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Supplement of

A 15-million-year-long record of phenotypic evolution in the heavily calcified coccolithophore *Helicosphaera* and its biogeochemical implications

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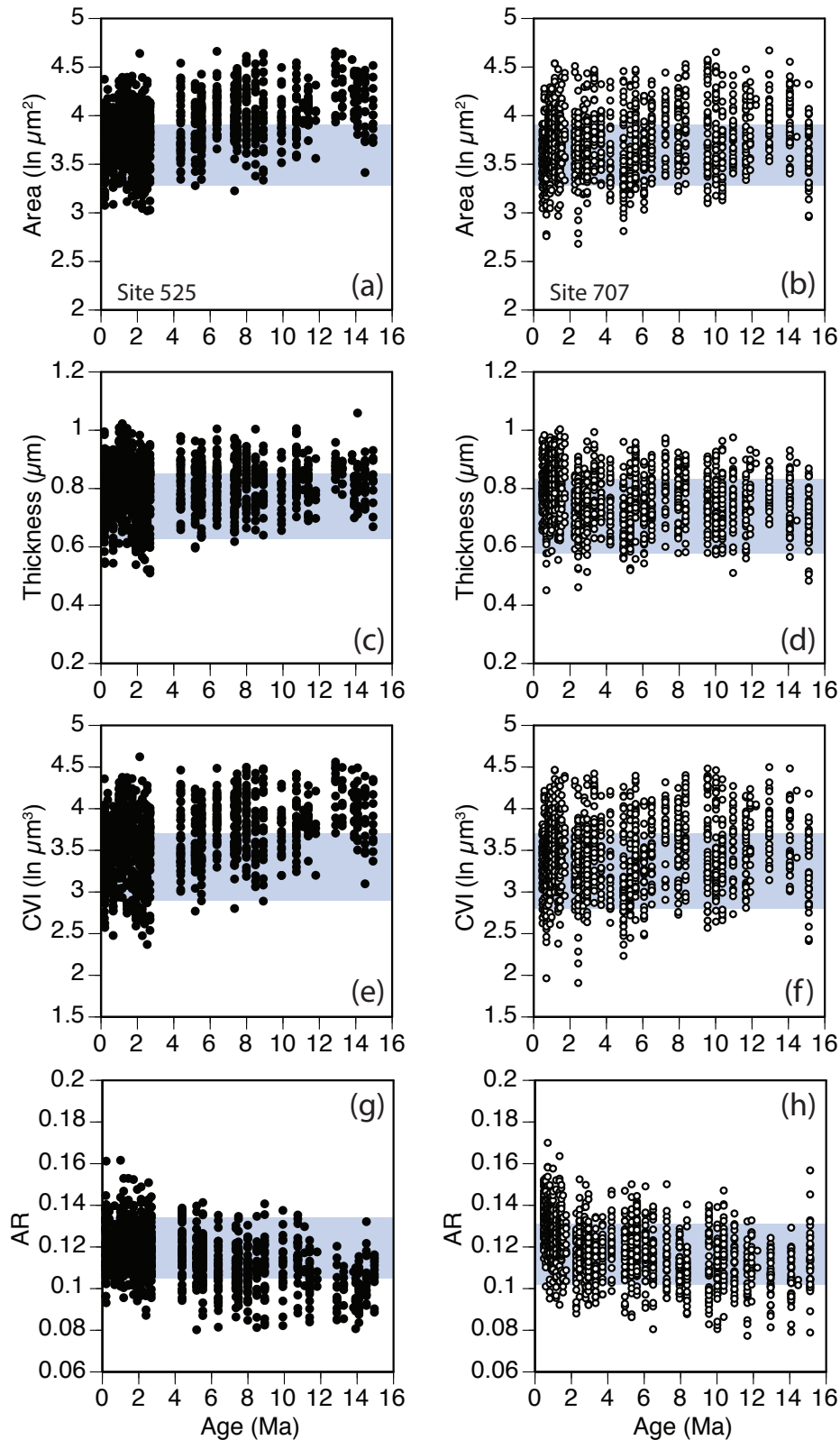


