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**The Permian-Triassic
of the Gartnerkofel-1 Core
(Carnic Alps, Austria):
Foraminifera and Algae of the Core and the Outcrop Section**

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With 1 Text-Figure, 4 Tables and 1 Plate

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Zusammenfassung

Die Foraminiferen- und Algenfauna der Bohrung Gartnerkofel-1 tritt in zwei Assoziationen auf: Eine wird dominiert von *Globivalvulina* sp. und *Hemigordius* sp.; *Paraglobivalvulina* sp. und *Paradigmarita* sp. belegen ein oberpermisches Alter. Die andere wird charakterisiert durch eine kleinwüchsige Mikrofauna von Nodosariiden, *Cyclogyra* sp., *Earlandia* sp., Ostracoden, Mikrogastropoden und Echinodermen, die triadischen Alters ist.

Proben von der Reppwand liefern beide Assoziationen.

Abstract

In the faunas of core Gartnerkofel-1 two associations have been found: One is dominated by *Globivalvulina* sp. and *Hemigordius* sp.; *Paraglobivalvulina* sp. and *Paradigmarita* sp. prove an Upper Permian age. The second is characterized by a dwarf microfauna of nodosariids, *Cyclogyra* sp., *Earlandia* sp., ostracods, microgastropods and echinoderms; it is Triassic in age.

Samples from the Reppwand outcrop section yield both associations.

Explanatory Remarks

Table 1 is a complete list of foraminifers found in an examination of all of the thin sections from the Gartnerkofel-1 core and the Reppwand outcrop section.

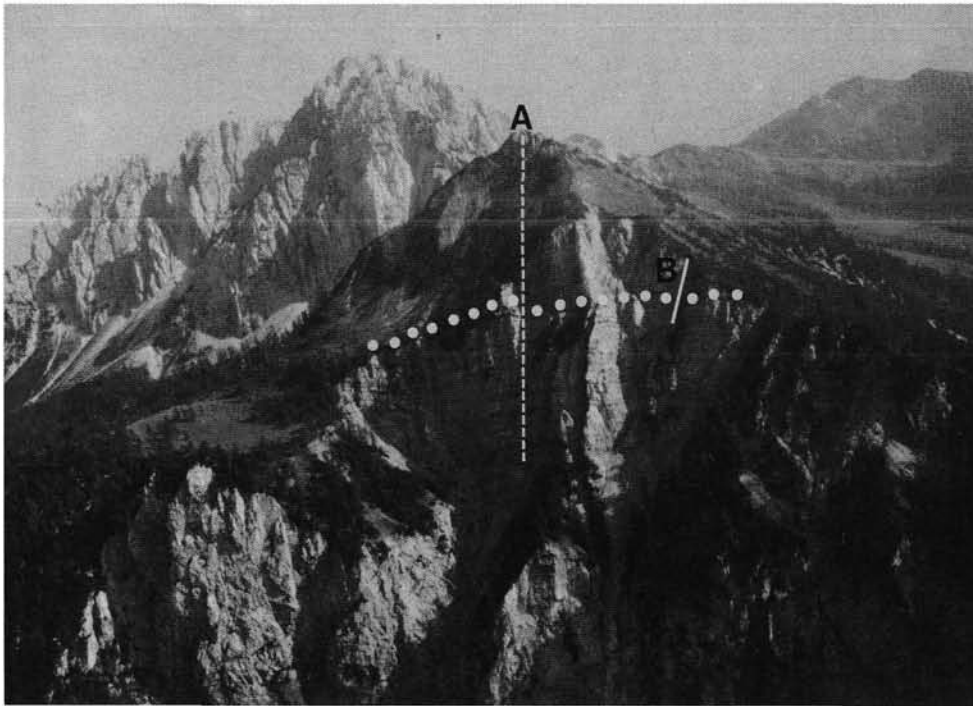
The microfauna is illustrated in Plate 1.

Two main associations of foraminifers, algae and other bioclasts can be recognized in the Gartnerkofel core (tables 2, 3) and the Reppwand outcrop (Table 4). The first of these associations, in samples 301 (330 m) to 206 (231 m) of the core is dominated by *Globivalvulina* sp. (Pl. 1, Fig. 9) and *Hemigordius* sp. (Pl. 1, Figs. 5-6).

