	fine gravelly sand ↑ coar. gravelly sand	proximal to mid fan local marine transgression	debris flow or sheet flood	mass wasting on highland and accumulation along footslope	200<<		very dry and warm ephemeral streams	local upwarping centered at Doeum
							mechanical weathering and slope denudation			very dry and warm	volcanic eruption at 19 my (Yeonil andesitic basalt)

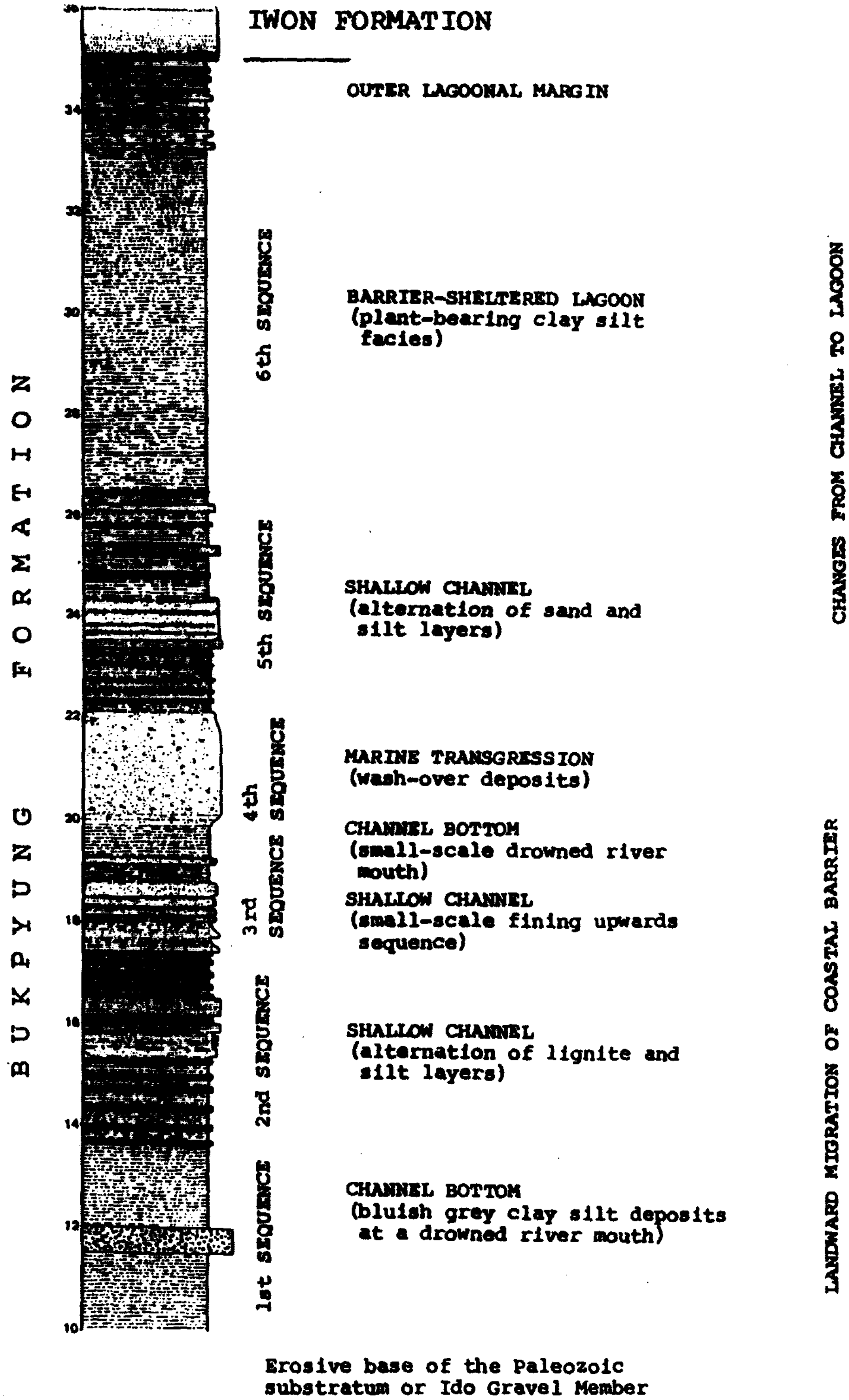

Fig. 2. Depositional environment of the Bukpyung Formation.

has been customary to define the Quaternary on the basis of palaeoclimatic interference, it is not exceptional to apply this concept in this area also to connect the Quaternary stratigrphy with the climatically induced geomorphic evidences.

At the end of the Tertiary, a very slow regression phase changed into a rather rapid drop of the base-level (Fig. 3). Accordingly a gently inclined Pliecene accretional surface near +100 m started to be incised, and thus, the first erosional cycle rather than a depositional episode corresponds with the very beginning to the Plesitocene. The first incision reached up to the level of +35 m along the present coastal area. This newly formed incised valley was then, easily filled up with graveliferous deposits (PHASE 1) following the base-level rise which possibly corresponds with the so-called "interglacial stage" of the Northern Hemisphere. The uppermost topographic position of the Phase 1 reached up to about +55 m in the Bukpyung plain. The Dogyung Formation overlying the Bukpyung Formation of the Pliocene represents a depositional episode of this phase. This formation consists mostly of channel sands, intercalated often by gravel sequences, whose palaeoenrironment was warm, humid with a rather continuous fluvial activity. The palaeomagnetic result shows negative polarities in the lower part of the formation, turning into positive polarities in the uppermost part, which leads to the conclusion that it belongs to the Matuyama magnetozone, but older than Réunion (Fig. 4).

As a result, the Plio-Pleistocene boundry, although not conceivable in the lithoseqence, is assumed to correspond with the first erosional phase certainly older than the Dogyung Formation, and thus, an approxiamte age of the boundary corresponds to the lower limit of the Matuyama magnetozone (2.4 my).

