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The bottom line: the seafloor regulates ocean chemistry

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Sediment-water exchange is essential for regulating carbonate chemistry, oxygen levels, and trace-element cycling in bottom waters. However, there is limited understanding of these processes across many benthic habitats. The work of Alfonso Mucci has contributed significantly to addressing this issue by linking thermodynamic and kinetic understanding of processes with field observations from multiple marine environments. Alfonso Mucci's early work established a foundational baseline for calcite and aragonite solubility, the mechanisms of dissolution/precipitation, and the partitioning of trace elements; a baseline still in use today. Alfonso Mucci's most recent broader benthic biogeochemistry research has integrated field data from pore-water, particle-phase, and water-column datasets with multi-scale modelling efforts to quantify sediment-water fluxes of dissolved carbon, alkalinity, nutrients, and redox-sensitive elements. A significant application of this work has been in the St. Lawrence Gulf and Estuary. This work has documented how ventilation and organic matter delivery influence the development of hypoxia and acidification signals, and how these modifications in sediment characteristics subsequently influence their ability to buffer against changes in the overlaying water mass.

Questions that will guide this presentation are those that have guided Alfonso's research: how to extrapolate interface rate processes from highly controlled laboratory settings to regions or ocean basins, how to separate steady diagenetic fluxes from episodic forcing (storms, lateral transport), and how warming, deoxygenation, and acidification alter dissolution-precipitation balances and alkalinity budgets through time. The answers to these three fundamental questions are important for understanding coastal resilience, long-term buffering of ocean environments, and detecting environmental changes, whether driven by carbon dioxide emissions or by human interventions aimed at sequestering carbon dioxide through alkalinity. In addition to an overview of scientific milestones, this presentation will offer a brief portrayal of Alfonso Mucci: his career, his collaborators, his many students and mentees, and the type of science he has influenced for "better living through chemistry."