

코노돈트 — 하부고생대를 중심으로 —

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요약: 우리나라 캄브리아계 코노돈트 연구가 시작된 것은 이하영(1975)에 의해서였고, 생층서 분대가 이루어진 것은 이병수 · 이하영(1988)에 의해서였다. 그 뒤에 이루어진 수 많은 연구를 통해 화절층에 대해 5개(*Proconodontus*, *Eoconodontus notchpeakensis*, *Cambrooistodus minutus*, *Cordylodus poavus*, *Fryxellodontus inornatus*-*Monocostodus sivierensis*-*Semiacontiodus lavadamensis* Zones), 마차리층에 대해 2개 생층서대(*Gapparodus bisulcatus*-*Westergaardonia matsushitai*-*Westergaardonia moessebergensis* Zone and *Proconodontus muelleri*-*Cambrooistodus cambricus* Zone)가 설정되어 세계 여러 곳의 상용 화석군과 대비된 바 있다. 1990년대에는 적은 양이기는 하나 상기 지층 하위 세송점판암, 대기층(두위봉), 삼방산층(영월) 및 하부석회암층(문경)에서도 코노돈트 미화석이 산출되어, 산출 층서 범위가 크게 하향 확대되었다. 코노돈트 생물구 연구도 부분적으로 이루어져 보다 구체적인 고생물지리 정보를 축적하게 되었다. 오르도비스계 코노돈트 생층서대는 두무골세일 4개대(*Chosonodina herfurthi*-*Rossodus manitouensis*, *Glyptoconus quadraplicatus*, *Paracordylodus gracilis*, *Triangulodus dumugolensis*대), 막골석회암 5개대(*Serratognathus bilobatus*, Unnamed Zone, *Rhipidognathus laiwuensis*, *Aurilobodus leptosomatus*, *Tangshanodus tangshanensis*대), 직운산세일 1개대(*Eoplacognathus suecicus*-*E. jigunsanensis*대), 그리고 두위봉석회암 2개대(*Plectodina onychodonta*, *Aurilobodus serratus*대) 등 모두 12개대로 세분된다. 이들 생층서대는 북미, 유럽, 호주, 중국 등 주요 오르도비스계 생층서대와 잘 대비된다. 두무골세일, 막골석회암과 두위봉석회암의 코노돈트 화석군은 고저위도(low-paleolatitude), 온수성 생물구(warm water faunal realm)인 북미 생물구(Midcontinent North America)의 특징을 보이거나, 직운산세일은 이것과 냉수성 북대서양 생물구와의 혼합상을 보인다.

최초 연구

우리나라 하부 고생대층은 잘 알려진 바와 같이 강원도 남부 영월 · 정선 · 평창 · 태백 · 삼척, 충북 단양 및 경북 문경 등에 분포되어 있는데, 코노돈트 연구가 활발히 이루어진 두위봉과 영월 지역의 캄브리아계 층서만을 소개하면 Figure 1과 같다.

우리나라 하부 고생대층에 대한 코노돈트 생층서 연구는 지금으로부터 40 여 년 전, 독일 본(Bonn) 대학교 고생물학자인 Müller(1964)에 의해 처음으로 이루어졌다. 그는 강원도 삼척군 상장면 혈리(=현재 태백시 혈동) 부근 하부 오르도비스계 석회암 중에서 코노돈트 미화석 7속 8종을 발견 · 기재하여, 미국 미시시피강 상류에 분포하는 하부 오르도비스계 Praire du Chien층 화석군과 대비하였던 것이다.

그러나 Müller(1964)가 용해 처리한 석회암 표본은 일찍이 Shiraki(1940, in Kobayashi, 1966)에 의해 채집되었던 것으로, 그의 연구는 야외 현장에 대한 답사 없이 수행되었고, 석회암 층준 또한 애매하여 이로 부터 후일 우리나라 캄브리아-오르도비스계 경계에 대한 활발한 연구를 촉발시킨 단초가 되었다.

캄브리아계 생층서

내국인에 의한 코노돈트 연구는 Müller(1964)로부터 6년 뒤에 이루어진 이하영(1970)의 두무골세일에 대한 것이었다. 그러나 세계적 조류가 그러하듯 이후의 우리나라 코노돈트 연구는 오르도비스계에

집중되었고, 최초의 캄브리아계 코노돈트 연구는 이하영(1975b)에 의해 이루어졌다. 그는 두위봉 지역의 화절층과 영월의 마차리층으로부터 각각 5속 8종과 4속 6종을 기재하고 양 지층의 시대가 상부 캄브리아계임을 확인하였다.

우리나라 캄브리아계에 대한 본격적인 코노돈트 생층서 연구는 1980년대 후반에서야 이루어져, 상부 캄브리아계 화절층의 많은 단면에서 나온 다양한 코노돈트 종을 토대로 분대(分帶, zonation)가 성립되었다(Lee and Lee, 1988). 즉, 하부로부터 *Proconodontus*, *Eoconodontus notchpeakensis*, *Cambroistodus minutus*, *Cordylodus poavus*대 등 4개 생층서대가 설정되었으며, 필자의 후속 연구(Lee, B. S., 1989b, 1989c, 1990, 1992; 이병수·이종덕, 1993)에 의해 최상위 *Fryxellodontus inornatus*-*Monocostodus*

	W. USA	Iran	North China	Korea		Australia	
				Machari Fm., Yeongweol	Hwajeol Fm., Duwibong		
Early Ordovician	<i>Loxodus bransoni</i>	6	<i>C. angulatus</i> - <i>Chosonodina herfurthi</i>		<i>C. herfurthi</i> - <i>Rossodus manitouensis</i>	<i>C. herfurthi</i> - <i>C. angulatus</i>	
	<i>Cordylodus angulatus</i>						
	<i>C. lindstroemi</i>						<i>C. lindstroemi</i>
<i>Cordylodus intermedius</i>	<i>Clavohamulus hintzei</i>	<i>Hirsutodontus simplex</i>	<i>Cordylodus intermedius</i>	No Zonation Established	<i>C. prolindstroemi</i>		
						<i>Cordylodus proavus</i>	<i>C. proavus</i>
<i>Fryxellodontus inornatus</i>	Middle Part						
		<i>Hirsutodontus hirsutus</i>	Lower Part				
Late Cambrian	<i>Cambroistodus minutus</i>	4	<i>Cambroistodus</i>		<i>Cambroistodus minutus</i>	<i>Hispidodontus discretus</i>	
							<i>Eoconodontus notchpeakensis</i>
	<i>Proconodontus muelleri</i>	<i>Proconodontus</i>	<i>P. muelleri</i>	<i>Hispidodontus resimus</i>			
					<i>Proconodontus posterocostatus</i>	2	<i>P. posterocostatus</i>
	<i>Proconodontus tenuiserratus</i>	1	<i>P. tenuiserratus</i>	<i>P. tenuiserratus</i>			
					No Zonation Established	1	<i>W. aff. fossa</i> - <i>P. rotundatus</i>
	No Zonation Established	1	<i>M.? erectus</i>	No Zonation Established			
					No Zonation Established	1	<i>W. matsushitai</i>
	No Zonation Established	1	<i>W. oryigma</i>	<i>G. bisulcatus</i> - <i>W. matsushitai</i> - <i>W. moessebergensis</i>			

Fig. 1. Correlation of the Upper Cambrian conodont biozones in Korea with those of western United States (Miller, 1988), Iran (Müller, 1973), North China (An et al., 1983; Chen and Gong, 1986) and Australia (Nicoll and Shergold, 1991).

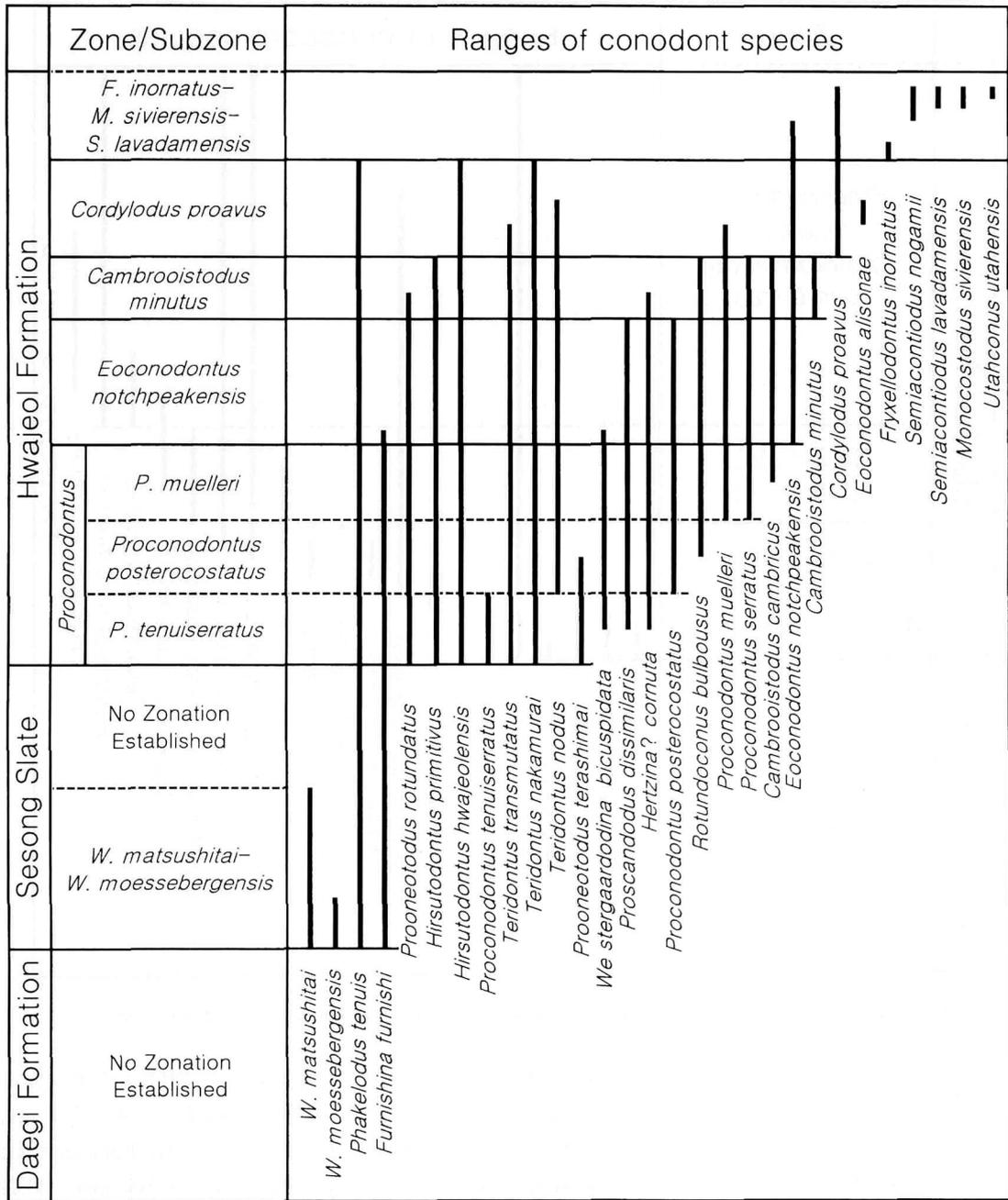


Fig. 2. Generalized ranges of selected conodont species of the Sesong Slate and Hwajeol Formation, Duwibong area.

sivierensis-*Semiacontiodus lavadamensis*대가 추가되어 화절층의 코노돈트 생층서대는 모두 5개 대로 구성되었음이 알려지게 되었다(Fig. 2).