This faunal association is typical for this region (C. BROGLIO LORIGA et al., 1988), but only *Paraglobivalvulina* sp. and *Paradigmarita* sp. prove an Upper Permian age. The absence of any Staffellids, which represent the Fusulinids in other sections in the Southern Alps (Dierico, Tesero, etc.) is important. The faunal association that is found, of long-ranging taxa, seems to be repeated at two or three levels in the core below 230 m to give a very thick section for this association (Table 2), a situation that has not been observed in other sections in the Southern Alps.

The second association, in samples 195 (223.94 m) to 137 (189.7 m) of the Gartnerkofel core and in sam-

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Text-Fig. 1.

Aerial photograph from the north of the Reppwand with the Gartnerkofel (2195 m) in the background. A: Drill site on Kammleiten (1998 m); B: Top of the outcrop section. Dotted line indicates the Permian-Triassic boundary between the Bellerophon Formation (below) and the Werfen Formation above. Photo: G. FLAJS, Aachen.

Table 1.
List of Permian-Triassic foraminifera in the Gartnerkofel-1 core and in the Reppwand outcrop.

<i>Earlandia</i> sp.
<i>Earlandia tintinniformis</i> (MISIK)
<i>Eotuberitina</i> sp.
<i>Nodosaria</i> sp.
<i>Geinitzina</i> sp.
<i>Geinitzina</i> gr. <i>postcarbonica</i> (S. DE CIVRIEUX & DESSAUVAGIE)
<i>Robulooides</i> sp.
<i>Fronkina</i> cf. <i>F. permica</i> S. DE C. & DESS.
<i>Ichtyolaria</i> sp.
<i>Dagmarita</i> sp.
<i>Paradagmarita</i> cf. <i>P. flabelliformis</i>
<i>Paradagmarita</i> cf. <i>P. monodi</i> LYS & MARCOUX
<i>Globivalvulina</i> sp.
<i>Globivalvulinoides</i> cf. <i>G. bulloides</i> (BRADY)
<i>Globivalvulina</i> cf. <i>G. kantharensis</i> REICHEL
<i>Paraglobivalvulina</i> sp.
<i>Neoendothyra</i> sp.
<i>Glomospira</i> sp.
<i>Meandrospira</i> sp.
<i>Agathammina</i> sp.
<i>Agathammina</i> cf. <i>pusilla</i> (GEINITZ)
<i>Cyclogyra</i> sp.
<i>Hemigordius</i> sp.
<i>Hemigordius</i> cf. <i>reicheli</i> LYS
<i>Lasiodiscus</i> sp.
Paleonubeculariids
<i>Planinvoluta</i> sp.

ples 28 (+4.0 m) to 88 (+57.7 m) of the Reppwand outcrop is characterized by a dwarf microfauna of nodosariids, *Cyclogyra* sp., *Earlandia* sp., ostracods, microgastropods (Pl. 1, Fig. 4) and echinoderms. This association is Triassic in age. The doubtful section of *Paraglobivalvulina* sp. in sample 161 (198.7 m) (Pl. 1, Fig. 1) of the Gartnerkofel core may be reworked.

Samples 4 (-3.1 m) to 11 (0.6 m) of the Reppwand outcrop may include both associations, with *Cyclogyra* sp., *Globivalvulina* sp. and *Hemigordius* sp. together in sample 11, but again without Upper Permian index taxa. In the critical interval of the outcrop section, from sample 12 (+0.02 m) to 26 (+3.8 m) no microfauna could be determined.

The microfaunal content of the Gartnerkofel core and the Reppwand outcrop is very poor in foraminifera and algae, both in numbers of individuals and in species diversity. What is more, many individuals are recrystallized, so as to preclude an easy determination. Nevertheless, the associations of microfauna determined in this thin-section study are consistent with the conodont zonation (SCHÖNLAUB, this volume) and with the assignment of the Permian/Triassic boundary within the basal Tesero Horizon (231-225 m in the core; 0.0-4.0 m in the outcrop).

Table 2.
List of foraminifera in all thin sections from the core and the outcrop section.