The second erosional phase began, possibly from the time of the Réunion, along the accretional surface of the Phase 1 at the level of +55 m. The valley became comparatively wider and deeper than the Phase 1, and thus, eroding most of the previous deposits. The lowest valley bottom along the present east coast reached up to the level of about +27 m. A subsequent rise of the base-level brought another episode of valley accretion (PHASE 2). The Goedong Formation in the Pohang plain was formed at this valley accretion. It consists of six gravel members, each representing a single flood episode with a subsequent flood plain deposit (Fig. 5). The lower two members are stream flood deposits and the 3rd and 4th are of a mudflow origin of alluvial fan deposits. The last two sequences are again stream flood deposits. The palaeoclimate of this period is characterized by dry wet, warm as seen by the predominance of smectite in the clay-mineral composition of the sediment. This Phase 2 is slightly drier than the Phase 1, but with incursions of temporary wet climates. The palaeomganetic direction of the Goedong Formation are all normal, possibly corresponding to the Olduvai. Based on this magnetostratigraphy, the time-span to form the 30 m-thick Goedong Formation (0.20 mys) is much shorter than for the same thickness of the Dogyung Formation (0.47 mys), and also the period of the base-level drop is much longer than the rise in the Phase 2.

The Phase 3 is characterized by a continuous valley development and also by a climatic change from warm-dry of the Phese 2 into warm-wet with an incursion of cold climate. The valley became much wider and deeper up to the lowest level of about +5 m. Hence the valley configuration became practically similar to the pressent by that time. Most of the former deposits of the Phase 1 and 2 were wiped out except where topographic shelters could protect the deposits from post-erosion by main river systems. On the contrary deposits, even if formed following a subsequent base-level rise, were

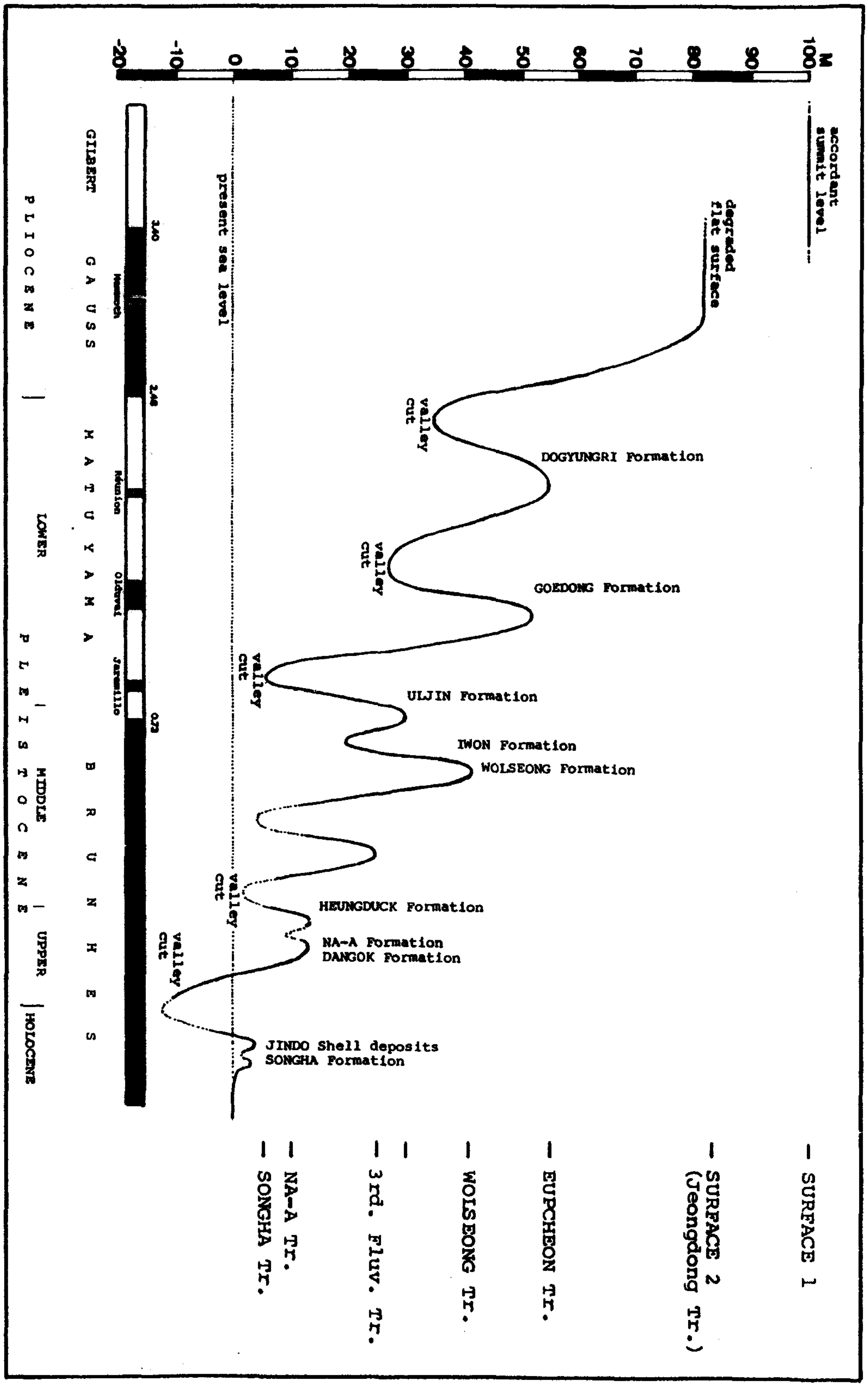

Fig. 3. Generalized curve depicting local base-level changes along the coast of the Korean Peninsula during the Quaternary.