1980년대 후반 체계적 연구 이후, 캄브리아계 코노돈트 연구는 당시 세계적 관심사로 등장했던 “캄브리아-오르도비스계 경계 재정의”에 초점이 맞추어져 진행되었다. 백운산항사 남북익(南北翼)의 화절층(Lee, B. S., 1989b, 1989c, 1990, 1992; 이병수 · 이종덕, 1993), 영춘-단양의 화절층-두무골세일(이병

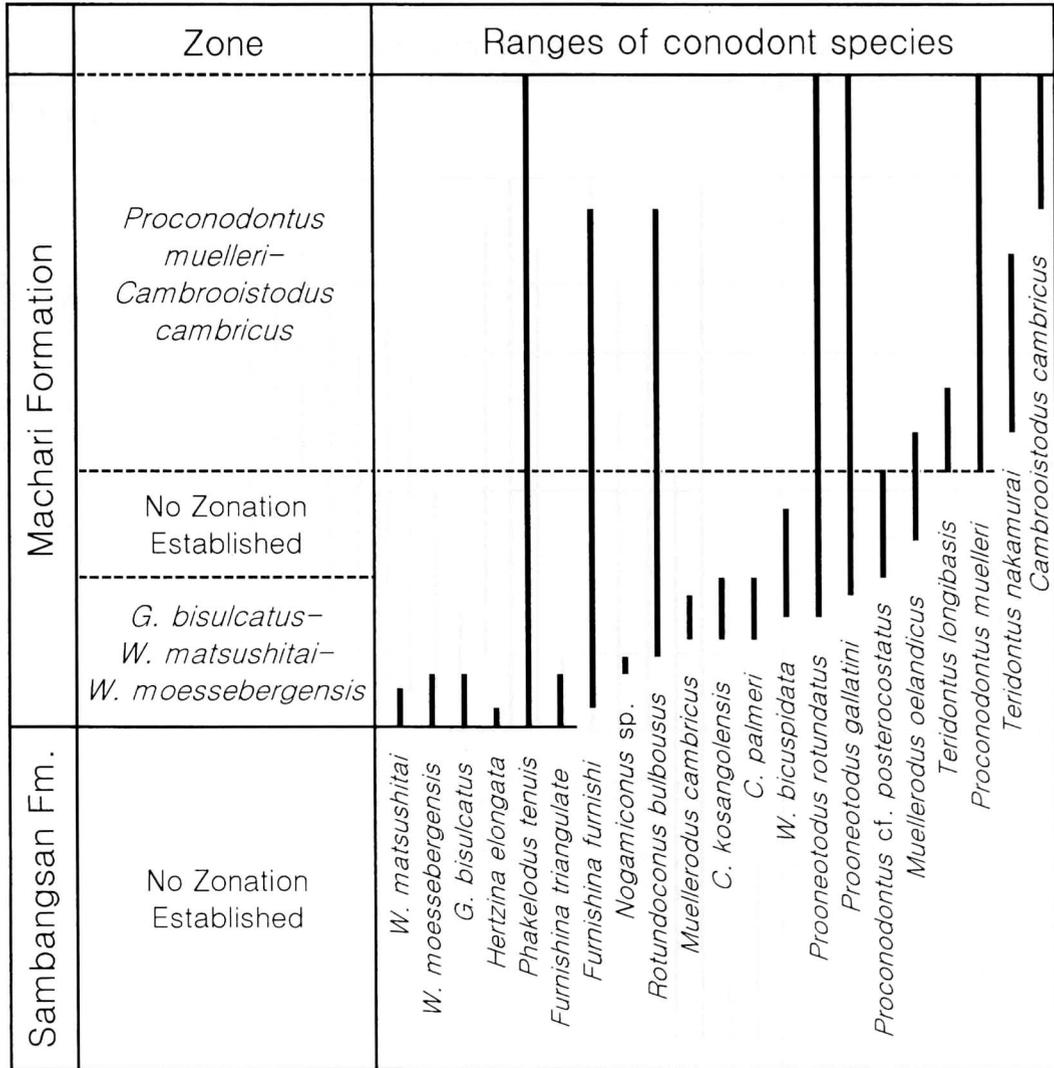


Fig. 3. Generalized ranges of selected conodont species of the Machari Formation, Yeongweol area.

수 · 이종덕 · 전희영, 1994; Lee, B. S., et al., 1996) 등이 그것이다. 위에 열거한 우리나라 상부 캄브리아계 및 캄브리아-오르도비스계 경계부 관련 코노돈트 연구는 그간 이병수에 의해 외국에 여러 차례 소개되었거나 소개될 예정이다. [Lee, B. S., 2001a(Jour. Geol. Soc. India), 2001b (Amehginiana=Jour. Paleontol. Soc. Argentina), 2002a(Tikhookeanskaya Geologiya, Russian Academy of Sciences), 2002b (Acta Geologica Sinica, English edition), 2004(Alcheringa=Jour. Australasian Paleontologists), 2004 (Jour. Paleontol.)].

두위봉 지역 캄브리아계 코노돈트 연구 과정 중, 세송점관암(Lee, B. S., 1990)에서 6속 9종의 하부 상부 캄브리아계(lower Upper Cambrian) 코노돈트가 최초로 발견됨으로써 코노돈트 산출 범위가 하위로 확대되었고(Fig. 3), 두위봉과 영월의 동계(同系) 대비를 위한 마차리층 연구(Lee, B. S., et al., 1991)를 통해 생층서 대비와 함께 위 세송점관암과 대비 가능한 다양한 하부 상부 캄브리아계 코노돈트를 발견하는 수확을 거두었다(Fig. 4).

캄브리아계 코노돈트는 소형 각질 미화석과 함께 산출되는 특성에 따라 여러 지역의 소형 각질 미화석

류와 함께 보고되기도 하였는데, 이러한 연구로는 영월의 삼방산층(이하영 · 유강민 · 이종덕, 1985; Lee, B. S., et al., 1991), 두위봉의 묘봉 및 대기층(Lee, H. Y., et al., 1992), 문경(하부 캄브리아계)-영월(삼방산층)-두위봉(묘봉 및 대기층)(Lee, H. Y., et al., 1992) 등이 있다. 하부 및 중부 캄브리아계 코노돈트 산출이 아직은 저조한 편이지만, *paraconodonts*(예, *Protohertzina* spp., *Phakelodus* spp., *Gapparodus* spp.)와 *paraconodonts*(예, *Furnishina* spp., *Westergaardodina* spp. etc.)가 산출될 여지는 많으므로 향후 이들의 산출 · 기재를 기대하며, 그간 보고된 소량의 중부 캄브리아계 코노돈트에 대해서는 여기에서 그 평가를 뒤로 미루고자 한다.

캄브리아계 생층서대

우리나라 캄브리아계 코노돈트 생층서대는 Figure 2에 요약되어 있는 바와 같이, 영월의 중-상부 캄브리아계 마차리층에 2개, 두위봉 지역 상부 캄브리아계 화절층에 5개 생층서대가 설정되어 있으며, 이들은 중국, 이란, 오스트레일리아, 아르헨티나, 유럽 및 북미 상층생층서대와 잘 대비된다. 두위봉 및 영월지역의 캄브리아계 코노돈트 생층서대는 아래와 같다.

- 두위봉 코노돈트 생층서대

<화절층>

Fryxellodontus inornatus-*Monocostodus sivierensis*-*Semiacontiodus lavadamensis*대
*Cordylodus poavus*대
*Cambrooistodus minutus*대
*Eoconodontus notchpeakensis*대
*Proconodontus*대

<세송점관암>

Westergaardodina matsushitai-*W. moessebergensis*대

- 영월 코노돈트 생층서대

<마차리층>

Proconodontus muelleri-*Cambrooistodus cambricus*대
Gapparodus bisulcatus-*Westergaardodina matsushitai*-*W. moessebergensis*대

캄브리아계 생물구

캄브리아계 코노돈트에 대한 생물구 및 생물지리 연구로는 이병수(1989a), 정현 · 이용일(2000) 등이 있다. 특히, 전자는 화절층 코노돈트 화석군이 온수성 생물구(warm-water faunal realm)에 속할 것으로 해석하였다. 코노돈트의 화학 조성 및 내부 구조에 대한 고생물학적(conodont paleobiologic) 예비 연구는 이종덕 · 이병수(1988)에 의해 수행되었다.

오르도비스계 연구

우리나라 남한에 분포하는 오르도비스계 코노돈트 연구는 Müller(1964)의해 최초로 시작된 이래, 지난 35년여에 걸쳐 두위봉, 영월, 정선, 문경 등 조선누층군 분포지에 대하여 이하영(1970), 이하영·이종덕(1971), 이하영(1975), 이하영(1977), 원문주·이하영(1977), 이하영(1980), 김인석(1983), 백철규(1984), 신재훈(1984), Lee and Lee(1986), 홍민화(1986), 김상희(1987), 이경진(1988), 이성주(1989), Lee and Lee(1990), Seo *et al.*(1994), Lee *et al.*(1991), 이병수 외(1994), 이병수 외(1997), 서광수(2000), Lee *et al.*(2001), Seo *et al.*(2002) 등 많은 연구가 이루어져 왔다.

오르도비스계 생층서대

Seo *et al.*(1994)는 백운산항사대 남익부와 일부 북익부의 두무골세일(하부 오오도비스계)의 146표본에서 7,819개체의 코노돈트 미화석을 선별하였다. 이들 코노돈트는 복합요소분류에 의해 12속 18종으로 분류하였으며, 복합요소 분류 방법에 의해 분류 할 수 없는 개체는 개체요소분류 방법에 의해 15속 39종으로 분류하였다. 그들은 선별한 코노돈트를 기초로 하여 두무골세일을 하부로부터, *Chosonodina herfurthi*-*Rossodus manitouensis*대, *Glyptoconus quadraplicatus*대, *Paracordylodus gracilis*대, *Triangulodus dumugolensis*대로 4개의 생층서대를 설정되었다. 이경우·이하영(1990), 김상희(1987)은 막골석회암을 코노돈트에 의해서 5개의 화석대로 분대하였다. 이는 하부로부터 *Serratognathus bilobatus*대, Unnamed Zone, *Riphidognathus laiwuensis*대, *Aurilobodus leptosomatus*대, *Tangshanodus tangshanensis*대이다. 이 화석대의 지질시대는 북미의 Whiterockian에, 그리고 유럽의 초기 오르도비스기 Arenigian에서 중기 오르도비스기 Llanvironian에 각각 대비된다.

<두위봉석회암>

*Aurilobodus serratus*대

*Plectodina onychodonta*대

<직운산세일>

Eoplacognathus suecicus-*E. jigunsanensis*대

<막골석회암>

*Tangshanodus tangshanensis*대

*Aurilobodus leptosomatus*대

*Riphidognathus laiwuensis*대

Unnamed Zone

*Serratognathus bilobatus*대

<두무골세일>

*Triangulodus dumugolensis*대

*Paracordylodus gracilis*대

*Scolopodus quadraplicatus*대

Chosonodina herfurthi-*Rossodus manitouensis*대

BRITISH SERIES		NORTH ATLANTIC	NORTH AMERICA	NORTH CHINA	KOREA									
		CONODONT ZONE												
Llandellian		Bergstorm. 1971, 1977	Cincinnatian Series	Sweet et al. 1971 Ethington & Clark. 1971	An and Zheng. 1990	Baegunsan Syncline Zone (Kim S.H. 1987, Lee and Lee. 1986, Lee, K.W. 1986, Seo et al, 1994)	Formations	Danyang Area (Seo, 1997)						
									<table border="1" style="width:100%; height:100%; border-collapse: collapse;"> <tr> <td style="width:10%;"></td> </tr> </table>					
Llanvirnian		<i>Pygodus serra</i> <i>E. lindstromi</i> <i>E. robustus</i> <i>E. reclinatus</i> <i>E. f. ollaceus</i>	Chazyan	6			<i>Aurilobodus - serratus</i> <i>P. onychodonta</i>	Duwibong <i>Aurilobodus serratus</i> <hr style="border-top: 1px dashed black;"/> <i>P. onychodonta</i>						
									5	<i>Aurilobodus serratus-Plectodina onychodonta</i> <i>E. suecicus - Acontiodus (?) linsiensis</i>	<i>E. suecicus - E. jigunsanensis</i>	Jigunsan <i>E. suecicus - E. jigunsanensis</i>		
													4	<i>Plectodina fragilis</i>
									Arenigian	<i>Microzorkodina Parva</i> <i>Paroistodus originalis</i> <i>Baltoniodus navis</i> <i>Baltoniodus triangularis</i> <i>Oepikodus evae</i> <i>Prioniodus elegans</i> <i>Paroistodus proteus</i>	Whiterockian	3		
2	<i>Paraserratognathus patodiformis-Serratognathus diversus</i>	Lower Zone unnamed zone <hr style="border-top: 1px dashed black;"/> <i>S. bilobatus</i>	<i>R. laivuensis</i>											
				1	<i>Serratognathus bilobatus</i>	<hr style="border-top: 1px dashed black;"/> <i>S. bilobatus - S. diversus</i>								
Tremadocian		<i>Paltodus deltifer</i> ? <i>cordylodus anglatus</i>	Whiterockian				Oepikodus communis D Scolopodus quadraplicatus-S. opimus C <i>Cordylodus rotundatus</i>	<i>Scalpellodus tersus</i> <i>Chosonodina herfurthi - R. manitouensis</i>	Dumugol <i>Triangulodus dumugolensis</i> <hr style="border-top: 1px dashed black;"/> <i>Paracordylodus gracilis</i> <hr style="border-top: 1px dashed black;"/> <i>Glyptoconus quadraplicatus</i> <hr style="border-top: 1px dashed black;"/> <i>Chosonodina herfurthi - R. manitouensis</i>					

Fig. 4. International correlation of conodont zones from upper Tremadocian to Llandellian in North Atlantic, North America, North China and Korea.

