

Magnetotelluric monitoring of unconventional resources

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by
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ABSTRACT

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Extraction of unconventional gas involves the movement of fluids at depth. In the case of shale gas, hydraulic fracturing is performed, where fluids are injected into sequences at high pressures resulting in permeable pathways for the trapped gas to escape. Coal seam gas (CSG) extraction involves a process termed depressurisation, where large volumes of groundwater are extracted from coal measures causing a pressure reduction that allows trapped gas to desorb from the coal seams. One of the key questions the industry sector is facing is whether it can effectively monitor movement of fluids and changes in Earth as these unconventional energy resources are being developed. We present two MT monitoring surveys of unconventional energy resource development. The first survey involves an industrial field study conducted in Queensland, Australia, where MT responses indicated the orientation of fluid flow resulting from depressurisation, which can be mapped and directly attributed to spatial and temporal variations in permeability. The second survey involves monitoring deep hydraulic fracturing of a shale gas reservoir in the Cooper Basin, Australia. MT observations indicated increases in bulk conductivity of 20 – 40% in both the temporal and spatial domain, with these changes caused by a combination of both injected fluid permeability and an increase in wider-scale in-situ permeability. Finally the telluric sounding method is introduced as a potential tool for monitoring hydraulic fracturing at depth. The advantage of this method is that it is relatively easy to measure electric fields with many dipoles and multi-channel systems and therefore electric field arrays

could be deployed and left out for continuous monitoring. Additionally, electric field transfer functions are essentially the identity matrix for a 1D Earth no matter what the vertical structure is and therefore monitoring involves plotting deviations relative to the identity matrix.

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