Faunal and environmental changes through the Cretaceous-Paleogene boundary (K-Pg) linked with Deccan Volcanism: evidence from the Neo-Tethys, Turkey

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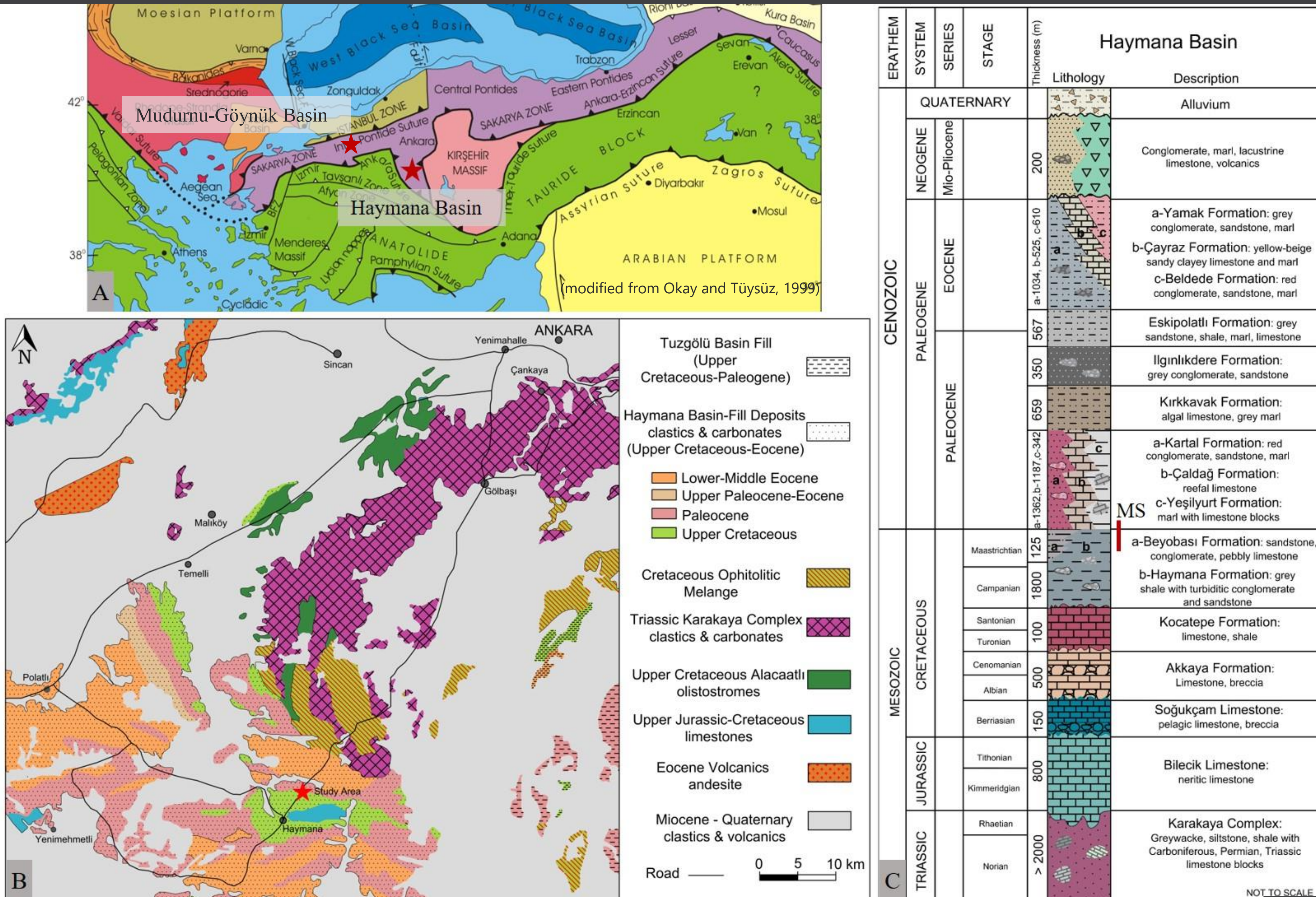
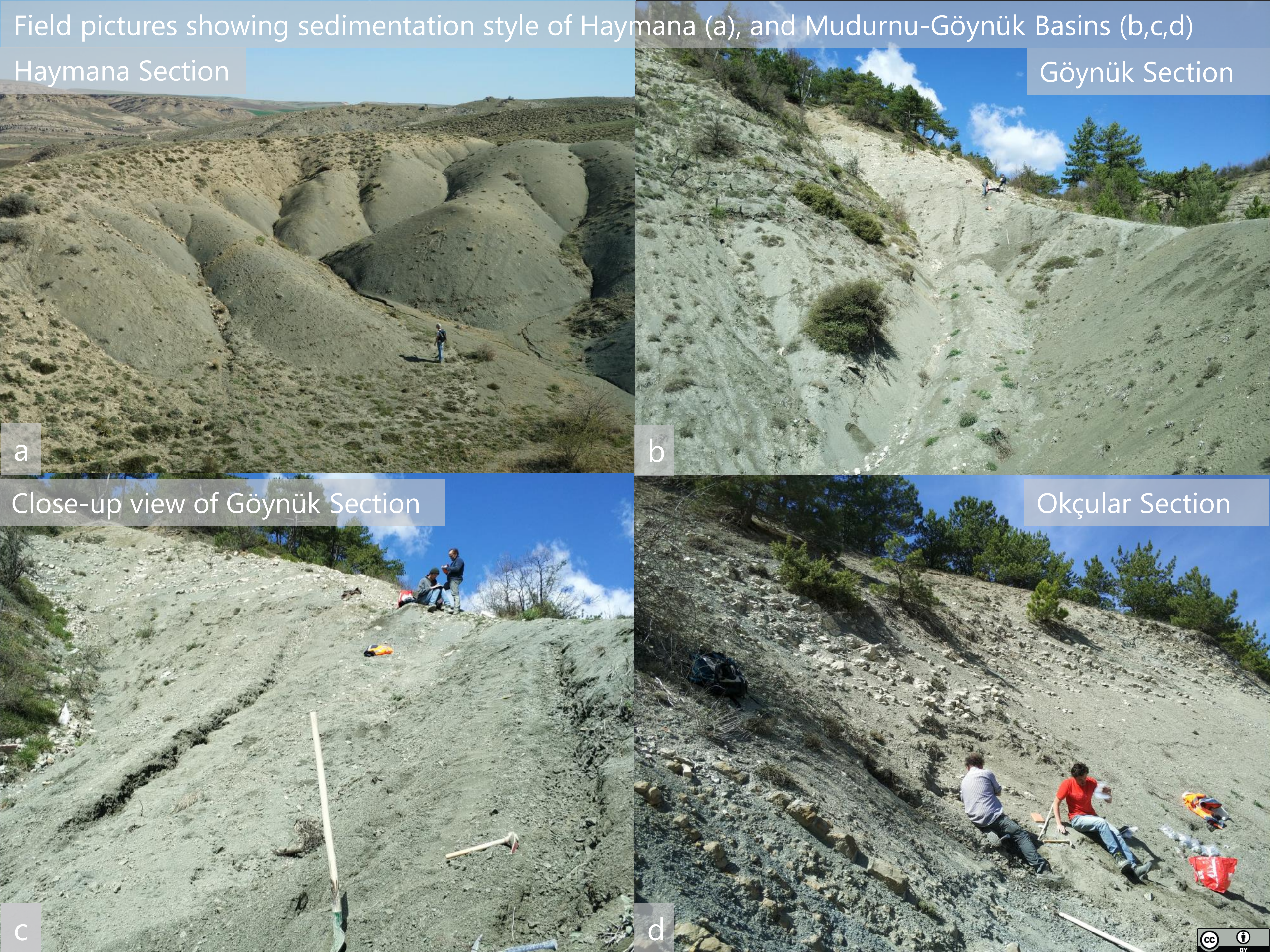
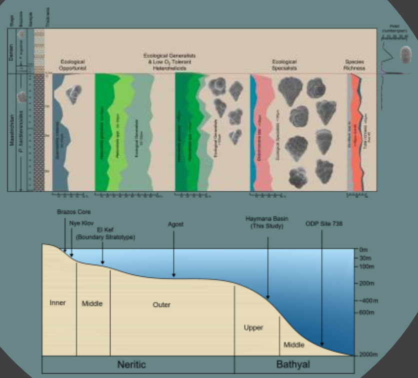
This presentation focuses on the work carried out in the Haymana Basin

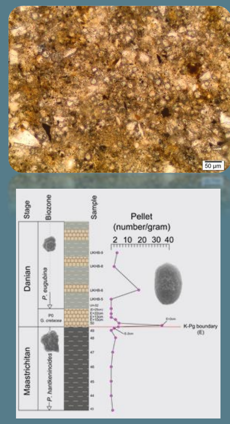



Field pictures showing sedimentation style of Haymana (a), and Mudurnu-Göynük Basins (b,c,d)
Haymana Section
Göynük Section
Close-up view of Göynük Section
Okçular Section
a
b
c
d

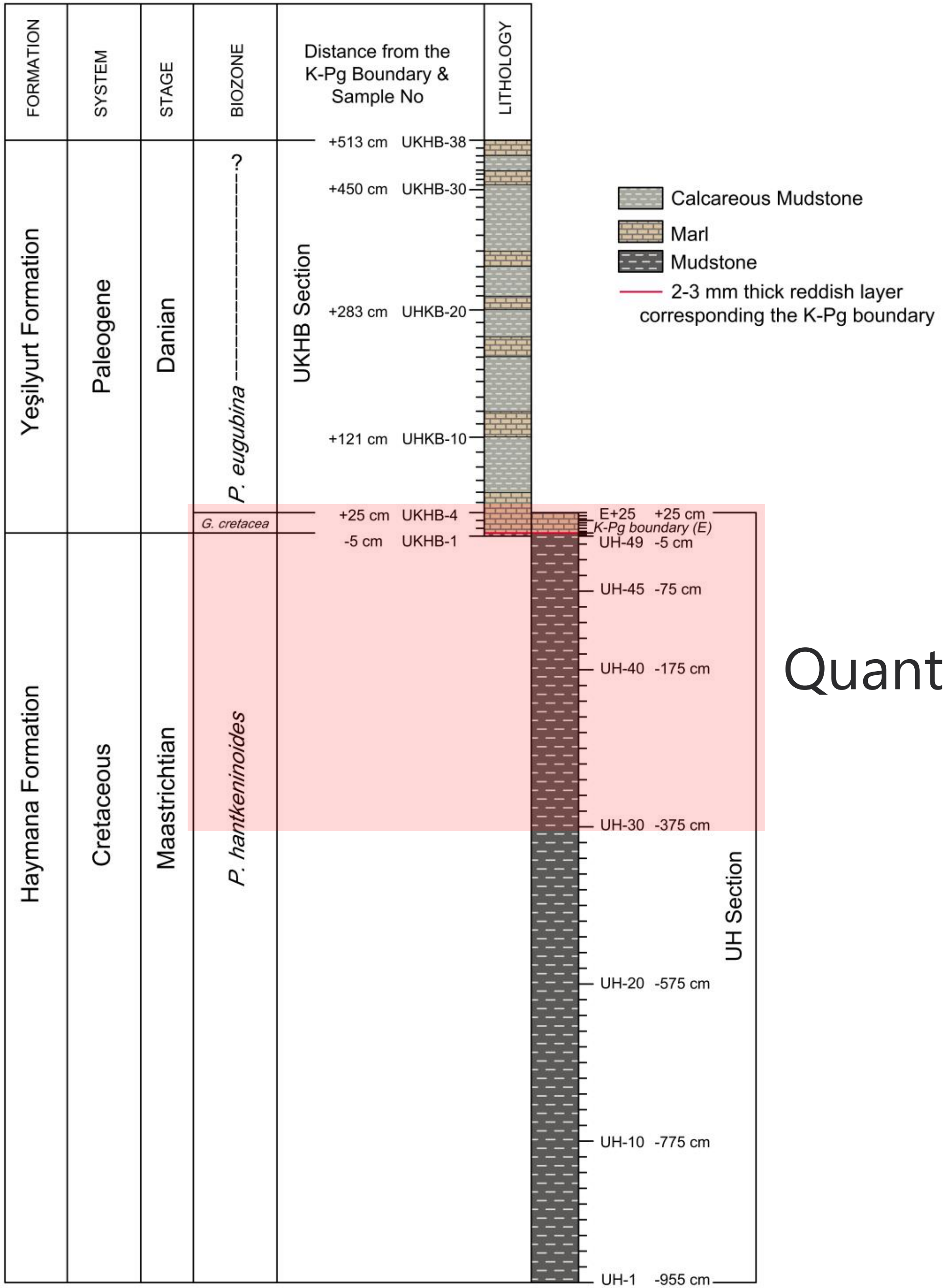
Outline of the work on Haymana Basin



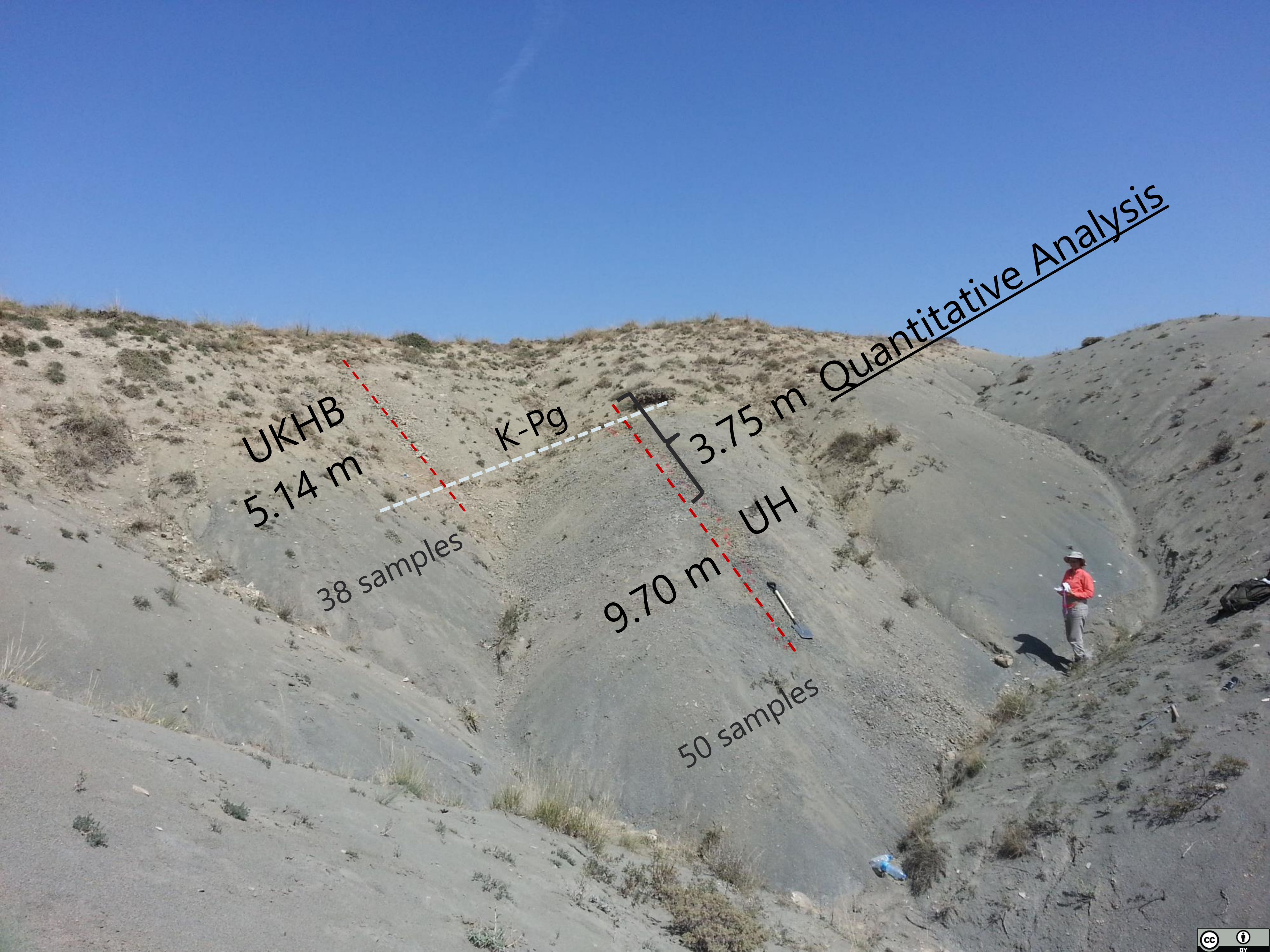
- Quantitative analysis: 63-150 µm & >150 µm
- Relative Abundances and Species Richness
- Paleobathymetric Analysis



