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Soil aggregate formation: the role of wetting-drying cycles in the genesis of interparticle bonding

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Soil structure influences many soil properties including aeration, water retention, drainage, bulk density, and resistance to erosion and indirectly influences most biological and chemical processes that occur in and around soil. In nature, soil is continually exposed to wetting (e.g., rainfall and diffusive flow) and drying (e.g., evaporation, diffusive flow and plant uptake). These natural wetting and drying cycles of soils are physical events that profoundly affect the development of soil structure, aggregate stability, carbon (C) flux and mineralization. We hypothesize that drying of capillary water transports suspended and/or dissolved cementing agents toward inter-particle contacts and eventually deposits part of the colloidal mass forming inter-particle bonds. Here, we will show the role of wetting and drying cycles on soil aggregation and stabilization and how these cycles transport and deposit organic cementing agents at the inter-particle contact. We found that aggregates of sand and silt particles can be formed by subjecting loose particles to wetting-drying cycles in the presence of dilute solutions of organic matter that mimic root or microbial exudates. Moreover, majority of the organic matter was deposited in the contact region between the sand particles, where the water accumulates during drying. The model predictions and aggregate stability measurements are supported by scanning electron micrographs that clearly show the process of aggregate formation.