Histor. Geologie (21): Geologische Zeittafel

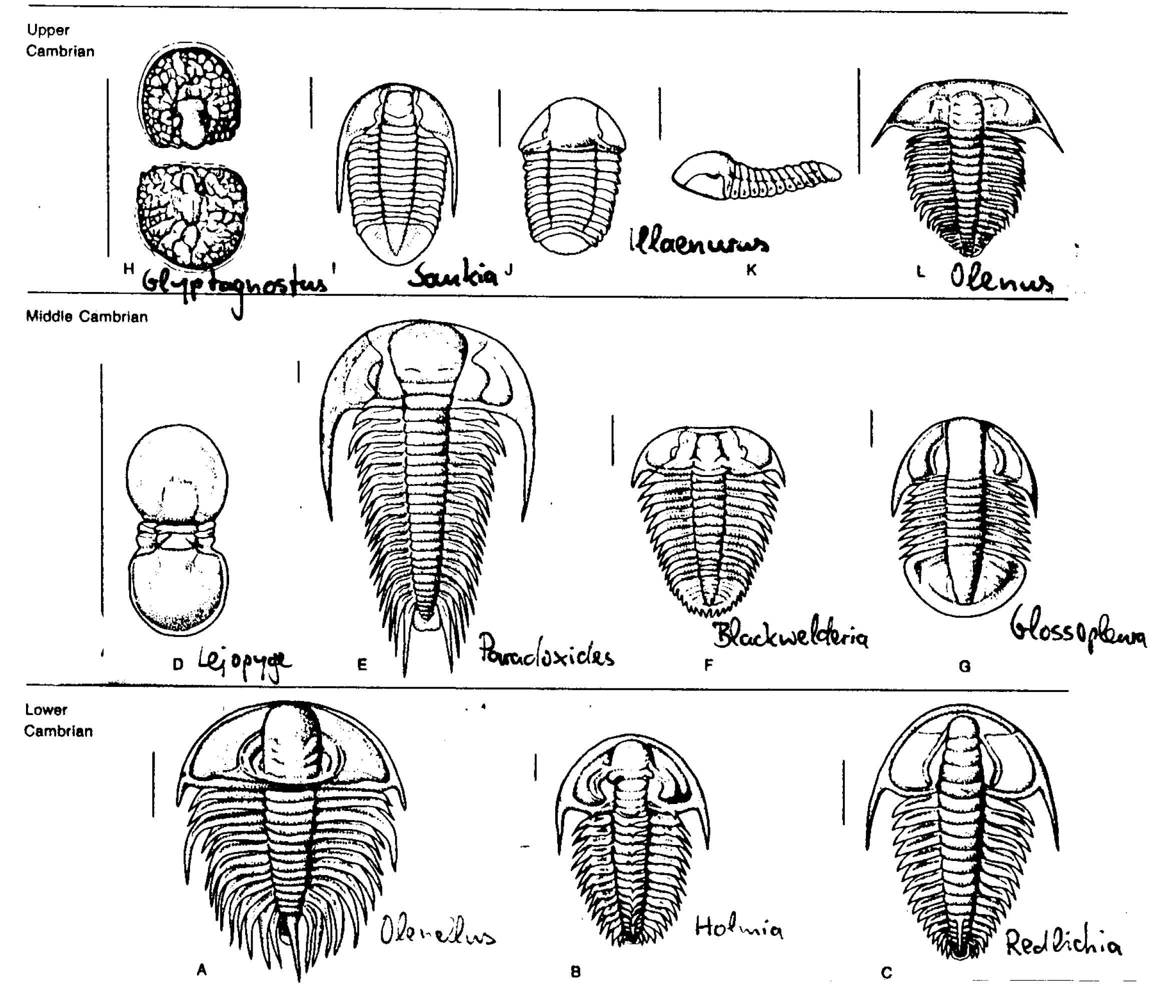
ÄRA	Mio J	SYSTEM/ PERIODE	SERIE/ EPOCHE	STUFE/ ALTER	Spezielle Gliederungen in Mitteleuropa und ältere, z.T. gebräuchliche Namen			
KÄNOZOIKUM	10300 J v. heute	QUARTÄR		Holozän (Alluvium)		Kaltzeiten:	Warmzeiten:	
	100000			Pleistozän (Diluvium)	Jung-	Würm/Weichsel	Eem	
	300000/400000				Mittel-	Riss/Saale	Holstein	
	800000				Alt-	Mindel/Elster	Cromer	
					Ältest-	Günz + Präglazial		
	1,8 Mio J v. heute	TERTIÄR	Neogen	Pliozän	Jung-Tertiär			ALPIDISCHE
				Miozän				
	24		Paläogen	Oligozän	Alt-Tertiär			
				Eozän				
				Paläozän				
MESOZOIKUM	65	KREIDE	Obere	Maastricht	"Senon"	("Senon")		OROGENESE
				Campan				
				Santon				
				Coniac	Emscher			
				Turon		"Mittlere Kreide"		
				Cenoman				
	97,5		Untere	Alb	Gault			
				Apt				
				Barrême	Neokom			
				Hauterive				
				Valangin (Valendis)				
				Berrias	"Wealden"			
	144	JURA	Malm	Tithon (Portland) (Purbeck)	Oberer	Weißer Jura	ζ	
				Kim(m)eridge	Unterer			
				Oxford			α	
	163		Dogger	Callov	Oberer	Brauner Jura	ζ	(MESOZOISCHE
				Bathon	Mittlerer			
				Bajoc	Unterer			
				Aalen			α	
	188		Lias	Toarc	Oberer	Schwarzer Jura	ζ	
				Pliensbach	Mittlerer			
				Sinemur	Unterer			
				Hettang			α	
	213	TRIAS	Obere	Rhaet	Keuper			OROGENESEN)
				Nor				
				Karn				
	231		Mittlere	Ladin	Muschelkalk			
				Anis				
	243		Untere	Skyth	Buntsandstein			
PALÄOZOIKUM	248	PERM	Ober-	Tatar	Zechstein	Aller, Leine, Stassfurt, Werra (Salz-zyklen)	Thuringium	
				Kazan				
				Ufa ("Mittleres")				
	258		Unter-	Kungur	Rotliegendes	Ober-	Saxon	VARISZISCHE
				Artinsk				
				Sakmar		Unter-	Autun	
				Assel				
	286	KARBON	Ober- (Pennsylvanian)	Ural ("Ober-"/C_3)	Stefan		Siles	
				Moscov ("Mittel-"/C_2)	Westfal			
				Bashkir	Namur			
	333		Unter- (Mississippian)	Serpukhov ("Unter-"/C_1)	Visé	cu III	Dinant	OROGENESE
				Visé		cu II		
				Tournais	Tournais	cu I		
	360	DEVON	Ober-	Famenne	Wocklum	to VI	Farlov	OLD RED
					Dasberg	to V		
					Hemberg	to IV, to III		
					Nehden	to II		
				Frasne	Adorf	to I		
	374		Mittel-	Givet	(Couvin)		Orcad	
				Eifel				
	387		Unter-	Ems	Dalej (Koblenz)		Brecon	
					Zlichov			
				Siegen	Prag			
				Gedinne	Lochkov		Ditton	
	408	SILUR	Přidoli		(GOTLANDIUM)		Downton	KALEDONISCHE
			Ludlow					
			Wenlock					
			Llandovery					
	438	ORDOVIZIUM	Oberes	Ashgill			("SILUR")	OROGENESE
				Caradoc				
			Mittleres	Llandeilo				
				Llanvirn				
			Unteres	Arenig				
				Tremadoc				
	505	KAMBRIUM	Ober-		(*Olenus* u.a.)			
			Mittel-		(*Paradoxides* u.a.)			
	545		Unter-	Lena, Atdaban, Tommot	(Olenelliden)			
PRÄKAMBRIUM	570	PROTEROZOIKUM	(Jüngst-)	Ediacara				PRÄKAMBRISCHE
	670		Ober-		Jung-			
	1800/1900		Mittel-					
	2500		Unter-		Mittel-	PRÄKAMBRIUM		OROGENESEN
	2600	ARCHAIKUM	Ober-					
			Mittel-		Alt-			
	3000		Unter-					
		(HADAEIKUM)						