이용남·이하영(1986), 이경우·이하영(1990), 서광수(2000)는 직운산세일과 두위봉석회암에서 40속 61종의 코노돈트를 발견하였으며, 이를 근거로 하부로부터 *Eoplacognathus suecicus*-*E. jigunsanensis*대, *Plectodina onychodonta*대, *Aurilobodus serratus*대 등 3개의 코노돈트대를 분대하였다. 이 화석대의 지질 시대는 북미지역의 Chazyan에, 유럽의 중기 오르도비스기 Llanvirnian에서 Llandellian에 각각 대비된다(Fig. 4).

오르도비스계 생물구

Seo *et al.*(1994)는 두무골세일의 코노돈트 화석군의 특징으로 보아 동 지층을 고저위도(low-paleolatitude), 온수성 생물구(warm water faunal realm)인 북미 생물구(Midcontinent North America)와 유사하다고 해석하였다. 이경우·이하영(1990)는 막골석회암과 두위봉석회암의 코노돈트 화석군은 북미 중부 대륙 생물구와의 근친성이 있고, 직운산세일은 북미 중부 대륙 생물구와 북대서양 생물구의 혼합상을 보인다고 하였다. 또한 그들은 Barnes 외(1973)가 설정한 코노돈트 화석군의 해수 정도분포 모델을 적용하여 직운산세일의 퇴적환경은 deep shelf 지역이었고, 두위봉석회암은 외해 천 해상(offshore shallow shelf) 지역이었을 것으로 해석한 바 있다.

Lower Paleozoic conodonts of Korea

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Abstract: Cambrian conodont study in Korea has been initiated by Lee, H. Y.(1975), and the conodont zonation has been accomplished by Lee, B. S. & Lee, H. Y.(1988). Subsequent studies made it possible to erect five conodont zones to the Hwajeol Formation in Duwibong (*Proconodontus*, *Eoconodontus notchpeakensis*, *Cambroistodus minutus*, *Cordylodus poavus*, *Fryxellodontus inornatus*-*Monocostodus siverensis*-*Semiacontiodus lavadamsensis* Zones), two zones to the Machari Formation in Yeongweol (*Gapparodus bisulcatus*-*Westergaardodina matsushitai*-*Westergaardodina moessebergensis* Zone and *Proconodontus muelleri*-*Cambroistodus cambricus* Zone), and they were correlated with the equivalent zones in various parts of the world. In 1990s, the conodonts were also recovered from the lower units of Daegi and Sesong formations in Duwibong, Sambangsan Formation in Yeongweol, and lower limestone formation in western Mungyeong, although their abundances of conodonts were low. Provincialism study was also carried out partially for Upper Cambrian conodonts of Korea, so many new paleogeographic informations were hitherto accumulated. Ordovician conodont biostratigraphic zones hitherto established are as follows: *Chosonodina herfurthi*-*Rosodus manitouensis*, *Scolopodus quadraplicatus*, *Paracordylodus gracilis*, *Triangulodus dumugolensis* Zones of Dumugol Shale, *Serratognathus bilobatus*, Unnamed Zone, *Riphidognathus laiwensis*, *Aurilobodus leptosomatus*, *Tangshanodus tangshanensis* Zones of Maggol Limestone, *Eoplacognathus suecicus*-*E. jigunsanensis* Zone of Jigunsan Shale, and *Plectodina onychodonta* and *Aurilobodus serratus* Zones of Duwubong Limestone. These are well correlated to those of equivalent zones of North America, Europe, Australia, China and so on. Ordovician conodonts show characteristic bioprovincial similarity of North American mid-continent type, that is, low-latitude, warm-water faunal realm, except the Jigunsan Shale, having both North American and North Atlantic affinities.

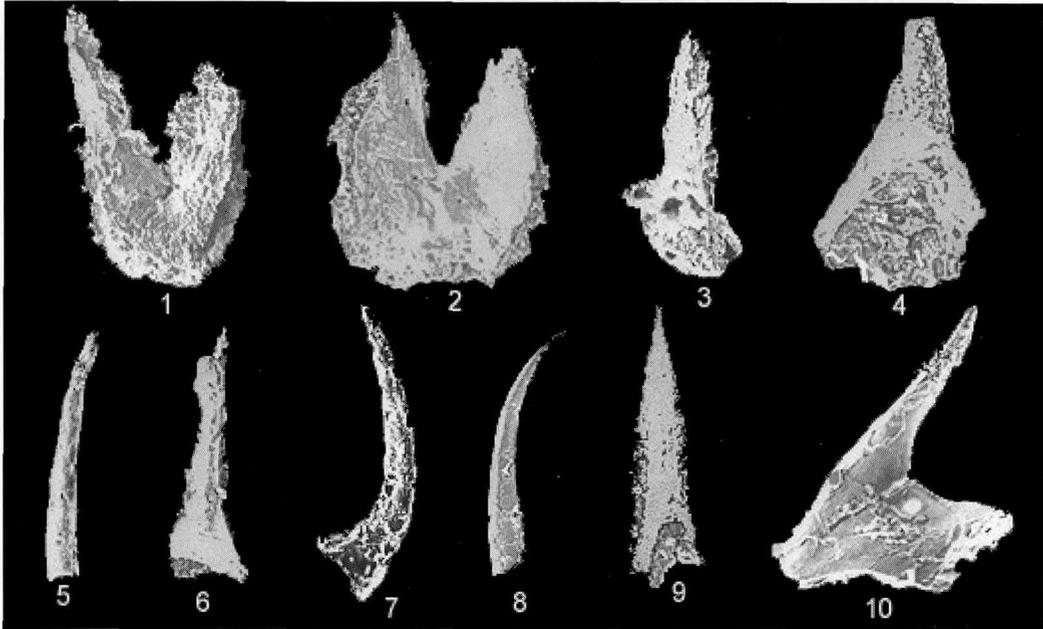
참고문헌

김상희. 1987: 강원도 영월 - 태백간의 백운산 향사 남부에 분포하는 막골석회암의 층서와 고생물학적 연구. 연세대학교 지질학과, 석사학위논문, 103p.

- 서광수. 2000: 강원도 정선군 신동읍 일대에 분포하는 하부 고생대층의 코노돈트와 그의 생층서. 지질학회지, 제36권 제4호, p. 499-516.
- 이경진. 1988: 경상북도 문경탄전 일대에 분포하는 조선누층군의 층서와 미고생물학적 연구. 연세대학교 지질학과, 석사학위논문, 95p.
- 이병수. 1989a: 강원도 삼척탄전지역, 화절층에서 산출된 상부 캄브리아기 코노돈트 화석군의 생물구 특성. 한국고생물학회지, 제5권 제1호, p. 53-61.
- 이병수, 이종덕. 1993: 백운산향사지역, 캄브리아-오르도비스계 경계 설정을 위한 코노돈트 생층서 재연구. 한국고생물학회지, 제9권 제2호, p. 155-165.
- 이병수, 이종덕, 전희영. 1994: 옥동-영춘지역, 캄브리아-오르도비스계 경계부의 층서와 코노돈트 생층서. 한국고생물학회지, 제10권 제1호, p. 83-98.
- 이종덕, 이병수. 1988: 코노돈트 화학 조성과 내부 구조에 대한 예비 연구. 교육논총, 전북대학교 교육대학원, 제8집, p. 161-170.
- 이성주. 1989: 강원도 영월지역에 분포하는 영흥층(하부 고생대층)에서 산출된 코노돈트 화석군의 생층서 및 고생대학적 연구. 연세대학교 지질학과, 석사학위논문, 107p.
- 이하영, 유강민, 이종덕. 1986: 강원도 영월-평창간에 분포하는 삼방산층과 이에 인접한 퇴적층의 퇴적, 층서 및 고생물학적 연구. 지질학회지, 제22권 제1호, p. 69-86.
- 홍민화. 1986: 강원도 영월, 상동-대백, 소도리 간에 분포하는 조선누층군 상부(직운산층, 두위봉층)의 층서와 고생물학적 연구. 연세대학교 대학원 지질학과, 석사학위논문 83p.
- Baik, C. K. 1984: Paleontology and stratigraphy of the lower Paleozoic Sequence in the Changri and Gongpyeongri areas, Mungyeong-Gun, Gyeongsangbug-Do, Korea. Journal of the Geological Society of Korea, vol. 10, p. 129-148.
- Jeong, H. and Lee, Y. I. 2000: Late Cambrian biogeography: conodont bioprovinces from Korea. Paleogeography, Paleoclimatology and Paleoecology, vol. 162, p. 119-136.
- Kim, I. S. 1983: A study on stratigraphy and paleontology of the Lower Paleozoic sequence in the Kogilri-Daehwari areas, Pyeongchang-Gun, Gangweon-Do. Unpubl. Ms. Thesis, Yonsei Univ., 62p.
- Kobayashi, T. 1966: Stratigraphy of the Chosen Group in Korea and south Manchuria and its relation to the Cambro-Ordovician formations and other areas, Section A, The Chosen Group of South Korea. Journal of the Faculty of Science, University of Tokyo, Section 2, vol. 16, p. 1-84.
- Lee, B. S. and Lee, H. Y. 1988: Upper Cambrian conodonts from the Hwajeol Formation in the southern limb of the Baegunsan syncline, eastern Yeongweol and Samcheog areas, Kangweon-do, Korea. Journal of the Geological Society of Korea, vol 24, no. 4, p. 356-375.
- Lee, B. S. 1989b: Conodonts from the Hwajeol Formation (Upper Cambrian-lowest Ordovician) in northern district of Taebaeg City, Kangweon-do, Korea. Journal of the Geological Society of Korea, vol. 25, no. 3, p. 322-336.
- Lee, B. S. 1989c: Upper Cambrian and lowest Ordovician conodont fauna of the Hwajeol Formation, Cheungsan area, Kangweon-do, Korea. Journal of the Paleontological Society of Korea, vol. 5, no. 2, p. 124-136.
- Lee, B. S. 1990: Conodont fauna of the Hwajeol Formation (Upper Cambrian-lowest Ordovician) in the Sabuk area, Kangweon-do and its implication on stratigraphy. Journal of the Geological Society of Korea, vol. 26, no. 3, p. 293-303.
- Lee, B. S., Choi, D. K. and Lee, H. Y. 1991: Conodonts from the Machari Formation (Middle?-Upper Cambrian) in the Yeongweol area, Kangweon-do, Korea. Journal of the Geological Society of Korea, vol. 27, no. 4, p. 394-408.
- Lee B. S., Seo K. S. and Lee H. Y. 1991: Conodonts from the lower Dumugol Shale(Lower Ordovician) of the Cheungsan - Sabuk area, Kangweon-do, Korea. Journal of Paleontological Society of Korea, vol. 7, p. 63-75.
- Lee, B. S., Lee, H. Y., Cheong, J. G. and Lee, S. J. 1991: Microfossils from the Sambangsang Formation in the Yeongweol area, Kangweondo and its stratigraphic implication. Journal of the Paleontological Society of Korea, vol. 7, no. 2, p. 116-137.
- Lee, B. S. 1992: Additional conodonts from the Cambrian-Ordovician boundary beds in the Paekunsan syncline. Journal of the Geological Society of Korea, vol. 28, no. 6, p. 590-603.
- Lee, B. S., Lee, J. D. and Ko, E. J. 1996: Lithostratigraphy and conodont biostratigraphy of the Choseon Supergroup (Cambro-Ordovician) in the Danyang area. Journal of the Paleontological Society of Korea, vol. 12, no. 1, p. 85-104.
- Lee, B. S. 2001a: Conodonts from the Cambrian succession of South Korea. Journal of the Geological Society of India, vol. 58, no. 10, p. 319-328.

