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The surface elemental composition of soil microaggregates of different size fractions – Possible implications for functioning

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Aggregate formation as well as functioning and stability of the formed aggregates depend on the surface properties (e.g., exposed functional groups, surface charge, wettability) of the aggregate building units (BU). Few studies revealed that BU exhibit a surface layer different in chemical composition from that of the bulk material. Specific analysis of the surface elemental composition of aggregates thus is a prerequisite to better understand aggregate formation, functioning, and stability. Here, water-stable free and occluded soil microaggregates (SMA) of three size fractions (53-250 μm, 20-53 μm, 0.2-20 μm) had been isolated from Luvisols along a clay gradient (clay contents 19–35%) and the surface elemental composition was determined by X-ray photoelectron spectroscopy (XPS). Some distinct differences could be identified between SMA origin, size fraction, and clay content of the bulk soil. For occluded SMA, the C content was greatest in the 0.2-20 μm size fraction which points to a greater protection of C compared to free SMA of the same size fraction as well as occluded and free 20-53 μm- and 53-250 μm-SMA. Phosphorus mainly was detected at the surfaces of free and occluded 53-250 μm-SMA, which might indicate the 53-250 μm-size fraction as a preferred habitat for microorganisms (MO), especially as variations in P content here were congruent with variations in N content. The atomic Si/Al ratio was lowest for both free and occluded 2 - 20 μm-SMA, probably reflecting less quartz in the smallest size fraction. Further, free and occluded 53 - 250- μm-SMA showed maximum O and minimum C contents at intermediate clay percentages, which might be related to the respective clay minerals present and their specific affinity for organic matter. The surface O/C ratio as a general parameter linking surface elemental composition and wetting properties indicated wettability for all tested surfaces, i.e. no restrictions for microbial life due to limited water availability.