

# Electrical Geophysics of Carbonate Mound Spring Complexes of the South-Western Great Artesian Basin

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THE UNIVERSITY  
*of* ADELAIDE

*To Pip*

The northern vent at Warburton Spring.

“... the party discovered a very beautiful and copious spring of excellent water between [Beresford and Warburton] hills. It rises to a rocky ledge over which it is then heard to fall underground with a sound most pleasant in that arid part of the world, whilst ere long emerging to the light it flows amongst reeds...”

— *South Australian Register*, 30 December 1859, p. 3.

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# Abstract

Artesian mound springs occur along the south-western edge of the Great Artesian Basin, in northern South Australia, but their underground structure and relationship to faulting is not well understood. This work aims to address this shortcoming with geophysical surveys over three mound spring systems (Beresford and Warburton Springs, the Bubbler Spring complex, and Freeling Springs), using a range of techniques: self-potential, magnetotellurics, and time-domain electromagnetics.

The self-potential data contain elevated local responses to spring vents and seeps. Spatial correlation suggests that these responses are caused by flow related to springs. Similar responses also occur underneath 'extinct' springs, suggesting shallow subsurface discharge of aquifer water is still occurring. Little evidence was found for significant downward infiltration from spring tails.

Modelling of time-domain electromagnetic and magnetotelluric data show that the confining Bulldog Shale, which is generally very conductive, contains slightly more resistive areas underneath springs and spring complexes, which may be related to a combination of carbonate buildup in the subsurface and more resistive aquifer water flowing to the surface. Magnetotelluric data and anisotropic 1D modelling suggests that fault zones exist under many of the mound springs, particularly at Beresford and Warburton Springs and the Bubbler Spring complex, with data consistent with models containing parallel vertical fault planes striking NW/SE. The models contain fault zones in the aquifer and the immediately underlying basement, suggesting that fluids may be sourced from the aquifer and deeper layers, and that faults may be acting as conduits through the aquitard. However, neither the faults nor the conduits to specific springs have been successfully imaged using the techniques employed here, suggesting that the conduits are narrow and present only a slight contrast in fluid resistivities.



# Declaration

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