

CICS-MD Science Meeting
November 12-13, 2014
College Park, MD

Liqing Jiang 1-4 Aragonite Saturation State in Surface and Subsurface Waters of the Global Oceans: Distributions, Controlling Factors, and Decadal Changes

Aragonite saturation state (Ω_{arag}) in surface and subsurface waters of the global oceans was calculated from the most up-to-date (by the year of 2010) ocean station data of dissolved inorganic carbon and total alkalinity. Results show that sea surface Ω_{arag} was highest where the ocean was warmest. It was always above 2.5 (2.5-4.5) within 40 degrees from the Equator (40° N to 40° S), and decreased quickly to 1.0-1.5 towards the polar regions. The high solubility and consequently enhanced concentrations of carbon dioxide in colder waters, combined with the temperature effects on inorganic carbon equilibrium and stoichiometric apparent solubility product (K_{sp}), helped explain the latitudinal differences of surface water Ω_{arag} . Vertically, Ω_{arag} was highest in the surface mixed layer (SML) and decreased with depth, although the vertical gradients diminished with increasing latitude. In the SML, air-sea gas exchange and biological activities helped maintain the higher Ω_{arag} than in the deep ocean. Underneath the thermocline, aerobic decomposition of organic matter along the global ocean conveyor belt played one of the dominant roles in shaping out the distributions of subsurface Ω_{arag} . Data in the Pacific Ocean allowed us to examine the decadal changes of Ω_{arag} in the region. Results showed that ocean acidification was happening fastest in the surface mixed layer, but leveled off quickly with depth. Ω_{arag} in the SML dropped by ~ 0.1 unit (0.3-0.9%) in 10 years from the period of 1989-1998 to 1998-2010 in waters shallower than 100 meters at 3 out of the 4 quarters of the Pacific Ocean. Mass balance calculation suggested that the drop of Ω_{arag} in the SML of the Pacific Ocean was primarily caused by the intrusion of atmospheric carbon dioxide.