Monitoring Groundwater Flow in Fractured Rock Environments using Self-Potential Methods

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SELF-POTENTIAL STUDY IN FRACTURED MEDIA

ABSTRACT

Self-potential (SP) data has been successfully utilised in porous media environments for mapping groundwater flow, through measurement of surface voltages. Little research has occurred into utilising this method in fractured rock aquifer systems. Such systems are highly heterogeneous in comparison, with groundwater flow focussed along discrete faults, fractures and bedding planes rather than through the bulk matrix as in porous systems. An SP field survey was conducted at Watervale, South Australia in association with a pumping test, with the aim to analyse the viability of this method in this hydrogeological environment. This data was then processed using both a 2D and 3D tomography algorithm, based on the assumption of uniform resistivity due to a lack of a resistivity profile. SP tomography delineated preferential flow directions centred on Line 2, in a NNE-SSW orientation, which was supported through physical drawdown measurements at the associated well. As the dominant fracture and bedding orientations in the region are similarly aligned, it can be assumed the SP response has resolved these discrete fluid pathways. These SP results are encouraging, correlating well with physical observed data and geological information, and support the hypothesis that the SP method has viability for use in fractured rock aquifers.

KEYWORDS

Self-potential, Groundwater, Monitoring, Feasibility, Tomography, Fractured rock

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