Reactive-transport modelling for dynamics of phospshorus retention and binding forms in the Bay of Quinte, Canada

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Phosphorus (P) is the typical limiting macronutrient for the growth of primary production and the threat of algal blooms. High P concentrations at surface water can reflect not only external runoff, but also that released from sediments. However, there is evidence that P release from sediments can represent a significant source of P and facilitate algal blooms; this process has been poorly characterised. In this study, we applied a non-steady state reactive transport diagenetic model to gain insights into the dynamics of phosphorus binding forms in the sediments and the phosphorus internal loading from the sediments of the Bay of Quinte, a Bay on the north eastern shore of Lake Ontario, Canada. The three basins of the Bay that we investigated had differences in their phosphorus binding forms and phosphorus release, reflecting the distinct spatial temporal patterns of land use and urbanization levels in the watershed. In the model, total phosphorus is divided into adsorbed phosphorus, phosphorus bound with aluminium, organic phosphorus, redox sensitive and apatite phosphorus, and dissolved phosphorus in pore water. Using the fluxes of organic and inorganic matter as dynamic boundary conditions, we simulated the depth profiles of solute and solid components. The model closely reproduced the fractionation data of phosphorus binding forms and soluble reactive phosphorus. We studied the effect of different conditions produced by human development and weather on phosphorus release in the Bay of Quinte.