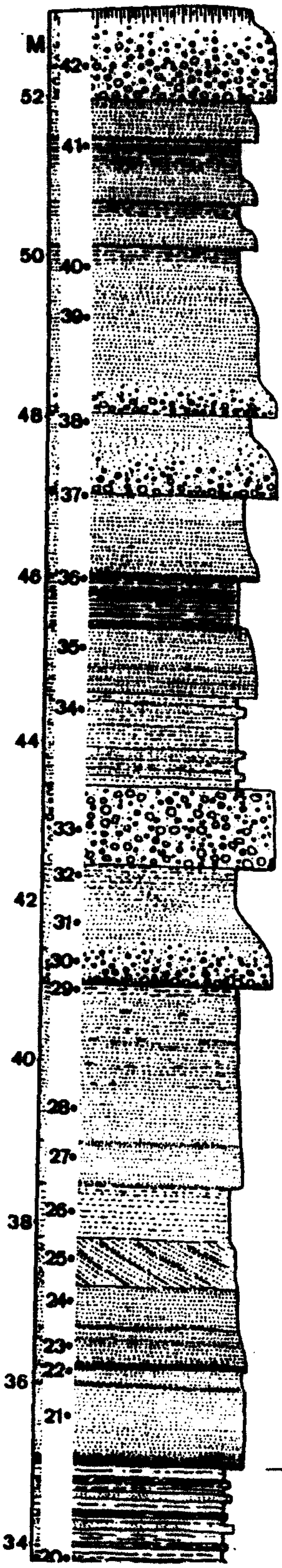

Fig. 4. The main lithosequence of the Dogyung Formation. The lower part up to the sample number 39 indicates negative polarity zone (Matuyama) and the upper part (40-42) indicates positive polarity zone (Réunion).

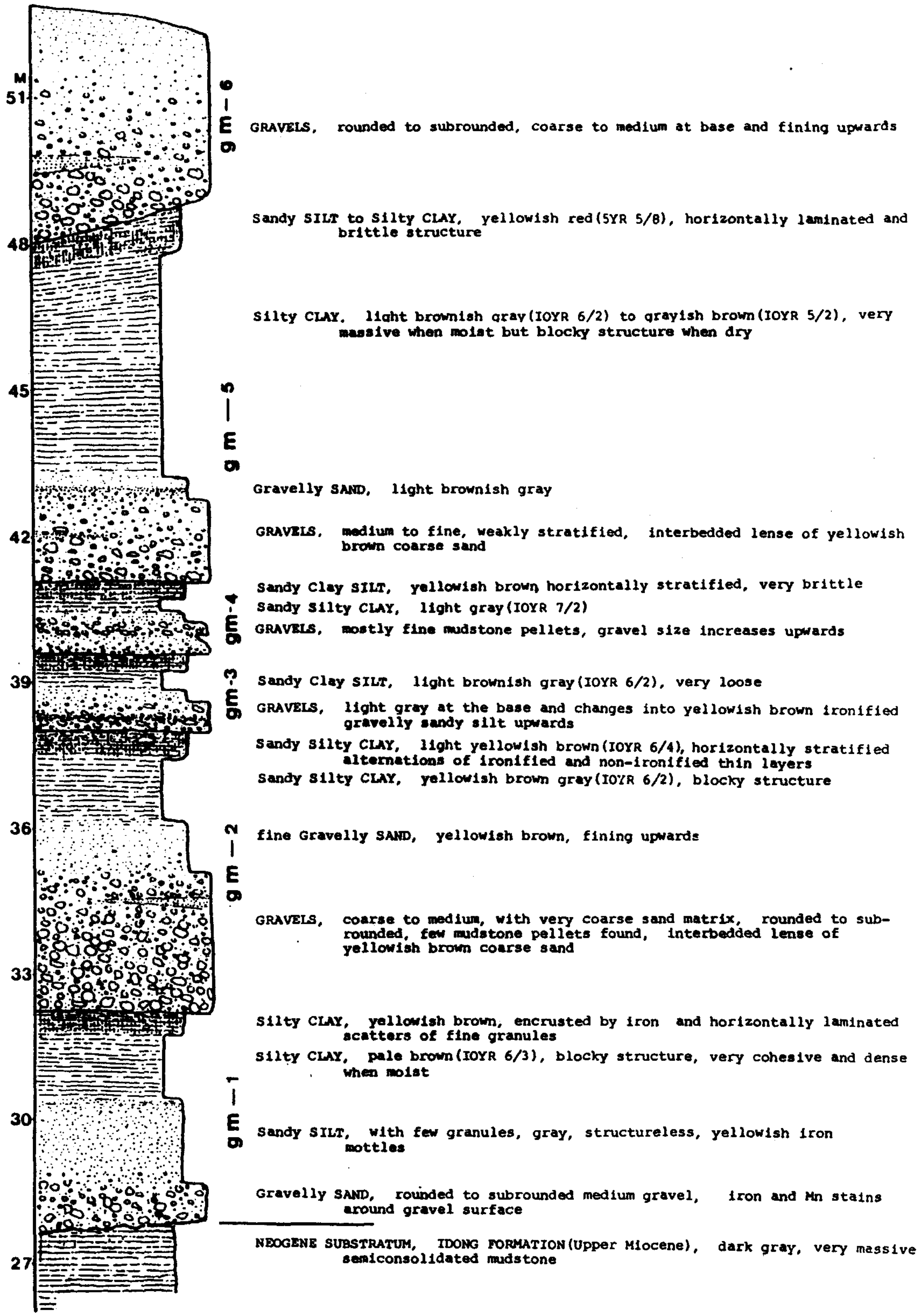

Fig. 5. The complete lithosequence of the GOEDONG FORMATION outcropped in the Pohang Basin.

more widely distributed along the enlarged valley walls. The Uljin Formation, outcropping at the level between +5 m and +30 m, coincides with this episode. It consists of several recurrent channel deposits reflecting a warm, but humid palaeoenvironment. In the middle of this formation, a cold climatic interference is marked as the sediments became highly contorted and irregular with fossil structures of the former ice segregations (Fig. 6). These features are indicative of the presence of a somewhat periglacial climate in the Uljin area. A positive polarity in the lower part, changing into a negative polarity in the upper part gave us an approximation of its age which must be older than the upper limit of the Matuyama. but younger than the Jaramillo (Fig. 7).

