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Detection of an organic-non volatile compound in variable-contaminated volcanic soil samples via Time Domain Reflectometry (TDR) technique: Preliminary results

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Hydrocarbons may be present in soils as non-aqueous phase liquids (NAPLs), which means that these organic compounds, exist as a separate and immiscible phase with respect to water and air commonly present in the soil. NAPLs, which can be accidentally introduced in the environment (for example by waste disposal sites, industrial spills, gasoline stations, etc), constitutes a serious geo-environmental problem, given the toxicity level and the high mobility. Time domain reflectometry (TDR) has became, over several decades, an important technique for water estimation in soils. In order to expand the potentiality of the TDR technique, the main objective of this study is to explore the capacity of dielectric response to detect the presence of NAPLs in volcanic soils. In laboratory, soil samples were oven dried at 105˚C and passed through a 2 mm sieve. Known quantities of soil, water and NAPL (corn oil, a non-volatile and non-toxic organic compound) were mixed and repacked into plastic cylinders (16 cm high and 9.5 cm in diameter); in order to obtain forty different volumetric combinations of water and oil (i.e. $\theta_f \mathrm{g} = \theta_{water} + \theta_{NAPL}$), with θ_{NAPL} varying from 0.05 to 0.40 by 0.05 cm^3/cm^3 increments. Data collected were employed to implement a multiphase mixing model which permitted conversion from a dielectric permittivity domain into a θ_f domain and vice versa. The results of this study show that, the TDR device is NAPL-sensitive, especially for θ_f values greater than 0.20. Further works will be built on this initial study, concentrating on improving the dielectric response-database, in order to: i) enhancing the model efficiency in terms of NAPL capability detention, and ii) validating the developed TDR interpretation tool with field results.