Älteste Gesteine der Erde: Sedimente, Vulkanite, Plutonite etwa 3,9 Milliarden Jahre
Älteste Minerale 4,2 Ma

Entstehung des Sonnensystems und der Erde vor etwa 4,6 Milliarden Jahren
Alter des Weltalls >13–>20 Milliarden Jahre

Anmerkung: Alle Stufen eigentlich mit Endung -ium z.B. Thuringium, Tournai(s) richtiger Tournaisium. Ausnahmen bilden Paläozän, Eozän etc. als Subserien. Die Silur-Stufen Llandovery, Wenlock etc. werden neuerdings als Serien angesprochen.

Histor. Geologie (22): Fauna des Kambrium und Ordovizium



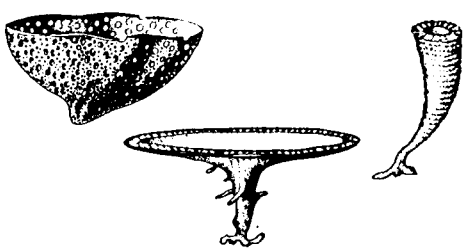


FIGURE 12-13 Reconstruction of three archeaocyathid species. All three were vase- or bowl-shaped. It seems likely that these animals were similar to sponges in that they pumped water through their porous walls, but it is not certain whether they were closely related to any group of modern organisms. *(After I. T. Zhuravleva, Akad. Nauk. U.S.S.R., Geol. Geofiz. Novosibirsk, 2:42–46, 1960.)*

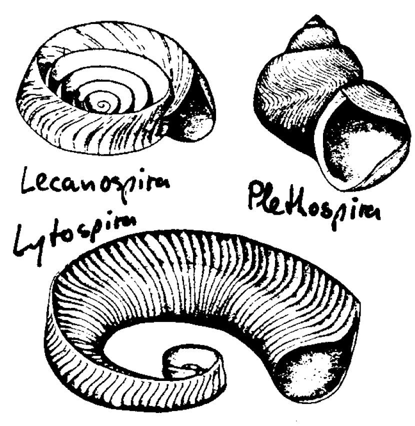
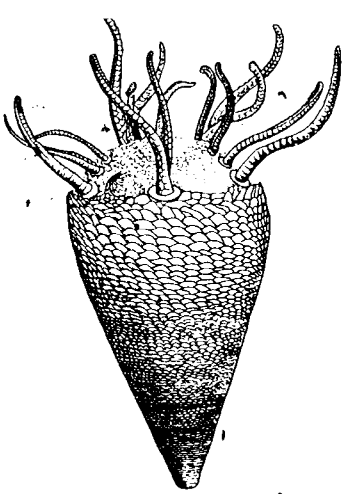


FIGURE 12-21 Snails (gastropods) that inhabited Ordovician seas. The shells at the upper left and bottom probably belonged to animals that were largely stationary and rested on the seafloor in the positions shown here. The shell in the upper right belongs to a group of crawling snails represented in modern seas by a few surviving species. Figure 12-16 shows this type of snail moving over a tabulate colony. *(After Treatise on Invertebrate Paleontology, Part I, R. C. Moore [ed.], the Geological Society of America and the University of Kansas Press, Lawrence, Kansas, 1960.)*



primitiver kambrischer Echinoderm

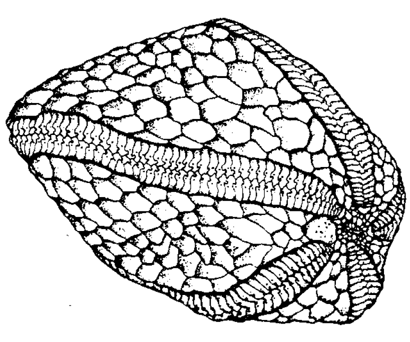


FIGURE 12-22 An Ordovician echinoid (sea urchin; ×2) that differed from living echinoids in its flexibility. In life, the globular skeleton was covered with spines, which served for locomotion. The animal probably fed on algae or plant debris. Its mouth was positioned underneath (at the "south pole") and the anus was positioned near the "north pole." *(After E. W. McBride and W. F. Spencer, Philos. Trans. Roy. Soc. London 229B:91–136, 1939.)*

Histor. Geologie (23): Kambrium, Ordovizium; Evolution etc.

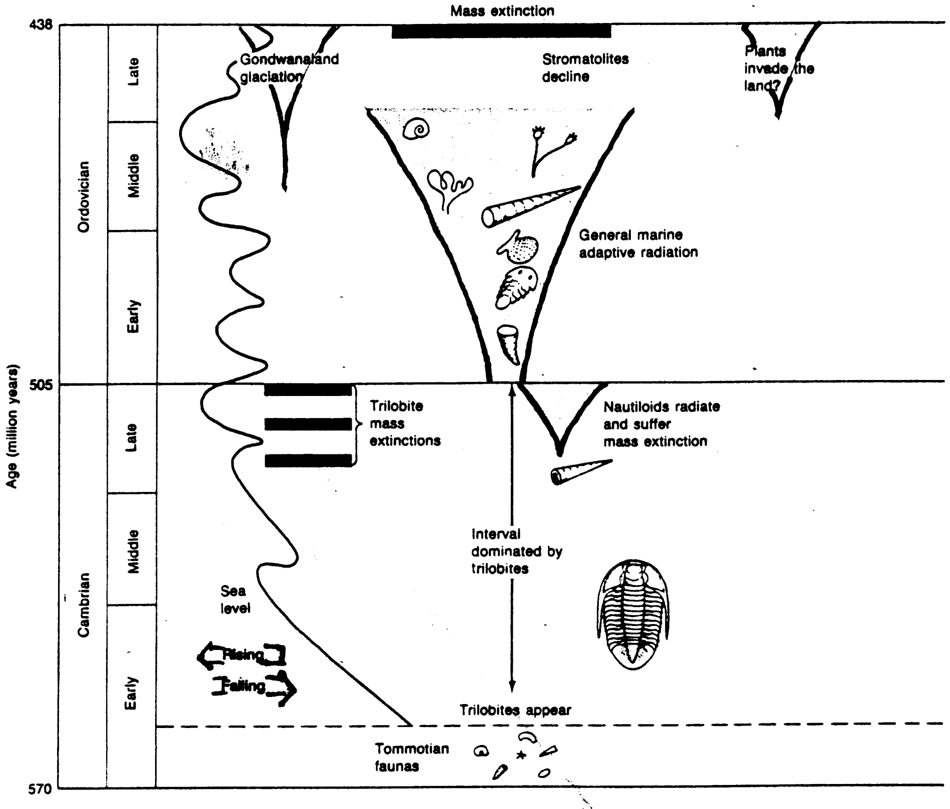


FIGURE 12-34 Major events of early Paleozoic time. During this time, there were three distinctive intervals in the history of life: (1) the Tommotian interval of the Cambrian, which was typified by very small animals; (2) the remainder of the Cambrian, which was dominated by trilobites; and (3) the Ordovician Period, when many groups of marine animals appeared and stromatolites declined. Note that several large drops of sea level failed to cause mass extinctions and that two of the Late Cambrian mass extinctions did not coincide with events of sea level lowering. The terminal Ordovician mass extinction coincided with the climax of glaciation in Gondwanaland.

