

B-7 Ocean Biogeochemical Processes Related to Uptake of CO₂ in the North Pacific (Final Report)

Contact Person Hitoshi Mukai

Senior Researcher, Global Warming Mechanism Research Team
Global Environment Research Group
National Institute for Environmental Studies, Environment Agency
16-2, Onogawa, Tsukuba, Ibaraki 305-0053, Japan
Tel: +81-298-50-2536 Fax: +81-298-50-2569
E-mail lnmukaih@nies.go.jp

Budget for FY 1996-2000 278,333,000 Yen (FY 2000; 68,341,000 Yen)

Key Words CO₂ oceanic uptake, pCO₂, North Pacific Ocean, Carbon isotope ratio, Oxygen

Because pCO₂ in the ocean has large spatial and seasonal variability, both intensive and periodical observations are necessary to estimate net flux of CO₂. An accurate estimation of pCO₂ distribution in the North Pacific is the target issue of the program, to evaluate the role of the North Pacific on the global carbon cycle. We used a commercial cargo ship to observe pCO₂ and other parameter (e.g. nutrients) in the North Pacific from 1996 to 2000. Also intensive ship observations were carried out in the region of Oyashio current around Japan. For accurate measurement pCO₂ and inorganic carbon in the seawater, analytical methodology was studied including inter-national cooperative comparison studies. Atmospheric observation was also conducted over the Pacific. Especially carbon isotope ratio of CO₂ in the atmosphere and oxygen concentration, which are both tracers to estimate CO₂ budget in the atmosphere, were observed at the background sites. In this study, we have tried several approaches to estimate oceanic uptake of CO₂. Major results were shown in below.

- 1) The tandem type equilibrator (bubbling and mixing) was newly developed. The equilibrator showed an excellent stability and precision, compared to the previous bubbling type equilibrator, which gave a relatively low pCO₂ value compare to that by shower type equilibrator. A dual system facilitated completely continuous monitoring of pCO₂ during the ship cruise.
- 2) International inter-calibration experiments for total inorganic carbon and total alkalinity in seawater were carried out in 1999 and 2000. In last comparison showed good agreement in both TC and TA analysis by several improvements of technology.
- 3) An inverse modeling of CO₂ showed that about 0.3 Gt-C/y was absorbed in the North Pacific, which was lower than the previous estimation (0.45Gt) by Takahashi.
- 4) Seasonal change of pCO₂ and nutrients (NO₃) were found to have a good relationship. The pCO₂ values change from May to August was estimated to be due to biological uptake.
- 5) The data sets of pCO₂ in the North Pacific, measured by a cargo ship, were analyzed to estimate CO₂ flux between ocean and atmosphere. The north Pacific oceanic CO₂ sink is evident in the mid latitude zone, but high latitude north Pacific was a CO₂ source region. The net sink flux of CO₂ in the north Pacific, north of 34°N, was estimated as 0.24GtC/year.
- 6) O₂/N₂ ratio was monitored by newly developed GC-TCD system. Tentative carbon isotope ratio and O₂/N₂ ratio trend indicated that comparable amount of CO₂ was taken by both land and ocean in recent 3 years. Large increase in CO₂ concentration with decrease of delta ¹³C from late '97 to '98 suggested that large portion of CO₂ was released from land biota at El Nino event.