MIDDLE PLEISTOCENE

As valley development had far progressed toward the Middle Pleistocene, most features of the Lower Pleistocene had been wiped out except for the area where direction of the main valley had eventually changed, leaving the outcrops of the Lower Pleistocene intact. Moreover the valley became very wide, so that the valley fills consisted mainly of finer sediments of channel deposits rather than graveliferous flood deposits. These finer sediments in turn, were easily eroded away afterwards. It is thus, very scarce to find continuous lithostratigraphic records of this period. On the contrary, the geomorphic surface related with the stratigraphic subdivision is better preserved. Marine and fluviatile terraces are develped along the coast of the Wolseong Block (Fig. 8), the Pohang plain and the Jeongdong area. The Eupcheon Terrace at +50 to +60 m and the Bonghwajae Terrace at +75 to +90 m both higher than the 3 rd Terrace are hardly distinguishable. But the 3rd marine Terrace (Wolseong) at the level of about +40 m is still recognizable by its low-relief surface with an escarpment. The terrace deposits (Wolseong Formation) are also preserved at the level from +35 to +42m. The origin of this Wolseong Formation has been confirmed to be of marine on the basis of gravel shapes and the lithofacies. There are several other outcrops corresponding to the Wolseong Formation along the coast. The Jungdan Formation in the Pohang Basin, the Iwon in the Bukyung Basin are among thsoe whose palaeomagnetic directions are all parallel to the present Earth's magnetic field. This normal polarity and the base level of about +40 m are some of the evidences to infer their ages near the lower limit of the Brunhes Magnetozone, thus, certainly younger than 0.73 my. The 3rd fluviatile terrace at the level of +25 m to +30 m is occasionally found in the Naengchoeon valley, but its areal extension is very limited.

Several types of soil depostis (Bong-gil Soil Complex) are successively developed on the backedge of the Wolseong Terrace (Fig. 9). Each soli is characterized by its specific lithological colour, soil structure, clay component, and grain-size distributions. The main palaeoclimatic variation within this soil complex is marked by a successive change from a wet-dry, warm climate in the lower part, through wet in the middle and finally wet in the upper part. The palaeomagnetic result of these deposits indicates a Brunhes age. Toward the Upp. Middle Pleistocene, the palaeoclimate became warm and wet, resulting in the the lithofacies of this period depended on the type of fluviatile system on the valley flat. Thus the concept of valley accretion with graveliferous deposits changed into a channel deposit with flood plain along the valley.

The Heungduck Formation represents the deposit of this period in the western coast. This formation extends vertically from near the present aluvial plain up to the level of about +13