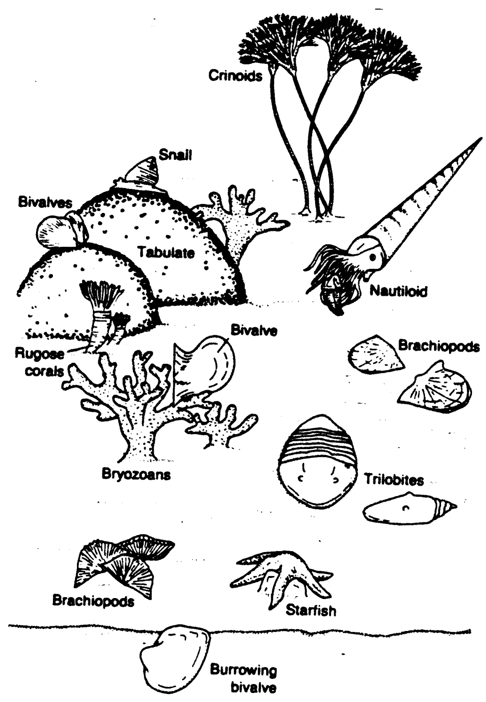


FIGURE 12-16 Life of a Late Ordovician seafloor in the area of Cincinnati, Ohio. Fossils of many of the groups of animals represented here can be seen in Figures 12-15 and 12-17 through 12-25. Note that at this early stage of Phanerozoic evolution, relatively few animals lived within the sediment. On the left, a snail crawls over a large tabulate colony, and two bivalve mollusks are attached to another tabulate colony by threads that give the bivalves stability. Another bivalve is similarly attached to the branch of a bryozoan colony. Two solitary rugose corals, lodged alongside colonies, have their tentacles outstretched for food. Stalked crinoids are waving about in the center of the picture, suspension feeding with their arms. To their right, a large nautiloid prepares to eat a trilobite that it has trapped in its tentacles; below the nautiloid's eye is a spoutlike siphon that is used to expel water for jet propulsion. Two kinds of brachiopods live as suspension feeders on the seafloor. In the right foreground are trilobites of a type that left trace fossils, indicating a burrowing mode of life. In the central foreground, a starfish prepares to devour a bivalve by prying apart the shell halves with its sucker-covered arms; then, by extruding its stomach, the starfish can digest the bivalve within its opened shell.

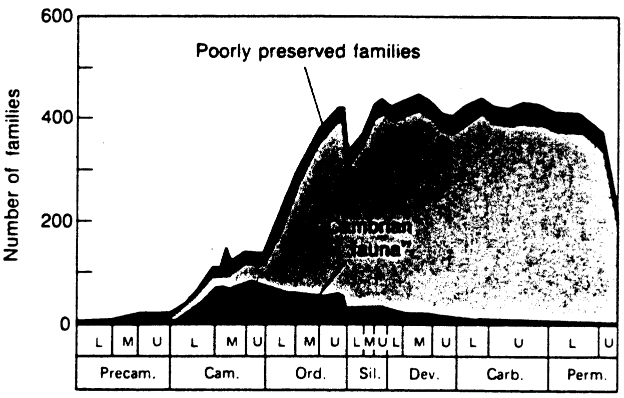
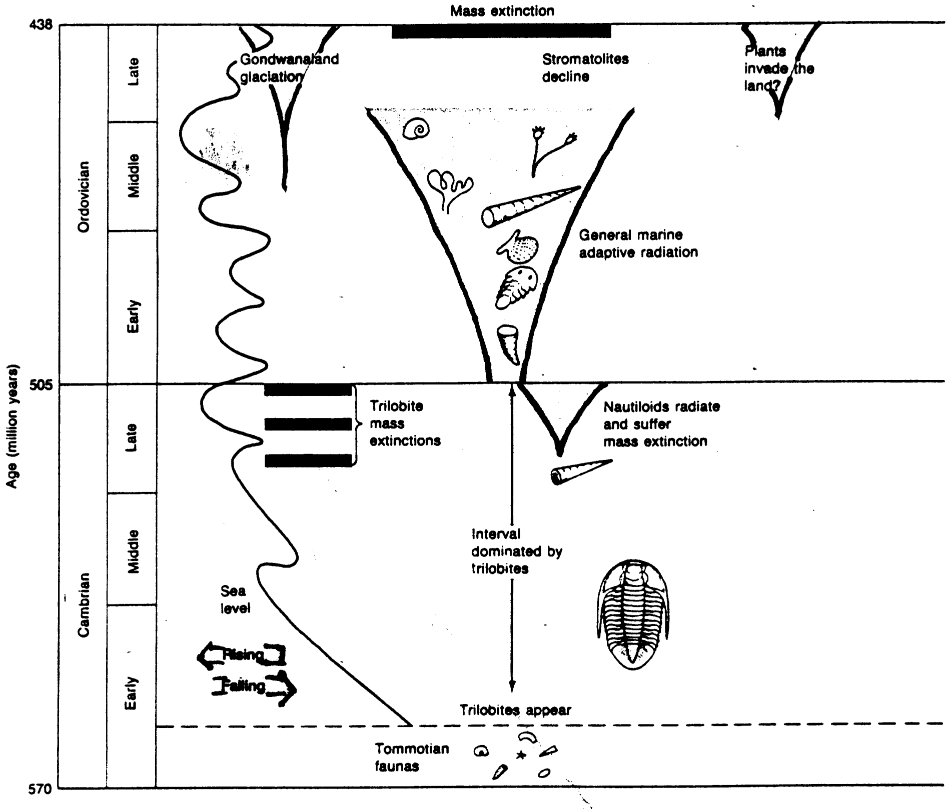


FIGURE 12-26 Changes in the number of families of marine invertebrates through the Phanerozoic Era. The "Cambrian fauna" consists of families that are found only in the Cambrian System or are best represented there. The expansion of life that produced the Cambrian fauna was followed by a new adaptive radiation in the Ordovician Period, and this Ordovician expansion produced a general level of diversity that was maintained until the end of the Paleozoic Era. *(After J. J. Sepkoski, Paleobiology 4:223–251, 1978.)*

Histor. Geologie (23): Kambrium, Ordovizium; Evolution etc.