Depth [m]	Thin section no.	Dasycladacea	Mizzia sp.	Gymnocodiacea	Gymnocodium sp.	Tubiphytes obscurus	Earlandia sp.	Eotuberitina reilingerae	Geinitzina sp.	Geinitzina gr. postcarbonica	Fronkina sp.	Fronkina permica	Ichtyolaria sp.	Dagmarita sp.	Paradagmarita cf. flabelliformis	Paradagmarita cf. monodi	Globivalvulina sp.	Globivalvulina cf. bulloides	Globivalvulina aff. kantharensis	Neendothyra sp.	Glomospira sp.	Nodosaria sp.	Robuloides sp.	Agathammina sp.	Cyclogyra sp.	Hemigordius sp.	Hemigordius cf. reicheli	Palaeonubeculariidae	Planivoluta sp.	Meandrospira sp.	Paraglobivalvulina	Lasiodiscus sp.				
231.25	206	x				x																														
231.37	207	x																x								x										
231.72	208																															x				
233.08	209																		x																	
235.25	211																																			
235.77	212								x								x					x														
236.65	213															?		x																		
236.76	214							x									x																			
237.84	215																							x			x									
240.26	216																x										x									
240.90	217																					x					x									
241.89	218																x					x														
243.17	219	x																								x										
243.60	220	x															x									x										
244.28	221				x		x								x							x					x									
247.95	222																x																			
251.00	223																	x	x			x						x								
251.85	224																											x								
252.36	225																											x								
254.28	226	x						x					x				x					x						x								
255.65	227																										x									
256.54	228																x																			
256.97	229																										x									
257.35	230																																	x		
259.17	231																	x									x							x		
261.83	234																	x										x								
263.25	235																	x										x								
265.13	237										x							x						x				x						x		
267.46	239	x																									x								?	
269.75	240																	x																		
270.80	242																	x					x				x									
272.95	244																	x					x				x									
273.85	245																																			
276.30	246																																			
277.98	247							x		x								x																	x	
278.75	248													x																						
279.67	249							x																												
280.44	250	x						x																												
281.45	251							x										x																	x	
282.45	252			x				x										x									x		x							
285.05	254																																			
286.33	255							x																												
287.83	256							x																												
289.07	257							x																												
290.37	259								x		x																		x		x					
291.15	260																																			
191.26	261																																			
292.60	263																																			
293.46	264							x																												
295.29	266																																			

Table 2 (continued).

Depth [m]	Thin section no.	Dasycladacea	Mizzia sp.	Gymnocodiacea	Gymnocodium sp.	Tubiphytes obscurus	Earlandia sp.	Eotuberitina reitingerae	Geinitzina sp.	Geinitzina gr. postcarbonica	Fronkina sp.	Fronkina permica	Ichtyolaria sp.	Dagmarita sp.	Paradagmarita cf. flabelliformis	Paradagmarita cf. monodi	Globivalvulina sp.	Globivalvulina cf. bulloides	Globivalvulina aff. kantharensis	Neendothya sp.	Glomospira sp.	Nodosaria sp.	Robuloides sp.	Agathammina sp.	Cyclogyra sp.	Hemigordius sp.	Hemigordius cf. reicheli	Palaeonubeculariidae	Planinvoluta sp.	Meandrospira sp.	Paraglobivalvulina	Lasiodiscus sp.			
296.40	268			??																															
297.77	269				x	x				x									x							x									
298.05	270									x	x						x															x			
299.60	271						x				x						x															x			
299.92	272	x				x	x				x						x									x									
301.10	273					x	x										x					x													
303.15	274																																		
305.80	275	x										x																							
306.80	276																																		
307.55	277																																		
308.10	278																																		
310.02	279						x											?							x										
311.34	280				x					x								x				x		x		x	x								
312.10	281						x										x																		
315.16	285																																		
315.76	287						x															x													
317.53	289																																		
318.50	290																																		
321.43	292										x																								
324.80	296																																		
326.55	297																																		
327.31	298						x																											x	
328.06	299	x					x															x	x				x				x	x			
329.04	300						x	x			x																								
	301																																		

Table 3.
List of algae and other bioclasts from all thin sections of the core.

