

## Effects of ocean acidification on marine ecosystem services: use of natural analogues around volcanic CO<sub>2</sub> vents

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Anthropogenic CO<sub>2</sub> is being drawn down into the ocean surface, and a subsequent shift in carbonate chemistry has been predicted. In the near future, increases of hydrogen ion (decline of pH) and aqueous CO<sub>2</sub>, and decrease of carbonate ions of seawater termed as ocean acidification (OA) will have a significant effect on marine ecosystems. While laboratory experiments have shown various impacts of OA on organisms, analysis at the species-level is sometimes incommensurable with responses at the ecosystem level. Area around volcanic CO<sub>2</sub> vents have been considered as a natural analogue of OA, because the conditions with higher CO<sub>2</sub> concentration would represent the environment found under OA. Our research team previously discovered natural CO<sub>2</sub> vents off the coast of Shikine Island in the Izu Archipelago in 2014. Intensive investigation of biota along the CO<sub>2</sub> gradient demonstrated a drastic shift in species composition (e.g., disappearance of calcifying organisms and dominance of turf algae).

About 500-600 people are living in Shikine Island. Their lifestyle is strongly dependent on marine ecosystems, because fishery and tourism such as recreational diving are major sources of income. Therefore, it is possible to assess the relationship between the ecosystem under OA and social activity on Shikine Island, and carry out an evaluation of the effect of OA on ecosystem services in Shikine Island. This will provide demonstrative information showing the impact that OA will have on human lives. In our project, the supporting, regulating, provisioning and cultural services are evaluated based on the monetary value attributed to biodiversity, carbon sequestration, fishery, and recreational diving, respectively.

Investigations of biota along CO<sub>2</sub> gradient have shown that the abundance of coral and canopy-forming macroalgae declines under high CO<sub>2</sub>, and that low-profile and turf algae will become more dominant. Since large organisms such as coral and canopy-forming macroalgae provide habitat complexity for micro-benthos, and so species diversity under high CO<sub>2</sub> is lowered. Carbon sequestration has been anticipated to increase due to OA, because marine plants would be subjected to CO<sub>2</sub> limitation at present ocean conditions. However, surveys along the CO<sub>2</sub> gradient showed no significant increase in photosynthesis regardless of the change in CO<sub>2</sub> concentrations. The value of the high CO<sub>2</sub> area as fishing ground is low based on our questionnaire for fisherman, for which their responses highlighted that the abundance of fish seems to be low in the high CO<sub>2</sub> area. Recreational diving is one of the other important incomes for Shikine Island, and coral and tropical fish are important targets that tourists wish to see. The analysis of seascape component using photo taken by recreational diver showed that the number of photos of coral and fish declined in high CO<sub>2</sub> area. Our investigation regarding ecosystem services in Shikine Island showed that OA is likely to reduce ecosystem services within the coastal area.

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