Figure S1. Evolutionary trends in *Helicosphaera carteri* over the past 15 Ma at Site 525 (black) and Site 707 (open symbols). Scatters represent measurements on individual fossil specimens of (a-b) coccolith area (ln μm^2), (c-d) thickness (μm), (e-f) coccolith volume index (CVI, ln μm^3) and (g-h) coccolith aspect ratio (AR, unitless). Data are shown for the fossil morphospecies *H. carteri* only, the blue shading indicates ranges measured in modern *H. carteri* strains RCC1323 (South Atlantic, left column) and RCC1334 (Mediterranean Sea, right column).

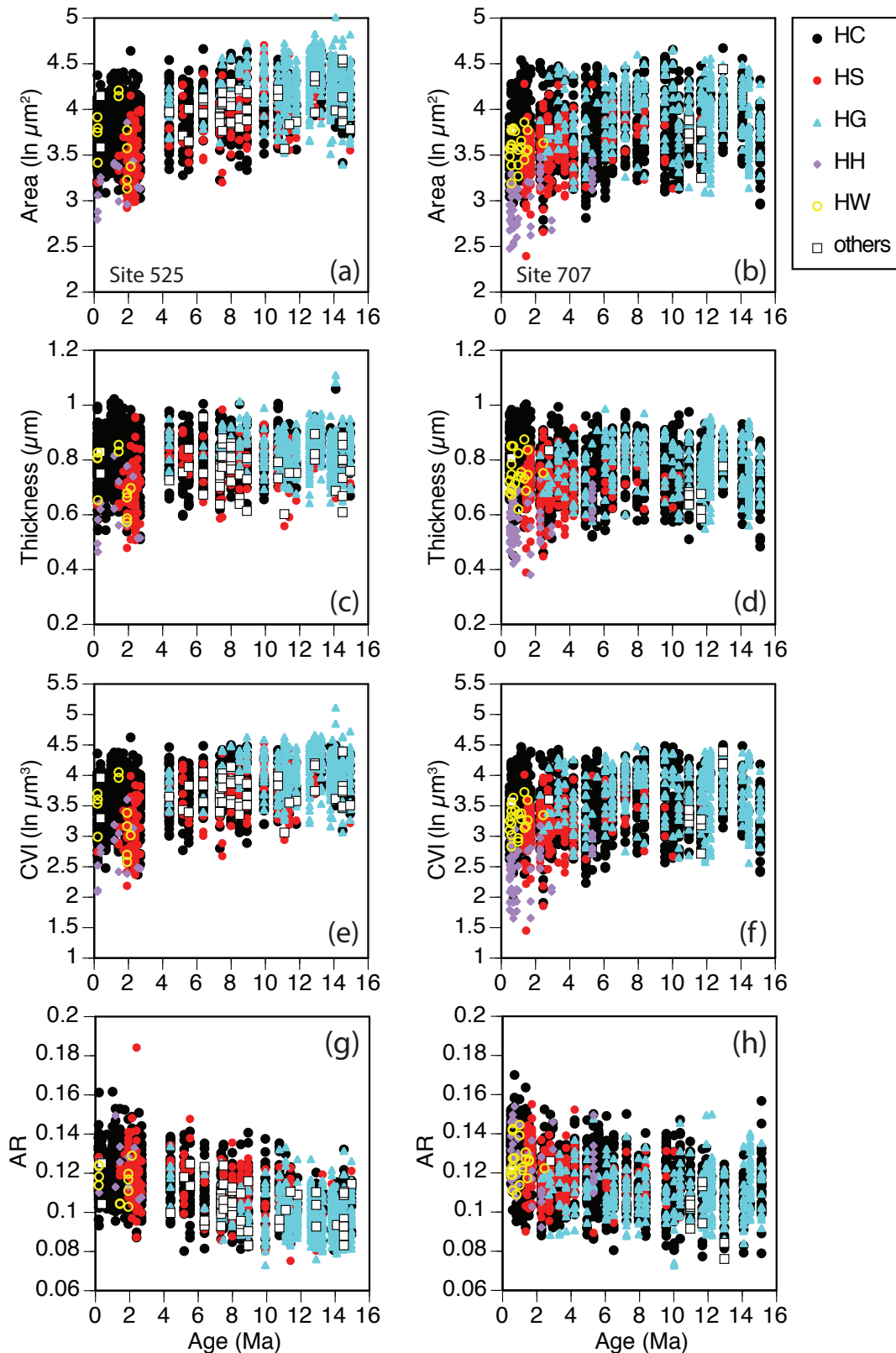


Figure S2. Evolutionary trends in all *Helicosphaera* morphospecies over the past 15 Ma at Site 525 (left column) and Site 707 (right