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Atacama Desert: Determination of two new extremophilic microbial model systems for space exploration and astrobiology studies – data from a large-scale transect study

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The hyper-arid region of Yungay in the Atacama Desert in Chile is believed to be the driest place on Earth thus harboring the most desiccation-resistant microorganisms. Hence the search for new extremophilic model organisms is traditionally limited to this rather narrow strip. However, it is not clear whether Yungay is indeed the most arid place, as this should be the one with the lowest soil organic carbon (SOC) stock and soil water (SW) content. Therefore we tested soil samples from a humidity-gradient transect with comparable sites (inclination, location in the rain shadow of the coastal mountain range, ∼100 km distance between the sites) spanning roughly 600 km in the Atacama Desert for SOC stocks and SW content. We found, that SOC stocks decreased with aridity from 25.5 to 2.1 kg m-2 cm-1, while the SW contents decreased at 5 of our sites and increased in the hyper-arid zone. To our surprise, we identified two sites located 100 km north and south of Yungay which had substantially lower (1.92 ± 0.73 kg m-2 cm-1) or slightly higher (2.39 ± 1.2 kg m-2 cm-1) SOC stocks than Yungay (2.21 ± 0.75 kg m-2 cm-1), but with 0.043 ± 0.03 g respectively 0.0033 ± 0.0016 g of water per 1 g of soil comparable or substantially lower SW contents, while Yungay has 0.043 ± 0.06 g. Thus we consider these sites to display different growth conditions and ecological niches compared to Yungay and therefore as promising candidate sites for the identification of new species of polyextremophilic radiation-resistant microorganisms, as the resistance against desiccation is paired with a distinct resistance to ionizing radiation due to same microbial DNA repair mechanisms. Soil samples were irradiated with high doses of gamma radiation up to 25 000 Gy. Surviving colonies were cultivated on a medium favoring the growth of Deinococcus-like species, currently the most radiation-resistant organisms on Earth, and their affiliation was determined using 16SrRNA next generation sequencing. Here, we discuss the hypothesis of ecological niching even at the most hyper-arid places of our planet on grounds of our recently identified sites – with implications for life-detection missions in hyper-arid Martian regolith.