



Advances in Atomic Force Microscopy (AFM) for investigating soil wettability states and soil organic matter (SOM) properties at the nano-scale

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Many environmental processes that have a major impact at the field-scale are determined by events occurring at the micro- and nanometer scales. Due to technical challenges, soil has only relatively recently been the focus of nanoscale studies. Recent advances in Atomic Force Microscopy (AFM) now allow the characterization of natural soil samples both topographically, mechanically and chemically at the micro- to nanometer scale.

To date AFM has been used for analysing materials that occur in soil ex-situ, such as minerals and organic matter as individual components; however its application to complete natural soil material has been very limited. Here we report on applications of AFM for mechanically and topographically characterising soil aggregates. Mechanical properties of interest are Young's modulus, surface deformation, adhesion and chemical mapping, all of which allow for gaining information on soil nano-mechanical properties that have implications for particle wettability. This presentation includes (i) a brief summary of recent advances in AFM capabilities and applications relevant to studying soil materials, and (ii) our latest findings in soil profiling for wettable and repellent soils, and the role of soil organic matter in affecting soil topographical and mechanical properties.