- Events across the K-Pg boundary



Quantitative analysis

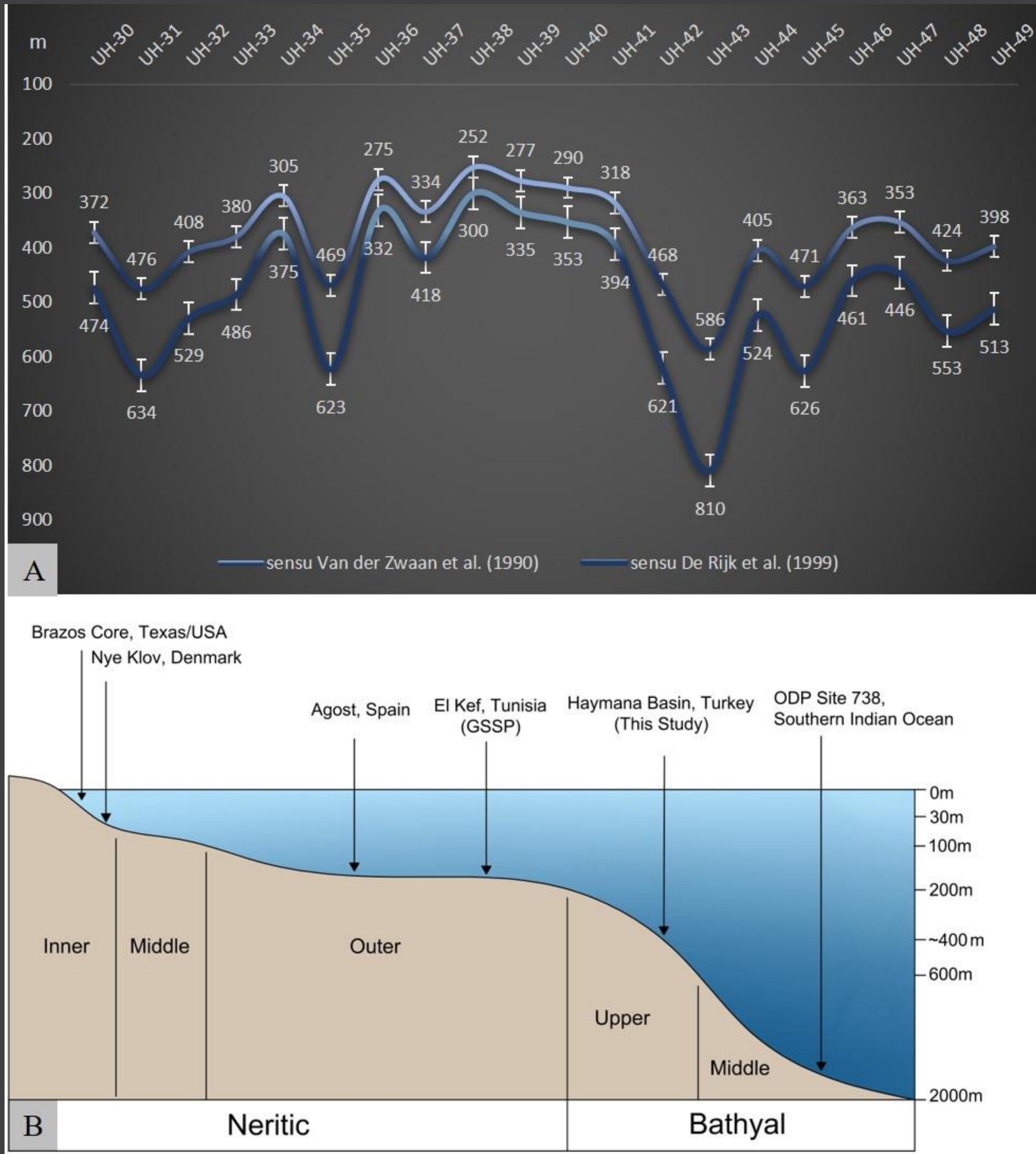


Quantitative Analysis
UKHB
5.14 m
K-Pg
3.75 m
UH
9.70 m
38 samples
50 samples


Paleocene
K-Pg boundary
Cretaceous

Paleobathymetric Calculation

Planktic/Benthic Ratio	$\%P = \left(\frac{P}{P+B}\right) \times 100$	Ave. Depth
Van der Zwaan *et al.* (1990)	$Depth(D) = e^{3.58718+(0.03534*\%\mathrm{P})}$	381m
De Rijk *et al.* (1999)	$Depth(D) = e^{(\%P+81.9)/24}$	490m



A) Paleobathymetric variations (depth in meters) through Maastrichtian are based on formulas of: Van der Zwaan et al. (1990) (upper graph), De Rijk et al. (1999) (lower graph). White bars represent standard errors. Paleobathymetric calculations revealed 400 m paleodepth for our study area corresponding upper bathyal zone.

B) Paleodepth of the study area in the Haymana Basin and its comparison with worldwide K-Pg boundary sections. Image modified after MacLeod and Keller (1994) and Molina et al. (2006 and references therein).

Quantitative Analysis

- 63-150 μm & >150 μm size fractions
- Relative abundance and species richness changes across the K-Pg boundary

Quantitative Analysis

Population at >150 µm fraction

- 394 individual count per sample
- Average 40 species richness

System	CRETACEOUS																				PALEOGENE			
Biozone	*P. hariaensis*																				P0			*P. eugubina*
Sample No	UH-30	UH-31	UH-32	UH-33	UH-34	UH-35	UH-36	UH-37	UH-38	UH-39	UH-40	UH-41	UH-42	UH-43	UH-44	UH-45	UH-46	UH-47	UH-48	UH-49	E+2cm	UH-50	UH-51	UH-52 (UHKB-4)
Split No	5 split	5 split	5 split	5 split	5 split	5 split	5 split	6 split	5 split	5 split	5 split	5 split	5 split	6 split	5 split	6 split	5 split	6 split	6 split	6 split	2 split	no split	no split	
Guembelitria cretacea		1	1	7	1	5	2	4	2	12										1				
Globotruncana aegyptiaca	4	4	3	6	7	4	1		1			1			2	5		2			3			
G. arca	3	5	6	8	2	3		1				3	7	1	4	7	7	4	2		1			
G. bulloides										1										1				
G. dupeublei			1	2		1	1			1	1		2		1									
G. esnehensis	13	2	4	12	4	4	4		1	9	11	2	2	5	11	4	6	9	2		1			
G. falsostuarti	1	3	3		4		3	1	4	1	3		2	2	1		3	1	1		1			
G. lapparenti				1																				
G. linneiana									3															
G. hilli	1	1		1					1	1	2	9	1											
G. mariei	8	6	14	6	6	4	1	3		7	1		1	1	2	12	10	1	6		2			
G. orientalis	5	1	3	5	8	4	2	4			3	1	1	1	1	8	1	2	2				1	
G. rosetta			2	1			2	2	3	2	1		1	1	3	1			4	1	2		2	
G. ventricosa							2	1				2	1		1									
Globotruncana sp.	7	5	12	7	3	7	5	3	5	7	9	7	6	5	13	10	9	8	4	3	3			
Globotruncanita angulata	3	1		1	5	1	1	1	5	2						2								
G. conica			1			1		1	1							1								
G. insignis	4			1			3	4	4	9	2	9	6	1	8	1		1	1		3			
G. pettersi	7	9	7	11	10	15	6	6	5	8	3	3	2	5	4	4	15	5	5	2	6			
G. stuarti		1		1		1		1			4		1				3		1		1			
G. stuartiformis	4	1	2	1	2		1	1	3	3	1	3	1	3	1	2	1	3	2					
Globotruncanita sp.	1			4	5	7	4	6	4	5	1	3	2	3		1	2		1		2			
Contusotruncana contusa																								
C. patelliformis	1	3		1	1												3				1			
C. plummerae																			1					
C. fornicata																								
C. plicata																2								
C. walfischensis																								
Contusotruncana sp.									2															
Globotruncanella pschadae	2	2	2	2	2	6			2	2			2	2		2			5		1			
G. havanensis	15	7	7	6	18	9	1	5	4	5	4	3	1	1	2	2	2	4	5	1	1		1	
G. petaloidea	3	9	6	7	4	1	2	1	1	5	1	2	2		3	1	2	1	2	2	3		1	
G. minuta	1	3	1		2	1		1	1	2	3				1									
Globotruncanella sp.	2		2	1	4	1	3	1	1	4	3	1	1				1	1						
Gansserina gansseri		1		1																				
G. wiedenmayeri		2		1										1				2						
Rugoglobigerina rugosa	11	5	6	3	7	11	2	1	9	3	4	10	3		1	1	1		4	3	1			
R. hexacamerata			2						3		1	4												
R. macrocephala				1				1	3	1		1							1					
R. milamensis	3	1	1	1	1	2		1																
R. pennyi	2	1	1	3	2	3			2				1					1	1					
Rugoglobigerina sp.	1		3	2		1	1	2	1	1	1	1									2			
Trinitella scotti	4	1	1	1			3	1	2	4	5	2						1			1			
Kuglerina rotundata	1																							
Archaeoglobigerina blowi	6		1	2	5	3	6	10	7	2	11	1	4	1	2	13	16	8	4	1				
A. cretacea									1							1								
A. australis	1									3	2	1	2			2	2	5						
Archeoglobigerina sp.					2	1										3	4	2						
Plummerita reichelli	3		1		1				1			1			1									
Plummerita hantkeninoides	1											1												
Plummerita sp.					1	3			2	1		3		1										
Muricohedbergella holmdelensis	2	1		3	3	1			3				2	1		1					2			
M. monmouthensis	4	1	3	5	2	2	2	1	1	2	2		2				2	1	2	2	6			
M. sliteri				1							1													
Muricohedbergella sp.	1		1			1		1	1															
'Globigerinelloides'' multispinus	4	18	23	21	7	5	1	2	1	4		4	5		4	1		3	4					
'G.'' subcarinatus	10	14	7	6	3	12	1		4	3		3	6	2	5	3	2	4	2	4	2	1		
'G.'' prairiehillensis								1	3	4		5	1		1			2	3		1	1		
'G.'' asper	9	9	5	4	2	6			1	6		5	4	5	4	5		3	1	3	5	1	3	
'G.'' alvarezi			1			2	2	1	1	1	1	1	2	1	3	1		1	1					
'G.'' rosebudensis	3	3	1		1								2	1		1								
'G.'' mendezensis									1															
'Globigerinelloides'' sp.	19	30	12	28	19	24	23	10	16	12	7	10	16	10	16		4		4		1		1	
Heterohelix globulosa	111	120	92	113	62	77	37	28	50	85	67	93	126	58	95	65	95	54	75	77	4	11	2	
H. labellosa	16	11	10	7	20	4	1	2	9	12	12	20	5	5	1	4	6	6	4				1	
H. navarroensis	1	1	2	1		3		1		4			9	1	2		1	4	3	2	1		2	
H. planata	12	12	15	22	6	31	21	18	10	11	8	15	9	9	16	10	8	10	8	5	2		1	
H. punctulata	31	24	26	16	16	25	10	10	16	6	2	12	13	8	12	12	7	3	4	10	1	1	1	
Heterohelix sp.	39	49	44	34	45	53	20	23	31	68	23	51	41	34	38	37	35	36	27	28	34	8		
Laeviheterohelix dentata	1	5	4	2	7	6	5	3	1	2	1		2	3	2	2	1	4	1	3	1			
L. glabrans	6	10	1	3	4	17	5	2	1	2		1				1	1		1	3	1			
Pseudotextularia elegans	12	12	21	9	4	8	10	4	6	11	7	15	6	1	1	13	3	3	6	3	1	4		
P. nuttalli	41	69	31	20	14	19	11	4	14	11	17	38	24	24	29	17	37	14	23	13	2	8	2	
P. intermedia	10	4	5	8	3	3	3		2	7	5	6	3	1	3	7	7	1	4	1	1	2		
Pseudotextularia sp.	6	6	5	8		7	3	3	7	3	3	1		1	2	8		4					1	
Planoglobulina acervulinodes	11	8	11	1	6	1	1	2	3	3	3	1	2	3	6	3	5	5	5			2		
P. brazoensis	2	3	3	2		1	2	3	5	4	1	5	5	6	5	3	3	3	3	5	3	1		
P. carseyae	28	24	20	12	6	6	8	6	3	11	10	12	11	5	16	13	12	3	11	6	2		1	
P. multicamerata															1									
Planoglobulina sp.	2	14	9	4	2	3	3	3	5	4	4	5	5	3	12	8	9	6	7	4	9			
Pseudoguembelina costulata				2		1			1	1	1		1	1	2									
P. excolata																								
P. hariaensis	2	1	3	5	8		2	1	3	4	1	1	4		2	1	2	1	6	2				
P. kempensis																								
P. palpebra	1		1	3		2		5	4				1	2	4	1		2	2	1	1			
Gublerina acuta																								
G. cuvilleri		3										1			1								1	
Racemiguembelina powelli	3	2	2			1	1					3	1				1							
R. fructicosa	2			2	1					1	2	1	2	1										
Abathomphalus intermedius													1						2					
A. mayaroensis		2			1	6				2						5					1			
Hartella harti						1	1			2														
Unidentified planktonic foraminifer	69	81	54	55	27	51	37	29	26	59	72	71	63	74	74	86	91	42	56	60	58	34		
Total Count	**576**	**612**	**505**	**504**	**376**	**478**	**266**	**226**	**313**	**446**	**327**	**454**	**426**	**294**	**419**	**393**	**420**	**276**	**319**	**247**	**174**	**74**	**21**	
BENTHIC COUNT	**297**	**227**	**231**	**253**	**247**	**181**	**197**	**133**	**256**	**328**	**228**	**284**	**162**	**79**	**194**	**148**	**223**	**152**	**139**	**117**				
Estimated Depth (m) by formula of Van der Zwaan et al. (1990)	372	476	408	380	305	469	275	334	252	277	290	318	468	586	405	471	363	353	424	398				
Average Depth (m)	**381**																							
Estimated Depth (m) by formula of De Rijk et al. (1999)	474	634	529	486	375	623	332	418	300	335	353	394	621	810	524	626	461	446	553	513				
Average Depth (m)	**490**																							
Species Richness	48	46	45	50	40	43	38	39	47	45	36	39	47	33	41	40	31	36	40	24	8*	3*	4*	
Average richness before K-Pg	40																							