- Lee, B. S. 2001b: Conodont biostratigraphy of the Hwajeol Formation (Upper Cambrian) in northern Taebaeg City, Korea. *Ameghiniana* (Journal of the Paleontological Society of Argentina), vol. 38, no. 4, p. 441-453.
- Lee, B. S. 2002a: Revision on conodont zones of the Hwajeol Formation (Upper Cambrian), Kangweon-do, South Korea. *Tikhookeanskaya Geologiya* (=Geology of the Pacific Ocean), Russian Academy of Sciences, vol. 21, no. 2, p. 18-30.
- Lee, B. S. 2002b: Conodonts from the Upper Cambrian Sesong and Hwajeol Formations in the Sabuk area, Korea. *Acta Geologica Sinica* (English edition), vol. 76, no. 2, p. 155-165.
- Lee, B. S. and Seo, K. S. 2002c: Conodont biostratigraphy of the Mungog Formation (Lower Ordovician), Yeongweol, Korea. *Geology of the Pacific Ocean*, Russian Academy of Sciences, vol. 21, no. 3, p. 66-79.
- Lee, B. S. 2004: Conodont fauna of the Upper Cambrian in Cheungsan area, Kangwon Province, Korea. *Alcheringa* (Journal of the Australasian Paleontologists), vol. 28, p. 53-64.
- Lee, B. S., Lee, Y. I. and Miller, J. F. 2004: Paraconodonts from the Machari Formation, Yeongweol, South Korea. *Journal of Paleontology of America*, in press.
- Lee, H. Y. 1970: Conodonten aus der Choson-Gruppe (Unteres Ordovizium) von Korea. *Neues Jahrbuch für Geologie und Paläontologie Abhandlung*, vol 136, no. 3, p. 303-344.
- Lee, H. Y. and Lee, J. D. 1971: Conodont fauna from the Great Limestone series in Dongjeom District, Samcheog-Gun, Kangweon-Do and its stratigraphical significance. *Journal of the Geological Society of Korea*, vol. 7, no. 2, p. 89-101.
- Lee, H. Y. 1975a: Conodonts from the Dumugol Formation (Lower Ordovician) South Korea. *Journal of the Geological Society of Korea*, vol. 11, no. 1, p. 75-93.
- Lee, H. Y. 1975b: Conodonts from the Upper Cambrian formations, Kangweon-Do, South Korea. *Journal of the Geological Society of Korea*, vol. 11, no. 3, p. 172-185.
- Lee, H. Y. 1977: Conodonten aus den Jigunsan und den Duwibong Schichten, (mittel Ordovizium) von Kangweon-do, süd Korea. *Journal of the Geological Society of Korea*, vol. 12, p. 151-182.
- Lee, H. Y. 1980: Lower Paleozoic conodonts of South Korea. *Geology and Paleontology of Southeast Asia*, vol. 21, p. 1-9.
- Lee, H. Y., Roh, D. S., Lee, B. S. and Yi, M. S. 1992: Small shelly fossils and conodonts from the Myobong and Daegi Formations in Baegunsan syncline, Yeongweol-Jeongseon areas, Kangweon-do. *Journal of the Paleontological Society of Korea*, vol. 8, no. 2, p. 140-163.
- Lee, H. Y., Lee, B. S. and Yi, M. S. 1992: Cambrian small shelly and sclerite fossils from South Korea and their biostratigraphic and bioprovincial implications. In: *Proceeding of the International Symposium on Biostratigraphy, Bioprovincialism, and Bioevents in the Far East*, Choi, D. K., Lee, J. D. and Yun, H. (eds.), *Paleontological Society of Korea Special Publication No. 1*, p. 35-53.
- Lee, K. W. and Lee, H. Y. 1990: Conodont Biostratigraphy of the upper Choseon Supergroup in Jangseong-Donjeom Area, Gangweon-Do. *Journal of Paleontology Society of Korea*, vol. 6, no. 2, p. 188-210.
- Lee, Y. N and Lee, H. Y. 1986: Conodont biostratigraphy of the Jigunsan Shale and Duwibong Limestone in the Nokjeon - Sangdong area, Yeongweol-Gun, Kangweon-Do, Korea. *Journal of the Paleontology society of Korea*, vol. 2, p. 114-136
- Müller, K. J. 1964: Conodonten aus dem unteren Ordovizium von Südkorea. *Neues Jahrbuch für Geologie und Paläontologie Abhandlung*, vol. 119, no. 1, p. 93-102.
- Seo, K. S., Lee, H. Y. and Ethington, R. 1994: Early Ordovician conodonts from the Dumugol Formation in the Baegunsan syncline, eastern Yeongweol and Samcheog areas, Kangweon-do, Korea. *Journal of the Paleontological Society of America*, vol. 68, no. 3, p. 599-616.
- Seo, K. S., Lee, D. W., Lyu, I. C. and Lee, B. S. 2002: Conodonts from the Dumugol Formation (Lower Ordovician), Danyang area, Korea. *Geology of the Pacific Ocean*, Russian Academy of Sciences, vol. 21, no. 4, p. 26-36.
- Shin, J. H. 1984: Paleontology and stratigraphy of the lower Paleozoic sequence in the Hogyeri and Ugori areas, Mungyeong-Gun, Gyeongsangbuk-Do. Unpubl. Ms. Thesis, Yonsei University, p. 1-95.
- Won, M. Z. and Lee, H. Y. 1977: Age and biostratigraphy of the Mungog (Samtaesan) Formation by means of the conodont fauna. *Journal of the Geological Society of Korea*, vol. 13, no. 2, p. 97-107.

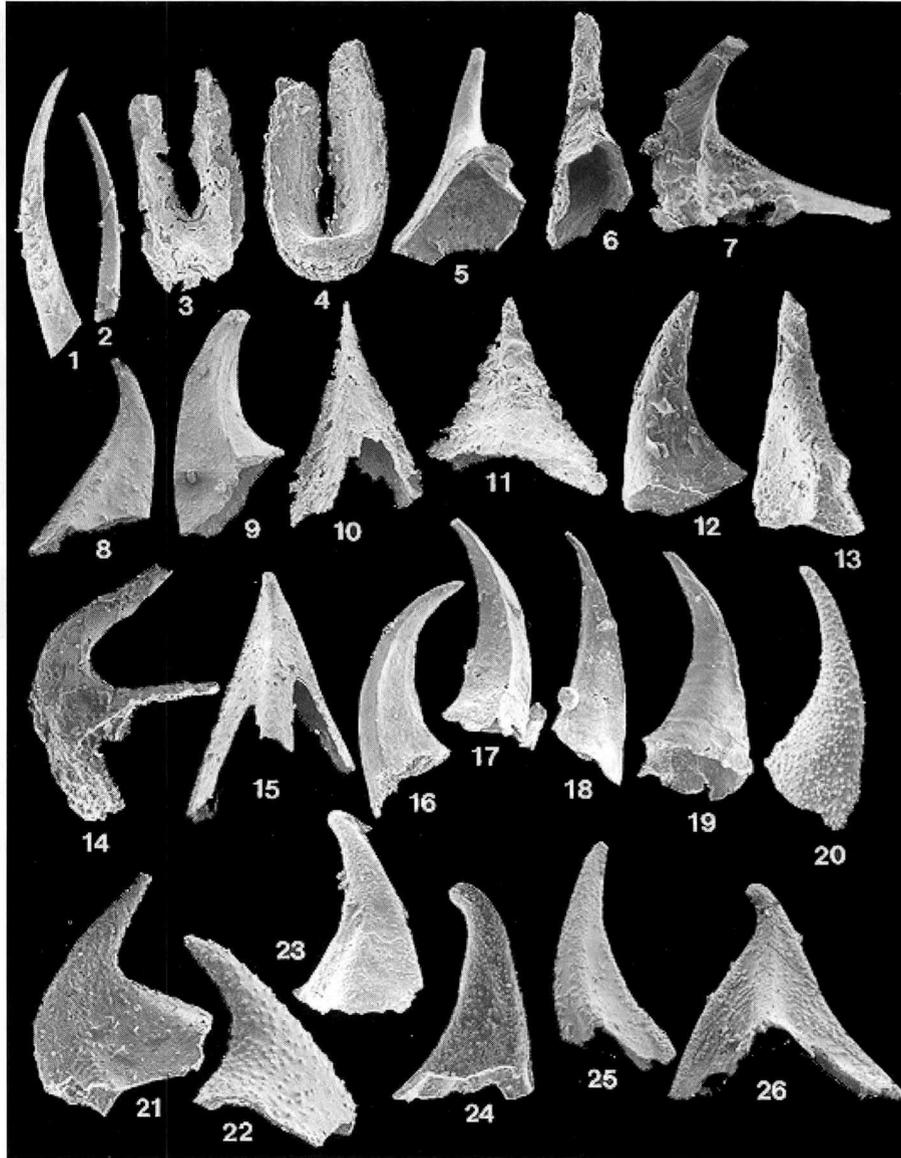
[Plate 1]



Conodonts from the Sesong Slate in Sabuk area. All magnifications ca. $\times 80$.

1. *Westergaardodina matsushitai* Nogami. Posterior view, YSUG 0832 (48). 2. *Westergaardodina moessebergensis* Müller. Posterior view, YSUG 0833 (48). 3. *Furnishina pernica?* An. Posterior view, YSUG 0797 (48). 4. *Furnishina kranzae* Müller and Hinz. Lateral view, YSUG 0796 (48). 5. *Hertzina elongata* Müller. Lateral view, YSUG 0801 (48). 6. *Lawugnathus doidyxus?* An. Posterior view, YSUG 0808 (48). 7. *Proscandodus obliquus* An. Lateral view, YSUG 0821 (48). 8. *Phakelodus tenuis* (Müller). Lateral view, YSUG 0809 (48). 9. *Furnishina triangulata* Xiang and Zhang. Posterior view, YSUG 0799 (48). 10. *Furnishina furnishi* Müller. Lateral view, and YSUG 0795 (48).

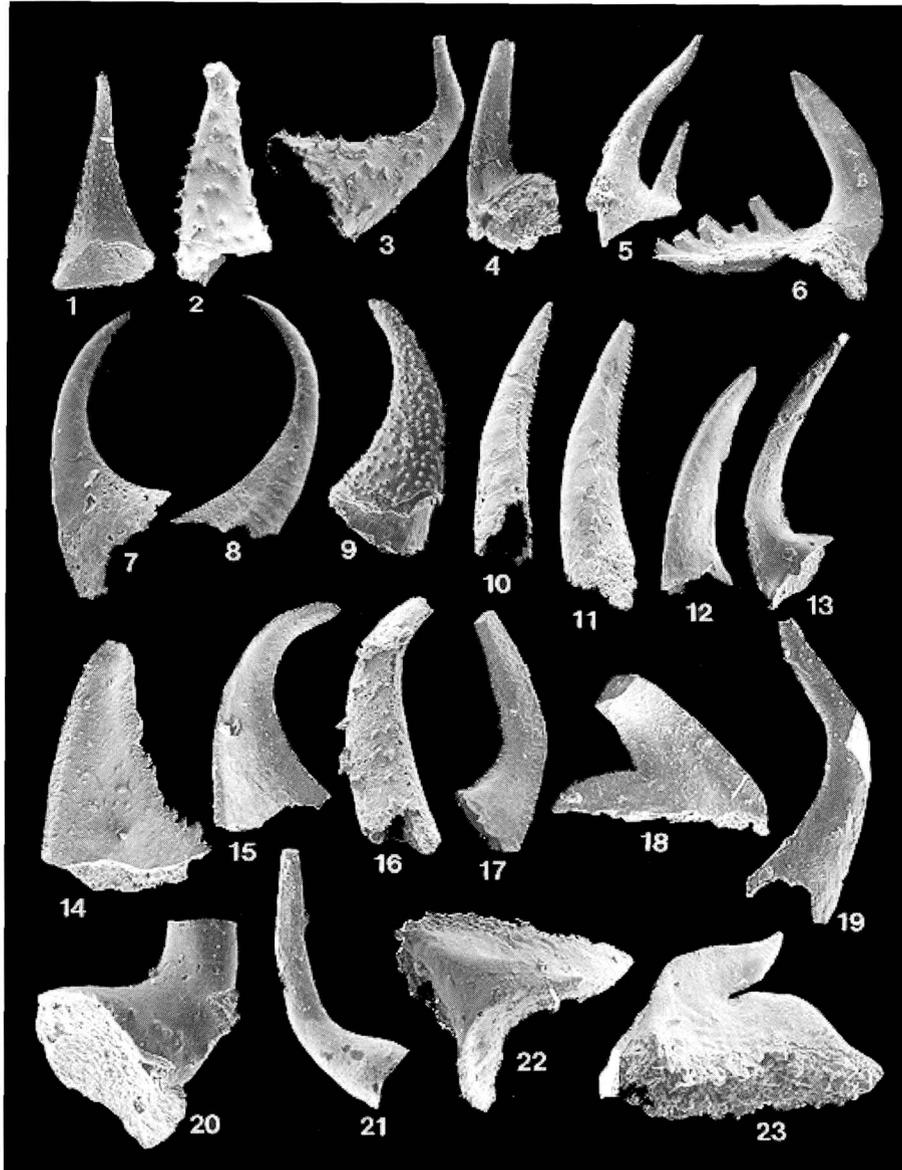
[Plate 2]



Conodonts from the Hwajeol Formation in Duwibong area.

