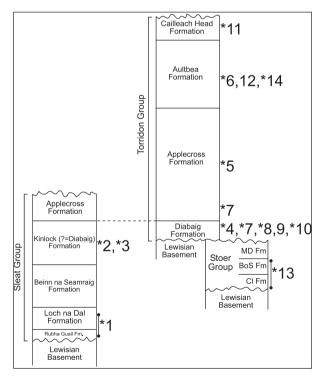


Supplementary Figure 1. Location map showing generalized bedrock geology and locations of all sampled sections used in this report.

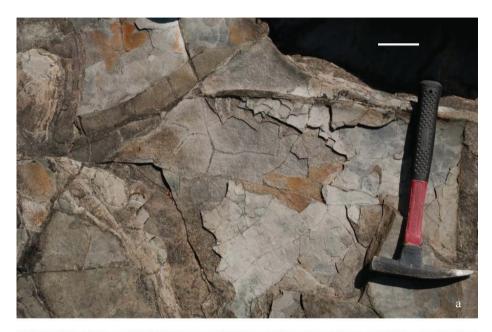


Supplementary Figure 2. Generalized stratigraphic column of the Torridonian Sequence. Numbers correspond to section locations on Supplementary Fig. 1; those marked with an asterisk (*) were productive palynological samples.





Supplementary Figure 3. Small-scale ripple marks from the Diabaig Fm at Loch Diabaig, the type section. **a**, Multidirectional ripple marks in grey shale/siltstone on wetted surface. Medium sized desiccation cracks, forming polygons also appear on this surface. Scale is approximately 10 cm. **b**, Low relief ripple marks in grey laminated siltstone are overlain by a distinctive reticulate microbially mediated sedimentary structure (MISS) described previously in Prave (2002). Scale is approximately 10 cm.



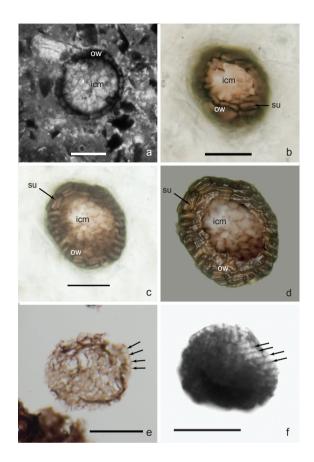


Supplementary Figure 4. Desiccation cracks from the Diabaig Fm at Loch Diabaig, the type section. a, Small desiccation cracks in planar gray siltstone. Scale is approximately 10 cm. b, Larger desiccation cracks and desiccation polygons, some of which are filled with localized phosphate. Phosphate nodules may be localized to desiccation cracks, but they also occur associated with laminated primary sediment throughout the section at Loch Diabaig. Hiking stick for scale is 1m.

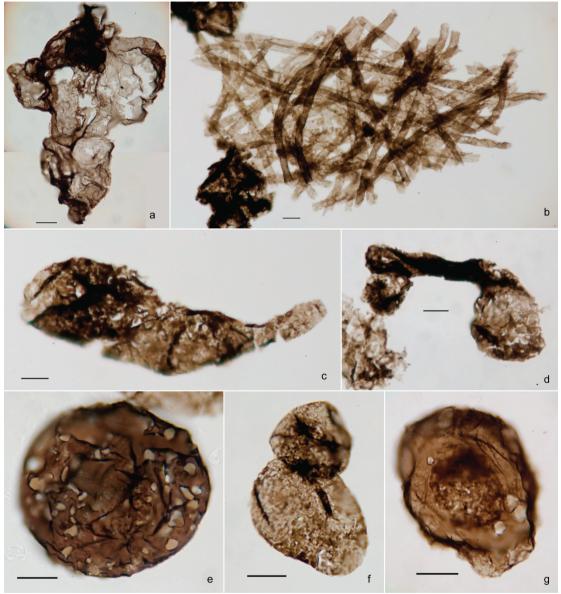




Supplementary Figure 5. Raindrop impressions from the Stoer and Torridon Groups. Raindrop impressions found in the Torridonian sequence are a general indicator of extensive and continued subaerial exposure throughout the entirety of the succession. a, Circular raindrop impressions preserved in weathered red sandstone exposed at promontory of Stac Fada, Bay of Stoer Formation (Stoer Group). Scale is approximately 1 cm. b, Circular raindrop impressions found in a freshly split slab at Rubh' n' Choin, Enard Bay, Diabaig Formation (Torridon Group). Scale is approximately 10 cm.



