The use of electrical resistivity to map water flow paths through ash dumps and the underlying fractured aquifers, Mpumalanga, South Africa.

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The protection of human health and ecosystems supported by groundwater depend amongst others on the flow path of contamination from the source to the possible receptor. The positions and role of preferential pathways in fractured rock aquifers pose a special challenge to groundwater research. In this study we investigated aquifers underneath ash dumps in the Mpumalanga area of South Africa in an attempt to quantify the flow of contaminated water through the ash dumps into the underlying aquifers. Electrical resistivity profiling was used as one of the tools to get a spatial understanding of preferential flow paths of ash water through the ash into the underlying aquifers.

Two different types of ash dumps were investigated namely dry placement and slurry placement of ash. Process water with high salt concentrations is irrigated on the ash or slurried with the ash onto these dumps. This causes some salts to leach through the ash dumps into the underlying aquifers. Electrical resistivity was used to map areas where salts are captured in the ash and moving into the underlying aquifers.

Electrical resistivity readings are mainly affected by a combination of aquifer media (ash and fractured rock), water saturation and water quality. A single resistivity line of about 1.8 km was done on each of the ash dumps, evaluating background geology values outside the ash, moving across older and younger parts of the ash dumps. The underlying geology forms the bottom boundary of the ash dumps and therefore controls the flow of water leaving the ash, as well as the water level inside the ash dump. Zones with high salt concentration could be mapped with electrical resistivity due to the very low resistivity values that was obtained due to the salts.

A resistivity model of the sites was compiled and will be combined with some available borehole data to conceptualize the site and the groundwater movement through it. Ash and aquifer coring will start during the next month and will be added to the conceptual model. These results and understanding can then be applied to the protection of aquifers through the better understanding of preferential flow paths through the ash and into the underlying aquifers.

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