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Carbon accrual in Atacama Desert soil

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The Atacama Desert is the oldest and driest desert on earth, nevertheless traces of life have been observed in several places, accumulating residues of organic matter (OM) on the desert surface, i.e. in its soil. We asked if these OM traces of life preferentially accumulate in topsoil, or whether also enrichment of OM in deeper subsoil layers appears. We also evaluated to which degree spatial and vertical heterogeneity in the distribution of soil organic carbon (SOC) stocks depends on increasing aridity in the desert ecosystem. We sampled an east-west directed aridity transect with several replicates spanning the Atacama Desert from north to south, i.e. Codpa (18.4°S), Rio Tana (19.2°S), Quebrada Aroma (19.4°S), Yungay (24.6°S) and Paposo (25.1°S). With a nested sampling design ($3 \geq n \leq 18$) we addressed topsoil heterogeneity at each sampling site (n=433). For 13 of these sites soil profiles were dug to 0.8 to 3.9 m depth depending on soil thickness. This amounted to a total of 637 samples. Bulk density was taken for each site and depth of 15 cm. SOC concentrations were taken for each sample by thermally resolved dry combustion with a Soli TOC (Elementar Analysensysteme, Hanau, Germany DIN 19539GS). We found that with decreasing precipitation ($\sim$7 to <0.1 mm yr-1), SOC stocks decreased from 3.42 ± 4.08 to 0.09 ± 0.01 kg SOC m-2 in the 15 cm of topsoil. Hence, traces of life were ubiquitously preserved both in the arid and hyper-arid desert areas. Intriguingly, relatively large amounts of soil organic matter were also found at depth below 15cm, adding an extra of 52.9 to 95.9 % of subsoil C to the topsoil SOC stock. Furthermore, the subsoil SOC concentrations peaked between 40 and 150 cm depth in the soil, irrespectively of the presence or absence of visible vegetation. Biomarker analyses are currently performed to reveal the origin of SOC found in the various depths. We conclude that C accrual in this arid to hyper-arid system shifts from the preferential C enrichment in topsoil to that in the subsoil, therewith providing the potential for deep(er) biosphere foodwebs and demonstrating the likelyhood to need to dig into soil for discovering traces of (active) life in comparable environments, including other planets such as Mars.