column). Scatters represent measurements on individual fossil specimens of (a-b) coccolith area (ln μm^2), (c-d) thickness (μm), (e-f) coccolith volume index (CVI, ln μm^3) and (g-h) coccolith aspect ratio (AR, unitless). Morphospecies: HC = *H. carteri*; HS = *H. sellii*; HG = *H. granulata*; HH = *H. hyalina*; HW = *H. wallichii*; others = all other types.

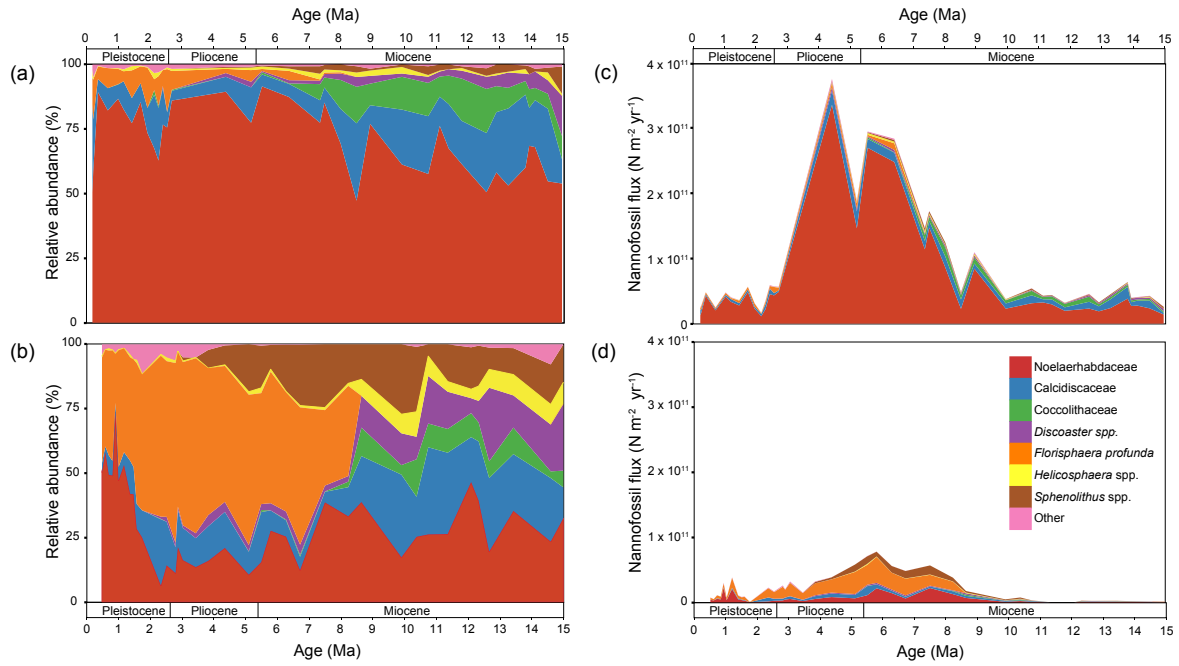


Figure S3. Coccolithophore community composition and total coccolith fluxes at the two investigated deep-sea sites. Relative abundance (%) of main nannofossil taxa at (a) South Atlantic Site 525 and (b) Equatorial Indian Ocean Site 707. Total fluxes ($N\ m^{-2}\ yr^{-1}$) of main nannofossil taxa at (c) Site 525 and (d) Site 707.

