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Life at the extreme: shaping the rhizosphere in the Atacama desert

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Due to their extreme aridity, heat, hypersaline conditions (20-25 mS/cm, pH 8-9), high rate of UV irradiation and low soil carbon (C) content, the soils of the Atacama Desert represent one of the world's most hostile environments for microbial and plant life. Further, these soils are often used as a model system for studying the potential for establishing life on Mars. Although infrequent, climatic and edaphic conditions may, however, prevail which temporarily remove these stresses and allow life to flourish. In this study we investigated how plants have naturally engineered the soils and microbial communities of the Atacama Desert to facilitate their survival. This includes the development of a unique plant growth form that leads to the development of a phyllosphere soil in which salt becomes enriched following transfer from the root zone and passage through the leaves into the phyllosphere soil. In addition, the roots of these plants have the potential to penetrate the concrete soil platform facilitating access to water trapped beneath the impermeable layer. The presence of plants has also promoted pedogenesis and the formation of an active and diverse microbial community which exhibits rapid rates of nutrient cycling. Unlike most soils, plant growth is not N limited due to the accumulation of nitrate deposits in these soils (ca. 1 g/kg), however, we demonstrate that P is more limiting due to the high rates of P fixation on the solid phase. In contrast to recent reports, we found that the presence of water does not lead to a loss of microbial activity in these soils but rather stimulates microbial activity.