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title: # Salt accumulation and groundwater recharge on granite slopes in Southeastern Australia

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INTRODUCTION

Previous work (e.g. Hocking, 2005) has suggested that low relief, highly weathered granites in the upper Wimmera catchment in southeastern Australia are a significant source of salts exported to the catchment via groundwater, whereas high relief, less weathered granites are a source of fresh, good quality groundwater. In order to understand the processes of salt accumulation and movement in the catchment, groundwater recharge and flow has been investigated using a combination of major ion chemistry, isotope ratios $\delta^{18}O$ and $\delta^{2}H$, groundwater dating using ^{3}H and ^{14}C, soil Cl^{-} profiles and downhole EM39 logging.

The upper Wimmera catchment forms part of the Murray Darling Basin (Fig. 1) in western Victoria, Australia. The main geological units in the area are: the highly weathered and fractured basement of Cambrian-Ordovician metasediments (St Arnaud Group), the Devonian granites that intruded the metasediments, and the overlying Miocene-Pleistocene alluvial sediments of the Shepparton Formation. These three geological units also form the main aquifers of interest in the study area.

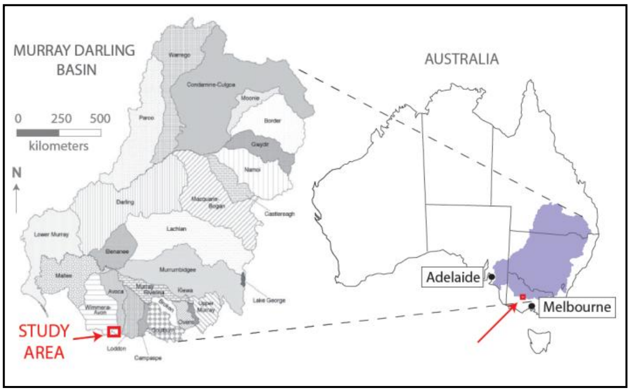

Figure 1. Study area location.

ACCUMULATION OF SALTS IN THE LANDSCAPE

Groundwater $\delta^{18}O$ and $\delta^{2}H$ composition reflects a mix of soil evaporation at a low evaporation slope (<3) and fresh local rainfall, as first outlined by Barnes and Allison (1988). A simple Rayleigh distillation calculation shows that the samples have undergone 4–20% evaporation. Assuming Cl^{-} is concentrated solely by evapotranspiration (Cl^{-}/Br^{-} ratios indicate halite dissolution is not significant), the samples have undergone 90–99.9% evapotranspiration. Hence, transpiration accounts for 76–95% of water loss and is the dominant control on salt accumulation.

GROUNDWATER RECHARGE

Tritium has been detected in bores screened as deep as 20 m, even where the groundwater is saline (up to 17 mS/cm). This cannot represent the overall piston-flow recharge rate because groundwater would be much fresher; preferential flow must occur in conjunction with piston flow in these landscapes. Radiocarbon dating shows that vertical recharge is significant in both the metasedimentary (St Arnaud Group) and granite terrain, because groundwater age increases with depth (Fig. 2).

a) b)

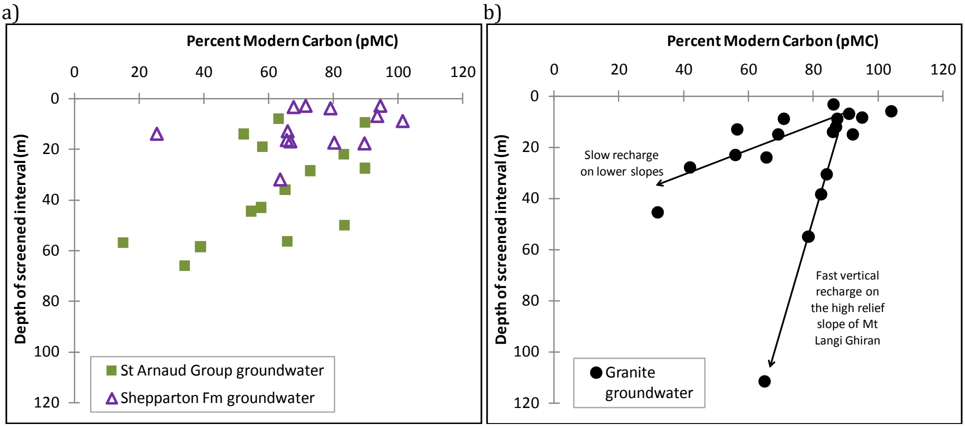

Figure 2. Groundwater percent Modern Carbon versus depth in a) St Arnaud Group and Shepparton Formation groundwater and b) granite groundwater.

Furthermore, vertical recharge on the higher relief granite slope of Mt Langi Ghiran is faster than on the slopes of the lower relief Stawell and Ararat granites (Fig. 2b). There is little evidence of vertical recharge in the alluvial Shepparton Formation; 6 out of 7 bores tested for tritium failed to detect any, and there is no evidence of increasing radiocarbon age with depth (Fig. 2a).

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