Important role of porewater stable isotope analysis in investigations of low permeability strata, Sydney Basin

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The need for water in the southern Sydney Basin is subject to competition between industry, the need for water supply and the environment. The area includes Sydney Water Catchment, several closed and operating underground coal mines, coal seam gas industry and private water supply bores. In addition, it is home to swamps and wetlands which form part of the sensitive ecosystems. This project was initiated to provide more understanding into groundwater movement and the role of low permeability rock formations as a barrier to vertical flow in sedimentary basins. A novel porewater stable isotope technique was applied as part of multi-disciplinary investigations of hydrogeology and geomechanical behaviour of rock formations. The rock core samples were collected immediately following drilling, and were carefully preserved. The samples were analysed for stable isotopes using Los Gatos analyser (calibrated with Los Gatos and VSMOW standards) and for Cl content in UNSW Australia analytical laboratory. In addition, pore pressure data from vibrating wire piezometers was used to assess the flow velocity to support the stable isotope data analysis. This research focused on conceptualising groundwater conditions and qualifying vertical and horizontal components of groundwater flow and seepage at the interface of high and low permeability rock strata. The study found that detailed vertical profiling using porewater stable isotopes, supported by other investigative methods, allows differentiation between hydrostratigraphic units and provides their detailed understanding within the southern part of the Basin. Due to overall low salinity within the sedimentary strata, Cl was not found to be a useful tracer. The research findings are important as they show that porewater stable isotope analysis can be a valuable method in the Australian setting where past climate had enough variability in δ 180 of the recharge water to introduce sufficient contrast. The method also has the advantage of being applied in the areas where it is not possible to have a suitable network of standpipe piezometers. Characterisation of groundwater flow in sedimentary basins using traditional groundwater methods can be greatly improved by the addition of porewater stable isotope analysis.