1. *Phakelodus elongatus* Müller. Lateral view, YSUG 00631(2396), x78.
2. *Phakelodus tenuis* Müller. Lateral view, YSUG 00633(2605), x100.
3. *Westergaardodina matsushitai* Nogami. Upper view, YSUG 00634(2365), x120.
4. *Westergaardodina ligula* Müller. Upper view, YSUG 00635(2487), x110.
5. *Furnishina furnishi* Müller. Posterior view of asymmetrical el., YSUG 00648(2520), x160.
6. *Furnishina quadrata* Müller. Posterior view, YSUG 00649(2487), x160.
7. *Furnishina longibasis* Bednarczyk. Lateral view, YSUG 00650(2520), x220.
8. *Hertzina americana* Müller. Posterior view, YSUG 00658(2575), x130.
9. *Hertzina? cornuta* Xiang. Lateral view, YSUG 00659(2362), x160.
10. *Prosagittodontus eureka* Müller. Posterior view, YSUG 00652(2458), x160.
11. *Prosagittodontus dunderbergiae* (Müller). Posterior view, YSUG 00651(2457), x240.
12. *Furnishina primitiva* Müller. Lateral view, YSUG 00645(2523), x220.
13. *Furnishina tortilis* Müller. Posterior view, YSUG 00644(2560), x120.
14. *Muellerodus pomeranensis* (Szaniawski). Lateral view, YSUG 00683(2586), x360.
15. *Prosagittodontus dahlmani* (Müller). Posterior view, YSUG 00653(2611), x120.
- 16,17. *Coelocerodontus cambricus* (Nogami) Lateral views of acodiform and distacodiform el., YSUG 00656(2356) and 00655(2262), x160 and x130.
- 18,19. *Proscanododus dissimilaris* Lee. Posterolateral views, YSUG 00689(2370) and 0690(2485), x150 and x130.
- 20,23,24. *Rotundoconus bulbosus* Lee. Lateral views of non-, tri- and tetracarinate el., YSUG 00667(2369), 00665(2358) and 00669(2560), x110, x160 and x130.
- 21, 22. *Hirsutodontus* sp. Lateral views, YSUG 00675(2236), x220; and YSUG 00676(2277), x220.
- 25,26. *Rotundoconus jingxiensis* An and Zhang. Lateral and posterior views of tetra- and tricarinate el., YSUG 00662(2395) and 00661(2487), x130 and x86.

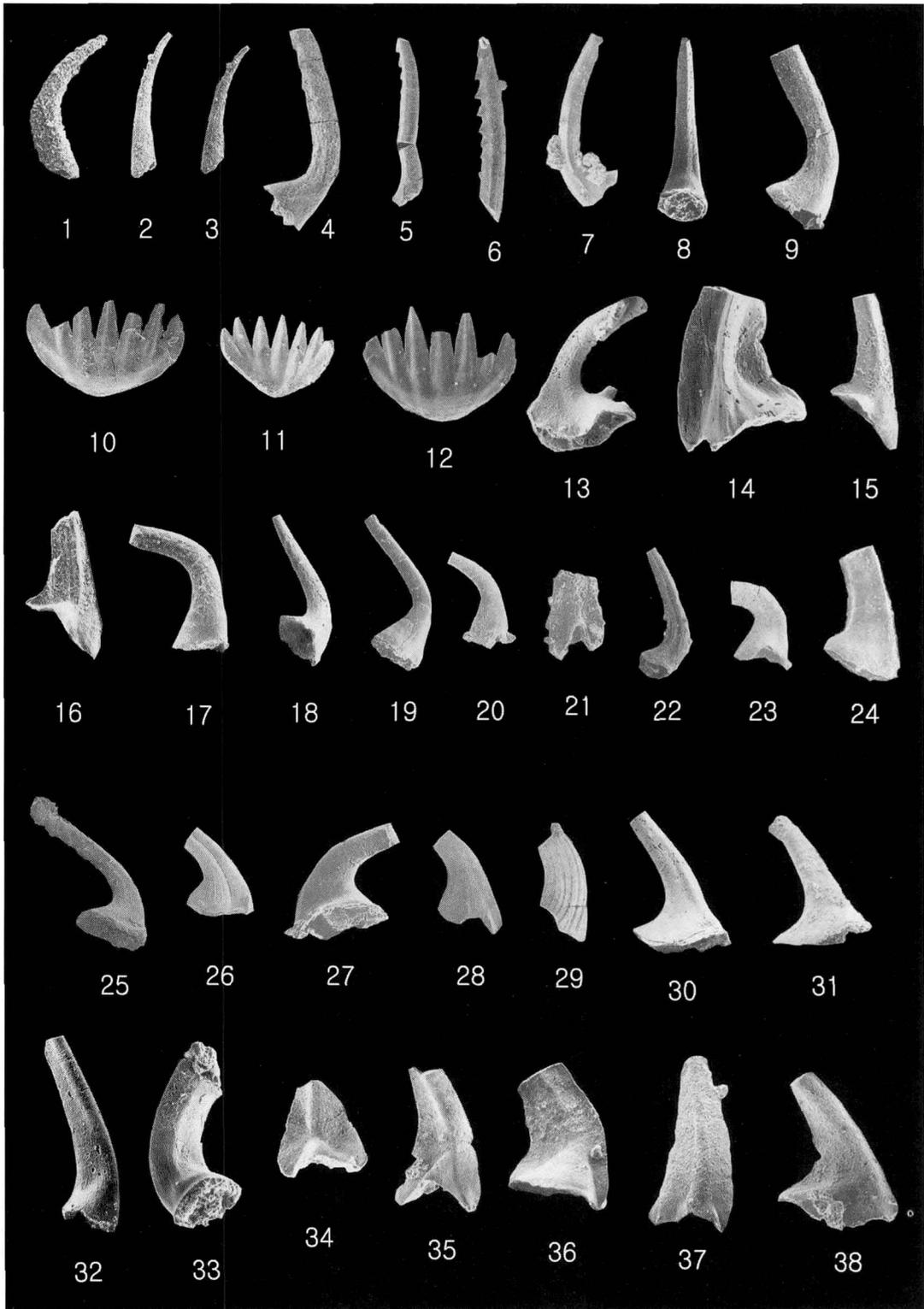
[Plate 3]



Conodonts from the Hwajeol Formation in Duwibong area.

1. *Hirsutodontus hwajeolensis* Lee. Posterior view, YSUG 00673(2576), x100. 2,3. *Teridontus transmutatus* (Xu and Xiang). Posterolateral and lateral views, YSUG 00715(2361) and 00714(2361), x150 and x200. 4. *Semiacontiodus nogami* Miller. Posterolateral view, YSUG 00741(2420), x100. 5,6. *Cordylodus proavus* (Müller). Lateral views of rounded and compressed el., YSUG 00734(2283) and 00740(2361), x130 and x150. 7. *Prooneotodus gallatini* (Müller). Lateral view, YSUG 00677(2357), x90. 8. *Prooneotodus rotundatus* (Druce and Jones). Lateral view, YSUG 00680(2357), x75. 9. *Hirsutodontus primitivus* An. Lateral view, YSUG 00672(2376), x160. 10,11. *Proconodontus tenuiserratus* Miller. Lateral views, YSUG 00691(2357) and 0692(2550), x130 and x150. 12. *Proconodontus posterocostatus* Miller. Lateral view, YSUG 00694(2365), x100. 13. *Cambroistodus minutus* (Miller). Lateral view, YSUG 00731(2260), x180. 14. *Proconodontus serratus* Miller. Lateral view, YSUG 00702(2370), x120. 15. *Proconodontus Muellerei* Miller. Lateral view, YSUG 00701(2261), x86. 16. *Prooneotodus terashimai* (Nogami). Lateral view, YSUG 00681(2355), x260. 17,19. *Eoconodontus notchpeakensis* (Miller). Lateral views of symmetrical drepanodiform and compressed scandodiform el., YSUG 00712(2263) and 00710(2285), x120 and x120. 18. *Cambroistodus cambricus* (Miller). Lateral view, YSUG 00726(2612), x180. 20. *Teridontus nodus* Zhang and Xiang. Lateral view, YSUG 00723(2275), x180. 21. *Teridontus nakamurai* (Nogami). Lateral view of short-based form, YSUG 00719(2573), x180. 22,23. *Fryxellodontus fengshanensis* Lee. Top and lateral views, YSUG 00686(2342) and 00686(2456), x200 and x180.

[Plate 4]



Conodonts from the Dumuggol Shale in Yeongweol-Samcheock area. Sample numbers from which the specimens were obtained are given in parentheses.

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1-3, *Phakelodus tenuis* (Müller, 1959), lateral views of all. 1, YSUG 0835(2742), ×120; 3, YSUG 0837(2743), ×80.

4-7, 25, *Acanthodus lineatus* (Furnish, 1983), lateral views of all. 4, YSUG 0838(2746), ×80; 5, YSUG 0893(2746), ×80; 6, YSUG 0840(2745), ×80; 7, YSUG 0841(2746), ×80; 25, lateral view, KUG00345(195136), ×80.

8, 9, *Monocostodus sevierensis* (Miller, 1969), 8, posterior view, YSUG 0842(2749), ×80; 9, lateral view, YSUG 0850(2749), ×100.

10-12, *Chosonodina herfurthi* Müller, 1964. 10, convex side view, YSUG 0851(2803), ×60; 11, concave side view, YSUG 0852, 0823(2804), ×80; 12, convex side view, YSUG 1011(2803), ×80.

13, *Cordylodus angulatus* Pander, 1856, lateral view, YSUG 0854(2804), ×80.

14, *Acodus oneotensis* Furnish, 1938 s.f., lateral view, YSUG 0855(2745), ×80.

15-16, *Acodus* sp., lateral views of both. 15, YSUG 0856(2750), ×80; 16, YSUG 0857(2750), ×80.

17-20, *Teridontus nakamurai* (Nogami, 1967), 17, lateral view, YSUG 0858(2753), ×80; 18, posterolateral view, YSUG 0859(2753), ×80. 19, 20, lateral views of both, 19, KUG00392(SS-8) ×100; 20, KUG00442(A95063), ×100.

21, 28, 34-38, *Rossodus manitouensis* Repetski & Ethington, 1983. lateral views of all, 21, drepanodiform el., KUG00345(195136), ×50; 28, drepanodiform el., KUG 00318(195106), ×50; 34, 37, posterior views of acantiodiform element, YSUG 0843(2743), ×60. YSUG 0867(2805), ×60; 35, posterolateral view of acantiodiform element, YSUG 0865(2805), ×80; 36, 38, lateral views of drepanodiform element, YSUG 0866, 0868, 0869(2743), ×80; 22, 24, *Variabiloconus bassleri* Furnish, 1983, lateral view, KUG00217(29452), ×100; 24, lateral view, KUG00217(29445), ×80.

23, *Drepanodus arcuatus* (Pander, 1856), drepanodiform el, lateral view, KUG00320(195108), ×80.

26, *Scolopodus nogamii* Lee, 1975. lateral view, KUG00329(195120), ×100.