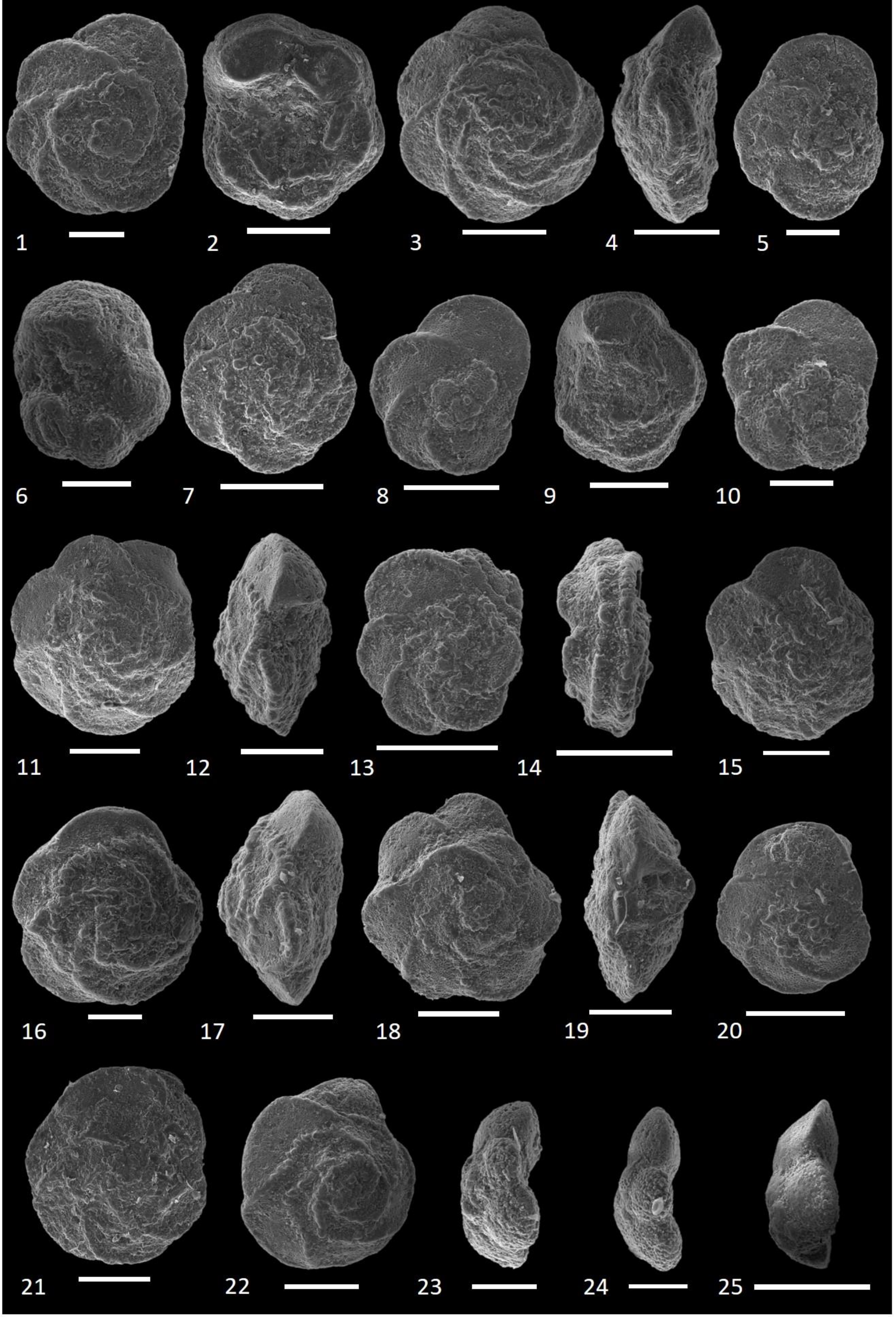
Quantitative Analysis

Population at 63-150 µm fraction

- Average 380 individual per sample
- Average 15 species richness

System	CRETACEOUS																				PALEOGENE			
Biozone	*P. hantkeninoides*																				P0			*P. eugubina*
Sample No	UH-30	UH-31	UH-32	UH-33	UH-34	UH-35	UH-36	UH-37	UH-38	UH-39	UH-40	UH-41	UH-42	UH-43	UH-44	UH-45	UH-46	UH-47	UH-48	UH-49	E+2cm	UH-50	UH-51	UH-52 (UHKB-4)
Split No	10 split	10 split	10 split	10 split	11 split	11 split	10 split	11 split	10 split	10 split	9 split	10 split	10 split	11 split	11 split	11 split	11 split	12 split	11 split	12 split	9 split	no split	no split	
Guembelitria cretacea	100	98	87	96	49	41	91	68	135	98	127	46	38	35	46	27	35	33	156	71	83			
Globotruncana hilli																		1						
Globotruncanita pettersi	1						2									1				1				
Globotruncanella citae	1	1		1				1	1															
G. havanensis	2	2									1						1							
G. petaloidea																2								
G. minuta		5	5	1	2	1	1	1	6		3		2				1	1		2				
Globotruncanella sp.	1								1				1	1		2	4							
Rugoglobigerina hexacamerata		1																						
R. macrocephala		1																						
Archaeoglobigerina blowi																1								
A. cretacea																	1							
Plummerita hantkeninoides	1																							
Muricohedbergella holmdelensis	6	5	11	4				2		1						11	3				1			
M. monmouthensis	6	2	1	2					1	1						2	4				2			
Muricohedbergella sp.	12	8	2	3	1					2	2	1				5								
'Globigerinelloides" *subcarinatus*	8	7	5	7	4	4	3	2	4	2	3	4	4	3	4	3	5	4	2					
'G." *prairiehillensis*			1	1			1																	
'G." *asper*	4	9	7	8	2	5	2	1	4	8	4	9	5	7	4	1		4	6	4		No Data. Recrystallization and Poor Preservation		
'G." *alvarezi*	2	4	2	3	1	1	6	4	3	3	6	8	3	9	7	15	14	7	9	9	2			
'G." *ultramicrus*													1			3	6		2	3				
'G." *rosebudensis*	1	1																	3					
'G." *mendezensis*	1	1															1		1					
'Globigerinelloides" sp.	38	39	28	26	18	14	54	26	29	20	39	29	24	22	31	36	51	6	27	9	1			
Heterohelix globulosa	71	86	87	67	64	40	97	78	99	98	133	88	56	42	106	134	189	63	335	124	27			
H. labellosa							1																	
H. navarroensis	15	5	16	9	6	8	6	9	5	4	12	8	2	2	7	5	14	9	40	15	1			
H. planata	27	16	28	10	16	10	12	14	18	5	8	24	14	15	19	17	15	14	23	13	1			
H. punctulata			2	7	2	2	4		6	3	5	2	5	6	3	3	3	3	1					
Heterohelix sp.	41	39	29	44	56	40	75	39	80	54	83	60	45	33	80	97	167	32	115	42	23			
Laeviheterohelix dentata	13	8	13	5	4	4	6	2	3	6	18	20	4	14	18	4	6	10	20	18	2			
L. glabrans	7	16	6	3	6	2	3	5	12	13	10	11	1		2	2	2		3	4	1			
Pseudotextularia nuttalli		1		1	1																			
Pseudoguembelina costulata		2																1						
P. kempensis																	1							
Hartella harti	11	10	4	2	5	7	9	5	8	2	7	9	8	3	13	1	21	12	26	16				
Unidentified planktonic foraminifer	22	29	35	55	33	21	40	40	38	25	54	46	15	23	34	49	63	15	38	19	26			
Total Count	**391**	**396**	**369**	**355**	**270**	**200**	**413**	**297**	**453**	**345**	**515**	**365**	**228**	**215**	**374**	**421**	**607**	**215**	**807**	**350**	**170**			
Species Richness	18	21	15	17	13	12	15	13	14	13	13	11	13	10	11	17	18	13	14	12	9			
Average richness	**14**																							

Here are some encountered planktonic foraminifera…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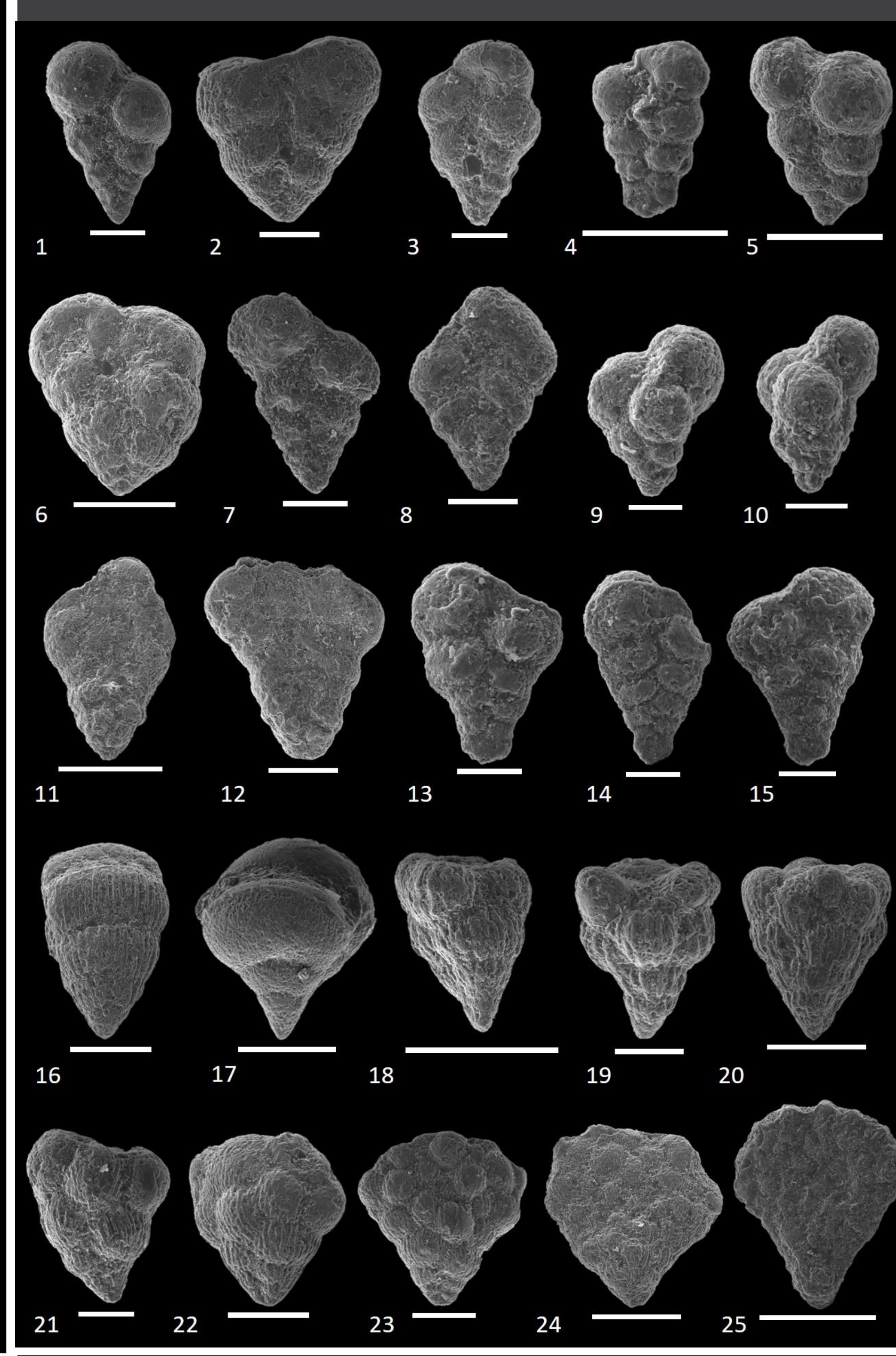
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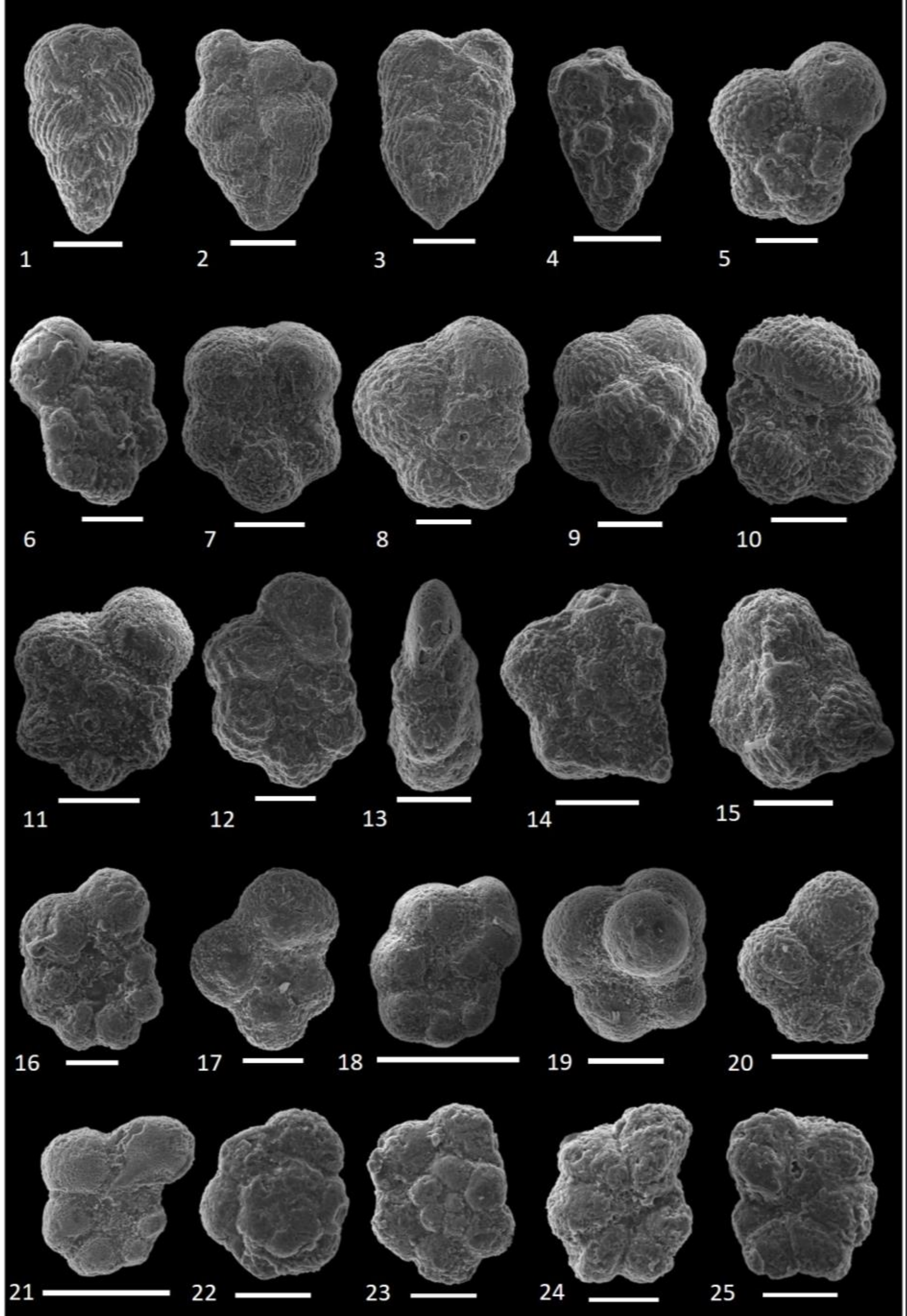
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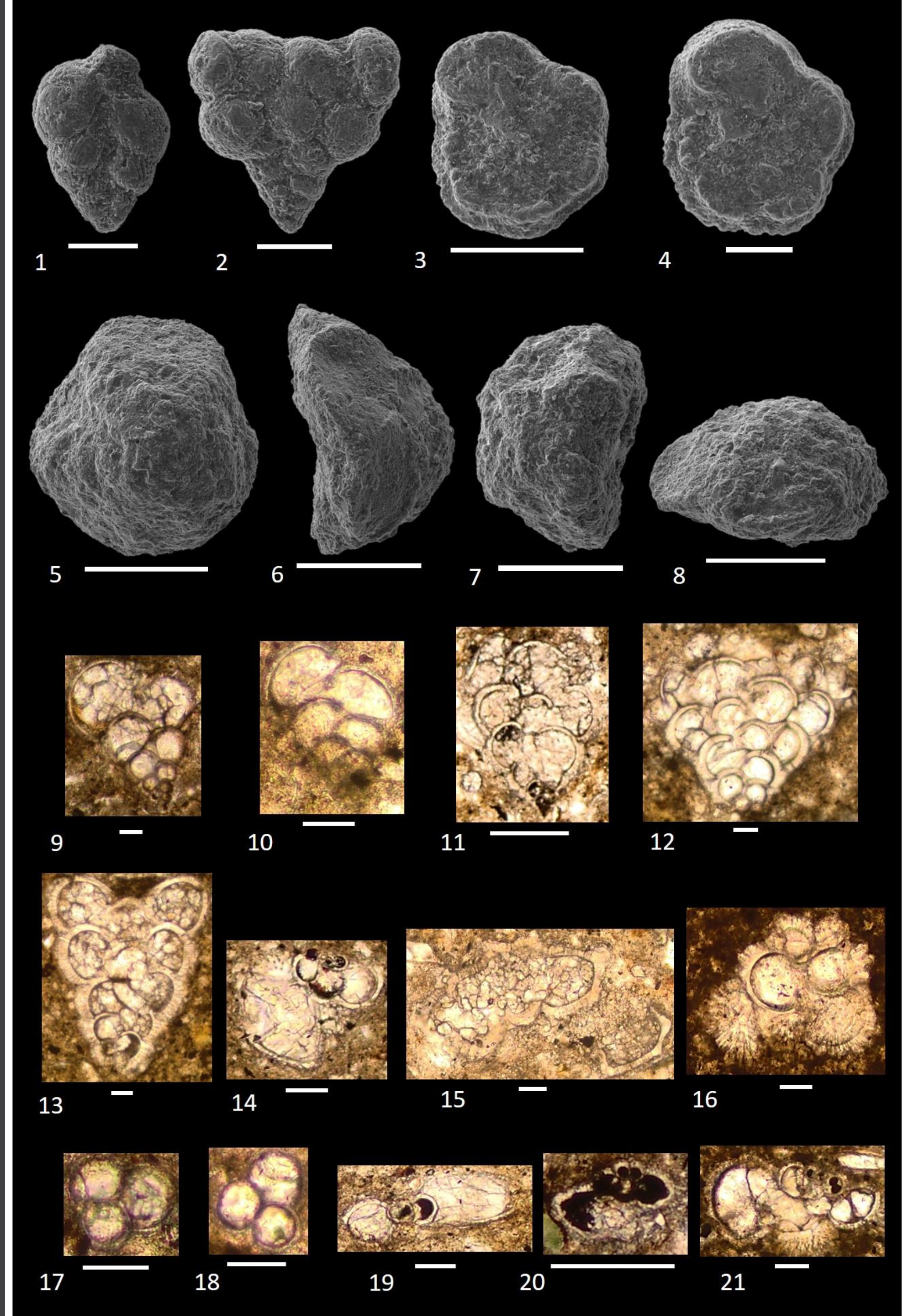
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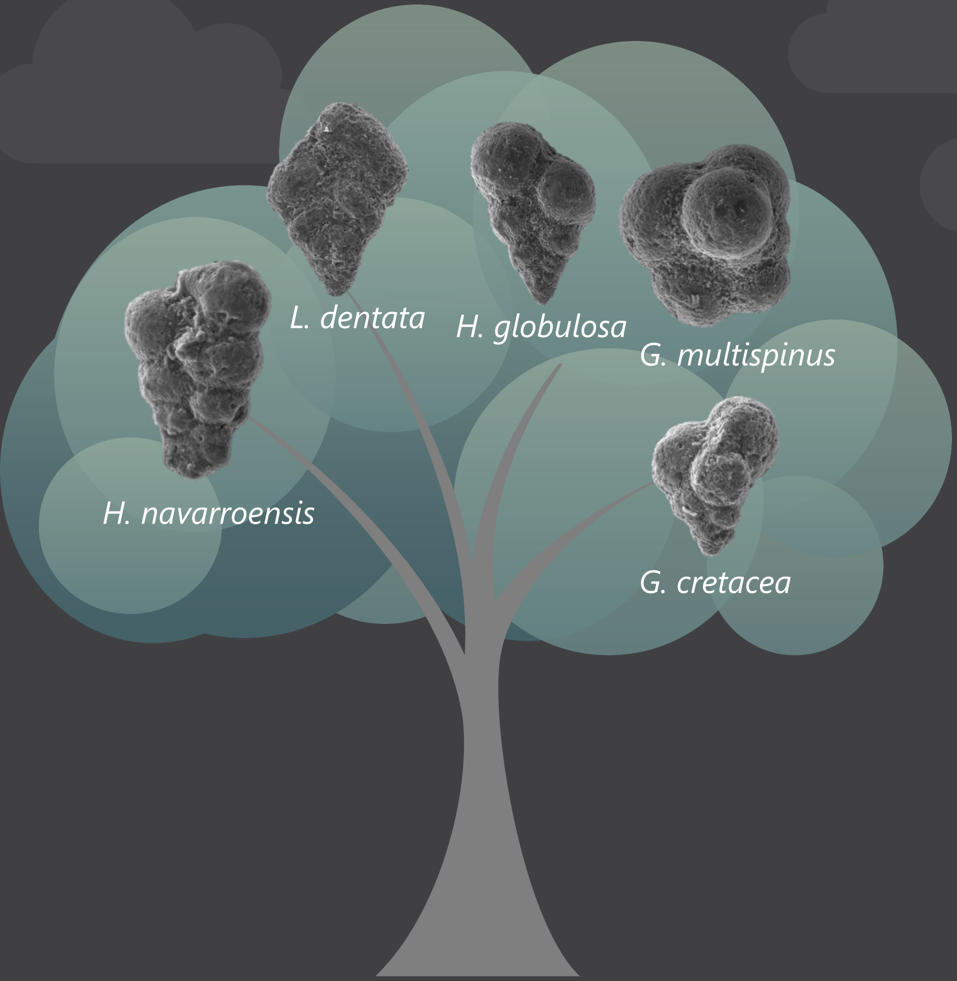
Relative Abundance Analysis