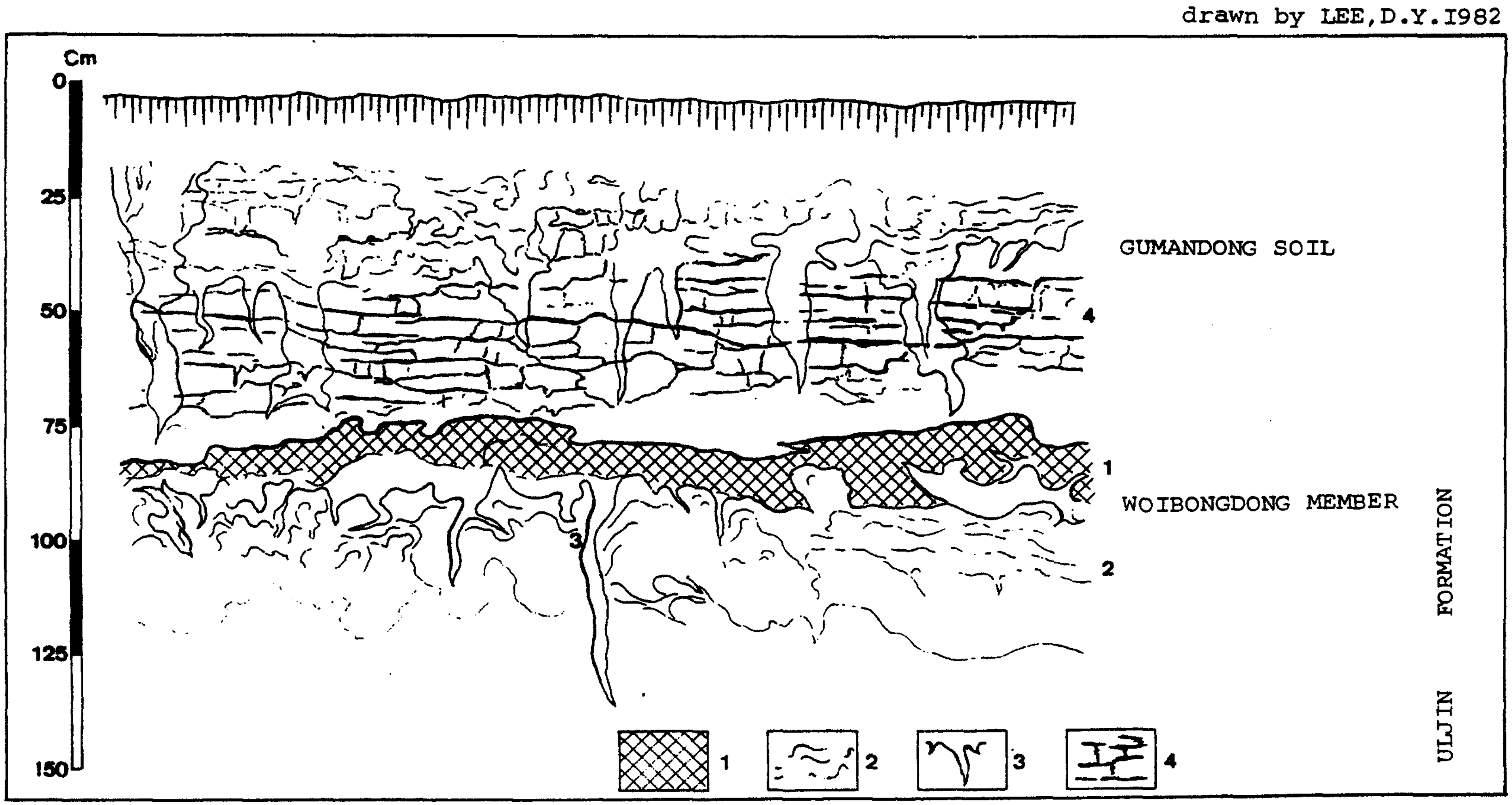

Fig. 6. The two different levels of the cryoturbated horizons exposed at Uljin. The lower part (WOIBONGDONG M.) shows weakly developed icewedges and cryoturbated horizon, while the upper part (GUMANDONG Soil) shows the overlaps of two different features, the first is the icewedge-like pseudo-cast, then the development of fragipan is overprinted at the same horizon. I: Silty loam strong brown (7.5YR 5/6), 2: sandy loam, brownish yellow (IOYR 6/8), 3: sandy loam, bleached light grey (IOYR 7/2), 4: platy or lenticular structure by clay accumulation.

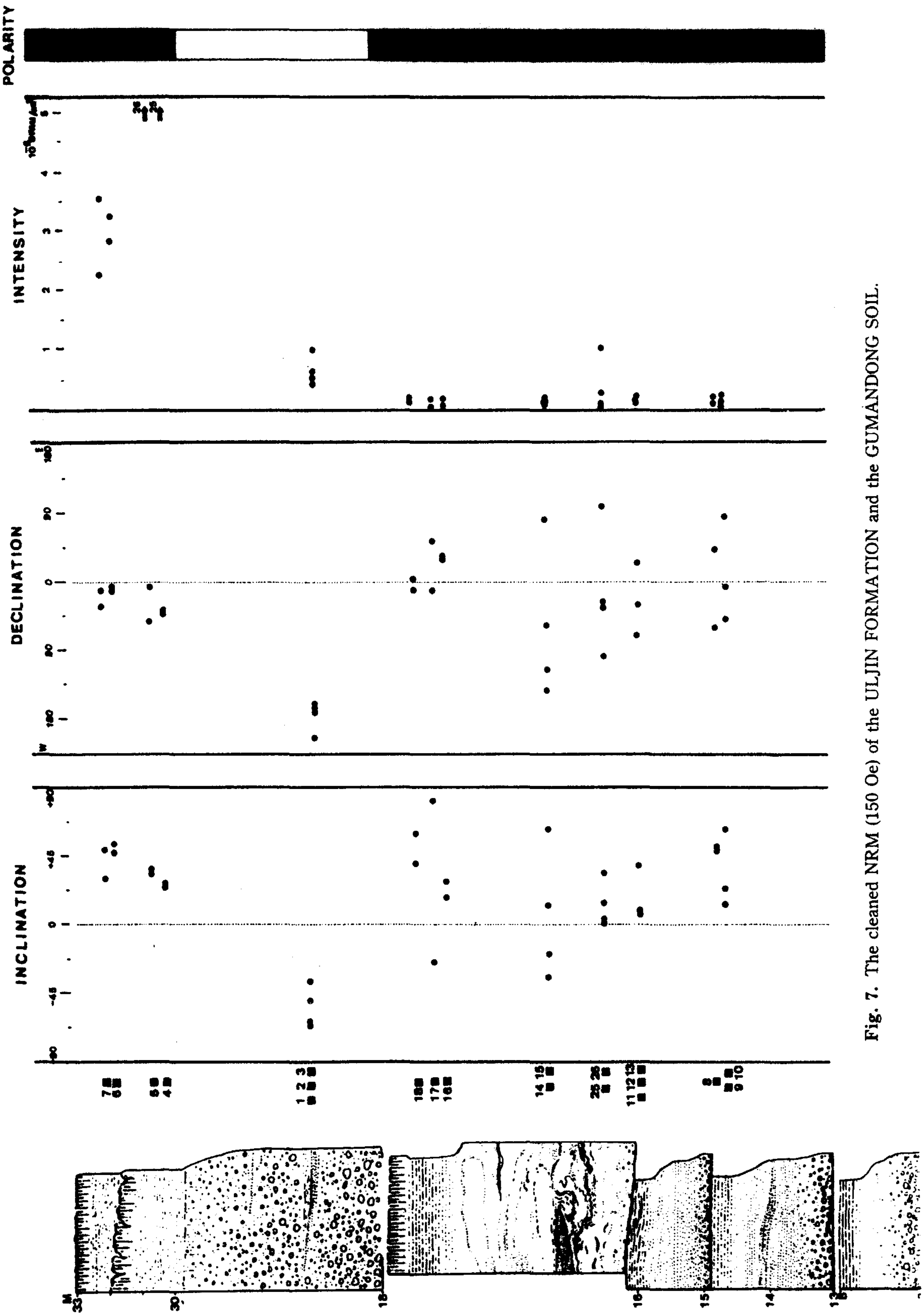

Fig. 7. The cleaned NRM (150 Oe) of the ULJIN FORMATION and the GUMANDONG SOIL.

