Remarkably preserved tephra with microfossil-like morphology from the ~3.43 Ga Strelley Pool Formation, Pilbara, Western Australia

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The ~3.43 Ga Strelley Pool Formation (SPF), Pilbara, Western Australia contains some of the most robust microfossil evidence for early life on Earth [1,2]. Here we describe newly discovered clasts from the lower sandstone unit and upper silicified ash unit of the SPF that contain pumice, tubular pumice and multiple morphologies of volcanic glass shards.

Pumice vesicles show several modes of preservation but the most conspicuous are almost spherical and lined with anatase and carbon. Their diameters range from 5-180 μm with 90% in the 5-50 μm range. Tubular pumice is also lined with anatase +/- carbon and has tube diameters of 5-15 μm. Other volcanic ejecta particles include tear-shaped, eye-shaped, and hair-like morphologies, plus a multitude of sub-rounded particles with or without vesicles. Most of these are coated in anatase +/- carbon, with about 1% possessing particularly thick coatings of anatase intergrown with a zirconium phosphate mineral phase.

Typically, both the pumice and glass shards are now entirely silicified with no compositional difference between the vesicle infill, former volcanic glass, and clast matrix. However, rare examples of pumice retain a partial aluminosilicate vesicle infilling phase, now chloritised. Lack of deformation or compaction indicates that anatase precipitation and massive silicification occurred rapidly after deposition.

It is relatively straightforward to identify this combination of multiple well-preserved morphologies as volcanic in origin. However, isolated occurrences strongly resemble simple microbial morphologies including pairs and clusters of cells (pumice), trichomes within sheaths (tubular pumice) and larger sheaths/cysts (certain glass shards). Given that silicification masks their original composition, and carbon linings/coatings mimic cell walls, these micro-structures represent another potential pseudofossil that should be considered when evaluating the earliest signs of life.

[1] Sugitani *et al*. (2010) *Astrobiol.* **10**, 899-920.

[2] Wacey *et al*. (2011) *Nat. Geosci.* **4**, 698-702.