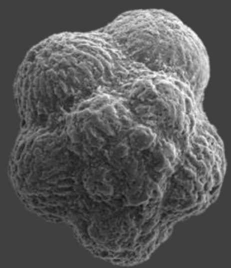
r-Strategists (Generalists)



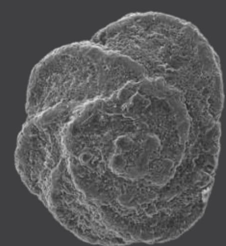
r stratejists

- Small, unornamented, tolerant to nutrient, temperature, acidity fluctuations in environment

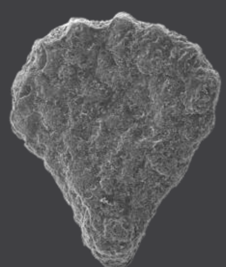
Some K-Strategists (Specialists)



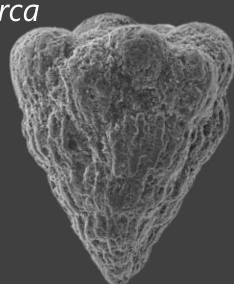
R. pennyi



G. arca



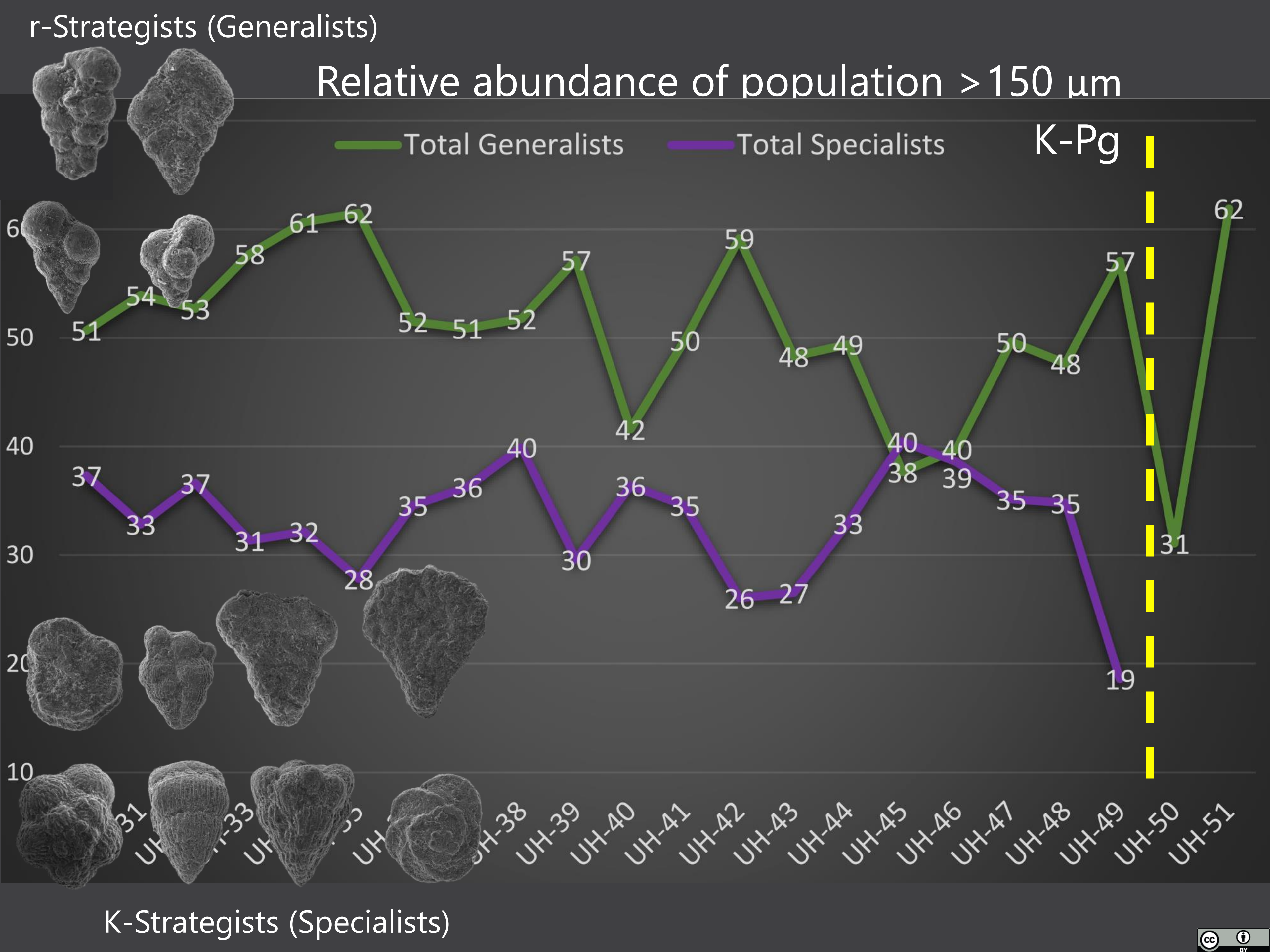
P. multicamerata



R. fructicosa

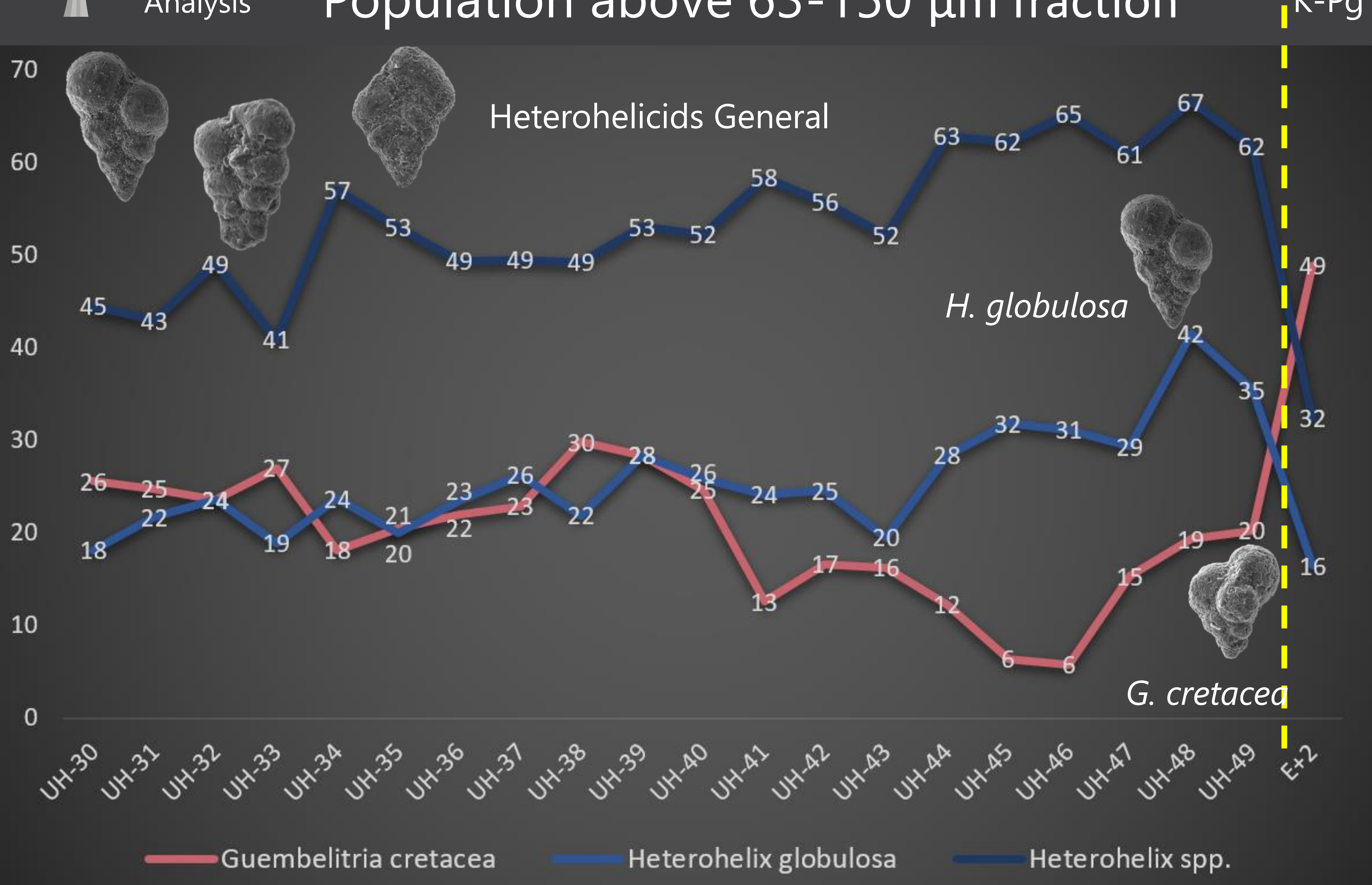
K stratejists

- Large, ornamented, diversified but occupy certain niches and intolerant to environmental fluctuations!


r-Strategists (Generalists)
Relative abundance of population >150 µm
Total Generalists
Total Specialists
K-Pg
50
40
30
10
51 54 53 58 61 62 52 51 52 57 42 50 59 48 49 38 39 50 48 57 31 62
37 33 37 31 32 28 35 36 40 30 36 35 26 27 33 40 40 35 35 19
UH-38
UH-39
UH-40
UH-41
UH-42
UH-43
UH-44
UH-45
UH-46
UH-47
UH-48
UH-49
UH-50
UH-51
K-Strategists (Specialists)

