

## The Year-Round Upwelling at the Shelf Break Near the Northern Tip of Taiwan as Evidenced by Chemical Hydrography

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### ABSTRACT

Upwelling of the Kuroshio subsurface water at the shelf break near the northern tip of Taiwan is an important oceanic phenomenon, that results from impingement of the Kuroshio onto the continental shelf and causes profound chemical and biological responses. This upwelling region was frequently observed in the past as a pool of cold water. However, such temperature contrast does not exist throughout the year due to the cooling of the shelf water in winter. Consequently, it has never been established until now that the upwelling is a year-round phenomenon. In this study, monthly cruises were conducted from August 1990 to July 1991, and a one year-long monthly record of upwelling was evidenced from the distribution of temperature, nitrate and dissolved oxygen. The last, which revealed the structure of the upwelling dome in winter similar to those in other months, was an especially useful indicator of upwelling when temperature or nitrate concentration failed to show the whole picture of upwelling. Undersaturation of oxygen in the surface water at the upwelling center was observed during December-May. The average downward flux of oxygen in the upwelling area was computed to be  $0.034 \text{ mol/m}^2/\text{day}$  in March 1991. According to a box model for thermal and mass balance, an upwelling speed of about 5 m/day was required to maintain the oxygen-deficiency in the surface layer. The upwelling velocity yielded a total volume transport of 0.2 Sv and nitrate transport of  $2 \times 10^9 \text{ gN/day}$  to the top 60m in the upwelling area of  $2900 \text{ km}^2$ .

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