

Regional groundwater flow: history, refinements and ramifications in Australia

Charles. R. Lawrence
School of Earth Sciences, University of Melbourne, Australia



ABSTRACT

Following the advance of the regional groundwater flow system (RGFS) theory developed by Tóth in the 1960s and the subsequent numerical analysis by Freeze and Witherspoon, researchers in Australia, beginning with Hodgson and Hitchon (1965), Hitchon and Hayes (1971) and Lawrence (1973, 75), were soon applying this theory to many of the 21 large sedimentary basins. In particular, Tóth's theory helped to define regional hydrodynamics, to trace hydrochemical evolution, to explain petroleum migration and to recognize and understand groundwater discharge features.

Evidence from groundwater discharge features, mostly as playas and particularly in the Murray Basin, demonstrated a dynamic hydrologic history of interplay between groundwater and surface water over at least the last 40 000 years. This temporal variation has swung between fresh water lakes, when the surrounds could be colonized by aborigines, to drying playas underlain by dense reflux brines driven counter to the upward flowing RGFS.

European settlement brought hydrologic changes, by extraction of fresh groundwater and increased recharge through the widespread clearing of deep-rooted native vegetation and surface water irrigation. This increased recharge, generated and reactivated local and intermediate GFS, mobilizing saline stores and causing salinization of land and streams. Much of this salinization is related to groundwater flow systems in low permeability weathered and fractured indurated rocks.

By the late 1990s and early 2000s, application of the RGFS had become mainstream in Australia. At the national level, with Coram as a major contributor, frameworks based on groundwater flow systems enabled development of strategies for salinization control. Also mapping coverage of RGFS across Australia for the National Land and Water Audit was published (in CD form) as the "Australian Groundwater Flow Systems contributing to Dryland Salinity". Furthermore, 1:250 000 hydrogeological map series, included fundamentals of RGFS with hydrostratigraphic cross sections depicting salinity classes and groundwater flow directions.