Quantitative Analysis

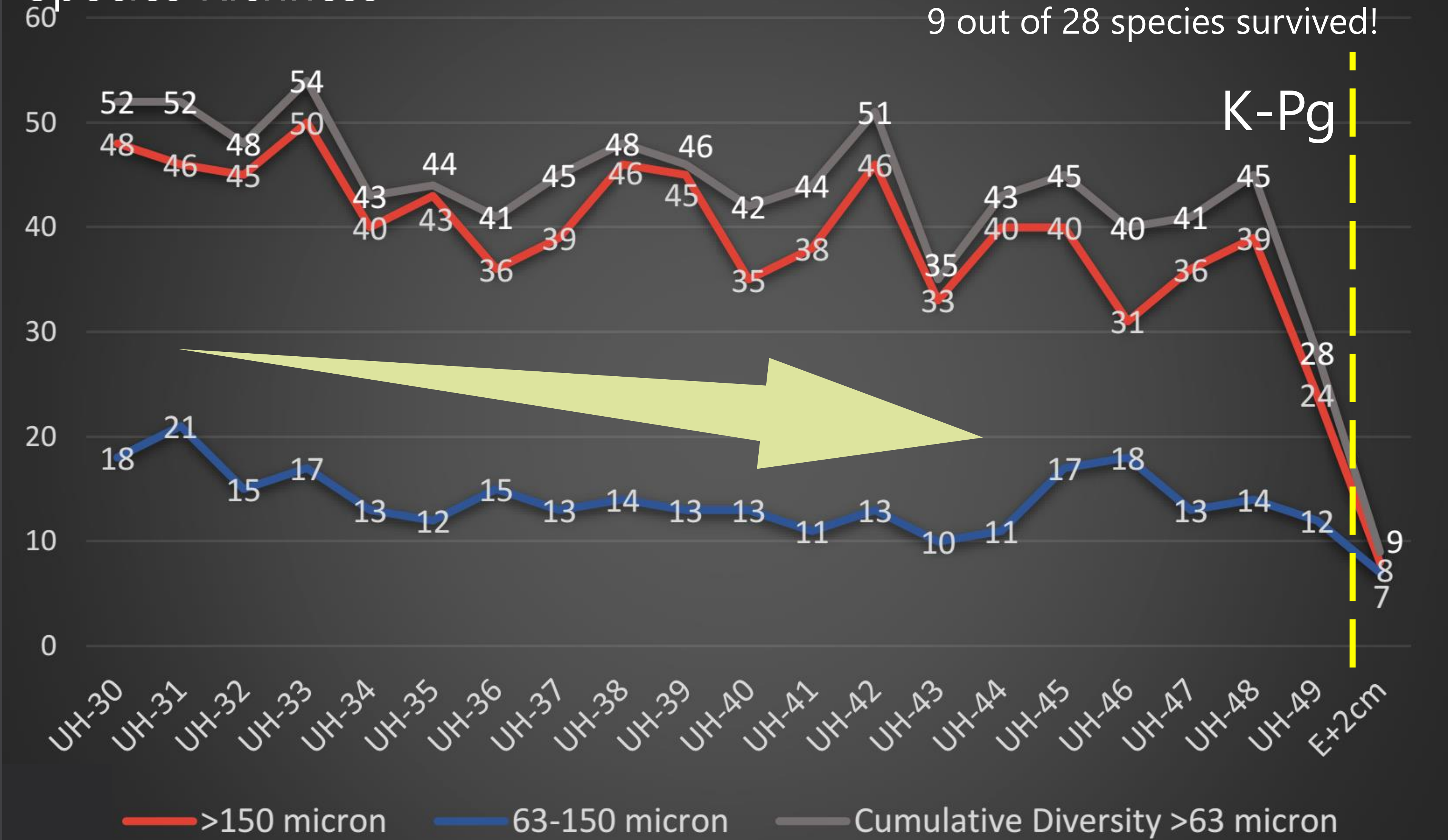
Population above 63-150 µm fraction

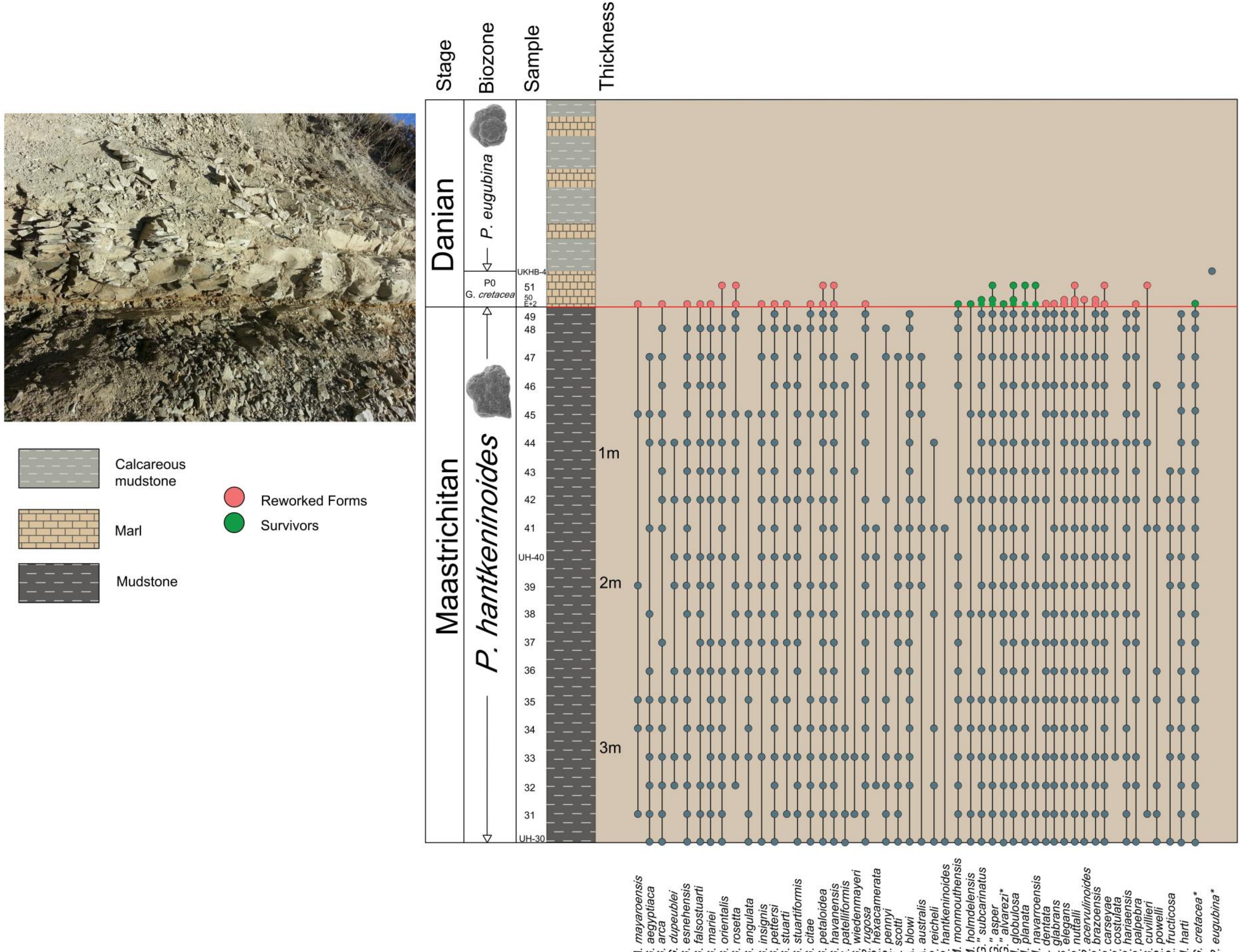


Quantitative Analysis

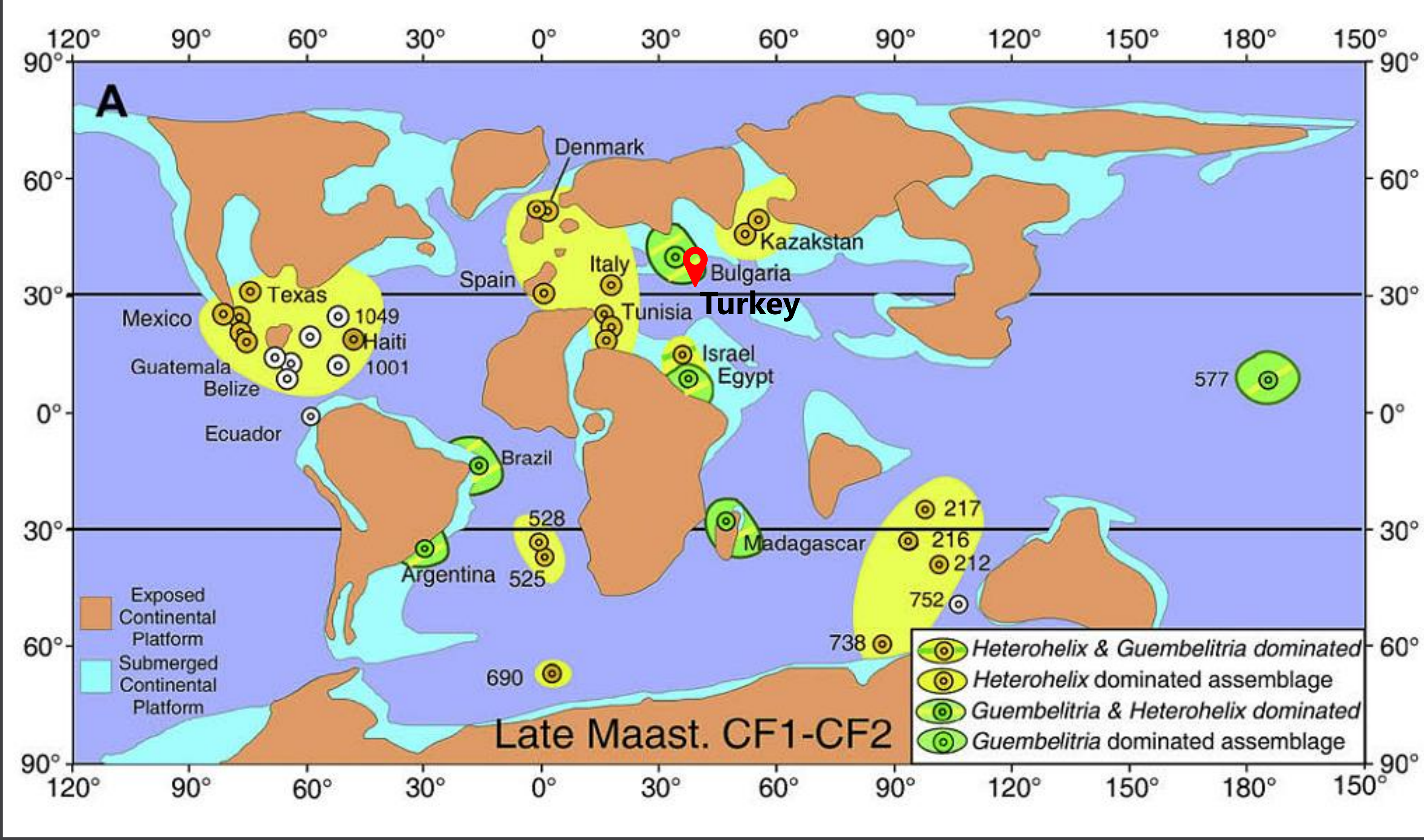
- 50% drop in the species richness before the KPB
  - Environmental stress prior to KPB!

Species Richness

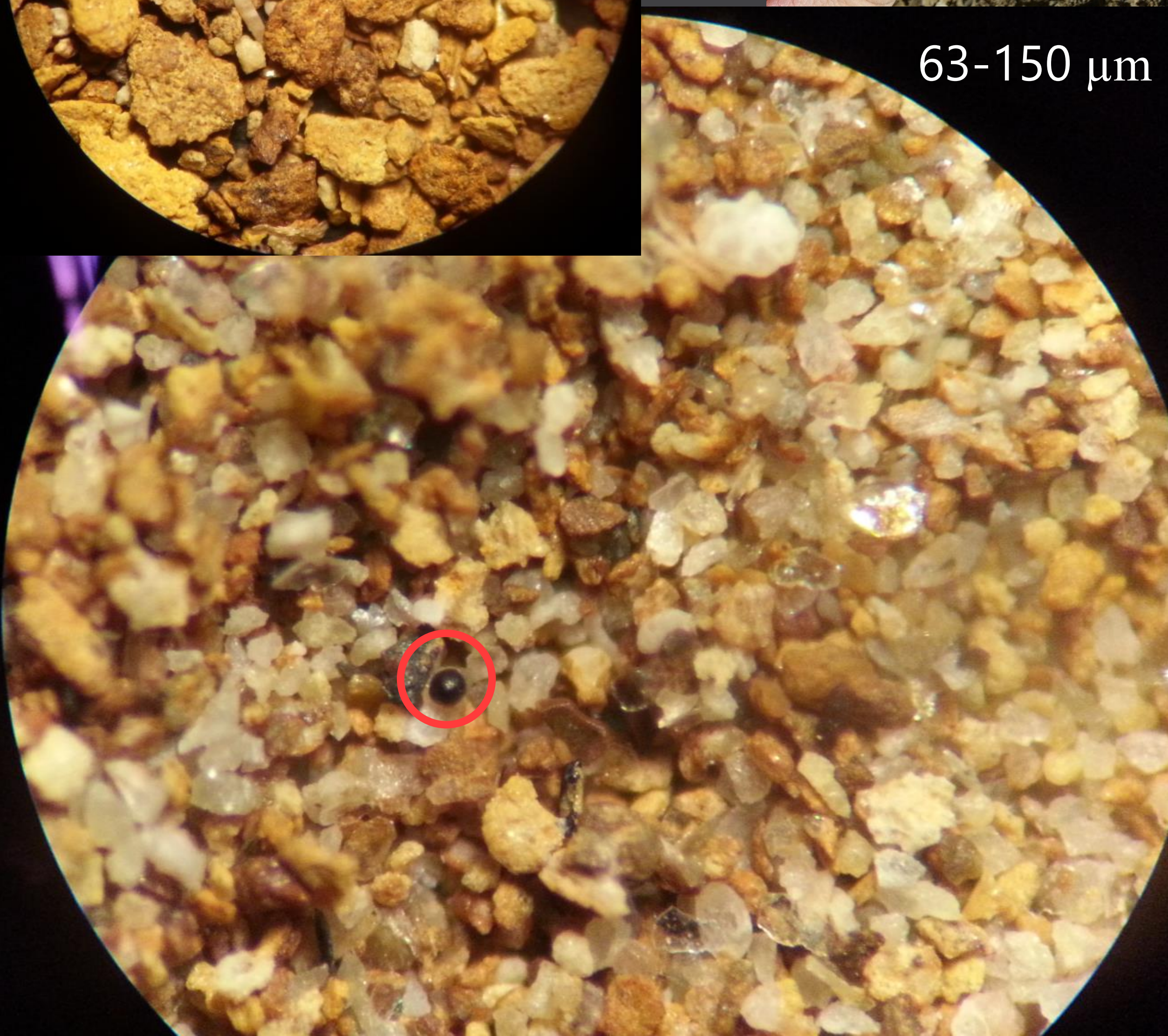



Calcareous mudstone
Marl
Mudstone
Reworked Forms
Survivors
Stage
Biozone
Sample
Thickness
Danian
Maastrichitan
P. eugubina
P0
G. cretacea
P. hantkeninoides
UKHB-4
51
50
E+2
49
48
47
46
45
44
43
42
41
UH-40
39
38
37
36
35
34
33
32
31
UH-30
1m
2m
3m
A. mayaroensis
G. aegyptiaca
G. arca
G. dupeublei
G. esnehensis
G. falsostuarti
G. mariei
G. orientalis
G. rosetta
G. angulata
G. insignis
G. pettersi
G. stuarti
G. stuartiformis
G. citae
G. petaloidea
G. havanensis
C. patelliformis
G. wiedenmayeri
R. rugosa
R. hexacamerata
R. pennyi
T. scotti
A. blowi
A. australis
P. reicheli
P. hantkeninoides
M. monmouthensis
M. holmdelensis
"G." subcarinatus
"G." asper
"G." alvarezi*
H. globulosa
H. planata
H. navarroensis
L. dentata
L. glabrans
P. elegans
P. nuttalli
P. acervulinoides
P. brazoensis
P. carseyae
P. costulata
P. hariaensis
P. palpebra
G. cuvillieri
R. powelli
R. fructicosa
H. harti
G. cretacea*
P. eugubina*

Maastrichtian CF1-CF2



Pardo & Keller 2008



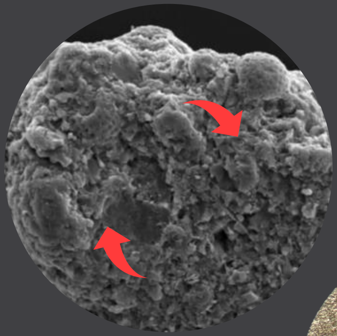
Nature of the K-Pg boundary layer

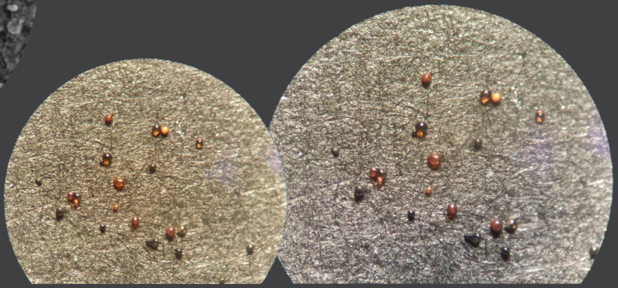
- 2-3 mm thick reddish oxidized layer
- Sharp extinction horizon!
- >63 μm Almost no planktonic foraminifera (only some heterohelicids, guembelitrids, globigerinellids & hedbergellids) & very rare benthics

Findings across the K-Pg boundary

Findings across the K-Pg boundary

- Thoracosphaera acme





- Black and Brown spherules

Only found within the 2-3mm thick reddish layer

- Amorphous Grains

Only found within the 2-3mm thick reddish layer!