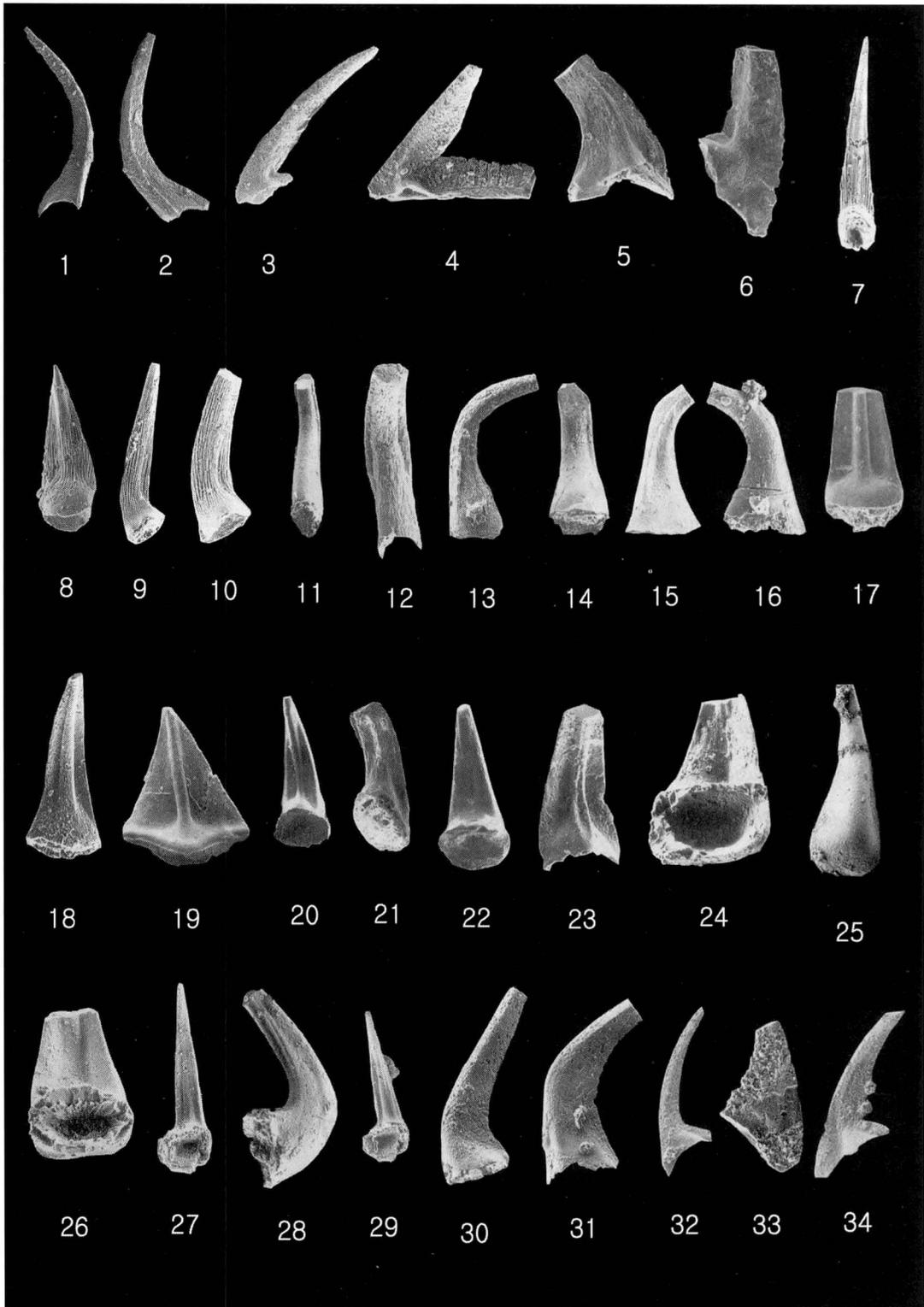
27, *Drepanoistodus basiovalis* Sergeeva, 1963. lateral view of drepanodiform el., KUG00251(195071), ×100;

29, *Scolopodus rex huolianshaiensis* An & Xu, 1983. lateral view, KUG00404(195071), ×35.

30-31, *Oneotodus erectus* Druce and Jones, 1971, lateral views of both, YSUG 0860, 0861(2747), ×80.

32-33, *Utahconus beimadaoensis* Chui and Zhag in An *et al.*, 1983. 32, lateral view of drepanodiform element, YSUG 0862(2817), ×80; 33, lateral view of scandodiform element, YSUG 0863(2747), ×100.

[Plate 5]



Conodonts from the Dumuggol Shale in Yeongweol-Samcheock area. Sample numbers from which the specimens were obtained are given in parentheses.



1-2, *Triangulodus dumugolensis* Seo *et al.*, lateral views of acontiodiform element, YSUG 1006, 1007, 1008 (2767), ×100.

3, 32-34, *Distacodus dumugolensis* Seo *et al.*, lateral view of oistodiform element, YSUG 1009 (2758), ×100; 32, lateral view of cordylodiform element, YSUG 0896 (2758), ×80; 33, lateral views of crytoniodiform element, YSUG 0898, 0899 (2758); 34, lateral view of cordylodiform element, YSUG 0897 (2758), ×80;

4, *Oistodus* (?) sp., lateral view, YSUG 1010 (2794), ×120.

5-6 *Rossodus manitouensis* Repetski and Ethington, 1983., 5, lateral views of drepanodiform element, YSUG 0866, 0868, 0869 (2743), ×80; 6, lateral view of oistodiform element, YSUG 0870 (2743), ×80.

7-10, *Parapanderodus acontiformis* Seo *et al.*, 1994, 7. poseterior view of acontiodiform element, YSUG 0871 (2779), ×60; 8. posterior view of acontiodiform element, 0872 (2779), ×60; 9, 10, lateral views of scandodiform element, YSUG 0873 (2779), ×80, YSUG 0874 (2779), ×50.

11-16, *Scolopodus longibasis* Seo *et al.* 1994, 11, 12, posteror views of symmetrical element, YSUG 0875 (2753), ×80, USUG 0876 (2754), ×100; 13, lateral view of symmetrical element, YSUG 0877 (2752), ×60; posterior view of asymmetrical element, YSUG0878 (2752), ×60; 15, 16, lateral views of asymmetrical element, YSUG 0879, 0880 (2754), ×60.

17-18, *Acontiodus iowensis* Furnish, 1938, posterior views of both, YSUG 0881, 0882 (2774), ×80;

19, *Acontiodus* sp. A., posterior view, 0883(2744), ×60.

20, 22, 24-26, *Acontiodus propinquus* Furnish, 1938, 20, 22, posterior views of both, YSUG 0884, 0885 (2785), ×80; 24, 26 posterior views, YSUG 0888, 0889 (2789), ×100; 25, anterior view, YSUG 0890 (2782), ×100.

21, *Glyptoconus quadraplicatus* (Branson and Mehl, 1933), posterolateral view, YSUG 0886 (2833), ×60.

23, *Acontiodus* sp. B., posterior view, YSUG 0887 (2819), ×80.

27-29, *Acontiodus shuiyuensis* Zhang in An *et al.*, 1983. 27, 29, posterior views, YSUG 0891, 0892 (2828), ×60; 28, lateral view, YSUG 0893 (2828), ×80.

30, 31, *Acodus tetrahedron* Lindström, 1955, lateral views of both, YSUG 2894, 0895 (2848), ×80.

[Plate 6]

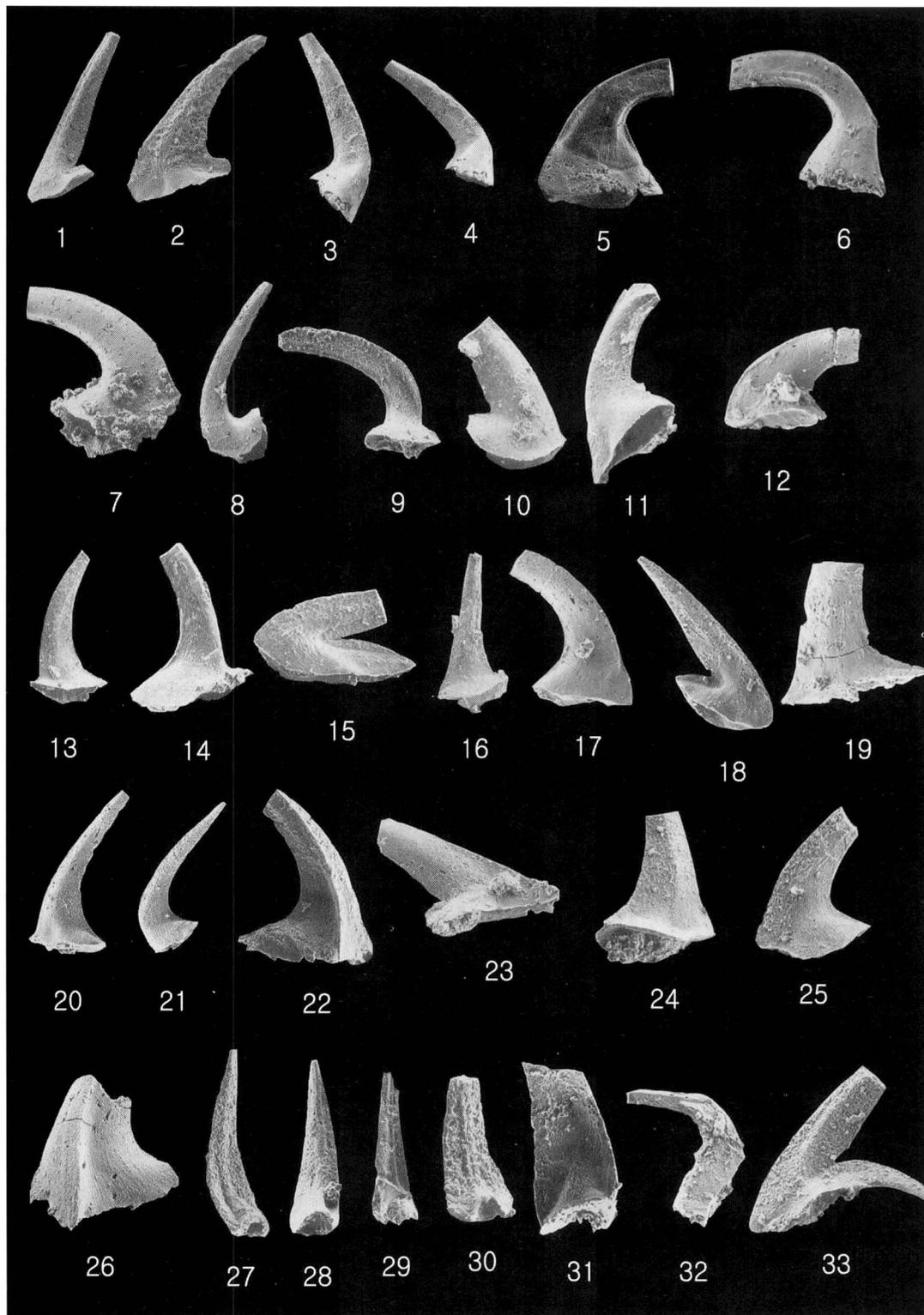


Conodonts from the Dumuggol Shale in Yeongweol-Samcheok area. Sample numbers from which the specimens were obtained are given in parentheses.

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1. *Variabiloconus bassleri* (Furnish, 1938). posterolateral view, YSUG 0964(2752), ×60.
- 2, 3, *Scolopodus warendensis* Druce and Jones, 1971, posterior views of all, YSUG 0993 (2827), ×80, USUG 0994 (2826), ×60.
- 4-9. *Scolopodus bolites* Repetski, 1982, 4-9, posterior views of symmetrical element, YSUG 0965, 0966, 0967, 0968, 0969(2907), ×80;
- 10-13, 16, *Scolopodus cornufomis* Sergeeva, 1963, 10-13, posterior views of acontiodiform element, YSUG 0971, 0972 (2841), ×60, YSUG 0973, 0974(2780), ×80; 16. lateral view of acontiodiform element, YSUG 0975 (2780), ×100.
- 14-15 *Walliserodus ethingtoni* (Fähræus, 1966), 14, posterior view, YSUG 0995 (2923), ×60, 15, lateral view, YSUG 0996 (2923), ×80.
17. *Scolopodus filiosus* Ethington and Clark, 1964, lateral view, YSUG 0976 (2839), ×100.
- 18, 19, 21, *Scolopodus gracilis* Ethington and Clark, 1964, posterior views of all, YSUG 0977, 0978, 0979, (2767), ×80.
- 20, *Ulrichodina simplex* Ethington and Clark, 1981, lateral view, YSUG 0997 (2768),
- 22-24, *Paltodus quinquecostatus* Müller, 1964, 22, 24, lateral views, YSUG 0980, 0981 (2746), ×60; 23, lateral view, YSUG 0982 (2747), ×80.
- 25-28, *Glyptoconus quadraplicatus* (Branson and Mehl, 1933), 25, posterior view, YSUG 0983 (2715), ×80; 26, posterolateral view, YSUG 0984 (2765), ×80; 27, lateral view, YSUG 0985(2765), ×80; 28, posterolateral view, YSUG 0986 (2758), ×80.
- 29-31, *Scolopodus* sp. A., 29, posterolateral view, YSUG 0987 (2748), ×60; 30, lateral view, YSUG 0988 (2748), ×60; 31, oral view, YSUG 0989 (2748).
- 32,33 *Scolopodus mancordatus* An and Xu in An *et al.*, 1983, 32, lateral view, YSUG 0990 (2956), ×60; 33, basal view, YSUG 0991 (2950), ×60.
- 34, *Parapanderodus* cf. *P. carlae* Repetski, 1982, posterior view, YSUG 0992(2805), ×80.
- 35-40, 42-43, *Triangulodus dumugolensis* Seo *et al.*, 35, posterior view of trichonodelliform element, YSUG 0998, (2768), ×80; 36, posterior view of trichonodelliform element, YSUG 0999, (2768), ×80; 37-40, lateral views of oistodiform element, YSUG 1000, 1001, 1002, 1003, (2768), ×80; 42, lateral view of cordylodiform element, YSUG 1005(2767), ×80; 43, lateral view of acontiodiform element, YSUG 1006, ×100.
- 41, *Distacodus dumugolensis* Seo *et al.*, lateral view of crytoniodiform element, YSUG 1004 (2767);