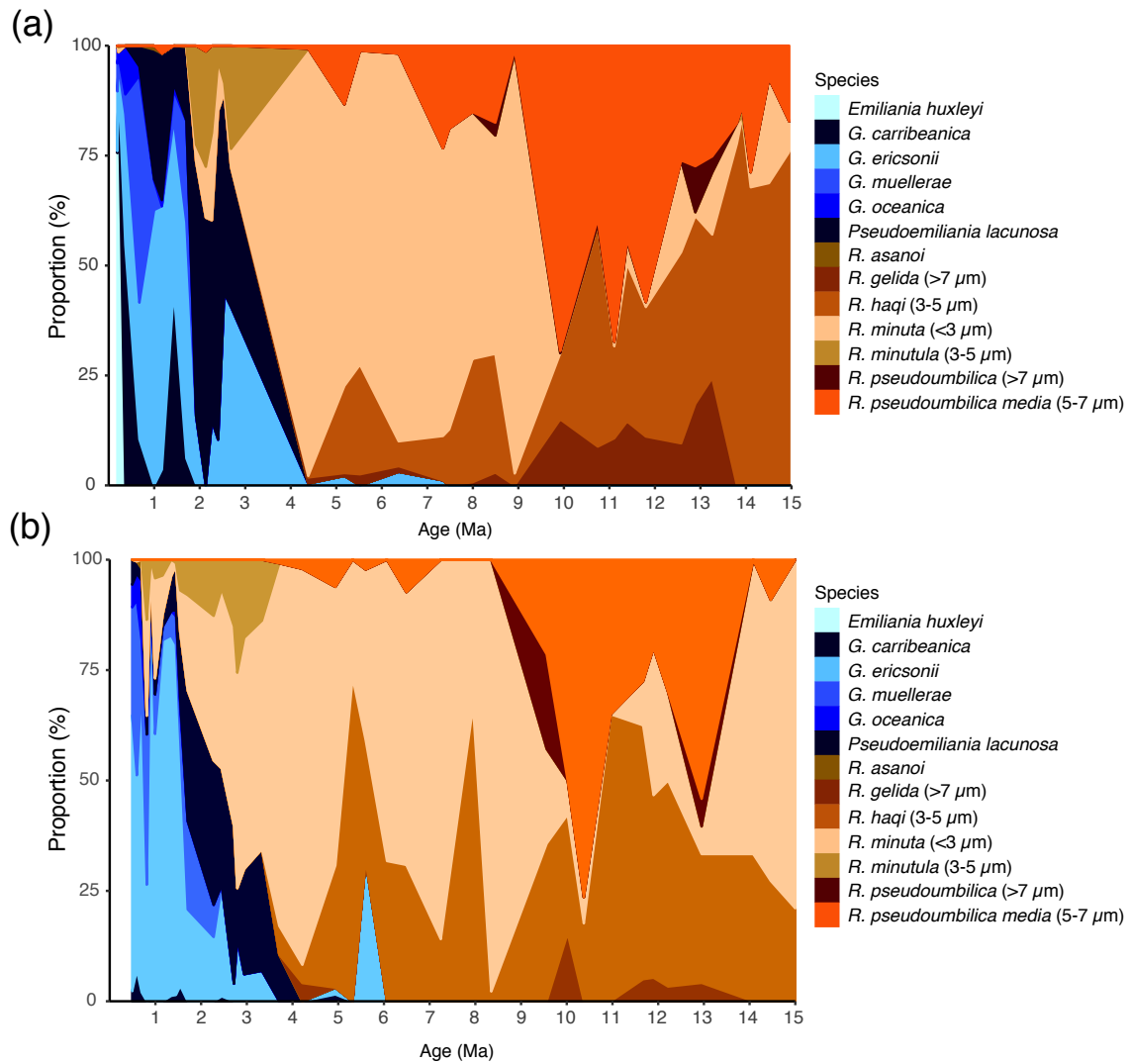


Figure S4. Proportions of morphospecies within the Noelaerhabdaceae family (genera *Emiliana*, *Gephyrocapsa*, *Pseudoemiliana* and *Reticulofenestra*). (a) South Atlantic Site 525. (b) Equatorial Indian Ocean Site 707.

Table S1. Age-depth models of DSDP Site 525 and ODP Site 707. Nannofossil bioevents as determined in this study. Depths marked in bold were compiled in Suchéras-Marx and Henderiks (2014), originally reported as shipboard data in Backman *et al.* (1988) and (Moore *et al.* (1984). Calibrated ages are on the geological timescale of Gradstein *et al.* (2012). FO=first occurrence; LO=last occurrence.

Nannofossil bioevent	Age (Ma)	525 Depth (mbsf)	707 Depth (mbsf)
FO <i>Emiliana huxleyi</i>	0.29	1.21	
LO <i>Pseudoemiliana lacunosa</i>	0.44	2.42	0.43
LO <i>Reticulofenestra asanoi</i> common	0.91	3.64	
LO <i>Helicosphaera sellii</i>	1.26	6.07	7.23
LO <i>Calcidiscus macintyreii</i>	1.60	7.34	
FO <i>Gephyrocapsa</i> spp. (<5.5µm)	1.62		10.76
LO <i>Discoaster brouweri</i>	1.93	9.30	13.46
LO <i>Discoaster pentaradiatus</i>	2.39		16.06
LO <i>Sphenolithus</i> spp. subtop	3.54		28.46
LO <i>Reticulofenestra pseudoumbilicus</i>	3.7	28.52	
FO <i>Amaurolithus</i> spp.	7.42	88.80	