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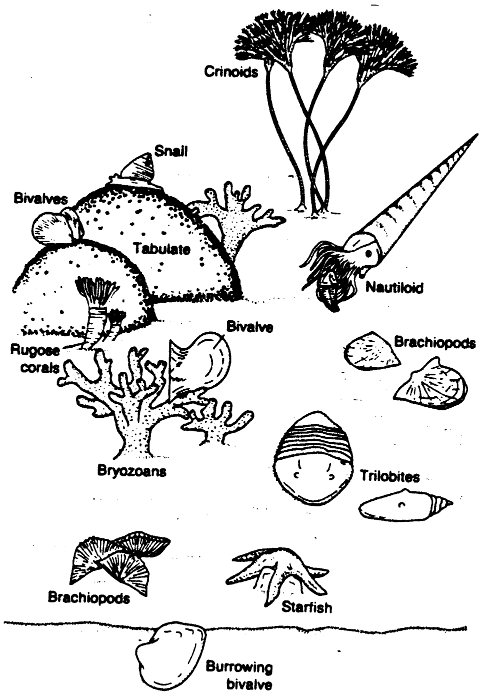

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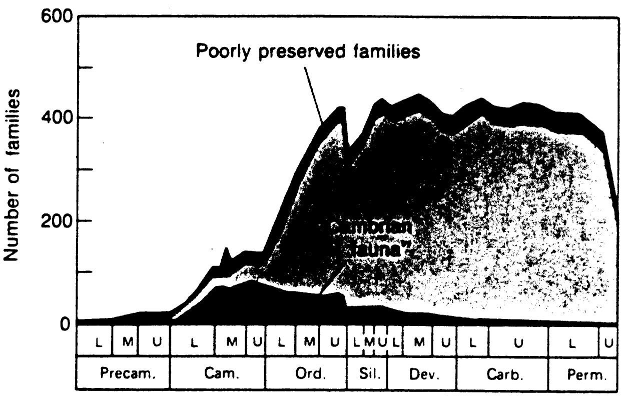

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Histor. Geologie (24): Paläogeographie, allg., Kambrium, Ordoviz

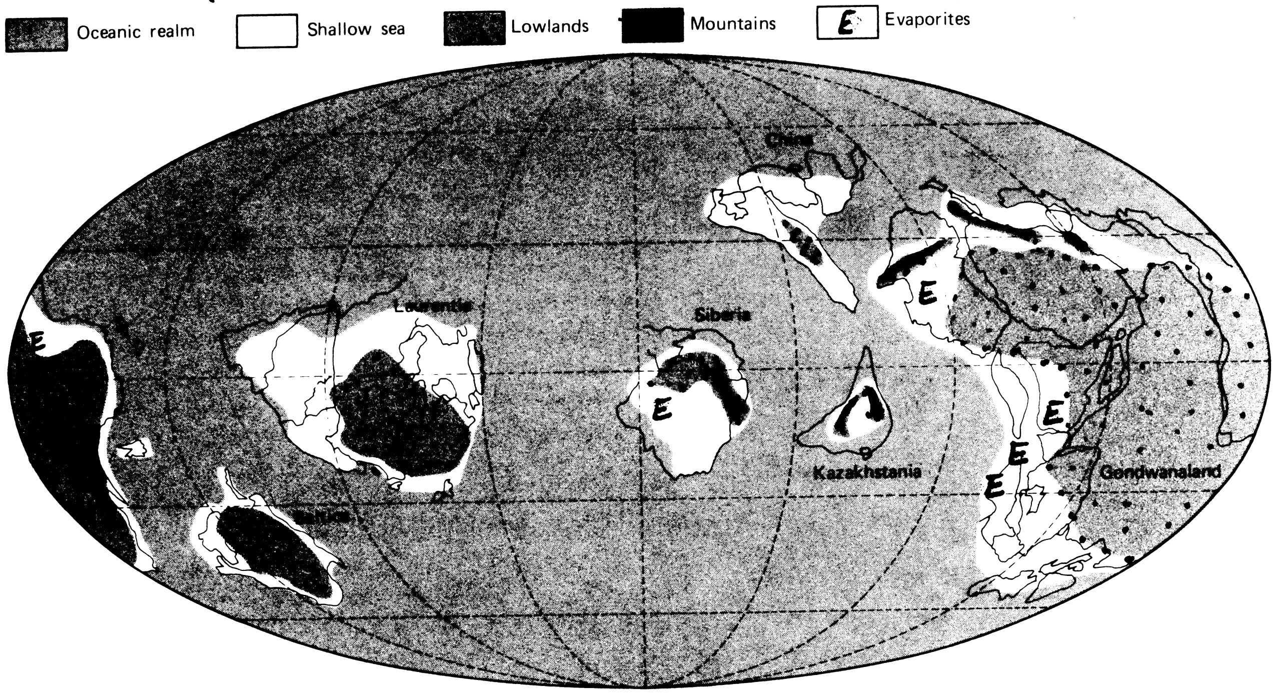


FIGURE 12-30 World paleogeography in Late Cambrian time. Continents were positioned at low latitudes, and many were inundated by shallow seas. *(After R. K. Bambach et al., American Scientist 68:26–38, 1980.)*

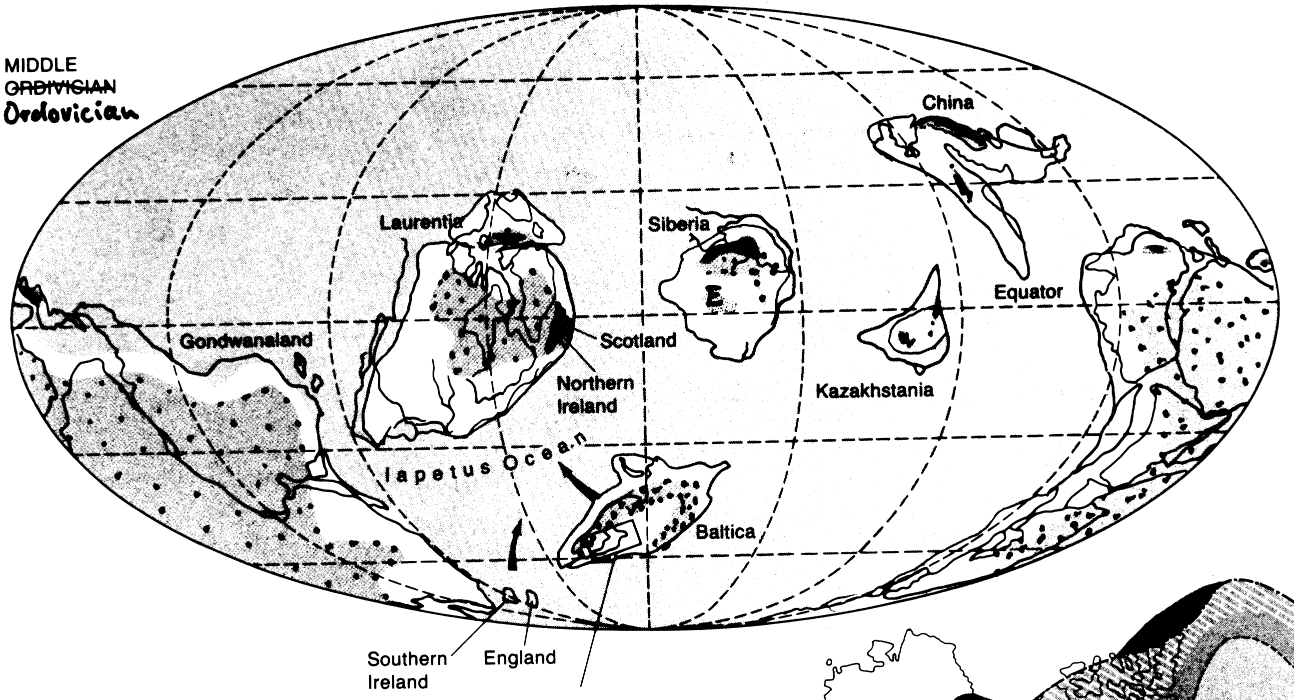


FIGURE 12-35 Movement of Baltica northward during the Ordovician Period. The map shows the paleogeography of the Middle Ordovician, and the large arrow shows the direction in which Baltica, southern Ireland, and England moved during Late Ordovician time.

