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Phosphorus adsorption onto structured soil

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Soil phosphorus interactions are frequently studied employing the slurry technique in which a soil sample is intensively mixed with phosphorus solutions of various concentrations. The result of such experiments is a "phosphorus adsorption potential", because the thorough mixing of soil and phosphorus solution as obtained by overhead or horizontal shaking of the slurry would probably not occur under natural conditions especially if the soil is structured. Here we present a methodological approach to investigate phosphorus adsorption onto intact soil aggregates aiming at quantifying the soil structure effect on phosphorus adsorption. Soil aggregates of a defined size class were prepared by carefully sieving the soil. The soil aggregates were placed on a sieve with a small mesh size, which was lowered into a basin containing a phosphorus solution of a given concentration. The solution was kept in slow motion by means of a magnetic stirrer. The decrease of the phosphorus solution concentration with time was registered at fixed intervals and adsorbed amounts were quantified by differences between initial and concentrations at the time of sampling. Interestingly, it was observed that the adsorption onto aggregates was elevated as compared to the classical batch experiments even if the same time period (24h) was observed in both approaches. Differences between approaches were more pronounced at lower initial phosphorus concentrations. This was unexpected since it was assumed that the soil surface area available for adsorption processes is greater or at least by far more accessible in the slurry batch experiment. We conclude that if the inner pore space of soil aggregates is readily accessible and diffusion is not hindered, the adsorption capacity of intact aggregates might be higher than that of the disturbed soil because the pore space can accommodate a certain fraction of phosphorus in addition to the adsorbed amount. The tested experimental approach allows for diffusion processes in structured soil, which shall be closer scrutinized for a more realistic depiction of soil phosphorus interactions in future studies.