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More favorable deep soil conditions provide potential habitat for life in the hyper arid Atacama Desert.

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Phosphorus (P) is a biogenic element essential to life as we know it. The geochemical properties of phosphorus, including its low solubility and variable reactivity under extreme dry soil conditions (i.e. high pH and salinity, low moisture content) make it very difficult to understand it role the formation of key biomolecules for life in inhospitable hyper arid and other extreme environments. Even so, studies have demonstrated microbial life in different habitats of the Atacama Desert, such as: underside of quartz rocks, fumaroles, inside of halite evaporates and salt caves. In our Yungay study site, cyanobacteria colonization inside of halite evaporates has also been reported. The aim of this work is to evaluate phosphorus distribution in a soil profile of hyper arid soil in Atacama Desert and link it with biotic and abiotic parameters necessary for life.
Our results showed that in the investigated soil profile (0-340 cm) the P values ranged from 120-890 mg kg-1. In soil surface (0-20 cm) 350 mg P kg-1 was found, at 20-50 cm the lowest values of P were found (172 mg P kg-1 soil) and below 50 cm depth the highest values of total P (>470 mg k-1) were found. According Hedley fractionation nearly all P was inorganic P probably from calcium phosphates. Less of 5% of total P was water soluble and less of 3% was extractable with sodium bicarbonate. Consistently high pH values were registered in all soil profile, with a pH average of 8.8. The highest values of electric conductivity (EC) were found at 30-60 cm (ranged 113-187 mS cm-1). According with XRD analysis at 40-50 cm depth, halite (NaCl) and araskite ($Na3(NO_3)(SO4)\cdot H_2O$) were present in high percentages (46 and 38%, respectively). Moisture content increased with soil depth from 0.6% (0-10 cm), 3% (50-60 cm), and being 20% (330-340 cm) in the brownish coloured layer which had started at 320 cm. It was possible to extract some DNA along the soil profile, with the highest amount extracted below 90 cm. Our results show that the halite rich soil part (here at 40-50 cm), and well known for housing cyanobacteria (with low content of P, low moisture content and high EC) is not the only soil layer where one extract DNA. We noted that when with increasing depth better conditions for life are present (e.g. high P content, high moisture content and low EC), then DNA can be isolated. Therefore the deep soil could be another suitable life habitat in the hyper arid soils of the Atacama Desert.

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