Depth [m]	Thin section	Earlandia sp.	Cyclogyra sp.	Nodosaria sp.	Paraglobivalvulina sp.	Gastropods	Ostracods	Echinoderms	Nodosariids
189.65	137		x						
190.00	139								
190.21	140		x				x		
190.50	141					x			
190.66	142						x		
191.53	145								
192.23	146								
192.90	147		x	x					
193.00	148								
193.55	149								
193.80	150								
194.33	151								
194.75	152					x			x
195.15	153								
195.38	154					x			
195.90	155								
196.23	156						x		
196.60	157								
197.05	158						x		

Table 3 (continued).

Depth [m]	Thin section	<i>Earlandia</i> sp.	<i>Cyclogyra</i> sp.	<i>Nodosaria</i> sp.	<i>Paraglobivalvulina</i> sp.	Gastropods	Ostracods	Echinoderms	Nodosariids
197.73	159								
198.36	160					x	x		
198.70	161				x		x		x
199.15	162								
199.45	163								
221.16	191A								
221.32	191B								
221.35	191C								
221.52	191D								
221.78	191E								
222.03	191F								
222.08	192								
222.13	192A								
222.25	193A								
222.35	194	x					x		
222.44	194A	x					x		
222.62	194B								
223.00	194C	x							
223.31	194D								
223.69	194E	?							
223.94	195		x				x	x	
224.02	195A					x			
224.35	195B	?							
224.52	196								
224.70	196A								
224.99	196B								
225.62	197A								
226.00	198								
226.10	198A								
227.00	198C								
227.46	199								
227.75	199A								
228.02	199B								
228.61	199D								
228.94	200								
229.19	201A								
229.65	202								
229.72	202A								
230.44	204B								
230.58	204C								

Table 4.
List of algae and other bioclasts from the Reppwand outcrop.

Height [m]	Sample No.	No micro-fauna	No thin section	Dasycladacea	<i>Earlandia tintinniformis</i>	<i>Agathammina cf. pusilla</i>	<i>Cyclogyra</i> sp.	<i>Geinitzina</i> sp.	<i>Globivalvulina</i> sp.	<i>Hemigordius</i> sp.	<i>Glomospira</i> sp.	Ostracods	Gastropods	<i>Spirorbis</i>
59.70	90	x												
56.70	87											x	x	
56.00	86	x												
55.50	85	x												
54.40	84	x												
53.40	83	x												
52.60	82	x												
51.80	81	x												
50.60	80	x												
49.60	79	x												
48.60	78	x												
47.60	77	x												

Table 4 (continued).

