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Microbial exopolysaccharides as determinants of geomorphological, hydrological and optical properties of soil crusts from the Precambrian till today

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The presence of microbial extracellular polysaccharides (EPS) in the soil solution and/or in association with particular microbial types can impart novel properties to biological soil crust (BSC), and hence to soil surfaces. For the most part these properties are of a geobiological relevance that exceeds what one could surmise from its relatively low specific mass content. I will review some examples that range from the mundane to the unexpected. EPS associated with filamentous cyanobacteria can effectively and in the long term stabilize the soil surface against erosive forces, even after the microbes are long gone. Electrostatic interactions between EPS and blowing dust may help retain dust particles, enriching the soil with new nutrient sources. In a telltale sign of BSC presence, EPS is the agent that allows sandy soils to fold and curl-up, to form pee-tee's and elephant-skin surfaces, and to crack into polygons like clays would. EPS in large quantities in flat crusts can retain fluids (both liquid and gaseous) resulting in the alteration of hydrological flow and in the formation of internal vesicular horizons, gas bubbles, pock-marked surfaces and other characteristic structures. Yet, in some settings, EPS plays an architectural role in creating a "spongy" texture that increases hydraulic conductivity. This architectural role can indirectly result in significant increases of a crust's albedo. While the diversity of consequences of EPS presence is far from understood, evidence for its sustained role through Earth's history can be found in the form of sedimentary bio-signatures as far back as the Proterozoic.