STREAMING-POTENTIAL FOR IDENTIFYING SURFACE LOCATIONS ALLOWING INFILTRATION INTO AN UNDERLYING AQUIFER

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Groundwater flow in the unsaturated zone following precipitation produces strong negative self-potential (SP) signals measured at the ground surface. These SP measurements can be used to identify locations where infiltration occurs. Once identified, the spatial distribution of recharge zones may be used in groundwater models and the area of recharge zones may be useful for developing water budgets. SP measurements were conducted over a 65 acre agricultural field located near the Tallahatchie River in Shellmound, MS. The thickness of the unsaturated zone in the area is about 8 m. A fixed-base SP measurement method using 80 non-polarizing $CuSO_4$ electrodes in an irregular electrode spacing was employed. The reference electrode was far away from the area of interest. The time-series SP data was measured at 5 minute intervals to monitor infiltration over a 24 hour period following a rainfall event. Spatio-temporal distributions of SP data showed the maximum and minimum negative SP anomalies correspond to the locations of higher and lower permeability of the overburden, respectively. The SP information is also consistent with the inverted resistivity model derived by the U.S. Geological Survey using Airborne Electromagnetic (AEM) data. The soil resistivity depends on the sand and clay content. In general, soils with higher clay content have a lower resistivity and a lower permeability. This preliminary study suggests that SP measurements could be used without verification against other geophysical methods to identify zones of infiltration in an unsaturated zone. Furthermore, measured SP data might be used to quantify groundwater flow within the unsaturated zone and estimate hydraulic parameters.

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