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Neoproterozoic fibrous calcite veins from Arkaroola, South Australia: the oldest known biomineralisation by deep microbial life

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Extremophile microbes are known to currently inhabit the surface and upper kilometres of the Earth's crust. Although deep microbial life may date back to the beginning of life on Earth, fossil evidence for deep life remains virtually non-existent. A main problem is the difficulty to find and recognise micron-sized fossil remains in the vast volume of rock.

We analysed 585 My old [1] antitaxial fibrous calcite veins that formed at about 4-6 km depth in dark carbon-rich shales, found near Arkaroola, northern Flinders Ranges, South Australia. SEM analysis shows that the veins contain micron-sized biomorph structures, such as coccus-shaped and globular structures, indications of cell division (wall bands, meridian constriction) and thin (0.1 μm) fibres with knots [2]. The combined morphological evidence indicates that these constitute fossil microbes. These microbes must have lived during vein growth and, therefore, possibly played a role in the formation of the veins, and making these veins wholly or partly biomineralisations.

The absence of known very old fossil deep life has led the scientific community towards seeking the origin of life at the Earth's surface. However, the fossil microbes from Arkaroola indicate that life had penetrated deeper rocks at least at the end of the Proterozoic, and probably well before that time. It may well be possible that life originated within the crust, not at the surface. If there is a link between the distinct antitaxial fibrous texture of the veins and microbial activity, this type of veins may

help in the search for more, and possibly older evidence for deep microbial life in the geological record. In the end it may aid in resolving the enigmatic origin of life itself.

[1] Elburg et al. 2002. The origin of fibrous veins: constrains from geochemistry. Geol. Soc, London, Spec. Publ. 200, 103-118.

[2] Bons & Montenari (in press) The formation of antitaxial calcite veins with well-developed fibres, Oppaminda Creek, South Australia.