



Preliminary study of submarine groundwater discharge in Tolo Harbour, Hong Kong

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Tolo Harbour is located in the northeastern part of Hong Kong's New Territories. Occurrence of algal blooms increased dramatically because of urban development since 1970s. The government implemented the Tolo Harbour Action Plan in the late 1980s in order to reduce the nutrient loading. Since then the water quality has been significantly improved, but still algal blooms occur with fairly high frequency. A research project has been carried out to quantify the submarine groundwater discharge (SGD) into Tolo Harbour so as to estimate the nutrient flux through this pathway. This paper summarizes the preliminary results. The geochemical tracers such as radon (^{222}Rn) and radium (^{223}Ra and ^{224}Ra) in seawater were measured while a continuous heat-type automated seepage meter was deployed continuously for 72 hours for direct SGD measurement. This study shows that overall the ^{224}Ra enrichment in Tolo Harbour decreased with distance offshore, which demonstrates a quite clear picture of SGD diffusion from coast into the harbour. Two sites with abnormally high ^{224}Ra activity were identified, which may represent areas with high SGD. Using the seepage meter, hourly averaged seepage rate is found to fluctuate within a range of 0.05-1.52 cm/hr. The seepage rates, coupled with the groundwater nutrients data from two private wells proximal to the harbour, placed the release rates of phosphate and nitrate-nitrite nitrogen to be 1.7-293.7 mg/m²·day and 77-6700 mg/m²·day, respectively. Temporal variations of ^{222}Rn and ^{224}Ra have also been investigated, which indicates that SGD is regulated by changes in hydrostatic pressure and tidal pumping with tides and enhanced by a more vigorous tidal oscillating force during spring tide. The residence time has been estimated to be 15-28 days using short-lived radium isotopes.