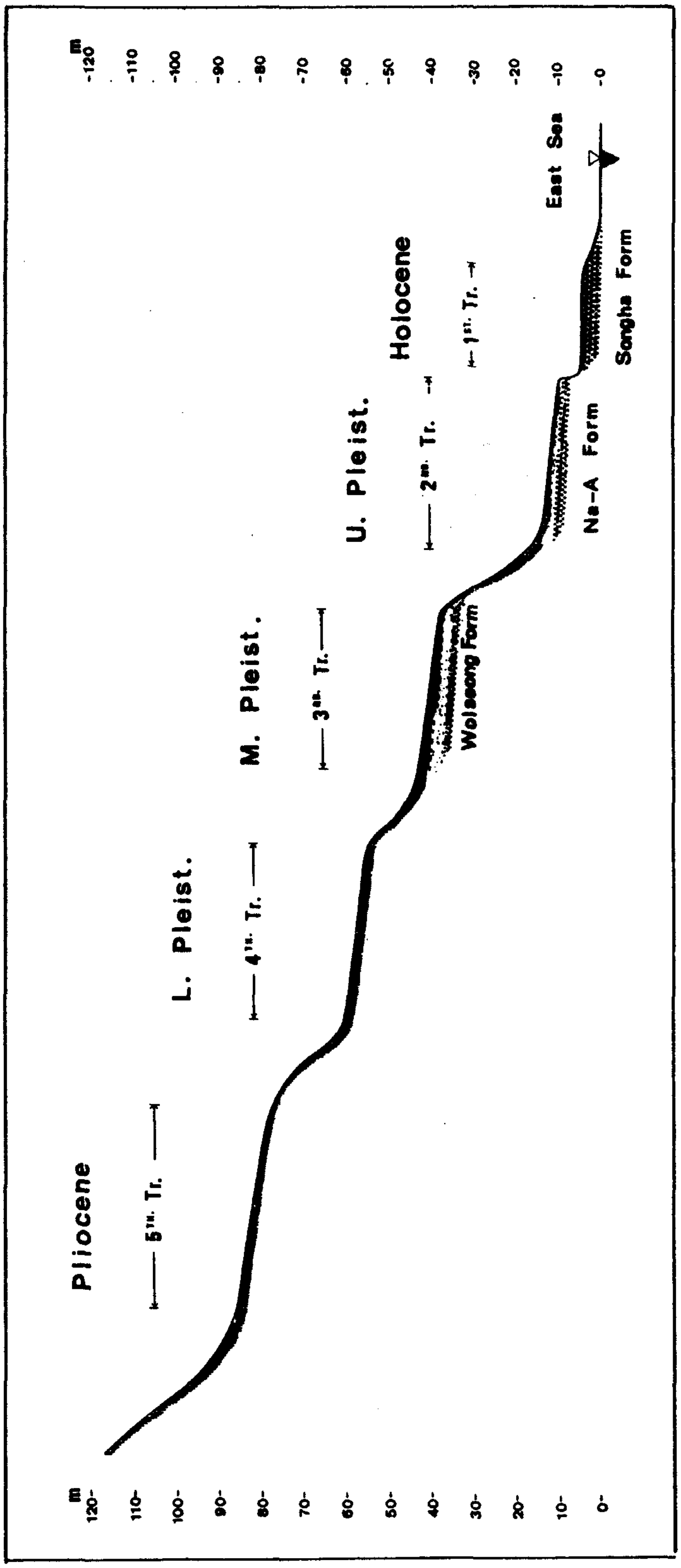

Fig. 8. Schematic view of the idealized succession of terraces and their lithostratigraphic units along the Wolseong coast.

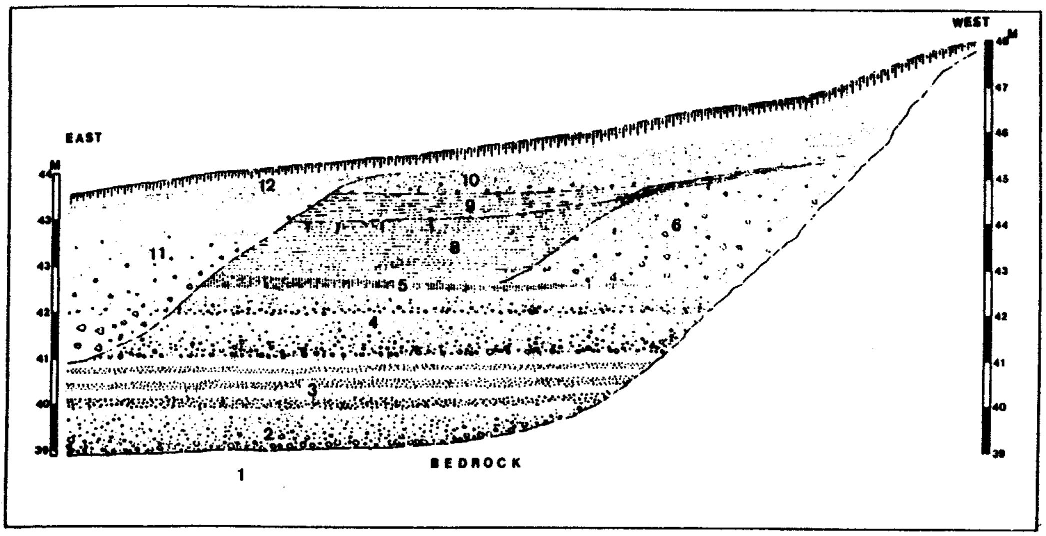

Fig. 9. The lithosequence of the deposits and its topographic location outcropping at the Wolseong Terrace of Mopo village, The Wolseong Formation surmounts the bedrock and is overlain by a succession of slope deposits. Each number indicates a different type of deposits:

1: Bedrock (argillite and dacite)	2: Basal gravelly sands
3: Gravels and sands (well sorted)	4: Gravelly sands (unsorted)
5: Dark brown silty clay	6: Grey brecciated gravelly loam
7: Dark greyish brown silty clay	8: Light grey silty loam
9: Brown clay silt	10: Brown sandy loam
11: Reddish brown brecciated gravelly loam	12: Semi-podzolic silty loam

m. Its lithosequence resembles the present alluvial deposits as gravelly sands in the bottom and silty clays of a flood plain origin on top. A very warm and wet palaeoclimate for this formation can be read by a high percentage of kaolinite content and a very low pH value (up to 3.5). The palaeomagnetic directions in this formation are all of normal polarity.