Supplementary Figure 6. Additional images of the multicellular balls. All scale bars are 10 μ m, ow = outer wall, icm = inner cellular mass, su = subunits of the vesicle wall. a, Confocal laser scanning image of the specimen in Fig. 1h. In this image, the cell interiors which are permineralized, are fluorescent (light) and the intervening organic matter (kerogen) demarcating the original cell walls are dark. Both the beaded appearance of the outer wall (ow) and the cellular nature of the inner cellular mass (icm) are visible in this laser transect which is .2 µm thick. b, c. Two different optical sections through another specimen preserved in phosphate. In b, the optical section is nearly tangent, revealing the nature of the subunits (su) which characterize the vesicle wall (ow) and the inner cells mass (icm) which is largely absent in this section. In c, the cellular nature of the inner cellular mass (icm) is more apparent. d, Artist reconstruction of the specimen in b, c. e, morphologically similar specimens to Supplementary Figs. a-d, but from macerated (palynological) sample TOR08-27, Allt na Beistre Member of the Applecross Fm, Loch Diabaig. Roughly corrugate form with arrows pointing to four of the marginal subunits that appear beaded in cross section. f, Roughly corrugate form with arrows pointing to short lines corresponding to the margins of the sausage-shaped subunits which make up the outer wall. This monochromatic image was produced in Photoshop CS4 using the channel mixer menu to select only the Green (G) channel. This specimen was macerated from a phosphatic nodule from sample TOR08-34, Diabaig Formation, Loch Diabaig.



Supplementary Figure 7. Additional examples of provisional taxa documented in Supplementary Table 2. a, Irregular saccate form; TOR08-46/Cailleach Head Fm. b, filamentous weft of tubes, these are masses of sub-parallel organic tubes which may represent the sheaths of cyanobacteria which formed microbial mats; TOR08-34/Diabaig Fm., Loch Diabaig. c, Tapered ellipsoid. This is a rather common form throughout the assemblages but it varies greatly in size and shape; TOR08-34/Diabaig Fm., Loch Diabaig. d, Germinosphaera sp. This form genus incorporates tubes with bulbous tips, some of which appear as if recently germinated; TOR08-25/Allt na Beistre Member of the Applecross Fm, Loch Diabaig. e, Sphaeromorph acritarch with a distinctive perforated wall; TOR08-34/Diabaig Fm., Loch Diabaig. f, Granular to shagrenate vesicle surface characteristic of Trachysphaeridium; TOR08-34/Diabaig Fm., Loch Diabaig. g, Finely striate, thinwalled outer vesicle referable to the genus Stictosphaeridium; TOR08-34/Diabaig Fm., Loch Diabaig.

Section	Sample #	Geologic Unit	GPS location
Rhuba Guail	TOR08 1-5	Sleat: Rubha Guail Fm	NG 73541581
Rhuba Guail	TOR08 6-8	Sleat: Loch Na Dal Fm	NG 72401505
nr Tarskavaig	TOR08 9	Sleat: Kinloch Fm	NG 58060979
Ob Gauscavaig	TOR08 10-12	Sleat: Kinloch Fm	NG 59001140
Brochel Castle	TOR08 13-17	Torridonian: Diabaig Fm	NG 58514624
nr Holoman Island	TOR08 18-20	Torridonian: Applecross Fm	NG 54994139
Toscaig	TOR08 21-23	Torridonian: Aultbea Fm	NG 70283675
Diabaig	TOR08 24-26	Torridonian: Applecross Fm	NG 79126027
Diabaig	TOR08 27-35	Torridonian: Diabaig Fm	NG 79696014
Ob Mhealliadh	TOR08 36-37	Torridonian: Diabaig Fm	NG 83345427
nr Gairloch	TOR08 38	Torridonian: Diabaig Fm	NG 95466878
Badachro	TOR08 39-41	Torridonian: Diabaig Fm	NG 78477311
Cailleach Head	TOR08 42-46	Torridonian: Cailleach Head Fm	NG 98709790
Mellon Charles	TOR08 47	Torridonian: Aultbea Fm	NG 84619086
Stoer	TOR08 48	Stoer: Clachtoll Fm	NG 03742854
Stoer	TOR08 49-53	Stoer: Bay of Stoer Fm	NC 03322849
Tanera Beg	TOR08 54-56	Torridonian: Aultbea Fm	NB 19720073

Supplementary Table 1. This table shows the names of the section localities, their placement on the map (Supplementary Fig. 1), the geolgic formation and their GPS location.