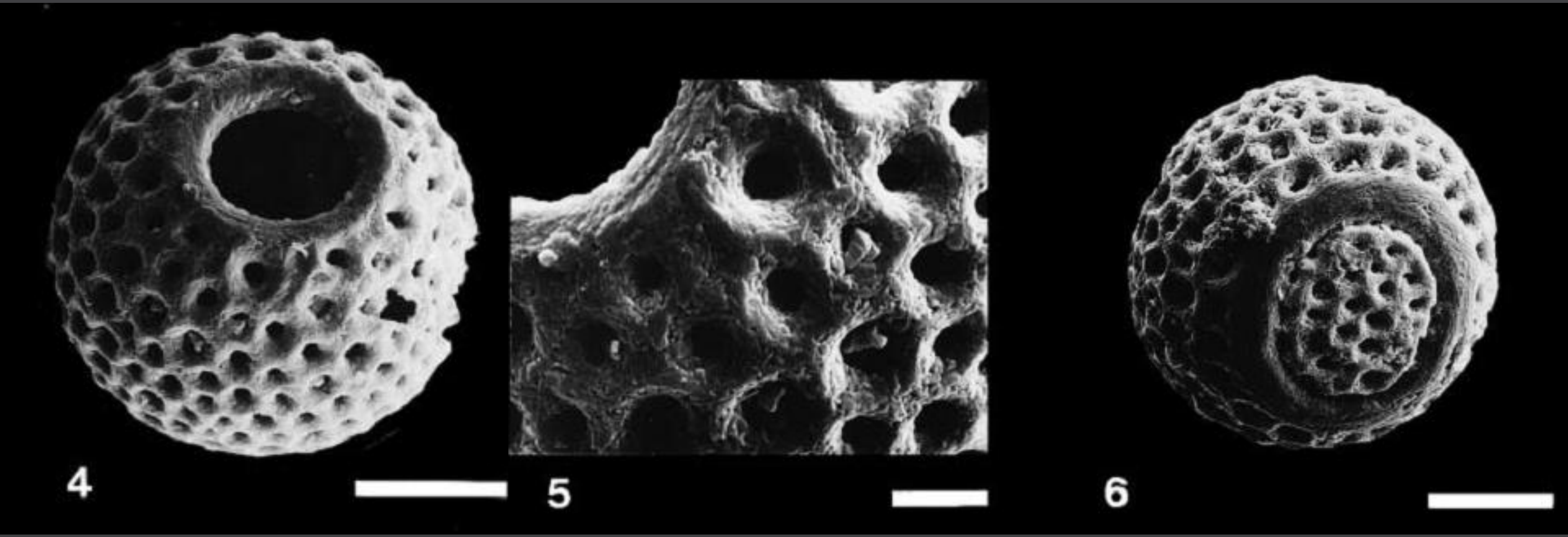
- Abrupt increase in pellets

- Euhedral Grains

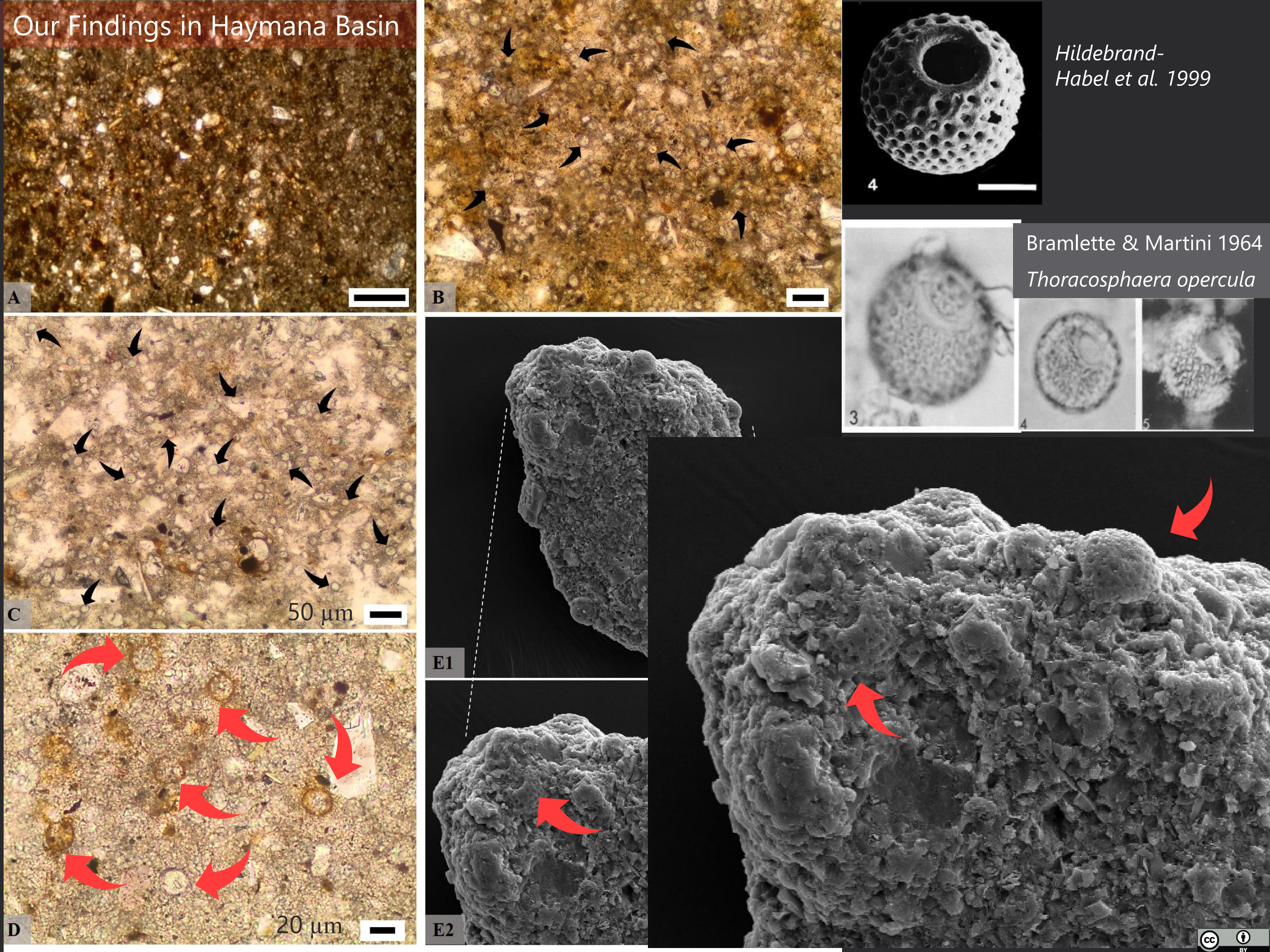
Found -2cm & at the K-Pg boundary layer.
Not above!

Thoracosphaera spp. increase

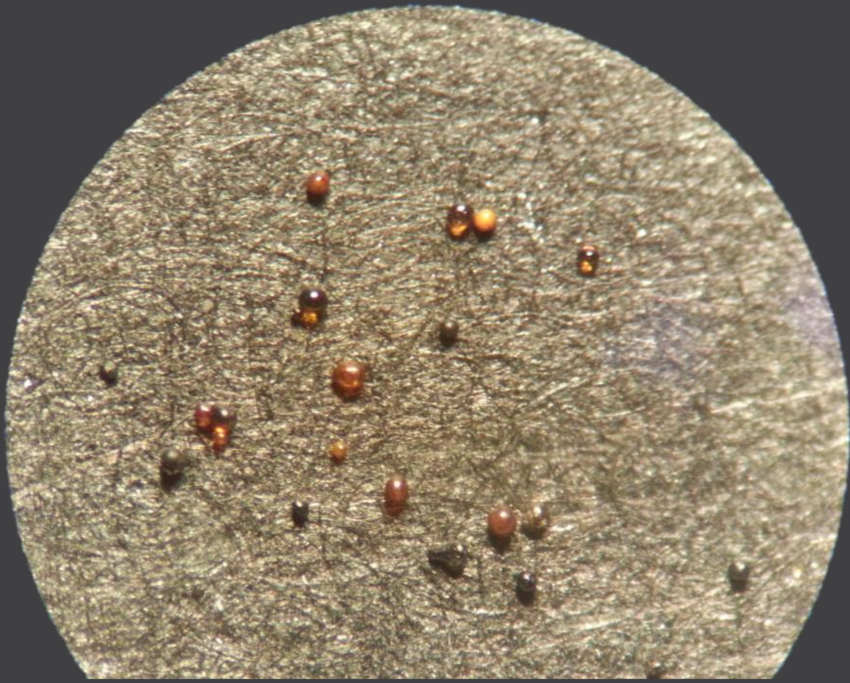
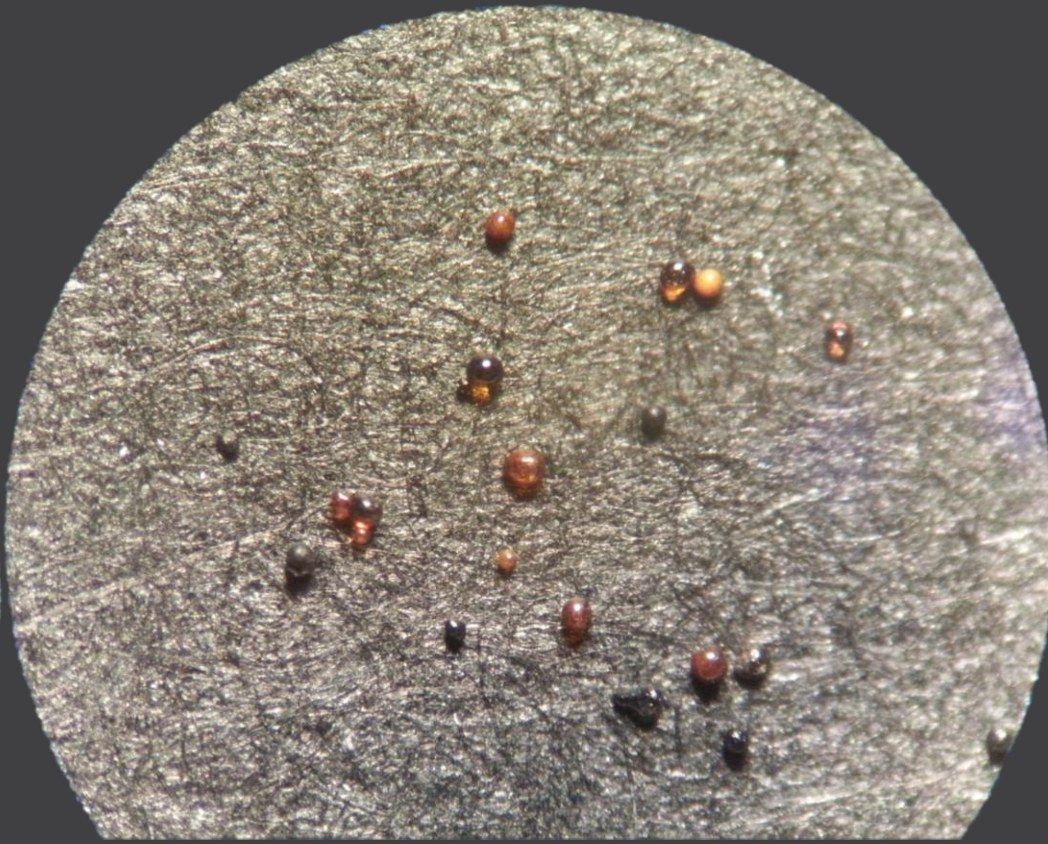
- Calcareous dinoflagellate-Phytoplankton
- Environmental Stress Marker (Lamolda *et al.*, 2005)



Hildebrand-Habel et al., 1999

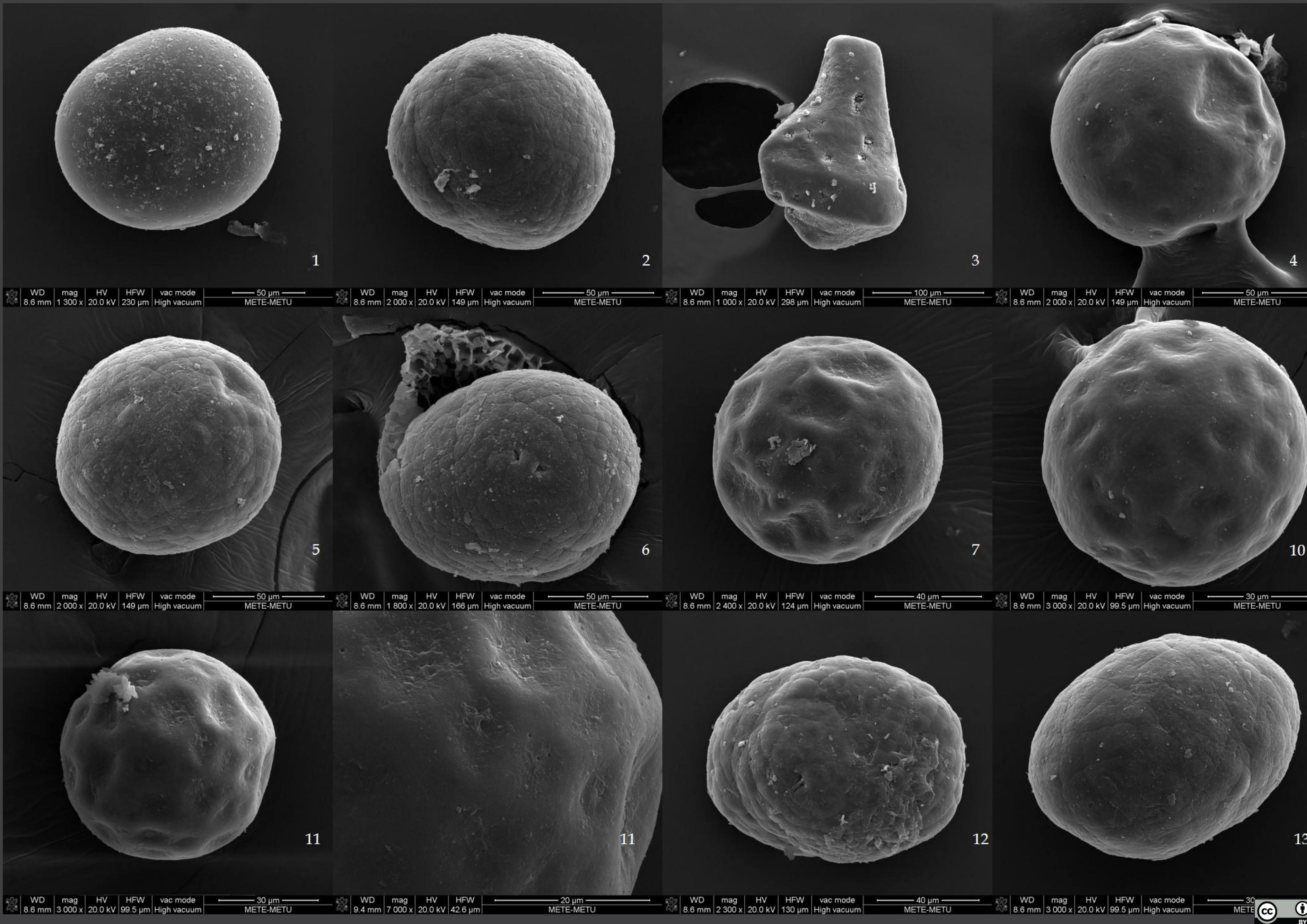

Our Findings in Haymana Basin
A
B
C
50 µm
D
20 µm
E1
E2
4
Hildebrand-Habel et al. 1999
Bramlette & Martini 1964
Thoracosphaera opercula
3
4
5

