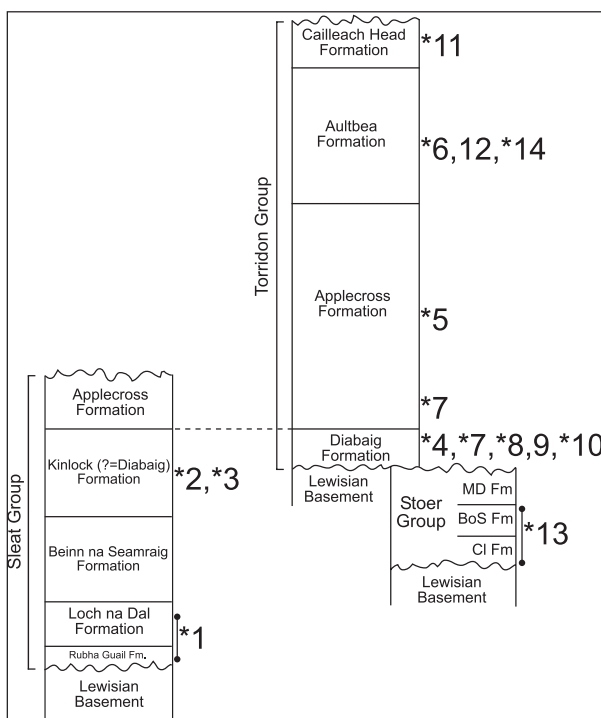




Supplementary Figure 1. Location map showing generalized bedrock geology and locations of all sampled sections used in this report.



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.



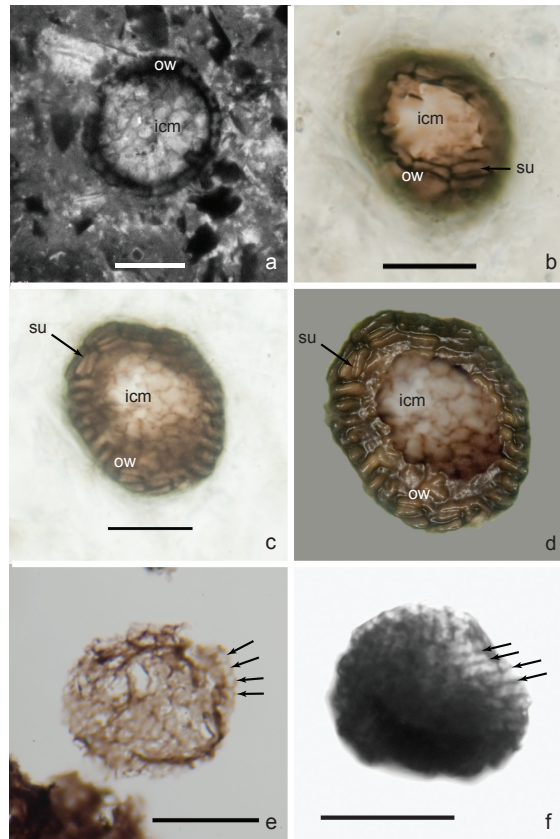
Supplementary Figure 3. Small-scale ripple marks from the Diabaig Fm at Loch Diabaig, the type section. **a**, Multidirectional ripple marks in grey shale/siltstone on wetted surface. Medium sized desiccation cracks, forming polygons also appear on this surface. Scale is approximately 10 cm. **b**, Low 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.



