Geometric preconditions for heteroaggregation of soil minerals: Light scattering experiments and modelling approaches

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Aggregates form when soil particles connect to larger secondary units. Stable microaggregates in soils are supposed to consist of close associations of Fe oxides and clay minerals, the components attracted by electrostatic forces. The geometric preconditions for the formation of stable associations between Fe oxides and clay minerals, however, are poorly known. Here we determined the geometric preconditions by using particle size and morphology analyses that control the arrangement of particles during aggregate formation. Aggregation kinetics was determined for nine combinations of each three particle size fractions of goethite and muscovite (mean diameters of 0.42, 0.46, and 0.84 µm and 0.16, 0.80, and 2.5 µm, respectively) in a Zetasizer at pH 6. For data interpretation, we quantified the surface charge density of the minerals and the bonding area of particles in these combinations. Whereas all combinations with fine-sized muscovite facilitated aggregation at very different mixing ratios, the amendment of the finest fraction of goethite to medium- and coarse-sized muscovite facilitated aggregation at small additions only, suggesting a strong impact of particle size on aggregation. The aggregation patterns suggest that mineral aggregation in soil by electrostatic interactions occurs only at certain mineral mixing ratios, depending highly on particle morphology. The experimental results will be incorporated in a modeling approach that is based on a cellular automaton which takes into account electric forces and different size classes (see Ray et al., Goldschmidt 2017 Abstracts).