Black and Brown spherules

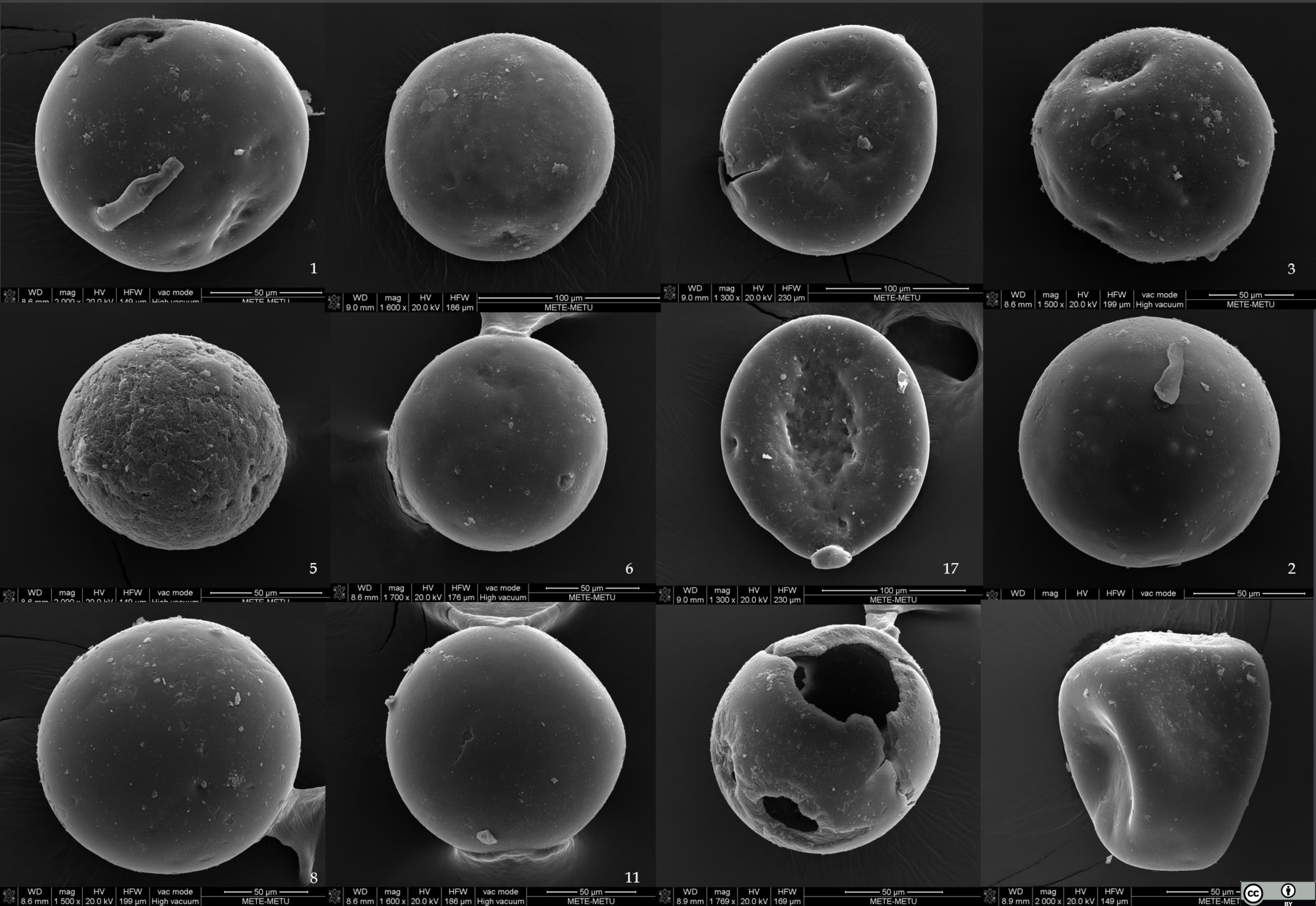
Series 1- Brownish, amber and yellow ones

Some specimens are pliable!

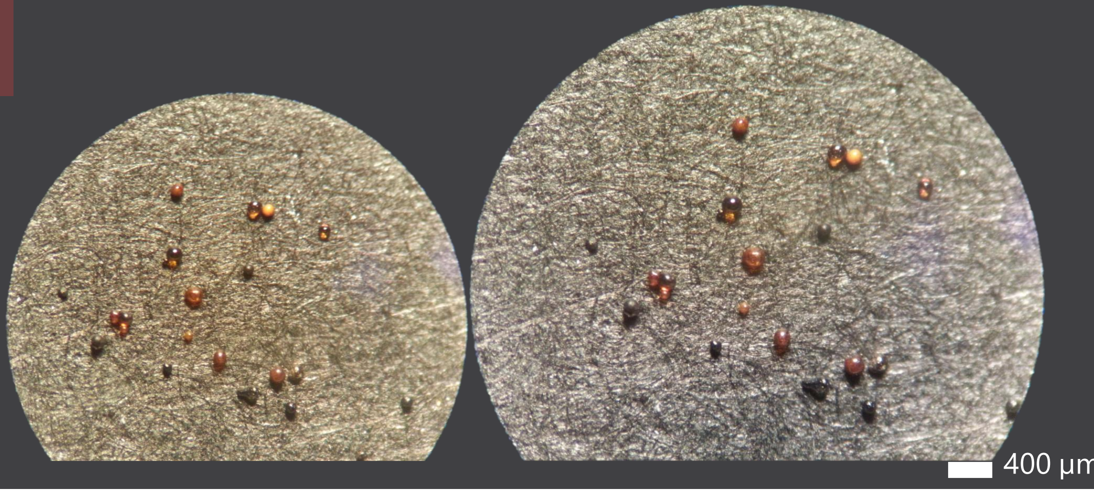


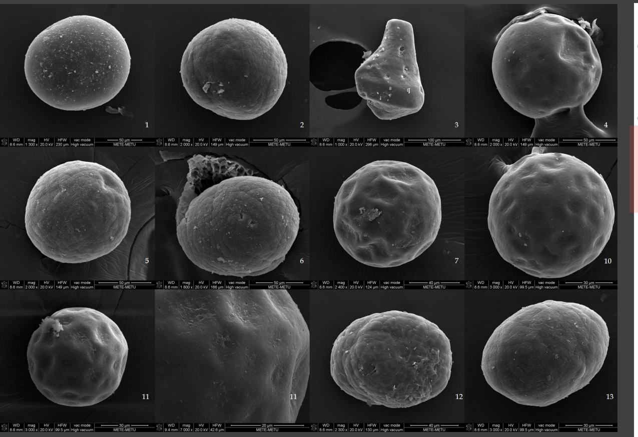
Series 1- Black ones

More smooth surface!

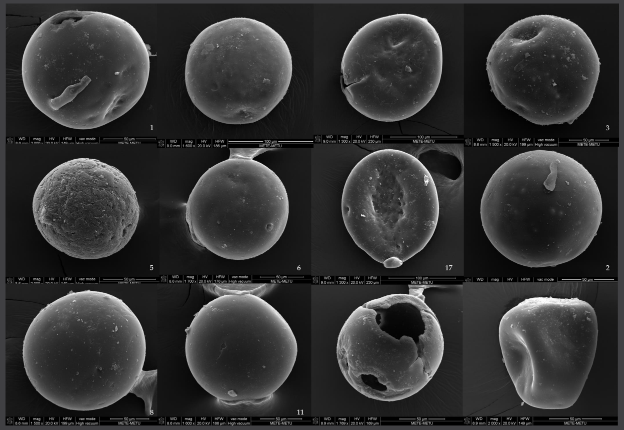


Black and Brown Spherules



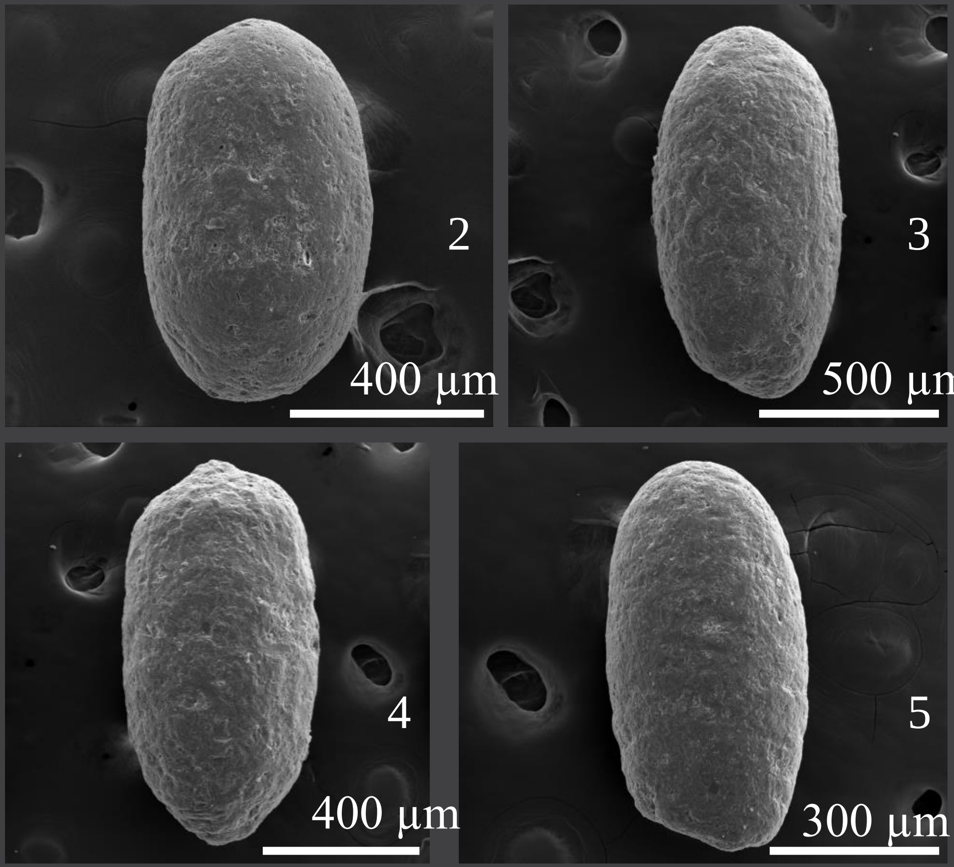


Brown-Yellow								
Sample No:	Series 1-a	Series 1-b	Series 1-d	Series 1-e	Series 1-f	Series 1-h	Series 1-i	
Wt %								Average
SiO_2	15,37	12,55	9,55	16,63	3,38	3,86	3,46	**9,3**
CaO	56,08	57,03	38,72	47,97	80,49	80	74,42	**62,1**
Na_2O	n.d.	3,13	10,91	4,42	n.d.	n.d.	2,44	**5,2**
MgO	12,94	13,53	15,92	16	9,88	8,9	15,47	**13,2**
Al_2O_3	6,2	6,9	4,76	4,91	1,88	3	1,85	**4,2**
Fe_2O_3	9,4	6,86	6,14	10,07	4,38	4,24	2,37	**6,2**
Cl_2O	n.d.	n.d.	13,99	n.d.	n.d.	n.d.	n.d.	



Black								
Sample No:	Series 2-a	Series 2-d	Series 2-e	Series 2-f	Series 2-g	Series 2-h	Series 2-i	
Wt %								Average
SiO_2	9,31	20,1	n.d.	6,58	n.d.	11,11	n.d.	**11,8**
CaO	73,01	46,98	73,01	76,78	81,92	66,39	91,01	**72,7**
Na_2O	4,65	n.d.	2,82	n.d.	n.d.	n.d.	n.d.	**3,7**
MgO	8,43	10,87	8,93	12,75	10,99	6,6	7,1	**9,4**
Al_2O_3	4,59	9,4	4,14	3,89	3,98	4,61	1,89	**4,6**
Fe_2O_3	n.d.	12,44	7,79	n.d.	n.d.	11,29	n.d.	**10,5**
Cl_2O	n.d.	n.d.	3,31	n.d.	3,11	n.d.	n.d.	**3,2**

Pellet Surge



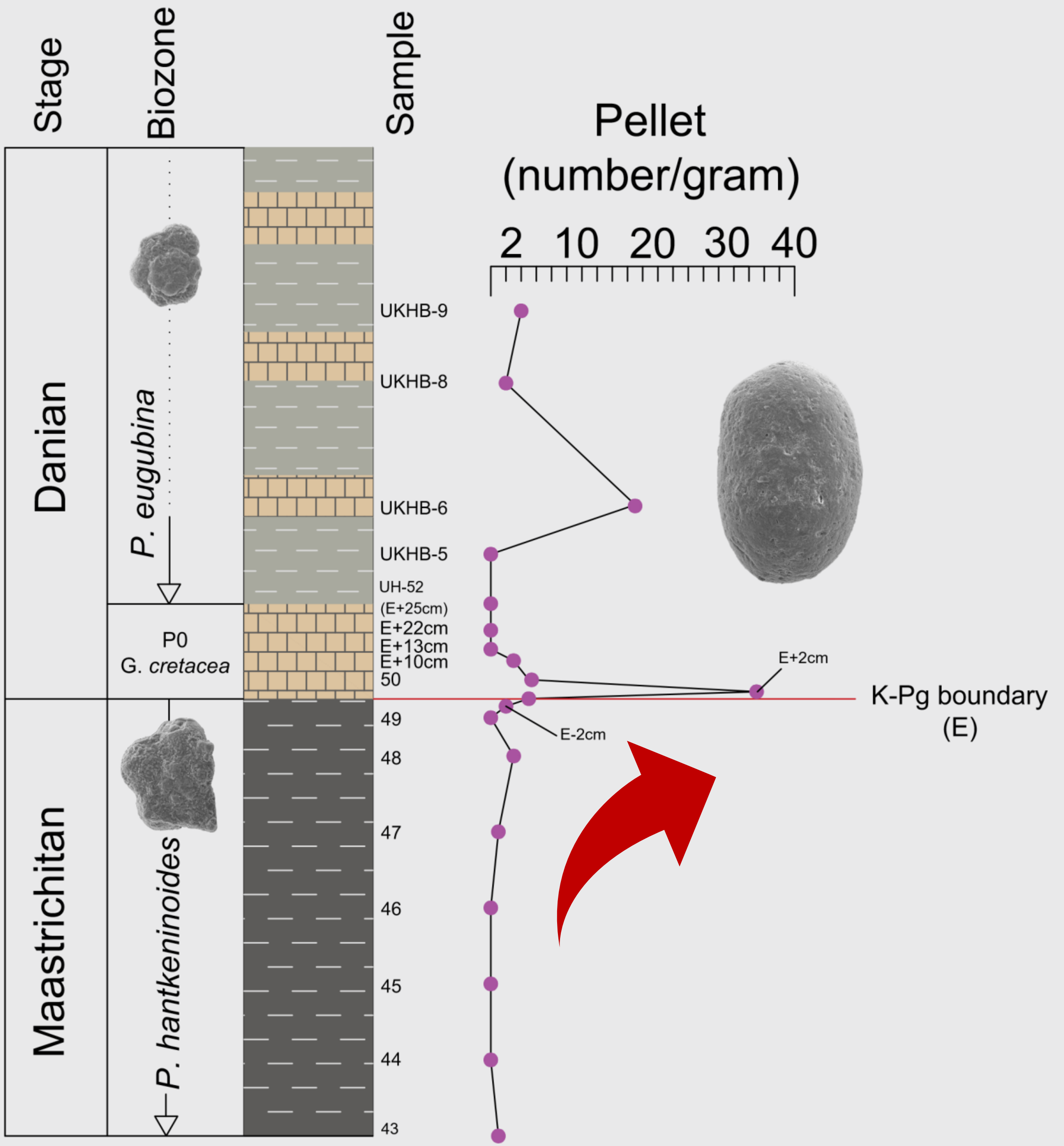
A) View of the fecal pellets in reflected light. Samples from E+2, 2 cm above the K-Pg boundary, recovered from >150 mm sieve, X60 magnification

B) Scanning electron microscope (SEM) views of the fecal pellets peak at 2 cm above the K-Pg boundary