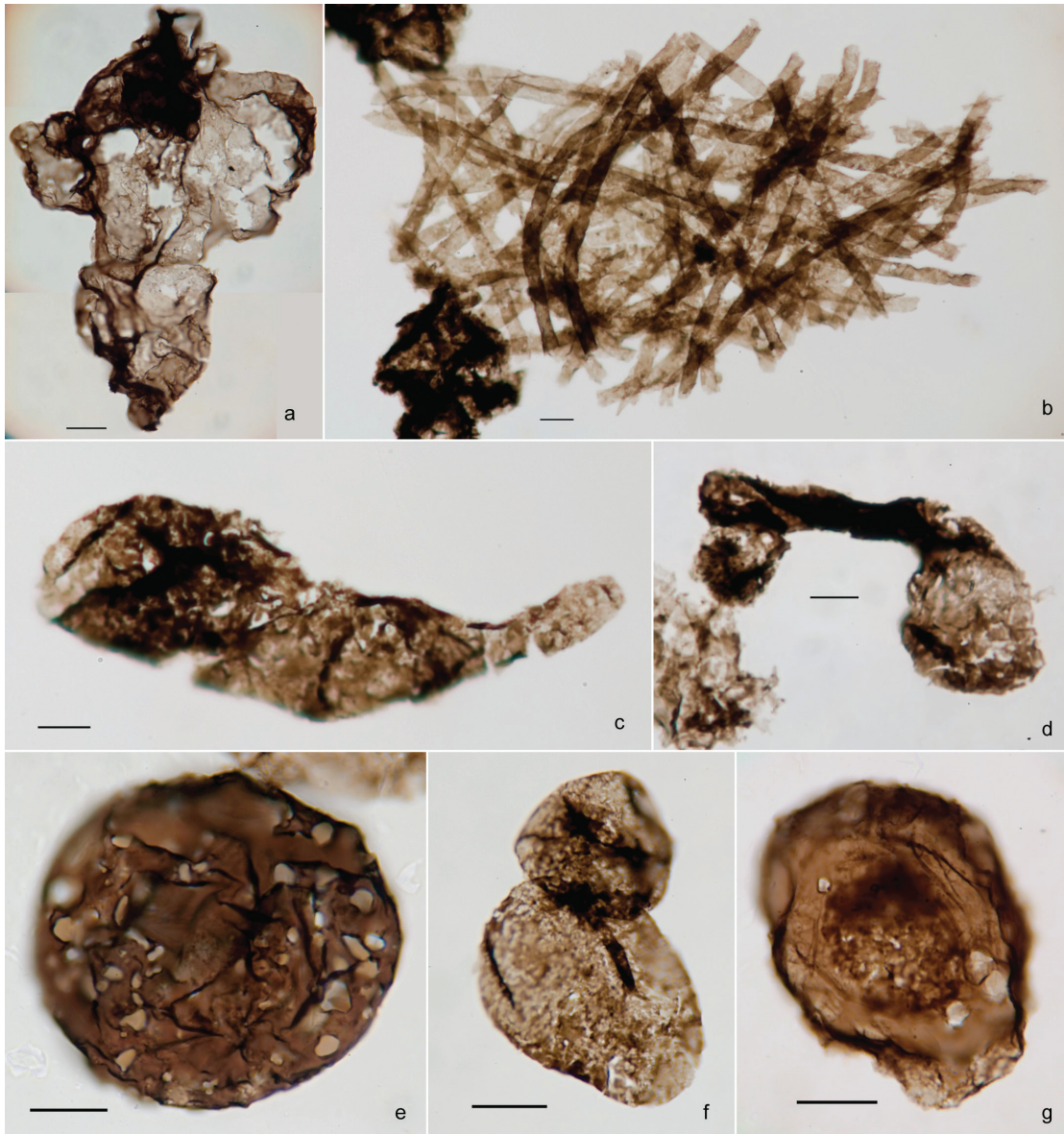
Supplementary Figure 4. Desiccation cracks from the Diabaig Fm at Loch Diabaig, the type section. **a**, Small desiccation cracks in planar gray siltstone. Scale is approximately 10 cm. **b**, Larger desiccation cracks and desiccation polygons, some of which are filled with localized phosphate. Phosphate 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  $\mu\text{m}$ , **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  $\mu\text{m}$  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, thin-walled outer vesicle referable to the genus *Stictosphaeridium*; TOR08-34/Diabaig Fm., Loch Diabaig.

| <b>Section</b>    | <b>Sample #</b> | <b>Geologic Unit</b>           | <b>GPS location</b> |
|-------------------|-----------------|--------------------------------|---------------------|
| 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 geologic formation and their GPS location.

