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title: **Deuterium and O-18 data to estimate the relative contribution of summer and winter season precipitation to surface water pools; A Case study from Hamersley Basin, Western Australia**

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INTRODUCTION

The Hamersley Basin of Western Australia contains the world's single biggest deposit of iron ore. Below water table (BWT) deposits often require substantial dewatering and drive the need to understand the source, flow and interconnections between the regional water table, the orebody and nearby groundwater dependent ecosystems. Conventional hydrogeological investigations allow measurements of water levels and hydraulic properties of aquifers and estimation of water balance through water table monitoring and pumping testing. However in some areas, drilling for installation of monitoring bores is not possible due to rugged terrain or indigenous cultural values and it is here that the chemical and isotopic tracers are useful as a non-evasive low cost method to supplement conventional hydrogeological investigations (Cook, Herczeg, 1999).

The Cl concentration in Stuart Pool (an environmentally sensitive water body near a proposed BWT mining area) is almost constant throughout the year ranging from 19 mg/l in August 2008 to 25 mg/l in April 2009. The δ^2H values on the other hand, change from enriched values of 5.1‰ in August 2008 to highly depleted values of –78‰ in April 2009 and more enriched values of –5.1‰ in August 2009. δ^2H of ore body groundwater is approximately 70‰ depleted compared to that measured in Stuart Pool in August 2008 and 2009 (Fig. 1a). Therefore groundwater seepage is not the processes that results in the variation in δ^2H values in Stuart Pool. Evaporation will result in enrichment of both heavy isotopes and Cl concentration. The only plausible explanation for the constant Cl and large difference in deuterium concentration is that the water in Stuart Pool is derived entirely from the mixing of dry and wet season rainfall with no significant evaporative effect.

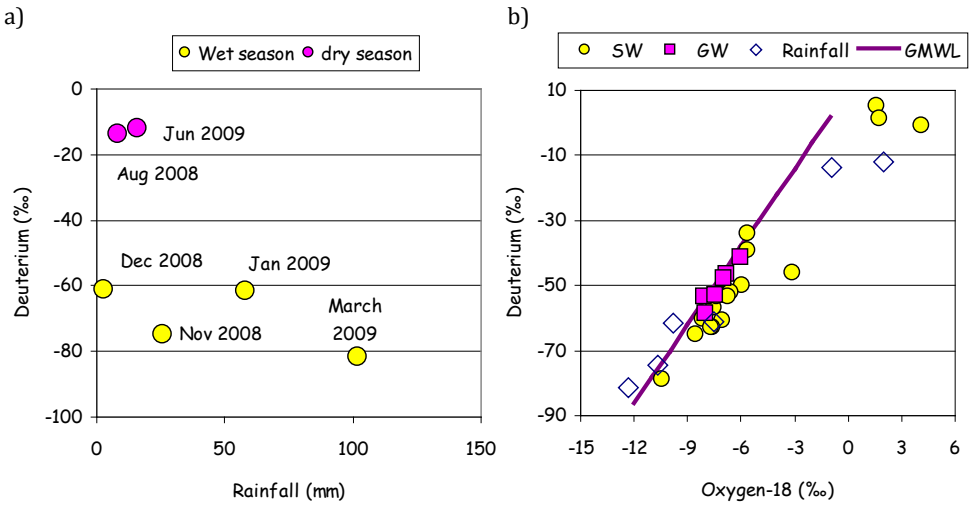

Figure 1. a) Deuterium concentrations versus amount of rainfall in the study area; b) Stable isotope concentrations in groundwater, surface water and rainfall. GMWL is plotted for comparison.

This hypothesis is corroborated by the results of stable isotope analysis of precipitation in the area showing that the isotopic signature of wet season rainfall (δ^2H~–60‰) is significantly depleted compared to dry season rainfall (δ^2H~–10‰). The summer wet season vapour flux is derived largely from the tropical Indian Ocean whereas; in winter the dry season vapour flux is originated

from lower latitudes that are characterised by enriched stable isotopes (Yurtsever, Gat, 1981; Rozanski et al., 1993); and the mixture of lower latitude and tropical band moisture sources may explain the comparably enriched stable isotope signatures observed within seasonal precipitation.

The distinct isotopic signature of summer and winter rainfall in the area is reflected in the isotopic signature of surface water and groundwater. The isotopic signature of permanent surface water of Stuart Pool and groundwater in the region shows that while the surface water pool can provide a reasonably good proxy for the event based precipitation; the isotopic signature of groundwater reflects the long term mean of wet season rainfall (Fig. 1b) as larger rainfall, and by inference greater recharge, are associated with the more depleted wet season stable isotope signature. Ultimately, the correct application of stable isotope and chemical tracers may prove invaluable in identifying the level of groundwater dependence in surface pools and for understanding the potential impacts of dewatering for below watertable mining within the Hamersley Basin.

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