UPPER PLEISTOCENE

A warm, humid palaeoclimate has continued, enhancing a chemical weathering of the surroundings. The fluviatile system on the flood plain became meandered at the level of about +10 m. The weathered materials gently moved downwards along the low slopes, forming slope deposits rich in kaolinite (Gumsan Soil). Fluviatile and marine terraces were formed at this level. The Na-A terrace along the southeast coast is quite conspicuous, still easily recognizable as a stepped flat surface. A marine terrace deposit (Na-A Formation) outcrops up to the level of +12 m and also a fluviatile terrace deposit in the Naengcheon valley outcrops at a similar altitude. A lacustrine deposit overlying the Na-A formation infers a local palaeoenvironment as very warm and wet with vegetation covers on the surface. The age of this deposit is older than 52,000ys BP. based on 21 carbon 14 datations. This warm climate changed into a cold one towards the end of the Upper Pleistocene, forming ice-wedges and fragipan on the slope. The Gummandog soil in the Uljin area represents such a cold period, possibly corresponding to the so-called "Last Glacial" stage.

THE HOLOCENE SERIES

As stated before, the Holocene deposits are

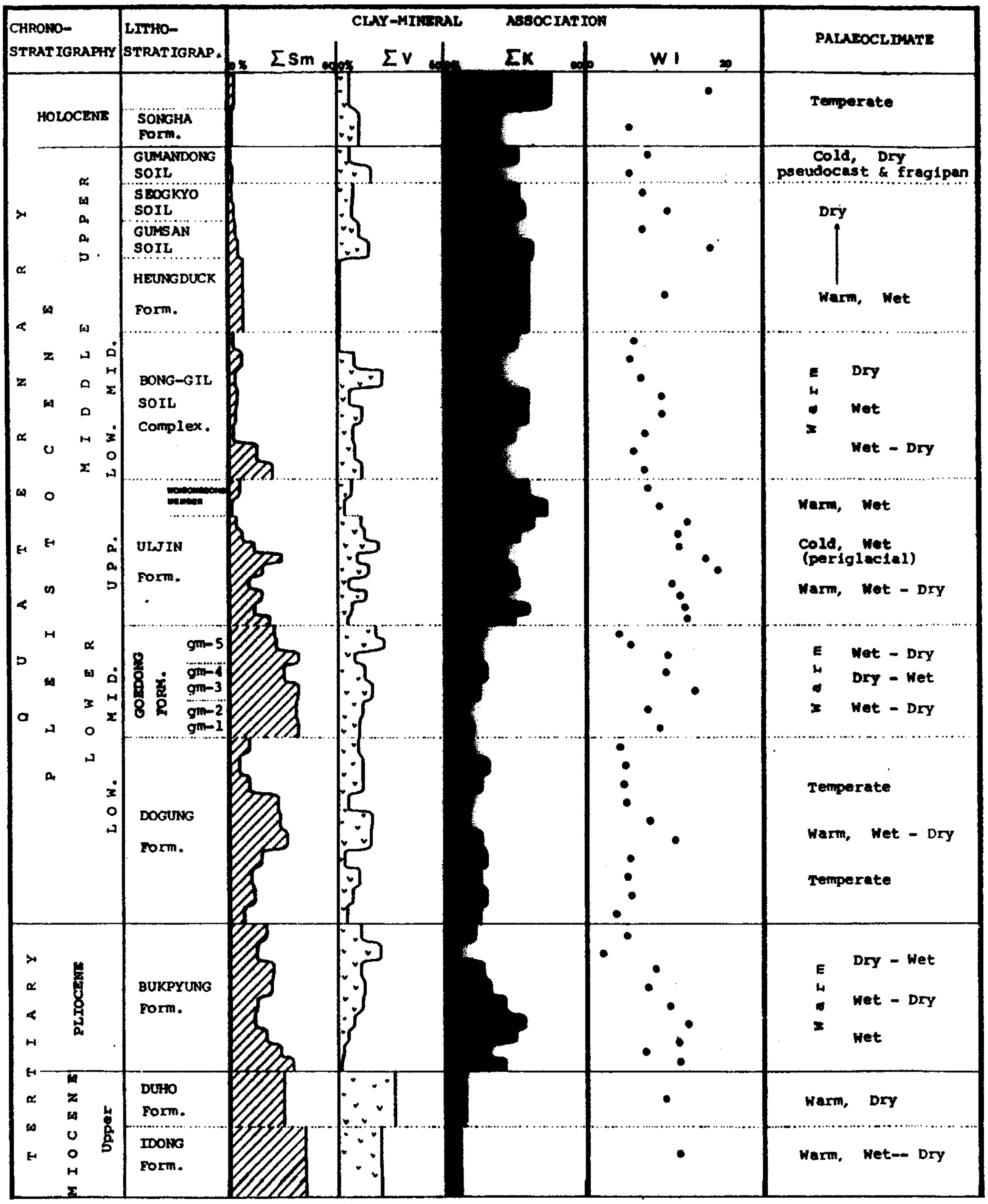

Fig. 10. Variation of the main clay components and of the weathering index in the Quaternary sediments and soils of the Korean Peninsula. Stratigraphy is based on the litho- and magnetostratigraphy, and their palaeoclimates are inferred on the basis of the clay-mineral association and the lithological characteristics.

widely present in the drowned valley. Their lithological sequences though they are not yet fully understood, consist mainly of gravelly deposits in the lower part and silty clay in the upper part. This feature corresponds with a general trend of Holocene sea-level rise. A relatively rapid sea-level rise up to about 5000 yr BP. corresponds with the coarse gravel dominent deposits in the lower part, and then a slow rise near to the present sea-level with minor fluc-

