

## Japan Meteorological Agency's ship-based observations for carbonate parameters in the surface and interior ocean

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Japan Meteorological Agency (JMA) has been conducting a series of hydrographic and biogeochemical observations in the western North Pacific to understand the changes in the ocean circulation, air-sea interactions, and biogeochemistry associated with the global change. Data of partial pressure of CO<sub>2</sub> in surface seawater (pCO<sub>2</sub><sup>sea</sup>) and in overlying air (pCO<sub>2</sub><sup>air</sup>) have been acquired along the 137°E and 165°E repeat lines since early 1980s and mid-1990s, respectively, on board R/V *Ryofu Maru* and R/V *Keifu Maru*. For the measurement of pCO<sub>2</sub>, we have been using a non-dispersive infrared (NDIR) gas analyzer, a showerhead-type equilibrator and a set of CO<sub>2</sub> standard gases calibrated with WMO mole fraction scale. We have also been making precise measurements of dissolved inorganic carbon (DIC), pH and total alkalinity (TA) in the water columns since 1994, 2003 and 2009, respectively. We have been using a coulometric DIC analyzer and using a spectrophotometric measurement for TA and pH. We have been using the certified reference materials provided by the Scripps Institution of Oceanography.

We are providing various information regarding ocean carbon cycle. The trend of pCO<sub>2</sub><sup>sea</sup> increase has been observed along 137°E and 165°E repeat lines together with the increase of pCO<sub>2</sub><sup>air</sup>. The growth rates of pCO<sub>2</sub><sup>sea</sup> and pCO<sub>2</sub><sup>air</sup> are 1.2~3.4 and 1.7~2.1 μatm/year, respectively. The rate of pH decrease in surface seawater was about 0.02 per decade in most regions. The accumulation rates of oceanic anthropogenic CO<sub>2</sub> inventory along 137°E and 165°E are approximately 4~12 and 3~13 tC·km<sup>-2</sup>·y<sup>-1</sup>, respectively. The rates of pH decrease in the ocean interior are 0.003~0.036 per decade ([http://www.data.jma.go.jp/gmd/kaiyou/english/oceanic\\_carbon\\_cycle\\_index.html](http://www.data.jma.go.jp/gmd/kaiyou/english/oceanic_carbon_cycle_index.html)).

The CO<sub>2</sub> data we obtained are publicly available from the WMO's World Data Centre for Greenhouse Gases (WDCGG) operated by JMA and from SOCAT database (<http://ds.data.jma.go.jp/gmd/wdcgg/wdcgg.html>) (<http://www.socat.info/>).