Geophysical Research Abstracts
Vol. 17, EGU2015-8192, 2015
EGU General Assembly 2015

Transit times of baseflow in New Zealand rivers

Uwe Morgenstern, Mike Stewart, Chris Daughney, and Dougal Townsend
Geological & Nuclear Sciences, Lower Hutt, New Zealand (u.morgenstern@gns.cri.nz)

Water quantity and quality responses of catchments to climate and land-use changes are difficult to understand and predict due to complexities of subsurface water flow paths and potentially large groundwater stores. It is difficult to relate the hydrologic responses of catchments to measurable catchment properties.
Tritium is ideally suited to provide a measurable parameter of hydrologic response. Tritium, a component of meteoric water, decays with a half-life of 12.32 years after the water enters the groundwater system, and can therefore provide information on transit time of water through the groundwater system over the time range 0 to 200 years mean residence time (MRT). Transit time of the water discharge is one of the most crucial parameters for understanding the response of catchments. In recent years it has become possible to use tritium in a straightforward way for dating of stream and river water due to the decay of the bomb-tritium from atmospheric thermo-nuclear weapons testing, and to improved measurement accuracy for the extremely low natural tritium concentrations.
Tritium dating of river water during baseflow conditions from over 120 sites throughout New Zealand show consistent patterns and a good correlation between geology and residence times of the water discharges. Basement rock catchments (greywacke, schist) have very young water of MRT less than 1year, sand-, mud-, limestone catchments have moderately old water of MRT 3-15 years, and porous ignimbrite catchments have very old water of MRT greater than 100 years.
For example, the tritium data indicate MRT of 6 – 7 years in the Whanganui River, 3 – 3.5 years in the Rangitikei River, and 9 – 11 years in the large discharges from the Tertiary sediments in the Manawatu catchment. The discharges from the greywacke Ruahine and Tararua Ranges contain very young water with MRT of 0 – 2 years. Associated groundwater stores for the Rangitikei, Manawatu, and Whanganui Rivers are 1, 2, and 5 x 109 m3 of water, respectively.
Significant residence times of greater than 3 years are observed in many river baseflow catchment discharges, indicating large groundwater storage reservoirs. The associated long lag times between rainfall infiltrating to groundwater in the catchments, and the arrival of the groundwater and therefore contaminants associated with different land use, at the river, need to be considered in water quantity and quality catchment response models.