

## 太平洋西部赤道域における過去30年間の海洋酸性化傾向

The ocean acidification trend in the western equatorial Pacific for the past three decades

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The western zone of the tropical Pacific Ocean includes the “Coral Triangle”, which comprises the most important coral habitats on Earth with maximum marine biodiversity. One of the emerging issues that broadly threatens the coral reef ecosystems over the tropical and subtropical oceans is ocean acidification. Acidification is the consequence of not only the approximately 25% anthropogenic CO<sub>2</sub> emissions being absorbed by the ocean, but also with land use changes. A direct manifestation is the lowering of the pH of the ocean (increasing acidity) and the saturation level of the calcium carbonate minerals aragonite and calcite, which are important components of skeletal materials for many marine organisms including corals. Here we demonstrate the occurrence of ocean acidification in the warm western equatorial zone of the Pacific with the data of CO<sub>2</sub> system measurements over the past ~30 years since mid-1980s. In surface water within 125°E-160°W, 5°S-5°N, the partial pressure of CO<sub>2</sub> was increasing at a mean rate of  $+1.15 \pm 0.08 \mu\text{atm yr}^{-1}$  while that in the atmosphere was  $+1.74 \pm 0.01 \mu\text{atm yr}^{-1}$ . Total alkalinity, being salinity-normalized at S=35, has not shown any significant trend towards increasing or decreasing levels since early 1990 (NTA =  $2296.6 \pm 3.8 \mu\text{mol kg}^{-1}$ ). They are indicative of the increase in salinity-normalized dissolved inorganic carbon (NDIC) at  $+0.67 \pm 0.08 \mu\text{mol kg}^{-1} \text{yr}^{-1}$ , lowering of pH at  $-0.0011 \pm 0.0001 \text{yr}^{-1}$  and a reduction of saturation index of aragonite ( $\Omega_{\text{arag}}$ ) and calcite ( $\Omega_{\text{calc}}$ ) at  $-0.0097 \pm 0.0007 \text{yr}^{-1}$  and  $-0.0064 \pm 0.0005 \text{yr}^{-1}$ , respectively. The trend towards increased preformed\_NDIC ( $+0.63 \pm 0.11$  to  $+0.73 \pm 0.12 \mu\text{mol kg}^{-1} \text{yr}^{-1}$ ) has also been observed on density classes of  $23.0 - 25.5 \sigma_\theta$  in the Equatorial Undercurrent that delivers waters to the equatorial divergence, and subsequently through transport in the South Equatorial Current to the surface of the warm western zone. Results of the measurements and numerical simulations with an ocean biogeochemistry / general circulation model suggest that equatorward transport of anthropogenic CO<sub>2</sub> by the shallow meridional overturning circulation from both hemispheres is an important process for the acidification in the equatorial Pacific. It is subsequently transported back into the subtropics and is considered to be contributing to the CO<sub>2</sub> increase and ocean acidification in the surface layers of the subtropical ocean.

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