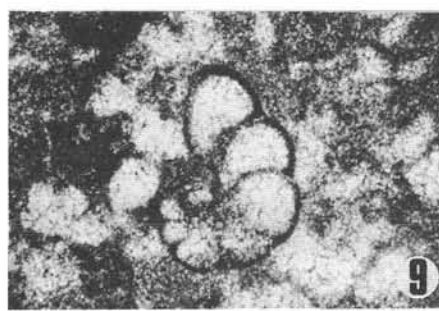
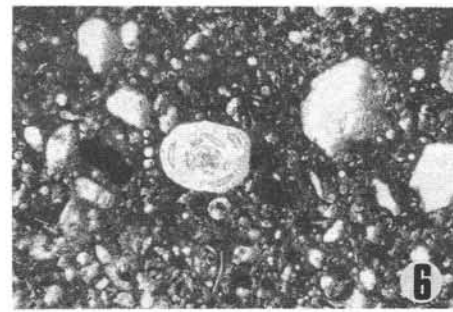
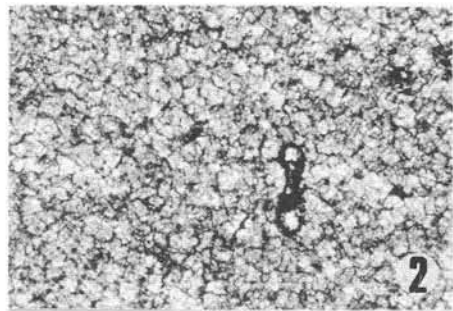
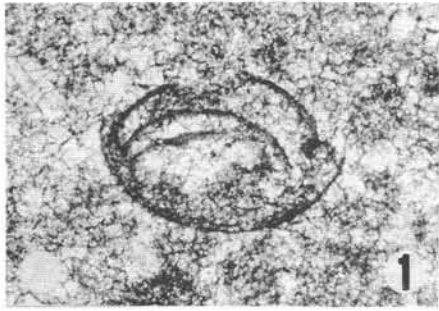
Height [m]	Sample No.	No micro-fauna	No thin section	Dasycladacea	<i>Earlandia tintinniformis</i>	<i>Agathammina cf. pusilla</i>	<i>Cyclogyra</i> sp.	<i>Geinitzina</i> sp.	<i>Globivalvulina</i> sp.	<i>Hemigordius</i> sp.	<i>Glomospira</i> sp.	Ostracods	Gastropods	<i>Spirorbis</i>
46.60	76	x												
45.60	75	x												
44.50	74	x												
43.40	73	x												
42.40	72	x												
41.40	71	x												
40.40	70	x												
39.40	69	x												
38.20	68										x		x	
37.20	67											x		
35.70	66	x												
34.20	65											x		
32.70	64	x												
31.20	63	x												
29.70	62	x												
28.20	61	x												
26.70	60										x			
25.20	59	x												
23.70	58											x		
22.20	57	x												
20.70	56	x												
17.70	54	x												
16.20	53	x												
14.70	52						x							
13.20	51	x												
11.70	50	x												
8.70	48	x												
8.20	47	x												
8.10	46	x												
8.00	45	x												
7.80	44	x												
7.00	43	x												
6.90	42	x												
6.70	41	x												
6.50	40	x												
5.80	38	x												
5.50	37	x												
4.80	36											x		
4.60	35	x												
4.50	34													x
4.45	33	x												
4.20	30	x												
4.10	29				x							x		
4.00	28				x							x		
3.80	26	x												
3.40	25		x											
3.00	24	x												
2.70	23	x												
2.30	22	x												
1.90	21		x											
1.60	20	x												
1.50	19													
1.30	18		x											
0.90	17	x												
0.59	16		x											
0.47	15	x												
0.37	14	x												
0.19	13	x												
0.02	12		x											

Table 4 (continued).

Height [m]	Sample No.	No micro-fauna	No thin section	Dasycladacea	<i>Earlandia lintinniformis</i>	<i>Agathammina cf. pusilla</i>	<i>Cyclogyra</i> sp.	<i>Geinitzina</i> sp.	<i>Globivalvulina</i> sp.	<i>Hemigordius</i> sp.	<i>Glomospira</i> sp.	Ostracods	Gastropods	<i>Spirorbis</i>
- 0.60	11					x	x	x	x	x				
- 0.80	10			x							x		x	
- 0.90	9						?				?			
- 1.20	8										x			
- 1.70	7										x			
- 2.00	6										x			
- 2.40	5	x												
- 3.10	4										x	x		

Plate 1

- Fig. 1: ***Paraglobivalvulina* sp.?**
Doubtful section in reworked deposit.
Samples 161 (198.7 m). Scale 400 μm .
- Fig. 2: ***Cyclogyra* sp.**
Sample 52 (127.1 m). Scale 200 μm .
- Fig. 3: ***Earlandia* sp.**
Sample 296 (324.8 m). Scale 300 μm .
- Fig. 4: **Microgastropod?**
Sample 159 (197.7 m). Scale 800 μm .
- Fig. 5: ***Hemigordius* cf. *H. reicheli* Lys.**
Sample 215 (237.8 m). Scale 150 μm .
- Fig. 6: ***Hemigordius* cf. *H. reicheli*.**
Section perpendicular to this one on Fig. 5. Sample 252 (281.5 m). Scale 1000 μm .
- Fig. 7: ***Fronkina permica* S. DE C. & DESS. and ostracods.**
Sample 275 (305.8 m). Scale 400 μm .
- Fig. 8: ***Agathammina* sp.**
Sample 215 (237.8 m). Scale 200 μm .
- Fig. 9: ***Globivalvulina* cf. *G. bulloides* (BRADY).**
Sample 287 (315.8 m). Scale 300 μm .
- Fig. 10: ***Glomospira* sp.**
Sample 229 (328.1 m). Scale 400 μm .



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