UNIVERSITY OF THE PHILIPPINES

Master of Science in Environmental Science

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Characterization of groundwater resources of Cagayan de Oro City using isotope hydrology and hydrogeochemistry

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ABSTRACT

A study was done in Cagayan de Oro City using combination of isotope hydrology and hydrogeochemical techniques to provide baseline hydrological information on the city's groundwater systems. This study aims to provide benchmark hydrogeochemical and isotopic data which could provide insights in the groundwater dynamics, recharge sources and mechanism. Monthly integrated rainwater samples were collected from four different stations from October 2012 to March 2015 to establish the local meteoric water line. Groundwater samples from springs, deep wells and shallow wells were collected in September 2012, January 2013 and June 2014. The samples were analyzed for stable isotopic composition and major ion concentrations. Selected samples were also analyzed for tritium concentrations for determination of groundwater age. A special sampling campaign was also done in August 2013 for collection of selected samples for tritium-helium dating and ^{14}C dating. A local meteoric water line of $\delta^{2}H = 8.08\ \delta^{18}O + 10.30$ was calculated, which did not differ significantly with the global meteoric water line. Isotopic compositions of water in shallow and deep wells indicates that they are drawing water from different formations. Some coastal shallow and deep wells have been shown to be affected by saltwater intrusion. Rainfall during wet season appear to have notable contribution to the recharge of the aquifers. Estimation of altitudes of recharge using the derived isotopic lapse rate of the study area indicate that coastal and inland shallow wells are recharge at altitudes of 35 – 80 and 100 – 200 meters above sea level (masl), respectively, springs at 80 – 300 masl, and deep wells at 125 – 375 masl. The groundwater is mostly of $Ca\text{-}HCO_3$ type representing meteoric signatures of fresh recharge water. Tritium and ^{14}C dating resulted to modern ages of the groundwater. Tritium-helium dating resulted to apparent groundwater ages between 17.4 to more than 71.6 years, translating to short transit time from recharge to discharge. Recharge rates of 50 – 120 mm/year was estimated for the unconfined aquifer. For the semi-confined aquifer, recharge rates of 142 – 218 mm/year and 268-412 mm/year were estimated using sandstone, and sand and gravel average porosities, respectively. Under steady-state condition (i.e. recharge rate remains constant through time), total water demand is estimated to exceed net groundwater recharge between 2043-2060. If the recharge rate will decline due to climate change, total water demand is estimated to exceed net groundwater recharge between 2030-2041.