FO <i>Discoaster quinqueramus</i>	8.12		89.26
FO <i>Discoaster berggrenii</i>	8.29	103.78	
FO <i>Discoaster pentaradiatus</i>	9.37	121.46	
FO <i>Discoaster hamatus</i>	10.55		113.12
LO <i>Sphenolithus heteromorphus</i>	13.53	170.81	123.82
LO <i>Helicosphaera ampliapertura</i>	14.91	193.15	
FO <i>Sphenolithus belemnos</i>	19.03		136.70

Table S2. T-test comparison of coccolith volume index (CVI), area, major diameter and AR between the two strains of *H. carteri* studied in Šupraha et al., (2015).

Strain	Area (μm^2)		Thickness (μm)		CVI (μm^3)		Major (μm)		AR	
	1323	1334	1323	1334	1323	1334	1323	1334	1323	1334
Mean	38.93	37.64	0.74	0.71	29.62	27.82	8.42	8.10	0.12	0.11
d	1.10		2.08		1.46		2.08		2.20	
df	325.92		317.22		328.39		324.87		327.32	
p-value	0.273		0.037		0.144		0.039		0.029	

Table S3. Site-to-site t-test comparisons of coccolith volume index (CVI, μm^3) on the genus (*Helicosphaera* spp.) and the morphospecies-level.

Site	<i>Helicosphaera</i> spp.		<i>H. carteri</i>		<i>H. sellii</i>		<i>H. granulata</i>	
	525	707	525	707	525	707	525	707
Mean	46.22	34.92	41.96	35.22	36.69	26.06	61.18	43.01
t	20.36		10.83		7.96		15.15	
df	3863.8		2427.2		324.91		890.57	
p-value	2.2e-16		2.2e-16		2.9e-16		2.2e-16	