[Plate 7]

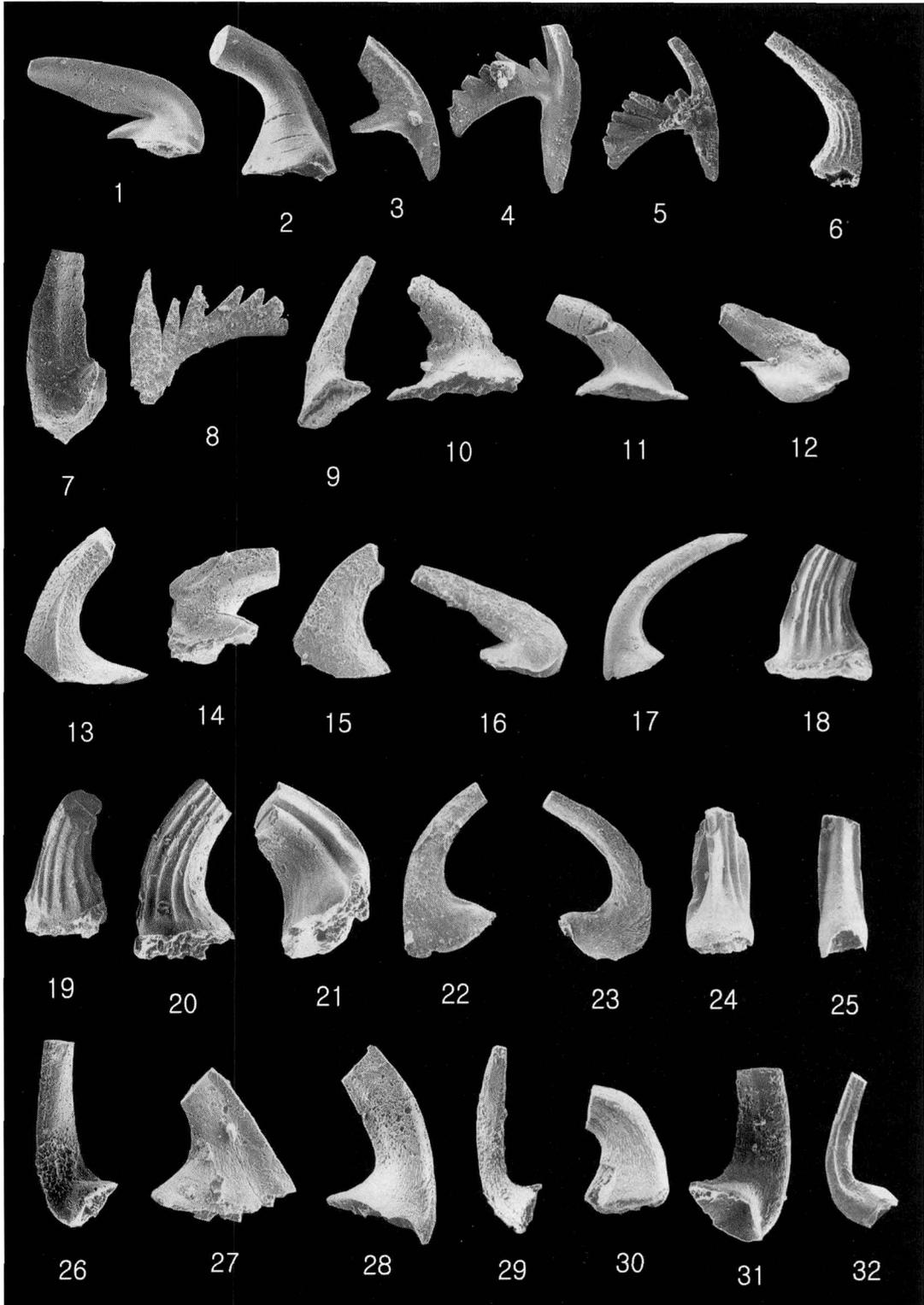


Conodonts from the Dumuggol Shale in Yeongweol-Samcheok area. Sample numbers from which the specimens were obtained are given in parentheses.

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- 1-2, *Distacodus dumugolensis*, Seo *et al.* 1, lateral view of oistodiform element, YSUG 0900(2757), ×100.
2, lateral views of crytoniodiform element, YSUG 0898, 0899(2758);
- 3-4, *Drepanodus conulatus* Lindström, 1955, lateral views of both, YSUG 0901, 0902(2755), ×80
- 5, *Drepanodus tenuis* Moskalenko, 1967, lateral view, YSUG 0903 (2819), ×100.
- 6-8, *Drepanodus arcuatus* (Pander, 1856), 6, 7, lateral views of drepanodiform element, YSUG 0904, 0905(2770), ×80; 8, lateral view of scandodiform element, YSUG 0906(2759), ×60.
- 9, *Drepanodus concavus*(Branson and Mehl, 1933), lateral view, YSUG 0907 (2755), ×80.
- 10-14, *Drepanoistodus basiovalis* (Sergeeva, 1963), 10, lateral view of oistodiform element, YSUG 0908(2842), ×60; 11,12, lateral views of drepanodiform element, YSUG 0909, 0910(2841), ×60; 13,14 lateral views of suberectiform element, YSUG 0911, 0912(2842), ×60;
- 15-18, *Drepanoistodus forceps* (Lindström, 1955), 15,18, lateral views of oistodiform element, YSUG 0913, 0914(2767), ×60; 16, lateral view of suberectiform element, YSUG 0915 (2767), ×80; 17, lateral view of drepanodiform element, YSUG 0916(2767), ×80.
- 19-21, *Drepanoistodus pervetus* Nowlan, 1985. 19, 20, lateral views of suberectiform element, YSUG 0917, 0918 (2860), ×80; 21, lateral view of drepanodiform element, YSUG 0919(2860), ×120.
- 22-26, *Drepanoistodus (?) inaequalis*(Pander, 1856), 22, 26, lateral views of acodiform element, YSUG 0920, 0921 (2752), ×80; 23, lateral view of oistodiform element, YSUG 0922(2752), ×80; 24, lateral view of suberectiform element, YSUG 0923(2755), ×100; 25, lateral view of drepanodiform element, YSUG 0924(2755), ×60.
- 27, *Parapanderodus* sp., posterior view, YSUG 0925(2841), ×80.
- 28-29, *Scolopodus warendensis* Druce and Jones, 1971, posterior views of both, YSUG 0926, 0927 (2841), ×80.
- 30, *Scolopodus* cf. *S. bolites* Repetski, 1982, posterior view, YSUG 0928 (2840), ×80.
- 31, *Juanognathus* sp., posterior view, YSUG 0929(2840), ×80.
- 32, *Macerodus* cf. *M. diana*e Fähræus and Nowlan, 1978, lateral view, YSUG 0930 (2841), ×120.
- 33, *Oistodus linguatus* Lindström, 1955, lateral view, YSUG 0931 (2841), ×50.

[Plate 8]



Conodonts from the Dumuggol Shale in Yeongweol-Samcheock area. Sample numbers from which the specimens were obtained are given in parentheses.



1. *Oistodus* cf. *O. selenopsis* Serpagli, 1974, lateral view, YSUG 0932(2923), ×80.
2. *Oistodus mehli* Furnish, 1938, posterolateral view, YSUG 0933(2856), ×80.

- 3-5, 8, *Paracordylodus gracilis* Lindström, 1955. 3, lateral view of oistodiform element, YSUG 0934(2841), ×100; 4,5, lateral views of paracordylodiform element, YSUG 0935, 0936(2842), ×60; 8, lateral view of crytoniodiform element, YSUG 0937(2841), ×80.

6. *Paltodus inconstans* Lindström, 1955, lateral view, YSUG 0938(2767), ×90.

7. *Oistodus contractus* Lindström, 1955, lateral view, YSUG 0939(2841), ×80.

- 9-11, 17, *Paltodus deltifer* (Lindström, 1971), 9, 10, basal views of oistodiform element, YSUG 0940, 0941(2780), ×80; 11, lateral view of oistodiform element, YSUG 0942(2780), ×120; 17, lateral view of drepanodiform element, YSUG 0943(2780), ×80.

- 12-14, *Paroistodus parallelus* (Pander, 1856), 12, 14, lateral views of oistodiform element, YSUG 0944, 0945(2841), ×100; 13, lateral view of drepanodiform element, YSUG 0946(2765), ×100.

- 15, 16, 22, 23, *Paroistodus proteus* (Lindström, 1955). 15, 22, 23, lateral views of drepanodiform element YSUG 0947, 0948, 0949(2841), ×80; 16, lateral view of oistodiform element, YSUG 0950(2841), ×100.

- 18-20, *Scolopodus rex* Lindström, 1955, 18, lateral view, YSUG 0951(2765), ×80; 19, 20, lateral views, YSUG 0952, 0953 (2767), ×60.

21. *Protopanderodus* sp., posterolateral view, YSUG 0954(2856), ×80.

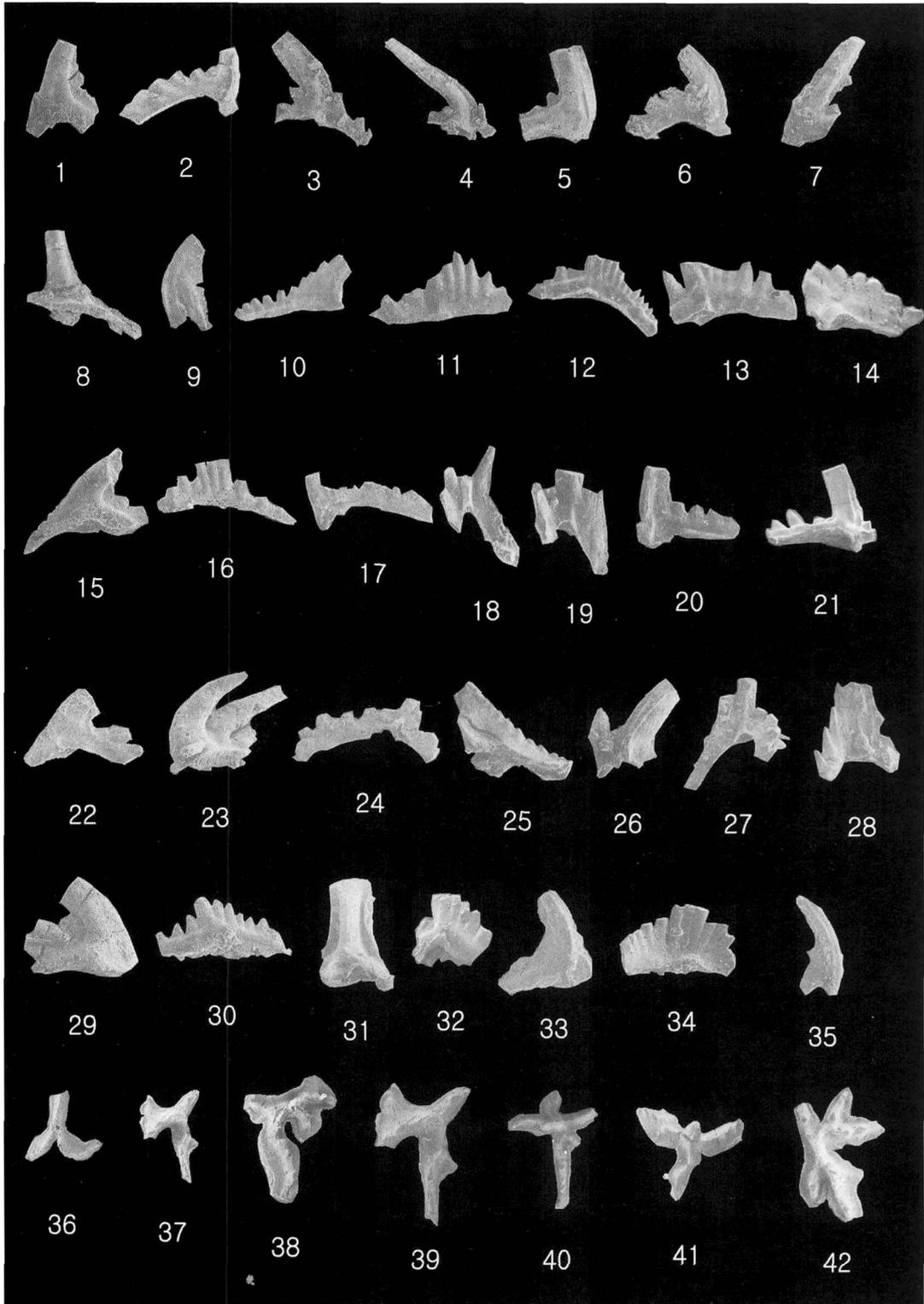
- 24, 25, *Scolopodus pingquanensis* Zhang in An *et al.*, 1983, 24, posterior view of bicostatiform element, YSUG 0955(2924), ×80; 25, posterior view of unicostatiform element, YSUG 0956(2924), ×80.