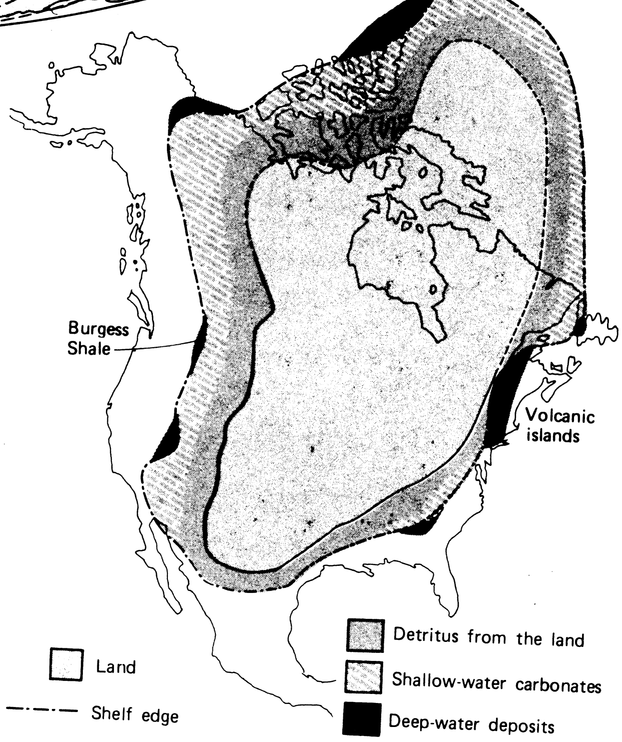


FIGURE 12-31 Concentric pattern of sediment deposition around the margin of Laurentia during Middle Cambrian time. Note the location of the Burgess Shale, renowned for its fauna of soft-bodied invertebrates, at the base of the Middle Cambrian continental shelf in western Canada. *(After A. R. Palmer, American Scientist 62:216–224, 1974.)*

Histor. Geologie (25): Kaledoniden 1

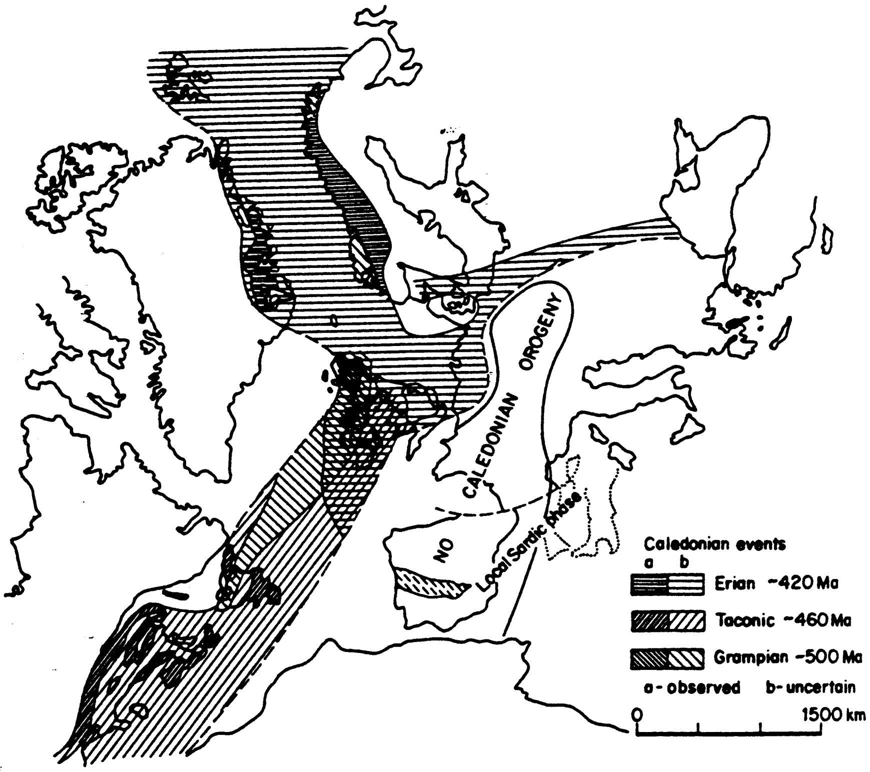


Fig. 13.1 The distribution of the three main tectonic events of Caledonian age in the North Atlantic region (after Zwart and Dornsieoen, 1980)

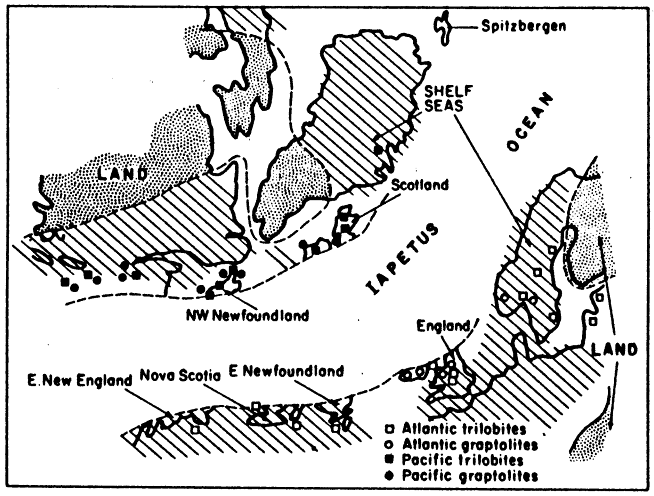


Fig. 13.2 Pacific- and Atlantic-type tribolites and graptolites in the shallow shelf seas bordering the Iapetus ocean in Cambrian–early Ordovician time (adapted from Cowie, 1974, with additional data from Cocks and Fortey, 1982)

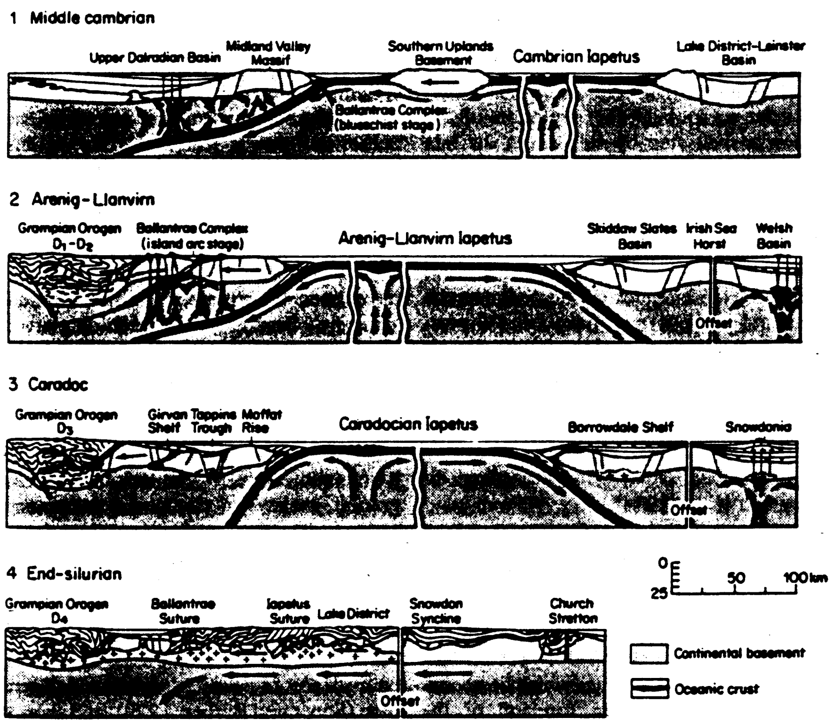


Fig. 13.5 A plate tectonic model to explain the evolution of the British Caledonides (after Watson and Dunning, 1979, in A. L. Harris *et al.* (Eds), *The Caledonides of the British Isles*, Scottish Academic Press, Edinburgh, Fig. 5, pp. 78–79)

