Environmental Genomics Reveals a Single-Species Ecosystem Deep Earth

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Environmental genomics is permitting a more complete understanding of life on and *in* the Earth, even when the isolation of organisms from a given ecosystem has proven intractable. The study of deep subsurface organisms is of particular interest as such investigations illuminate a mode of life that exists without input from the photosphere, giving us a better understanding of the physiology of anaerobic microorganisms that may be used in bioremediation applications. DNA from low biodiversity fracture water collected at 2.8 km depth in a South African gold mine was sequenced and assembled into a single, complete genome. This uncultured Gram-positive bacterium, *Candidatus Desulforudis audaxviator*, is prevalent at depths > 1.5 km and its near-clonal population comprises > 99.9% of the microorganisms inhabiting the fluid phase of the MP104 fracture. Its genome indicates a motile, sporulating, sulfate reducing, chemoautotrophic thermophile that is capable of fixing its own nitrogen and carbon using machinery shared with archaea. *Candidatus Desulforudis audaxviator* appears capable of an independent lifestyle well suited to long-term isolation from the photosphere deep within Earth's crust, and offers the first example of a natural ecosystem that has its biological component entirely encoded within a single genome.