



## **Surface energy of water repellent soils decreases at high relative humidity as determined by inverse gas chromatography**

Enoch V. SW. Wong (1), Phil R. Ward (2), Daniel V. Murphy (1), Matthias Leopold (1), and Louise Barton (1)

(1) UWA School of Agriculture and Environment, The University of Western Australia, 35 Stirling Hwy, Crawley, WA 6009, Australia, (2) CSIRO Agriculture, Private Bag No 5, Wembley WA 6913, Australia

Soil water infiltration measurements often exhibit high variability due to soil heterogeneity such as soil water repellency. The severity of soil water repellency can be measured in terms of surface energy. The lower the surface energy, the greater the soil water repellency. Former studies have also found soil water repellency increases with relative humidity, however the effect of relative humidity on surface energy of bulk soil (<2 mm) has not been determined. Surface energy of water repellent soils is often calculated from contact angle measurements, such as Wilhelmy plate and sessile drop methods. These methods require a relatively uniform and flat soil surface using sieved fine soil fractions (<200  $\mu\text{m}$ ) that do not represent bulk soil (<2 mm) properties; plus, sieving can also affect the measured soil water repellency. Capillary rise method had also been applied but no surface energy of bulk soil has been determined. Employing inverse gas chromatography (iGC) may overcome the drawbacks to measuring surface energy using contact angles, as it can measure the surface energy of a bulk soil sample without the need for further sieving. We investigated the feasibility of iGC to determine the surface energy of a water repellent soil at 10% and 90% relative humidity. We hypothesised that the surface energy of the bulk soil at relative humidity of 90% would be lower than at a relative humidity of 10%. A water repellent soil [molarity of ethanol (MED), 2.0 M 0.2] was packed into iGC silanised glass columns before analysing the soil with non-polar molecules (nonane, octane and heptane) to determine the dispersive surface energy, and polar molecules (chloroform, dichloromethane, toluene) to determine the acid-base free energy of adsorption, at both 10% and 90% relative humidity. Our results showed the total surface energy (sum of dispersive and acid-base surface energy) of the soils at 90% relative humidity was approximately 1.4 times lower than when determined at 10% relative humidity. Both the dispersive and acid-base surface energy were lower at 90% than at 10% relative humidity, with a greater difference observed for the dispersive (non-polar) component. As far as we are aware, this is the first time that iGC has been used for soil analysis, and specifically determine the difference in surface energy of the water repellent soil. This technology has the potential to aid routine analysis of the surface energy of bulk soil samples, which can affect the capacity for water infiltration in soils.