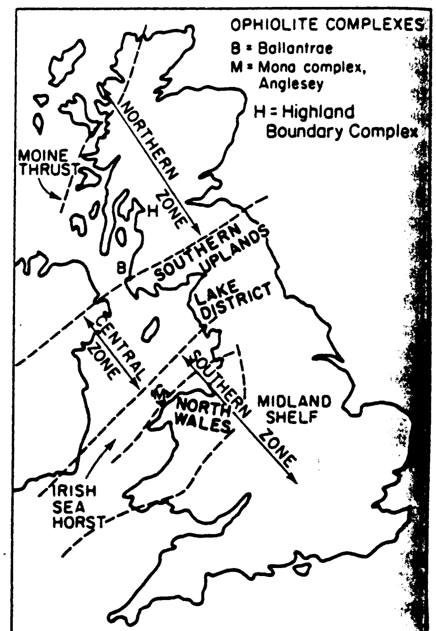


Fig. 13.4 Structural subdivisions of the British Caledonides with position of the Ballantrae, Highland Boundary and Anglesey ophiolite complexes

Histor. Geologie (26) : Kaledoniden 2

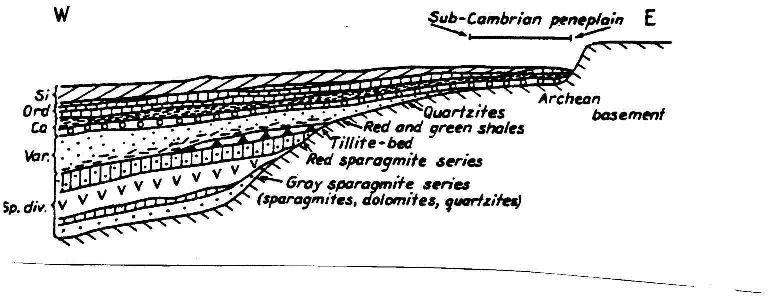


Fig.10. Schematic ideal sections of the sedimentary series of the Caledonides of Scandinavia. The Varegian is the equivalent of the upper sparagmite series of authors. Like the Paleozoic, it shows definite onlap over earlier series. There is often a nonconformity at its base. The tillite layers are normally found at this nonconformity, but may occur slightly higher in the series. (After Asklund, 1960.)

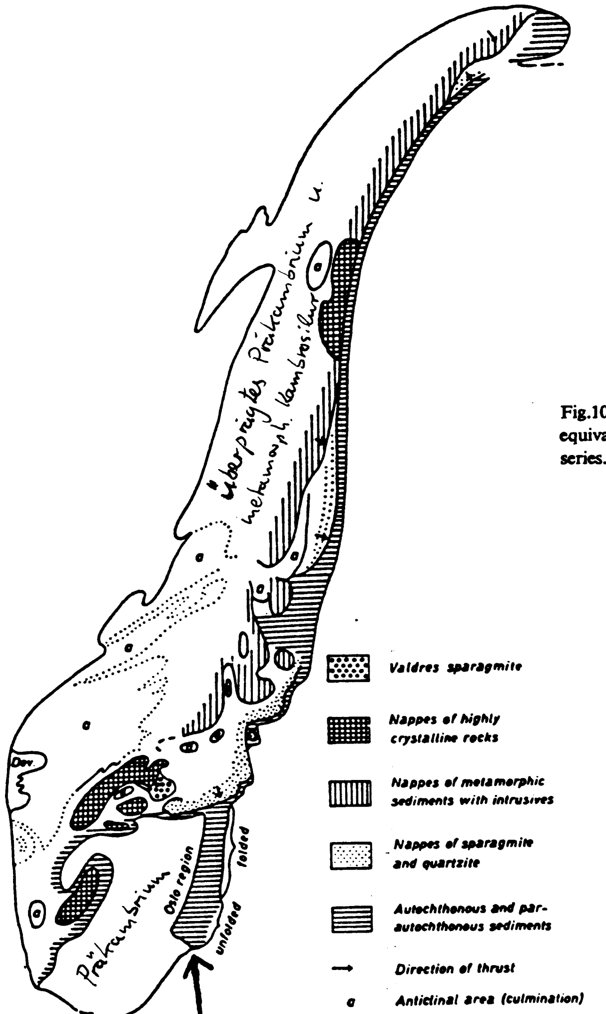


Fig.12. The main tectonic features of the Caledonides of Scandinavia. (After Holtedahl, 1960.)

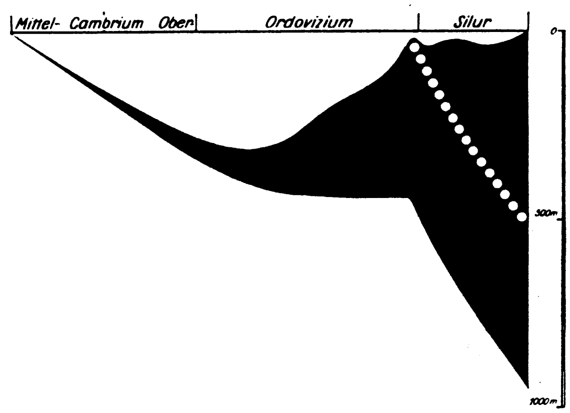


Fig.30. Oscillogram of the Cambro-Silurian of the Oslo region. Black area indicates accumulated sediment thickness. Upper white area indicates contemporary depth of the basin. White dots indicate the position of the conglomerate of zone *5* (Fig.29), at the base of the Silurian.

The diagram has been constructed under the assumption that the alum shales of the Cambrian represent deep water sediments. (After Seilacher and Meinschner, 1965.)

