Geophysical Research Abstracts
Vol. 18, EGU2016-10783, 2016
EGU General Assembly 2016

Minimal groundwater leakage restricts salinity in a hydrologically terminal basin of northwest Australia

Grzegorz Skrzypek (1), Shawan Dogramaci (1,2), Alexandra Rouillard (1), and Pauline Grierson (1)

(1) The University of Western Australia, School of Plant Biology, Crawley, Australia (grzegorz.skrzypek@uwa.edu.au, alexandra.rouillard@research.uwa.edu.au, pauline.grierson@uwa.edu.au), (2) Rio Tinto Iron Ore, Perth, Australia (Shawan.Dogramaci@riotinto.com)

The Fortescue Marsh (FM) is one of the largest wetlands of arid northwest Australia (∼1200 km2) and is thought to act as a terminal basin for the Upper Fortescue River catchment. Unlike the playa lake systems that predominate in most arid regions, where salinity is driven by inflow and evaporation of groundwater, the hydrological regime of the FM is driven by inundation from irregular cyclonic events [1]. Surface water of the FM is fresh to brackish and the salinity of the deepest groundwater (80 m b.g.l.) does not exceed 160 g/L; salt efflorescences are rarely present on the surface [2]. In this study, we tested the hypothesis that persistent but low rates of groundwater outflow have restricted the accumulation of salt in the FM over time. Using hydrological, hydrochemical data and dimensionless time evaporation modelling along with the water and salt budget, we calculated the time and the annual groundwater discharge volume that would be required to achieve and maintain the range of salinity levels observed in the Marsh.

Groundwater outflow from alluvial and colluvial aquifers to the Lower Fortescue catchment is limited by an extremely low hydraulic gradient of 0.001 and is restricted to a relatively small ‘alluvial window’ of 0.35 km2 because of the elevation of the basement bedrock at the Marsh outflow. We show that if the Marsh was 100% "leakage free" i.e. a true terminal basin for the Upper Fortescue Catchment, the basin water would have achieved salt saturation after ∼45 ka. This is not the case and only a very small outflow of saline groundwater of <2 GL/yr (<0.03% of the FM water volume) is needed to maintain the current salinity conditions. The minimum time required to develop the current hydrochemical composition of the water in the Marsh and the steady-state conditions for salt concentration is between 58 and 164 ka. This is a minimum age of the Marsh but it can be much older as nearly steady-state conditions could be maintained infinitely.

Our approach using a combined water and salt mass balance allows a more robust assessment of the hydrological budget of such a large-scale basin. The dimensionless time versus inflow over outflow ratio model is also more accurate than the classical water budget calculations.

[1] Rouillard A., Skrzypek G, Dogramaci S, Turney C, Grierson PF, 2015. Impacts of high inter-annual variability of rainfall on a century of extreme hydrological regime of northwest Australia. Hydrology and Earth System Sciences 19: 2057-2078.
[2] Skrzypek G., Dogramaci S., Grierson P.F., 2013, Geochemical and hydrological processes controlling groundwater salinity of a large inland wetland of northwest Australia. Chemical Geology 357: 164–177.