

A Study of Submarine Groundwater Discharge

On Two Shorelines of Oahu

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ABSTRACT

Both terrestrial and marine forces drive the flow of fluids into nearby coastal waters. Comparing submarine groundwater discharge (SGD) along coastlines of Oahu, differences in the characteristics of groundwater flow are examined, particularly with respect to salinity and nutrient variations. A salinity/temperature probe tested water sources allowing for immediate data collection. Water samples were taken along a transect line via hand-dug pits from the shoreline up the beach face. There is a direct relationship between water samples having low salinity value and high nutrient (N,P) content. This correlation can be shown by examining beachface to shoreline data. These results may be significant in that marine ecosystems can be strongly influenced by minute changes in dissolved nutrient concentrations to coastal marine waters.

Water samples were collected from two separate coastlines: Aina Haina, southeast Oahu (November 2005 & May 2006), and Sunset Point, northeast Oahu (November 2005). Salinity was used as a natural conservative tracer because its chemical behavior is controlled by physical processes and its physical transport is faster than any chemical processes that it alters. Concentrations of nitrate, nitrite, phosphate, ammonium and silica were used as geochemical indicators that may be of biogeochemical interest at these coastal sites. The water sampling techniques used were hand-dug pits and offshore water sample collection.

A noticeable submarine spring and beach face seepage was discovered at Kawaiku'i Beach Park area, in Aina Haina. The spring exists the beach at the base of a resident's beach access exhibiting pronounced elevations in dissolved

nutrients relative to normal seawater (i.e. at a maxima of $1.71\mu\text{M PO}_4$, $213.8\mu\text{M Si(OH)}_4$, $137.2\mu\text{M NO}_3$, $0.30\mu\text{M NH}_4$, $2.33\mu\text{M TP}$, and $69.6\mu\text{M TN}$ at 0.88 psu salinity). Dissolved nutrient concentrations measured for samples from hand dug pits in the nearby beachface showed very similar nutrient/salinity values to that of the spring. Transect data of water samples measured seaward from the spring at low tide showed strong linear correlation between decreasing salinity and increasing concentrations of individual nutrient species. These results show that groundwater locally contributes a significant quantity of these species to the ocean in the vicinity of Maunaulua Bay, and also that these groundwaters are rapidly mixed with normal, nutrient-depleted seawater within about 100-200 meters of the identified source input.

At Sunset Point, springs are absent. There, use of hand-dig pits are required to reach water levels below the beach face. Within the pits, concentrations of nitrate, phosphate, silica and ammonium showed weak linear correlation with salinity. Nonetheless, the nutrient concentrations at Sunset Point were significantly greater (with maxima of $1.76\mu\text{M PO}_4$, $23.35\mu\text{M Si(OH)}_4$, $137.20\mu\text{M NO}_3$, and $4.61\mu\text{M NH}_4$ at a salinity of 12.77 psu) than those obtained from Aina Haina, possibly due to anthropogenic influences.

The results from these two locations may help to elucidate the importance that SGD in Hawaii plays in the delivery of terrestrial water and dissolved nutrients to coastal marine waters. Further field work examining SGD needs to be done to determine its extent islandwide.