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What can ^{81}Kr and other environmental tracers tell us about paleoclimate in the Pleistocene: an example from the south-western Great Artesian Basin, Australia

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Environmental tracers such as radiocarbon, stable isotopes of the water molecule and NGRT have been used as proxies for paleo climate and providing valuable environmental information on the last glacial maximum, 18 ky BP. In recent times ^{81}Kr dating (1/2 life 229 kyrs) now provides a reliable dating tool for ground waters with an age of up to 1.3 million years. We ask the question can we use ^{81}Kr dating to provide temporally times scale for paleo climate proxies further into the Pleistocene. Of the three groundwater dating tools for old groundwater (> 50 kyrs) ^{36}Cl, ^{4}He and .^{81}Kr, this study has shown that ^{81}Kr is far more reliable than the other two dating techniques as it has an almost constant input function and has far less sources or sinks in the sub surface. In this study we use a comprehensive set of environmental tracers that include ^{81}Kr, ^{36}Cl, ^{4}He, stable isotopes of the water molecule and noble gases. Our field site is in the southwestern Great Artesian Basin in this desert environment, rainfall is less than 200 mm/yr and evaporation in the order of 2-3 m/year. Modern recharge is restricted to heavy monsoonal rainfall beneath the Finke River. This rainfall is sourced from monsoonal activity in February and March that travels some 1500 kms away from the north of the continent. In this small, focused recharge zone we have recorded recharge rates of up to 400 mm/yr. Diffuse recharge away from the rivers is in the order of < 2 mm/yr. As we move down the flow path groundwater ages increase up to 400 kyr BP while stable isotopes become more enriched. This indicates a greater contribution of diffuse recharge and less rapid recharge beneath the Finke River bed over time. The environmental tracer data suggests at least three decreasing changes in recharge rate over the last 400 kyr. We conclude that there has been a significant decrease in monsoonal activity in central Australia in the late Pleistocene compared to today.