

Natural gas seepage in the shallow coastal seabed off the Kujukuri Beach, Japan.

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The Boso Peninsula including the Kujukuri Beach is located on the Minami Kanto gas field, the largest gas field in Japan. Industrial and residential sectors have utilized natural gas as a fuel in this area. Gas seepage from soils has often caused damages to plants as well as accidental gas explosions in the worst cases. Compared to the land area, little is known about the presence of natural gas seepage from the subseabed to coastal waters off the Boso Peninsula, while a few cases have been found in tidal pools on the Kujukuri Beach (Yoshida et al., 2012).

Aside from gas seepage, coastal waters off the Kujukuri Beach represent a particularly interesting feature from the perspectives of marine and fisheries sciences. This area has been known as an excellent fisheries ground and provided abundant catches of fish and shellfish including sardines and clams. Fisheries are likely enhanced by the abundant biomass of phytoplankton here, which is shown as a band-shape high chlorophyll zone along the shoreline of the Kujukuri Beach via satellite observation. However, large riverine inputs and other noticeable sources of nutrients sustaining the high productivity are absent around the area. Since the water is shallow to a considerable distance from shore, coastal upwelling is unlikely a major source of nutrients from the open ocean.

Natural gas seepage may be a source of nutrients in coastal waters off the Kujukuri Beach. As well as natural gas, Chiba prefecture is well known as the largest iodine producer in Japan and accounts for approximately 20% of global iodine production from natural gas brines. The gas brine, paleo-seawater trapped in the aquifer, contains extremely high concentrations of ammonia derived from organic matter decomposition. If gas seepage extended to a broad range of the Kujukuri Beach offshore area, ammonia contained in the brines could be a potentially source of nutrient nitrogen. Gas-lift pumping, caused by bubbles rising in vertical channels in the overburden sediments of the aquifers, might enhance to release ammonia-rich brines and groundwater into the overlying water column. Considering the potential of microbial aerobic and anaerobic oxidation of natural gas, anoxic condition would likely develop in sediments around gas seepage sites. While little information is available about phosphorus contents in the gas brine, such anoxic conditions can enhance phosphorus release from sediments. Identifying and quantifying the role of subseabed gas seepage in nutrient inputs can provide important insights into unknown linkages between underground geochemical processes and coastal marine ecosystems.

As a preliminary survey, we conducted field observation for gas seepage in the offshore area of the Kujukuri Beach in December 2020. A multibeam echosounder system was utilized to detect gas bubbles in the water column. At water depths between 14 m and 20 m, in an area approximately 0.5 km x 2 km, we observed numerous gas bubbles in the water column and identified clusters of seepage points on the

seabed. An underwater drone and scientific divers visually observed and recorded gas seepage sites and collected samples of seawater and sediments as well as gas bubbles. Chemical and biological analyses are currently being implemented.

Keywords: natural gas seepage, nutrients, coastal sea, multibeam echosounder system, Minami Kanto gas field