# Application of stable noble gases, $^{85}$Kr and $^{39}$Ar to investigate the freshwater lens on Rottnest Island, Western Australia

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We report on a multi-tracer study of a freshwater lens on Rottnest Island west of Perth (Western Australia). The potable water supply of this carbonate island is entirely based on a shallow freshwater lens 'floating' on more saline water. Former studies (Bryan 2016) identified rain as the sole source of the fresh groundwater and that this very vulnerable system is threatened by anthropogenic usage and reduced rainfall due to climate change, causing salt water intrusion. Since the freshwater lens only has a thickness of approx. 20 m, even the short screens of the observation wells (1-2 m length) cause significant mixing of water of different ages. The combination of tritium ($^{3}$H) and radiocarbon ($^{14}$C) used earlier cannot resolve details of the age distribution because of the low values for tritium in precipitation on the southern hemisphere and because of mixing corrosion of the carbonate aquifer together with seawater intrusion changing the initial radiocarbon values. Therefore, this study focussed on the application of $^{85}$Kr (half-life 10,8 yr) and $^{39}$Ar (half-life 269 yr) as well as the stable noble gases. Here $^{85}$Kr complements $^{3}$H to resolve the component of very young water in the age distribution, whereas $^{39}$Ar fills the dating gap between $^{3}$H and $^{14}$C. The heavy noble gases (Ar, Kr, Xe) can give additional information on the infiltration of freshwater or seawater and $^{4}$He can identify admixtures of old water.