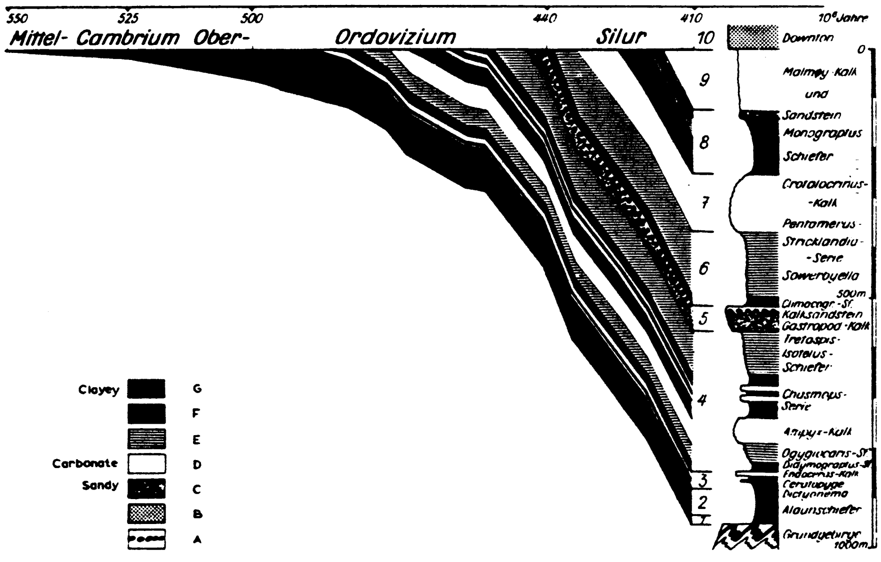
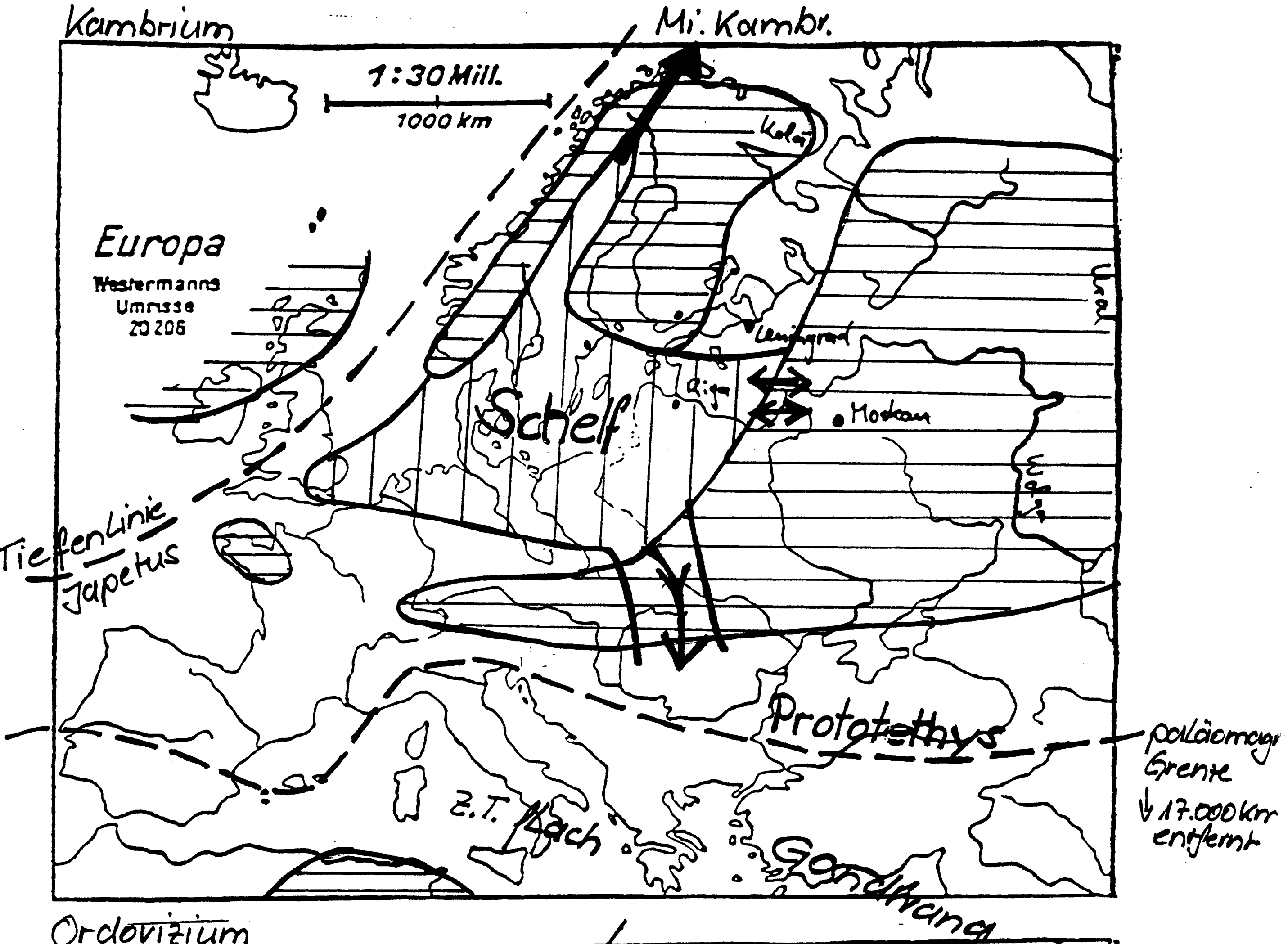


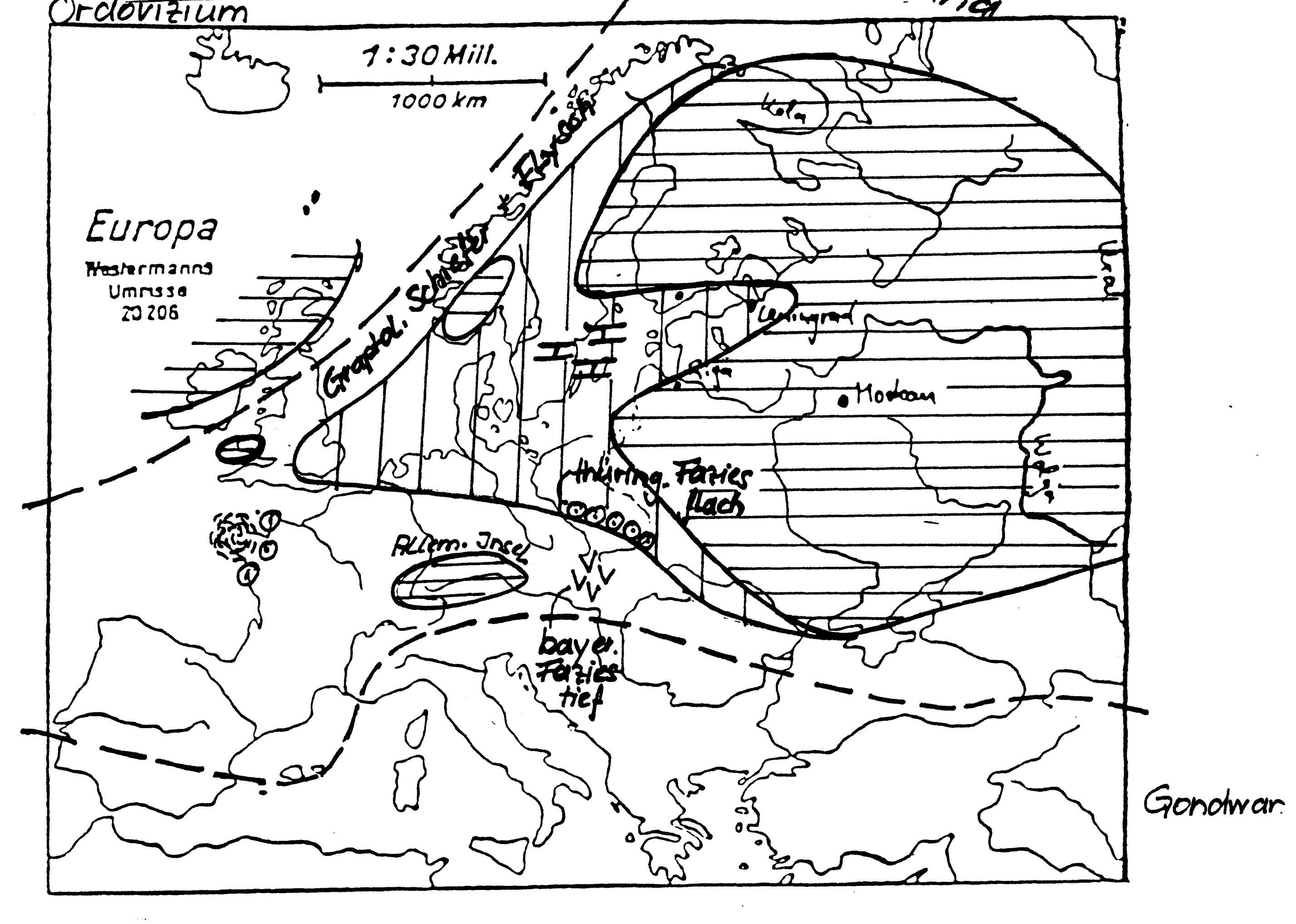
Fig.29. Sedimentation of the Cambro-Silurian of the Oslo region. Accumulated sediment thickness is presented against isotopic age. Under the assumption that all sediments shown were formed at or about sea level, this graph also presents an oscillogram of the Oslo region. *G* = clayey; *D* = carbonate; *C* = sandy. (After Seilacher and Meinschner, 1965.)