Table 2. Quaternary Stratigraphy of the Korean Peninsula

CHRONO-STRATIGRAPHY		PALEO-MAGNETISM	LITHOSTRATIGRAPHY: EASTERN PART, INLAND	EASTERN PART, COAST	WESTERN PART, INLAND	WESTERN PART, COAST	GEOMORPHOLOGY: MARINE	GEOMORPHOLOGY: FLUV	PEDOLOGY	CLIMATE	TECTONISM AND VOLCANIC SEDIMENTS
QUATERNARY	HOLOCENE	BRUNHES	KIMJAE FORMATION	SONGHA FORMATION	KIMJAE FORMATION; ANJUNG PEAT MEMBER	KIMJAE FORMATION; JINDO UPPER SHELL DEP., LOWER SHELL DEP.	SONGHA TERRACE (3-5m)	1st TERRACE (3-4m)		MODERATE VEGETATED	SEONGIN FORMATION (CALDERA DEPOSITS)
							VALLEY FILL				
	PLEISTOCENE, UPPER	Laschamp					VALLEY CUT		GUMANDONG SOIL; SEOGKYO SOIL; GUMSAN SOIL	COLD, HUMID; WARM, HUMID VEGETATED	
			DANGOK GRAVEL MEMBER	NA-A FORMATION FORMATION			NA-A TERRACE (10-15m)	2nd TERRACE (10-12m)			SINYANGRI FORMATION
	PLEISTOCENE, MIDDLE				HEUNGDUCK FORMATION		CUT AND FILL; VALLEY FILL	3rd TERRACE (25-30m)	BONGIL SOIL COMPLEX	WARM, HUMID; WARM, DRY LESS VEGETATED; MODERATE VEGETATED	VOLCANIC ERUPTIONS ALONG THE HANTAN RIVER (6 FLOWS) 0.54my-0.28my
							VALLEY CUT				
		0.73	JUNGDAN FORMATION; IWON FORMATION	WOLSEONG FORMATION			WOLSEONG TERRACE (35-42m)	4th TERRACE (40-45m)		WARM, DRY (LESS VEGETATED); COLD, HUMID; WARM, HUMID	GOSAN FORMATION
	PLEISTOCENE, LOWER	MATUYAMA; Jaramillo	ULJIN FORMATION; [illegible]								
							VALLEY FILL; VALLEY CUT	PHASE III			
		Olduvai	GOEDONG FORMATION				VALLEY FILL; VALLEY CUT	PHASE II		WARM, DRY-WET	CREATION OF THE ULREUNG ISLAND (1.82my)
		Réunion	DOGYUNG FORMATION				EUPCHEON TERRACE (50-60m)	PHASE I		TEMPERATE WET-DRY	
TERTIARY	PLIOCENE	GAUSS; 2.48; Kaena; Mammoth; 3.40	YONAM FORMATION							WARM, DRY LESS VEGETATED	SEOGUIPO FORMATION; HWASOON FORMATION
		GILBERT	BUKPYUNG FORMATION; IDC GRAVEL MEMBER				BONGHWAJAE TERRACE (75-90m)	5th TERRACE (80-90m)		WARM, HUMID VEGETATED	CREATION OF THE JEJU ISLAND

tuations, corresponds with a silty clay alluvial flood plain deposit.

Along the minor fluctuations of this post-Holocene sea-level, coastal deposits indicative of marine transgression are often encountered. The Songha Terrace underlain by beach gravels was formed at the level of about +4 m in the southeast coast. The Jindo shell beds show two marine transgressions at the level of +5 m and +3 m in the south coast. A peat layer of about +3 m thick is often found in the west coast overlying the former mudflats.

CONCLUSION

Quaternary deposits other than Holocene alluvium in the Korean Peninsula are far more developed than was mentioned in the previous literature. Several lithostratigraphic units (formations and members) are newly defined throughout the Quaternary, and five geomorphic surfaces are identified. Palaeoenvironments characterized by each stratigraphic level were often somewhat different from the present (Fig. 10). A warm and dry climate prevailed in the Lower Pleistocene, changing into warm, but wet or wet-dry climate in the Middle Pleistocene. Two cold episodes, one in the Middle Plesitocene, the other in the Upper Pleistocene are marked by cryoturbated horizons. The palaeomagnetic results in the deposist studied show several magnetozones (Matuyama, Brunhes) and magneto-subzones (Réunion, Olduvai, Jaramillo). All these results are compiled to establish a comprehensive stratigraphy of the Quaternary deposits in the Korean Peninsula (Table 2)

REFERENCES

GUILCHER, A.(1976a). Presence de plages eeminees normanniennes dans l'Ouest et le Sud de la République Corée, et conséquences géomorphologiques. C.R. Acad. Sci. Paris, 282, Ser. D. 149-151.

GUILCHER, A. (1976b). Les cotes à rias de Corée et leur évolution morphologique. Ann. De Géog.,472, 641-671.

JO, H. R. (1980). Holocene sea-level changes on the east coast of Korea Peninsula. Geogr. Rev. of Japan, 53-5, 317-328.

KIM. B.K. (1965). The stratigraphic and paleontologic studies on the Tertiary (Miocene) of the Pohang area, Korea, Seoul Nat. Univ. J., 15, 32-121.

KIM. B.K. (1969). A stratigraphic and paleontologic study of the Sinyangri formation in the vicinity of Sinyangri and Gosanri, the Jeju Island. J. Geol. Soc. Korea, 2, 103-121.

KIM. S.W. (1973). A study of the terraces along the southeastern coast (Bangeojin-Pohang) of the Korean Peninsula. J. Geol. Soc. Korea, 9, 89-121.

LIM. S.B. and CHOI, Y.J. (1982). Geology and lignite resources of Bukpyung area, Gangwondo, Korea, Ko. Inst. Ener. and Res. Bull., 35, 38p.

OH, G.H. (1977). The geomorphic history of the southeastern coast of the Korean Peninsula. Geogr. Rev. of Japan. 50-12, 689-699.

PARK, Y.A. (1969). Submergence of the Yellow Sea coast of Korea and stratigraphy of the Sinpyeongcheon marsh, Kimje, Korea. J. Geol. Soc. Korea, 5, 57-66.

TATEIWA, I. (1924), Ennichi kyuruho and Choyosheets. Geol. Atlas Chosen, N°2, Geol. Surv. Chosen.

UM, S.H., LEE, D.W. and PARK. B.S. (1964). Geological map of Korea, Pohang Sheet. Geol. Surv. Korea.

YOON, S. (1975). Geology and paleontology of the Tertiary Pohang Basin, Pohang District, Korea. J. Geol. Soc., Korea, 11, 187-214.

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