						S	single-celled sphaeromorphs and other llikely eukaryotic forms										m	multiwalled and colonial forms						Complex morphologies								prokaryotes					char	acters			
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Cailleach Head	Cailleach Head	TOR08-45	4	167	A			:			•		R		R						R	C		R										•						С	
Cailleach Head	Cailleach Head	TOR08-44	3	206	A	R	2	:	C																										C	R				•	
Canicach Ficau	Cameach ricau	10100-44																																							
Aultbea Fm	Toscaig	TOR08-22	6	143	Α		Α	R			R					R																			C						
Aultbea Fm		TOR08-21	14	166												R																								•	
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Ax(Glame Mb)	Isle of Raasay	TOR08-20	13	136	C		R											•				R	R																		
Ax(Glame Mb)	Isle of Raasay	TOR08-19	5	131	C	•	•																					•													
Ax(Glame Mb)	Isle of Raasay	TOR08-18	4	105	C	•	•				•														R																
		TOR08-24	13	181	А		. (R								С												С						
Ax(Allt na Beistre Mb)	Loch Diabaig		6	143	Α		Α								R	R						С	C									F	₹		R						
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Ax(Allt na Beistre Mb)	Loch Diabaig	TOR08-26	9	193		R					R	R	10						R	R	10			R								F	,	R			• R	,			
Ax(Allt na Beistre Mb)	Loch Diabaig	TOR08-27		.,,,	А	K					ı				-									K	-									IC			. 1				
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Kinloch	Tarsvaig	TOR08-9b	11	472.3	А		. .		ı				K	K										K					K	K											
Diabaig (Brochel Mb)	Brochel Castle	TOR08-17	10	124	A	R	R R													•															•						
Diabaig (Brochel Mb)	Brochel Castle	TOR08-16	9	126	A	•	•										•	•		•	•	R													R						
Diabaig (Brochel Mb)	Brochel Castle	TOR08-15	4	252	A	R	R R													•			•			•													•		
Diabaig (Brochel Mb)	Brochel Castle	TOR08-14	7	179	A	R	2	1			•	•								C	•																		R		
Diabaig (Brochel Mb)	Brochel Castle	TOR08-13B	5	223	A	R	٠ ،			•	C				•		•			R		•												R							
Diabaig (Brochel Mb)	Brochel Castle	TOR08-13	3	98	A	R	2	:							•					R									R	R				C	•		R	}			
			,	290				,													R		R			R									R						
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Diabaig Fm	Loch Diabaig	TOR08-32	8	459			R					_				_		•		_	R	_	R			_	•								R					_	
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Diabaig Fm	Ob Mhealliadh	TOR08-37	0	112	C		R																•																		
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Diabaig Fm	Badachro	TOR08-40	4	915	Α	(,					•			•						•	•	•				•								R						
Stoer Group	Stoer Peninsula	TOR08-48	0	28 230.9 (mc	C ean dian		of larg		cimen)													R																			

Supplementary Table 2. Provisional taxonomic assessment of microfossils from the Torridonian Sequence. Formations are listed in stratigraphic order, but relative ages within formations are not constrained. Locality names and sample numbers refer to Supplementary Table 1. "OM Density" is a semi-quantitative measure of palynomorph recovery. Possible values range from 0 to 20 and represent the number of specimens intersected by the cross hair of an optical reticule in a random linear transect of 20 counts per microscope slide. "Max diameter" refers to the maximum size of vesicles assessed per microscope slide. The values were measured using an optical micrometer reticule which was fixed parallel to the long axis of the microscope slide, effectively randomizing the diameter measurement. We found that the average maximum diameter of all productive samples from the Sleat and Torridon Groups exceeded 200 μ m. Microfossils were grouped into four general structural classes: 1, single-celled sphaeromorph and other likely eukaryotic forms; 2, multi-walled and colonial morphologies; 3, complex morphologies which include various structural remains that are not vesicular in nature; and 4, possible cyanobacterial (prokaryotic) remains. The presence of pre-formed excystment openings were noted as a separate character category. Values in chart: A = Abundant, > 10 %; C = Common, between 1 and 10 %; R = Rare, <1 %; • = Present, referring to fewer than three specimens per slide.