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In situ imaging of drying-induced pore microstructure changes of Biological Soil Crusts.

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Biological Soil Crusts (BSCs) are the millimeter size epidermal layer of many dryland soils. They cover around 20% of the Earth's land area, a global extension that is predicted to increase due to ongoing desertification. BSCs consist of an assemblage of mineral soil particles consolidated into a crust by the addition of organic polymeric substances mainly produced by the filamentous bundle forming cyanobacterium, Microcoleus sp.. This cyanobacterium is both the primary producer for, and architect of BSCs, sustaining the development of a diverse microbial community. Despite their ecological importance, little is known about how BSC communities endure long dry periods while remaining viable for rapid resuscitation upon wetting. We hypothesized that bundle-forming is a trait of Microcoleus sp. that serves as an adaptive advantage, slowing the dehydration process and allowing the cyanobacterium more time to prepare for desiccation thanks to its larger size. To test this hypothesis, we tracked the water dynamics within a undisturbed BSC core throughout a hydration-dehydration cycle, using synchrotron based X-ray microtomography to resolve the distribution of air, water, soil particles and cyanobacterial bundles at the microscale and to quantify changes of the pore architecture during wetting and drying.