- 27-30, *Scalpellodus tersus* Zhang in An *et al.*, 1983. 27, 28, lateral views of scandodiform element, YSUG 0957, 0958(2917), ×80. 29, lateral view of drepanodiform element, YSUG 0959(2817), ×60; 30, lateral view of acontiodiform element, YSUG 0960(2817), ×60.

- 26, 31, *Scandodus furnishi* Lindström, 1955, lateral views of both, YSUG 0961, 0962 (2754), ×80.

- 32, *Variabiloconus bassleri* (Furnish, 1938), lateral view, YSUG 0963(2752) ×80.

[Plate 9]



Conodonts from the Makgol Formation in Yeongweol-Samcheock and Danyang areas. Sample numbers from which the specimens were obtained are given in parentheses.



1-8. *Tangshanodus tangshanensis* An, 1983. lateral views of all, 1. KUG00331(195122), ×80; 2, cordylodontiform el., KUG00360(195149), ×80; 3, prioniodiform el., KUG00394(195176), ×100; 4, prioniodontiform el., KUG00358(195147), ×80; 5, cordylodontiform el., KUG00275(195072), ×100; 6, cordylodontiform el., 00394(195185), ×80; 7, oistodontiform el., KUG00282(195076), ×50; 8, lateral view, KUG00331(195122), ×80;

9. *Bellodina rigida* An, 1983., lateral view, KUG00330(195121), ×90;

10. *Bergstroemognathus hubeiensis* An, 1981. lateral view of falodontiform el., KUG00305(195076), ×80;

11-14, 16-22, 24, 27, 32. *Plectodina onychodonta* An et Xu, 1983. lateral views of all, 11, prioniodontiform el., KUG00275(195069), ×80; 12, prioniodontiform el., KUG00305(195076), ×80; 13, prioniodontiform el., KUG00272(195066), ×100;

14, prioniodontiform el., KUG00272(195066), ×80; 16, lateral view of prioniodontiform el., KUG00272(195066), ×100; 17, lateral view of subcordylodontiform el., KUG00409(195176), ×80; 18, posterior view of trichognathiform el., KUG00409(195176), ×50; 19, prioniodontiform el., KUG00275(195069), ×100;

20, dichognathiform el., KUG00409(195176), ×50; 21, dichognathiform el., KUG00409(195176), ×80; 22, subcordylodontiform el., KUG00275(195069), ×80; 24, lateral view of trichognathiform el., Ghoigadong section, KUG00331(095091), ×150; 27, posterior view of trichognathiform el., KUG00409(195176), ×80; 32, anterior view of trichognathiform el., KUG00409(195176), ×50.

15, 23, 29. *Erraticodon tangshanensis* Yang C. S & Xu, 1983. lateral view of of all, 15, prioniodontiform el., KUG00305(195076), ×80; 23, cordylodontiform el., KUG00331(195122), ×80; 29, cordylodontiform el., CKUG00229(195120), ×80.

25, *Pygodus serratus* Hadding, 1913. lateral view, KUG00275(195069), ×80.

26, *Tangshanodus tangshanensis* An, 1983. lateral view of oistodontiform el., KUG00331(195122), ×80.

28, 34, *Aurilobodus serratus* Xiang & Zhang F, 1983, lateral views of both, 28, symmetrical el., KUG00302(195076), ×80; 34, symmetrical el., KUG00275(195069), ×80.

30, *Histodella serratus* Harris, 1962. lateral view, KUG00358(195147), ×80.

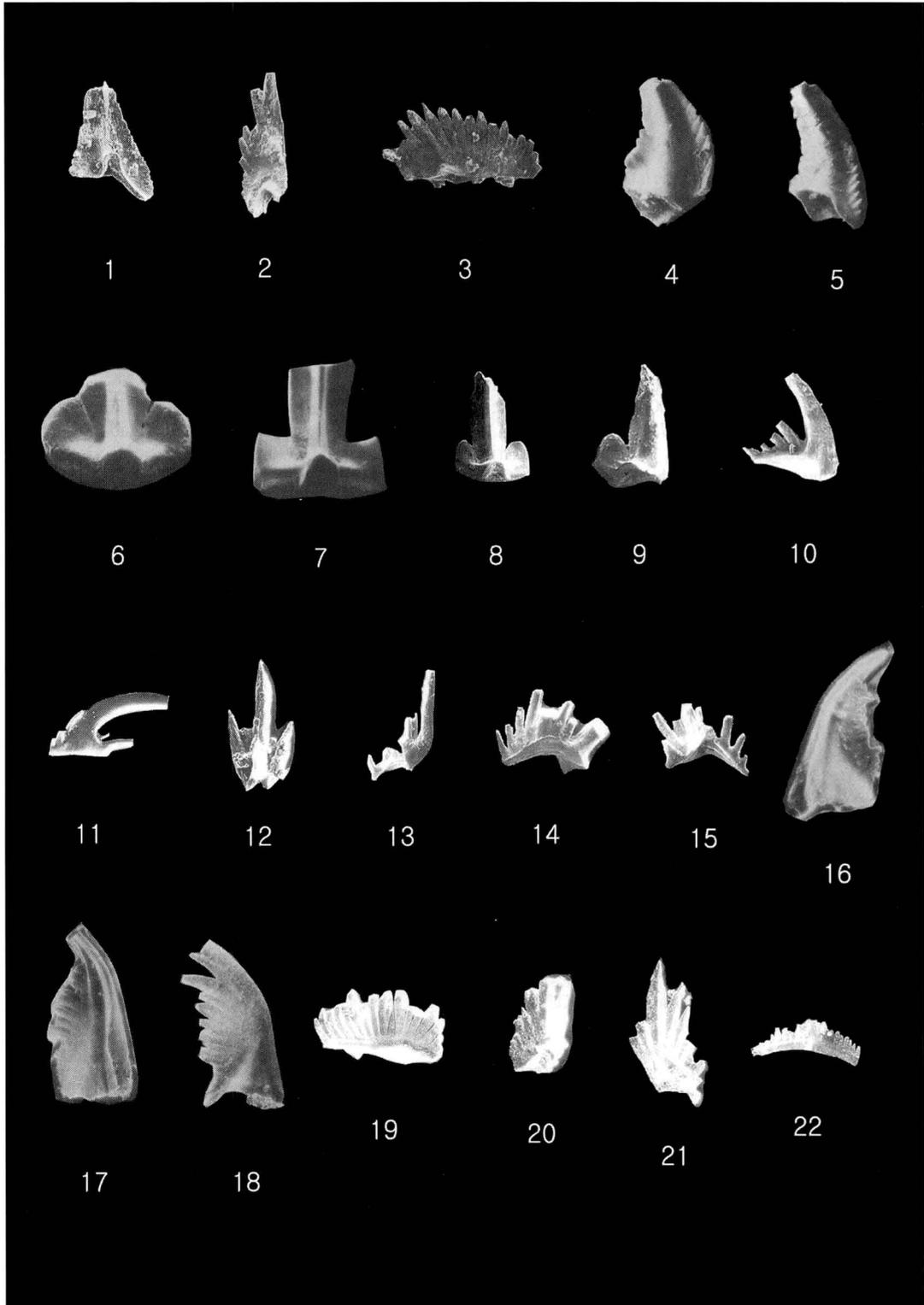
31, *Triangulodus brevibasis* Sergeeva, 1966. lateral view of triangulodontiform el., KUG00314,(195175), ×80.

33, 35. *Baltoniodus approximatus* Zhang F, 1983. lateral view, prioniodontiform el., KUG00394(195151), ×100; 35, lateral view of tetraprioniodontiform el., KUG00394(195151), ×80.

36-37, 39, 42. *Eoplacognatus pseudoplanus* Bergström, 1971. upper view of sinistral ambalodontiform el., KUG00314(195102), ×70; 37, upper view of sinistral ambalodontiform el., KUG00314(195120). ×70; 39, upper view of sinistral ambalodontiform el., KUG00314(195120), ×80; 42, upper view of sinistral ambalodontiform el., KUG00314(195120), ×80.

38, 40. 41. *Eoplacognatus suecicus* Bergström, 1971. upper view sinistral ambalodontiform el., KUG00314(195120), ×70; 40, upper view of sinistral ambalodontiform el., KUG00314(195120), ×70; 41, upper view of sinistral ambalodontiform el., KUG00314(195120), ×70.

[Plate 10]



Conodonts from the Maggol Formation, Jikunsan Shale and Duwibong Limestone in Yeongweol-Samcheok and Danyang areas. Sample numbers from which the specimens were obtained are given in parentheses.



- 1, *Aurilobodus leptosomatus* An, 1983, Posterior view, x240, sample No. 2702, Maggol Ls.
- 2-3, 19-22. *Rhipidognathus laiwuensis* Zhang, 1983, 2, trichonodelliform el., posterior view, x120, sample No. 2706, Maggol Ls., 3, prioniodiform el., lateral view, x120; 19, prioniodiniform el., posterior view, x86, sample No. 2171, YSUG00913 Maggol Ls.; 20, bryanthodiniform el., posterior view, x86, Sample No. 2196, YSUG00914 Maggol Ls.; 21, trichonodelliform el., posterior view, 200x, sample No. 2196, YSUG00915 Maggol Ls.; 22, ozarkodiniform el., YSUG00916 lateral view, x78. No. 2723 Maggol Ls.
- 4-5, *Aurilobodus serratus* Xiang & Zhang, 1993, 4, asymmetricus element, posterior view, x94, sample No. 2093 Duwibong Formation. 5, asymmetricus element, posterior view, x72 Sample No. 2094 Duwibong Formation.
- 6-9, *Aurilobodus aurilobus* (Lee, 1975), 6, symmetricus element, posterior view, x110, sample No. 2091 Duwibong Formation, 7, symmetricus element, posterior view, x100, sample No. 2111 Duwibong Formation. 8, symmetricus el., posterior view, x94, sample No. 2177, YSUG00891 Duwibong Ls., 9, asymmetricus el., posterior view, x78, sample No. 2174, YSUG00892 Duwibong Ls.
- 10-15, *Erraticodon tangshanensis* Yang & Xu, 1983, 10, cordylodontiform el., postero-lateral view, x150, sample No. 2131, YSUG 00877 Duwibong Ls., 11, prioniodiniform el., Lateral view, x110, sample No. 2185, YSUG00878 Jigunsan Sh., 12, trichonodelliform el., posterior view x94, Sample No. 2196, YSUG00879 Maggol Ls., 13, hindeodelliform el., lateral view, x86, Sample No. 2131, YSUG00880 Duwibong Ls., 14, angulodontiform el., Posterior view, x100, Sample No. 2178, YSUG00881 Duwibong Ls., 15, plectospathognathiform el., Posterior view, x120, Sample No. 2135, YSUG00882 Duwibong Ls.
- 16-18, *Belodella rigida* An, 1983, 16, denticulated triangular element, lateral view, x180, Sample No. 2080, Duwibong Formation, 17, denticulatd plano-convex element, Lateral View, x180, sample No. 2094 Duwibong Formation, 18, denticulated plano-convex element, lateral View, x180, Sample No. 2094 Duwibong Formation.