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Effects of isopropanol/ammonia extraction on soil water repellency as determined by Atomic Force Microscopy

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Extraction of soil with solvents is commonly used to isolate fractions of soil organic matter (SOM) thought to cause soil water repellency. Previous studies have assessed the efficiency of extraction procedures by determining sample water repellency and SOM content, before and after extraction, and the ability of extracts to render wettable materials repellent.

Here we use atomic force microscopy (AFM) for the direct, high-resolution examination of the effects of the most commonly used solvent (isopropanol/ammonia) on physico–chemical properties of soil particle surfaces. Particles, from three pairs of wettable and water repellent sandy soils, were examined before and after Soxhlet extraction and following extract application to extracted soil material. Complementary evidence was provided by comparison with the effects of exposing clean sand to organic compounds of known composition.

The extraction rendered all soils wettable and resulted in a reduction in particle surface area covered by SOM. Subsequent exposure of these wettable particles to extracts (i) re-introduced some level of water repellency despite achieving only a minimal increase in SOM; (ii) led to a more uniform scatter of soft regions, indicative of SOM; but (iii) did not consistently re-create original surface features. The outcomes suggest that (a) although isopropanol/ammonia extraction may be able to isolate key compounds involved in causing water repellency, these compounds appear to be obtained in a form with little affinity for clean mineral surfaces; (b) the extent and distribution of SOM on soil particle surfaces appears to be a critical factor in the expression of water repellency.