



## **Influence of soil pH on properties of the soil-water interface**

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Surface characteristics of soils are one of the main factors controlling processes at the soil-water interface like wetting, sorption or dissolution processes and, thereby, have a high impact on natural soil functions like habitat, filter, buffer, storage and transformation functions. Since surface characteristics, like wettability or repellency, are not static soil properties but continuously changing, the relevant processes and mechanisms are in the focus of the presented study. These mechanisms help to gain further insight into the behaviour of soil and its dynamics under changing environmental conditions.

The influence of water content, relative air humidity and drying temperature on soil water repellency has been investigated in many studies. In contrast, few studies have systematically investigated the relationship between soil water repellency (SWR) and soil pH. Several studies found alkaline soils to be less prone to SWR compared to acidic soils (e.g., Cerdà and Doerr 2007; Mataix-Solera et al. 2007). Furthermore, SWR has been successfully reduced in acidic soils by increasing soil pH via liming (e.g., Karnok et al. 1993; Roper 2005). However, SWR has also been reported in calcareous soils in the Netherlands (Dekker and Jungerius 1990), California, USA (Holzhey 1968) and Spain (Mataix-Solera and Doerr 2004).

The hypothesis that the pH may control repellency via changes in the variable surface charge of soil material has not yet been tested. Previously it has been shown that it is necessary to eliminate the direct influence of changes in soil moisture content so that the unique relationship between pH and SWR can be isolated (Bayer and Schaumann 2007).

A method has been developed which allows adjustment of the pH of soils with low moisture content via the gas phase with minimal change in moisture content. The method was applied to 14 soil samples from Germany, Netherlands, the UK and Australia, using the water drop penetration time (WDPT) as the indicator of SWR. Sessile drop and Wilhelmy plate contact angles (CAs<sub>sess</sub> and CAs<sub>wpm</sub> resp.) were measured on the four samples from Germany and the data correlated with those of WDPT. The titratable surface charge of these four soils was measured at selected pH values using a particle charge detector (PCD).

Changes in SWR with soil pH were found to be influenced by the density and type of sites able to interact with protons at the available surfaces of organic and mineral materials in soil. The maximum SWR occurred for soil at natural pH and where the charge density was minimal. As pH increased, negative surface charge increased due to deprotonation of sites and WDPT decreased. Two types of behaviour were observed: Those in which (i) WDPT shortened with decreasing pH and ii) WDPT was sensibly constant with decreasing pH. The data suggest that the availability and relative abundance of proton active sites at mineral surfaces, and those at organic functional groups influence the behaviour.

Bayer, J. V. and G. E. Schaumann (2007). *Hydrological processes* 21(17): 2266 - 2275.

Cerdà, A. and S. H. Doerr (2007). *Hydrological Processes* 21(17): 2325-2336.

Dekker, L. W. and P. D. Jungerius (1990). *Dunes of the European coasts*, Catena-Verlag, 18: 173-183.

Holzhey, C. S. (1968). *Symposium on water repellent soils*, Riverside, California.

Karnok, K. A., E. J. Rowland, et al. (1993). *Agronomy Journal* 85(5): 983-986.

Mataix-Solera, J., V. Arcenegui, et al. (2007). *Hydrological Processes* 21(17): 2300-2309.

Mataix-Solera, J. and S. H. Doerr (2004). *Geoderma* 118(1-2): 77-88.

Roper, M. M. (2005). *Australian Journal of Soil research* 43: 803-810.