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Monitoring Groundwater Flow Using Electrokinetics

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Abstract

Very little is known about the groundwater flow paths from the subsurface of the Great Artesian Basin to the surface basins throughout the Australian continent. The Wabma Kadarbu Mound Springs in northern South Australia lie at the south-west margin of the Great Artesian Basin and contain a number of springs that continually discharge groundwater over time.

This work deals with the self potential (SP) method which was used along three intersecting lines in the area to help gain a better understanding of groundwater flow. The SP method responds to the electrokinetic phenomenon of streaming potential which can be applied to hydrogeological investigations to help evaluate the subsurface groundwater flow conditions. Because the SP data do not intrinsically yield a good indication of the depth of the sources generating groundwater flow, numerical models are developed to assess the SP distribution resulting from subsurface fluid flow.

The self-potential associated with groundwater flow in an electrolytic environment is modelled by assuming a primary source as an electric double layer between the flowing groundwater and the porous media created by the flowing SP currents. This primary flow generates the secondary surface charge and double layers on the interfaces between media with different conductivities. The geometry of the sources is obtained from an image reconstruction technique which determines the spatial locations of SP sources. The modelling and image reconstructions help to obtain a better understanding of these flow paths and how they make their way to the surface can give a greater chance of collecting the groundwater to use to good effect.

The results showed evidence for groundwater flow networks in the subsurface of the Wabma Kadarbu springs. The groundwater flow networks for all three lines had similar characteristics

including having individual columns connected at depth and large widths for the columns. This research showed that SP can be used to help better understand groundwater flow patterns in the subsurface.

Key words: self potential, groundwater, mound springs, electrokinetics, Great Artesian Basin