Pellet Surge

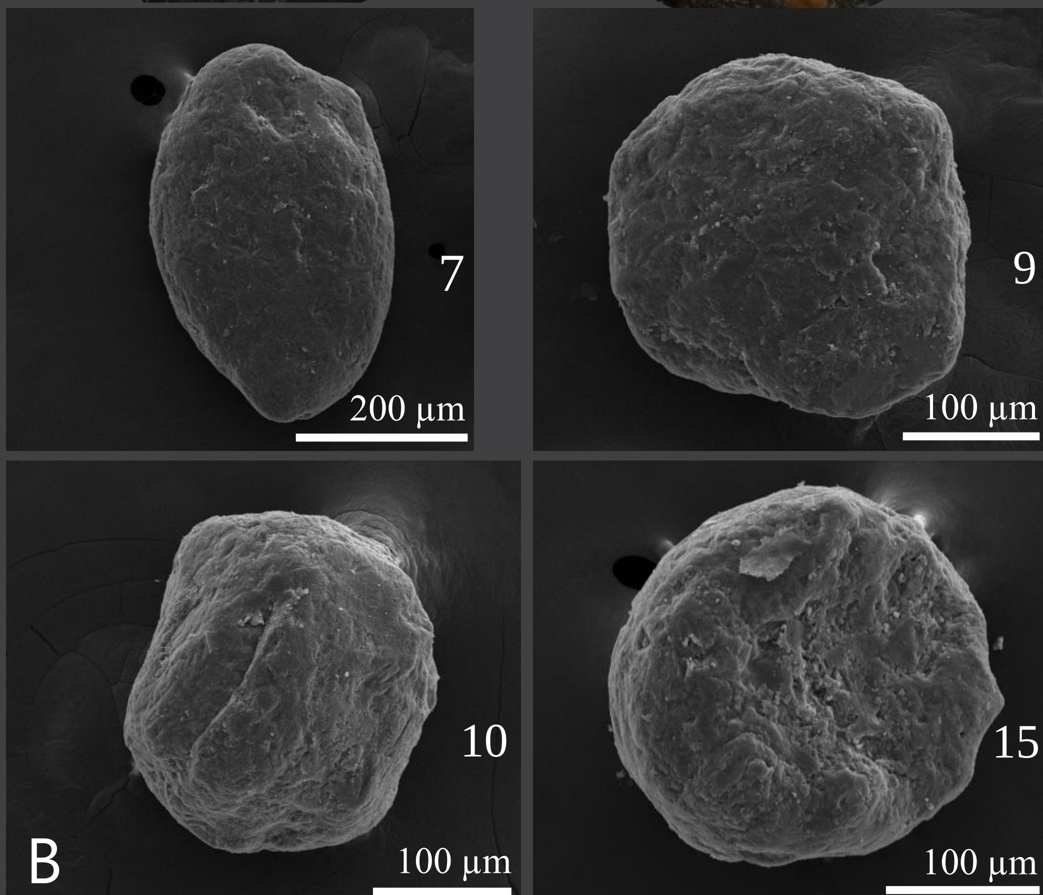
Sample No	Pellet Count per gram
UKHB-9	4
UKHB-8	2
UKHB-6	19
UKHB-5	0
E+25 UKHB-4	0
E+22	0
E+13	0
E+10	3
UH-50	5
E+2	35
K-Pg boundary	5
E-2	2
UH-49	0
UH-48	3
UH-47	1
UH-46	0
UH-45	0
UH-44	0
UH-43	1

Number of fecal pellets rapidly increases right after the K-Pg boundary in the Danian P0 Zone. Notice the abrupt increase right after the K-Pg boundary. Another but much
minor increase was detected in the lower Pα Zone



Amorphous Grains

Sample No:	7	9	10	15	
Wt %					Average
SiO_2	44,65	42,91	36,35	44,92	**42,2**
CaO	1,87	2,13	1,92	1,92	**2,0**
K_2O	1,76	0,77	0,29	1,17	**1,0**
MgO	8,19	8,95	9,21	8,53	**8,7**
Al_2O_3	15,32	16,19	14,29	17,27	**15,8**
Fe_2O_3	28,21	29,05	37,95	26,19	**30,4**



A) Brown grains were found in washed residues of the 2-3 mm thick reddish layer corresponding the K-Pg boundary.
Displayed grains were recovered from >150 mm sieve.
Left view x40 magnification, right view x60 magnification.

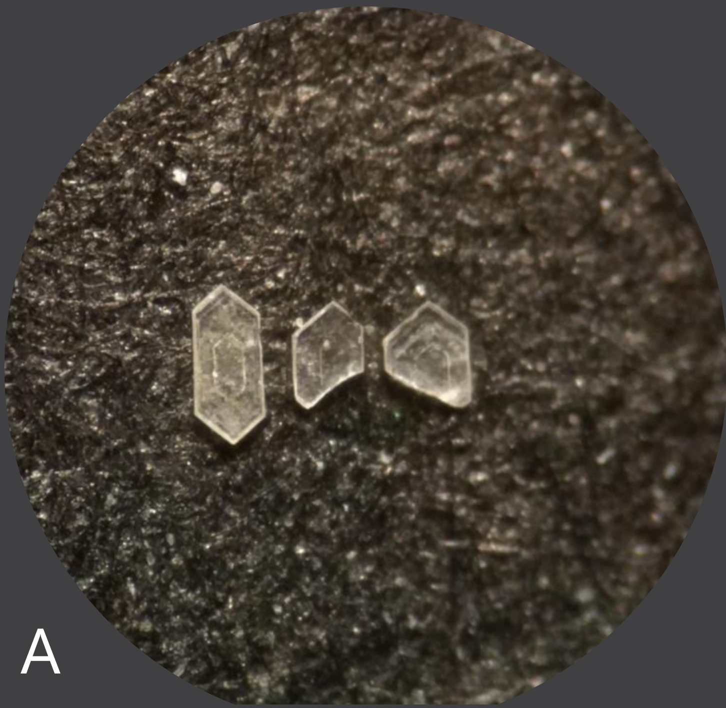
B) SEM images of the brown grains

No solid interpretation is pronounced at this stage about their genesis.

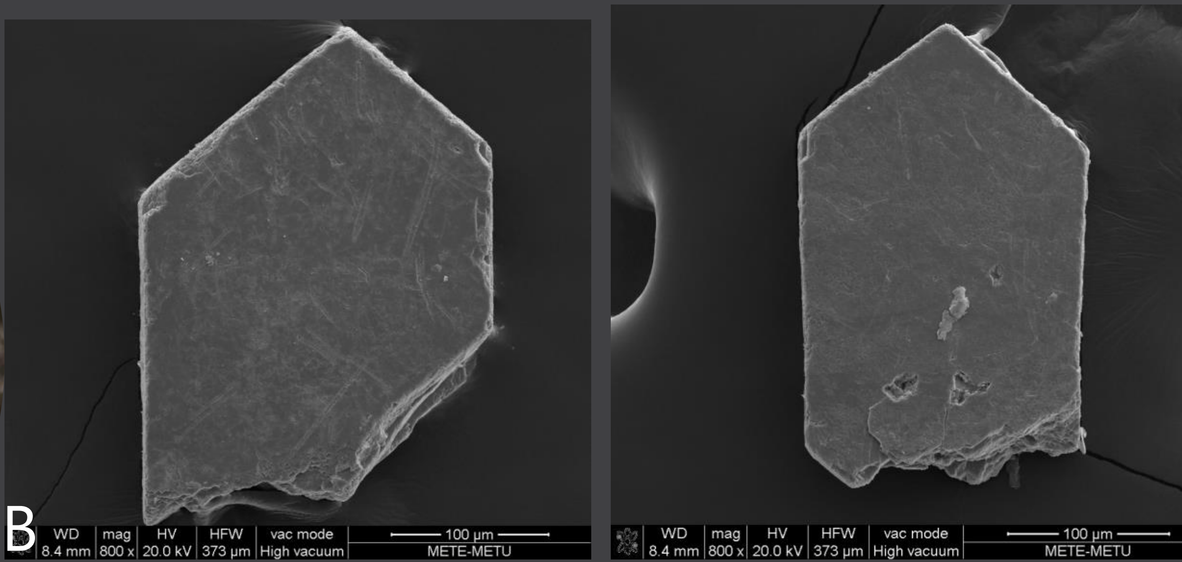
Yet, being present only in the 2-3 mm thick layer corresponding the K-Pg boundary may infer the impact origin.

Euhedral Grains

Found -2cm & at the K-Pg boundary layer. Not above!



A



B

Sample No: Wt %	19	20	Average
Ba	74,5	61,03	**67,8**
S	19,85	34	**26,9**
Sr	5,65	4,97	**5,3**

A) Barite crystals were found only from 2 cm below and right at the K-Pg boundary level (2-3 mm thick reddish layer). View in reflected light. Sample E-2 from >150 mm screen, x100 magnification. B) SEM images of Barite grains.

The increase in the barite grains below and at the K-Pg boundary layer may be a record of paleoproductivity enhancement across the K-Pg interval and/or increase in atmospheric sulphur oxides caused by the Chicxulub impact

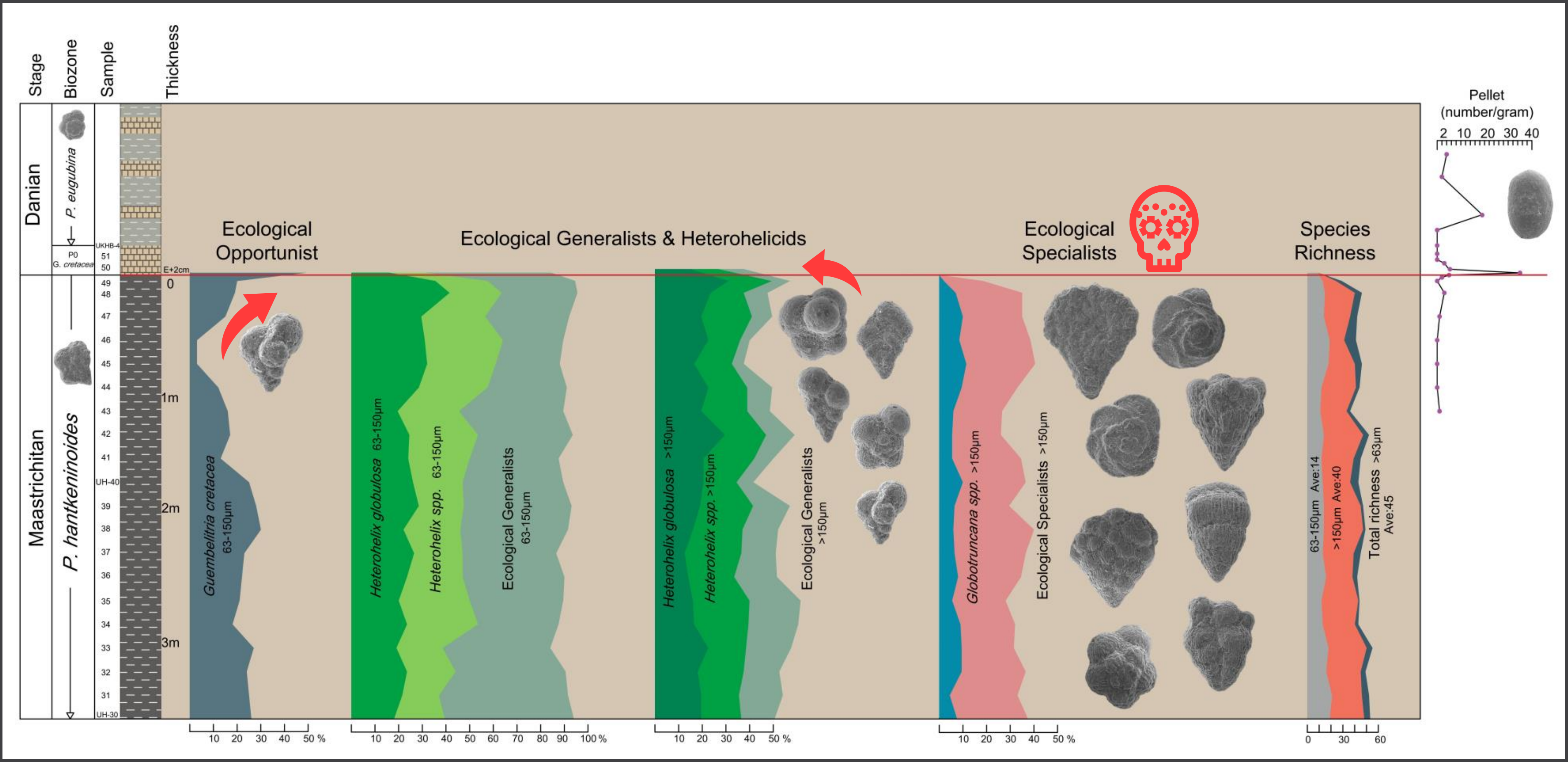
CONCLUSION

63-150 µm

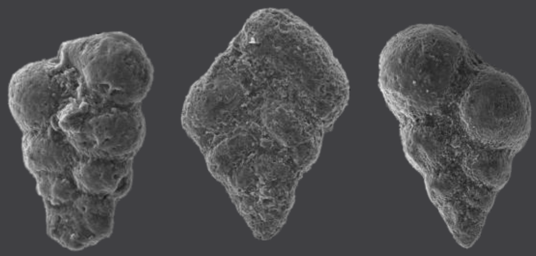
Almost complete dominance of *r-Strategists*
Heterohelix ve *Guembelitria* domination

>150 µm

- *r-Strategists (Generalists)>K-Strategists (Specialists)*
- *Heterohelix* domination
- More species richness (Average 40 species)



Events *before* the K-Pg boundary



Dominance of *Heterohelix* species

Guembelitria blooms

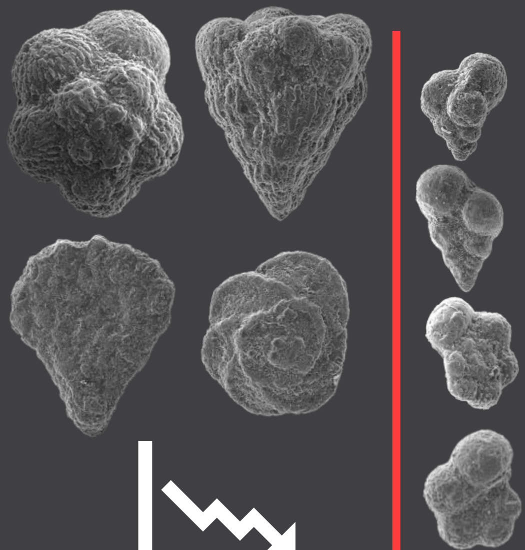
Decreasing species richness

Interpretation:

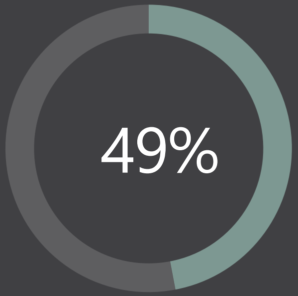
- Expanded Oxygen Minimum Zone (OMZ)
- High terrigenous influx (increased weathering) directing augmented nutrient levels/ *eutrophication*. This might have caused by Deccan-induced climate change and enhanced weathering.
- Environmental stress

Deccan Volcanism

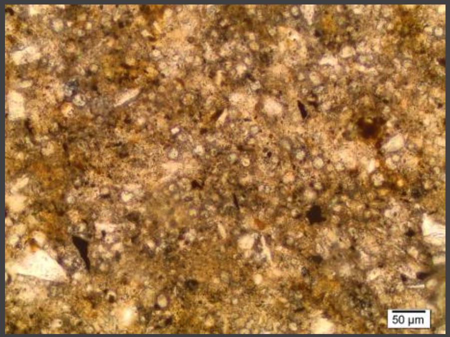
Events at & after the K-Pg boundary



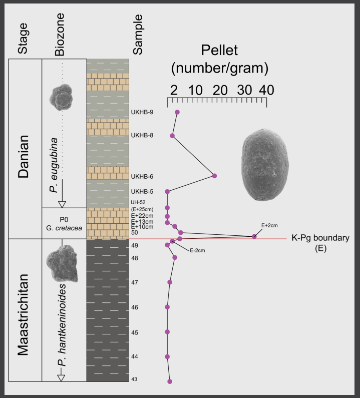
68% of planktonic foraminifera underwent extinction at the K-Pg boundary



Guembelitria cretacea bloom after the KPB



Thoracosphaera acme



Abrupt increase in echinoid pellets

Environmental crisis after the KPB


Thank you…