Hütor. Geologie (27): Kambrium, Ordovizium: Europa-Paläogeographie

Kambrium



Ordovizium



Histor. Geologie (28) – Kambrium, Ordovizium: Schichtfolgen

	Stufen	Z*	Trondheim	Schonen	Rheinisch. Schiefergeb.	Thüringen	Böhmen
Ordovizium	435 Mio J	16	Hovin Sdst 60m	Dalmanites Schiefer Staurocephalus-Sch.		50-300m Lederschiefer	Kosov-Quarzit Kraluv-Dvur-Sch. V ▲
	Ashgill	14		20-60m Obere		1-20m Oberer Erzhorizont	125 m
		13	Ekne-Ph	Dicellograptus-	260m Obere Tonschiefer	0-40m Lagerquarzit	Bohdalec-Schf. V V ▲
		12	Karlstad-Kalk	Mittlere			
	Caradoc	11		Ampyx-Kalk			Zahorany-Schf. V Vinice-Schf. V
		10	Hareklett-Schichten	Schiefer	300m Grauwacken Schiefer		Letná-Schf ▲V V
		9		Untere			Libeň Schf.
	Llandeilo	8	(Hovin-Gruppe 4000m)			~8m Unteres Erzlager	Dobrotivá-Schf. Skalka-Quarzit V
	Llanvirn	7	Hølanda- u Bjørkum Sch	1-30m Obere Didymograptus Schiefer	Untere Tonschiefer Plettenberger Banderschf.		10-300m ▲V Šarka-Schichten V V
		6	Stokkvola Kgl				
	Arenig	5	Trondh Ph	Orthoceren-Kalk		Griffelschiefer	0-300m ▲V
		4 3		4-25m Untere Didymograptus-Schiefer		Quarzitschf. Unt Erzhoriz	Klabava-Schf. V V
	Tremadoc		Grunsteine Jaspilite	1m Kalk mit Ceratopyge u Shumardia		-1400m Phykoden Schichten	Milina-Kieselschf.
	500 Mio J	2 1	(Støren-Gruppe 2500m) Dictyonema-Schiefer	10m Dictyonema-Schiefer		650m Frauenbach Serie (z T)	Sdst u Arkosen von Trenice

* Graptolithen-Zonen n ELLES & WOOD   V Vulkanite   ▲ Fe

Abteilung	Stufen Zonen	Wales	Schonen	Armorik. Massiv	Böhmen	Frankenwald	Lausitz
500 Mio J Oberkambrium	Acerocare	1200m Lingula Flags	20-60m Obere Alaun-Schiefer		500m Strašice Vulkanite	Frauenbach Serie (z T)	
	Peltura						
	Leptoplastus						
	Parabolina						?
	Olenus				Kongl.		
Mittelkambrium	Paradoxides forchhammeri	230m Menevian Group	Andrarum-Kalk 1-12m Untere Alaun-Schiefer	600-750m Rote Schiefer u Feldspat-führende Sandsteine	400m Schiefer v Jince u Skryje	100m Bergleshof Sch 150m Lippertsgruner Schichten 50m Triebenreuther Schichten 100m Wildenstein-Schichten 100m Galgenberg Sch Tiefenbach-Sch.	1000m Bober Katzb. Geb. Grunschiefer
	paradoxissimus		exsulans-Kalk				
	oelandicus	Solva Group					?
Unterkambrium	Protoleniden	Caerfai Group		Schiefer mit Stromatolithen	2500m Kongl Grauw Sandst.		Protolenus-Mgl.
	Olenelliden	2500m Harlech Grits	2m Grauwacken-Schiefer 3m Rispebjerg-Sandstein	Kalke		?	Eodiscus-Schf.
570 Mio J.	ohne Trilobiten		4m Norretorp-Sandstein 25m Hardeberga-Quarzit Brantevik-Sdst.	Rote Kongl. (assynt.	? Diskordanz)		Archaeocyath.-Kalke und Vulkanite ?

(28) - Zusatz

Zu Historische Geologie: Altpaläozoikum, Zusatz

Kaledoniden und Vorland in Norwegen / Südschweden

	Entwicklung im orogenen Gürtel	**randlich + Vorland**
O. Ordoviz + Silur	Flysch → Molasse	Graptolithenschiefer und Trilobitenschiefer; seltener Flachwasserkalke (z.B. Riffe in S. Schweden); viele Schichtlücken
M. Ordoviz	Flysch: Hovin-Gruppe oooooooooo Trondheim-Phase Vulkanitserie, v.a. Tuffite: Stören-Gruppe	
U. Ordoviz	Dictyonema-Graptolithenschiefer	
Kambrium	Alaunschiefer, z.T. Phosphorite (Alaun: $KAl_3(SO_4)(OH)_6$ (Gerbsalz, Sekundärprodukt aus Pyrit)	Alaunschiefer Kalke Sandstein

Paläotethys

	Thüringische Fazies ("flach")	**Bayerische Fazies ("tief")**
O-Ordoviz	Gräfenthaler Schichten: Eisenoolith Sandige Schiefer Eisenoolith (Chamosit)	Schiefer, z.T. Sandsteine
M. Ordoviz	Phycoden-Serie: sandige Schiefer	Basalte ("Diabase")
U.Ordoviz	Frauenbach-Serie: sandige Schiefer	Basalte und Schichtlücken
Kambrium	Grauwacken, Konglomerate, Tone, selten Tuffite	Schichtlücken; M.Kambrium: Schiefer

Rheinisches Schiefergebirge:
Ab Mittlerem Ordovizium: Schiefer, z.T. Sandsteine, sehr lückenhaft und reduziert; z.B. Plettenberger Tonschiefer.

Restliche Welt

Gondwana-Rand (z.B. Australien, Antarktis):

Kambrium: Sandsteine und/oder Kalke (z.B. Archaeocyathidenkalke), z.T. Evaporite
Ordovizium: oft Graptolithen-Schiefer
Arabische Länder: z.T. Sandsteinserie von Kambrium bis Unterkreide, mit Schichtlücken ("Nubischer Sandstein" i.w.S.)

Gondwana-Inneres: keine Sedimentation

Sibirische Plattform: Kalke, z.T. Evaporite und Sandsteine
"Angara-Gürtel": U.Kambrium: oft Archaeocyathidenkalke und Sandsteine, darüber Tone, Sandsteine, viele Tuffe und Vulkanite.