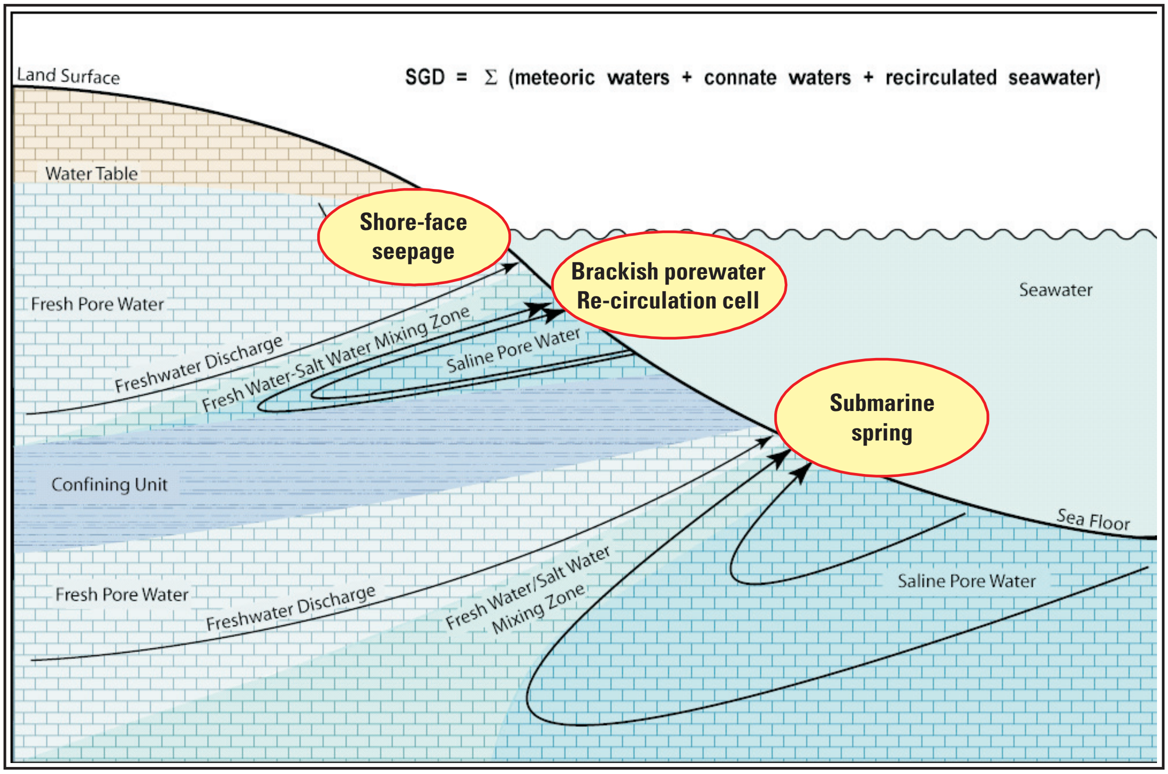
Submarine Ground-Water Discharge (SGD) and Associated Nutrient Fluxes to the Coastal Ocean

Peter Swarzenski[1], Kevin Kroeger[1], Chris Reich[1], Brian Blake-Collins[2] and Jason Greenwood[2]
[1]U.S. Geological Survey, Florida Integrated Science Center, St. Petersburg, Florida
[2]ETI, St. Petersburg, Florida

Submarine ground-water discharge (SGD) is an almost ubiquitous coastal feature that is driven by a composite of climatologic, hydrogeologic, and oceanographic processes. For example, terrestrial hydraulic gradients that reflect both short- and long-term climatic conditions almost always transport both surface and ground water toward the coast. In coastal waters, physical oceanographic processes such as wave set-up, tidal pumping, and density-driven circulation may impact these hydraulic gradients and thus affect rates of submarine ground-water discharge. Although only fresh ground-water discharge has traditionally been accounted for in numerical simulations of coastal water budgets, saline ground-water discharge may be equally or even more important in terms of material transport (i.e., nutrients, metals, organics) across land/sea margins. For this presentation, we therefore define SGD to consist either of fresh ground water, re-circulated seawater, or a composite therefore, and will evaluate and present SGD in terms of a vector for nutrient delivery to coastal waters.

Until the mid-1990s, studies on SGD did not receive widespread attention, because it was generally thought that SGD rates were not large enough to be a direct influence ocean water budgets. This omission may in part be due to the inherent difficulty in identifying sites and quantifying rates of SGD, because most SGD occurs as diffusive flow, rather than discrete spring flow. This is in sharp contrast to studies of river discharge or river chemistry, which are obviously more easily sampled and quantified. However, there is a growing recognition that the submarine discharge of fresh, brackish, and marine ground water into coastal oceans is just as important as river discharge in some areas of the coastal ocean. In this presentation, we will thus review the progress made in SGD science, with emphasis on new applications of geochemical tracers and novel geophysical tools, and will examine nutrient fluxes through SGD. The eventual goal of our SGD science is to develop some forecasting or predictive capability based on being able to de-couple climatic and seasonal signatures from SGD rates.



Processes driving SGD:

- **Terrestrial - hydraulic gradient, climate**
- **Marine - tidal pumping, wave setup,**
  current-induced topographic flow,
  convection (e.g., salt fingering),
  sealevel differences (e.g., across barrier islands)