Cyanobacteria Fossils from Neo-Archaean Chitradurga Schist Belt: Evidence of a bioherm

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The Chitradurga Schist Belt (CSB) is a volcano sedimentary sequence comprising of polymodal meta-volcanics, greywackes, banded iron formations (BIFs), shales, and carbonates ± stromatolites. These are intruded by Chitradurga granite dated at 2.6 Ga [1]. The different facies of BIFs such as oxide, carbonate, sulphide and mixed facies occur in the central part of CSB in various lithological associations [2]. The carbonate facies banded iron formations (CBIFs) are associated with amphibolite, stromatolite, carbonaceous chert, manganiferrous carbonate and phyllite - interlayered metavolcanics are dated at 2.7 Ga. Petrographic and Microprobe studies revealed that these CBIFs are mainly made up of siderite, ankerite, ferron-dolomite, dolomite, calcite, magnesium siderite. Micro-filaments and bioherms are observed in carbonate facies BIFs and these microfilments are mostly found near the bedding planes between the chert and carbonate rich layers. They are usually concentrated in the carbonate rich layers and appear to be similar to the bioherms reported from associated rocks of Proterozoic BIF. The syngenetic nature of these filaments is clearly evident in the samples wherein the filaments are seen cutting across the carbonate grains (Figure 1).

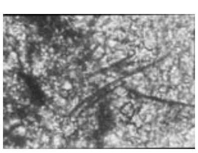
Figure 1

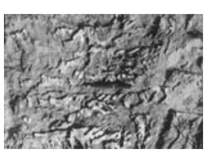
Figure 2

The presence of stromatolites (Fig.2) and the δC^{13} values (-16‰, -17‰ and -12‰) of the carbon rich fractions separated from samples confirms their organic nature.

References

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[2] Gnaneshwara Rao, T. and Naqvi, S.M., (1995), *Chem. Geol.* **121.** 217-243.

Structural and chemical characterization of a natural fracture surface from 2.8 kilometers below land surface

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The ultra-deep gold mines located in the Witwatersrand basin, Republic of South Africa offer unprecedented access to the terrestrial deep subsurface.

A water bearing fracture, intersected by an advancing tunnel 2.8 kilometres below land surface, was investigated and samples of the fracture surface were collected soon after the tunnel was extended through the feature. Micro X-Ray diffraction demonstrated that the fracture material (approximately 1 mm thick) coating the fracture surface consisted of chamosite with other chlorite group minerals as secondary phases. Using Scanning Electron Microscopy, the surface was found to be colonized by small, highly dispersed 'microcolonies' of bacteria containing between 1 and 5 cells/microcolony. Some microcolonies were adsorbed to the fracture surface via exopolysaccharide material while others were not. Cell densities were determined to be $5x10^3$ cells/cm^2 adsorbed to the surface and $5x10^4$ cells/ml in the fluid phase. Using a 100 µm thick in situ fracture void, the 'biofilm' population is 2 orders of magnitude greater than the cell density in the fluid phase.

Water analysis and energetics calculations reveal abundant nutrient and energy availability, suggesting that more bacteria should have been observed in these samples. Also, Time of Flight – Secondary Ion Mass Spectrometry (ToF-SIMS) of the fracture surface revealed that a most of the fracture surface was coated with a molecular-scale organic conditioning film separate from the exopolysaccarides associated with some of the microcolonies. This environment, then possesses even more 'nutrients' than measured in the aqueous phase. The observation that the subsurface biosphere is "underpopulated" is supplemented by the presence of large scale biofilms (mine slimes), which develop on the tunnel walls where subsurface water encounters the oxygenated mine environment.