

## TEMPERATURE-NUTRIENT RELATIONSHIPS IN THE KUROSHIO AND ADJACENT WATERS NEAR TAIWAN

K.-K. LIU<sup>1,2</sup>, S.-C. PAI<sup>1</sup> and C.-T. LIU<sup>1</sup>

### ABSTRACT

The surface water in the Kuroshio is very depleted in nutrients, whereas the subsurface water (200~700 m) shows linearly increasing nitrate and phosphate concentrations with decreasing temperature. The linear regression equations are:

$$\begin{aligned}[\text{NO}_3^-] (\mu\text{M}) &= 43.7 - 2.22 T (^\circ\text{C}) & R &= 0.96 \\ [\text{PO}_4^{3-}] (\mu\text{M}) &= 3.26 - 0.172 T (^\circ\text{C}) & R &= 0.95\end{aligned}$$

Contrasting with the Kuroshio surface layer, the adjacent shallow water on the continental shelf off northern Taiwan is fertile. A nutrient front near the shelf break has been observed twice in two different seasons. The waters near the shelf break exhibited a linear T-nutrient relationships, which possibly resulted from mixing of the nutrient-depleted surface water and a nutrient-rich upwelled water from the Kuroshio subsurface layer. The nutrient distribution in the more landward region of the shelf appears to be affected by more complicated processes than those controlling the outer shelf water.

### INTRODUCTION

A frontal system, which manifests both a strong temperature gradient and dramatic nutrient change, was observed off the northern Taiwan in March, 1987 (Liu and Pai, 1987). This frontal system perhaps exists permanently near the shelf break (Chern personal communication 1988). It probably results from topographically enhanced upwelling related to the turn of the Kuroshio (Liu and Pai, 1987; Chern and Wang, 1988). This area is an important fishing ground, which warrants an investigation of its nutrient dynamics.

The input of nutrients to this area may come from four major sources: the China Coastal Current (CCC), river runoff, benthic regeneration and upwelling of the Kuroshio subsurface water. Direct discharge of river runoff to this area is limited to the streams in the northern Taiwan. On the other hand, indirect riverine input may be significant, because the CCC receives nutrients from the runoff of the Yangtze River and the Pearl River in mainland China. The benthic fluxes of nutrients in the open shelf near Taiwan are unknown. In a benthic study of the Penghu Bay, the total diffusive flux of nitrogenous nutrients out of the sediments was estimated to be 1.6-2.6 mg-at N/m<sup>2</sup>/day (Liu and Fang, 1986).

The upwelling input of nutrients is the main concern of this paper, because it is considered the most important source of nutrient in the southeastern U.S. continental shelf (Atkinson, 1985), which is a similar western boundary region. The southeastern U.S. continental shelf is periodically intruded by the Gulf Stream water (GSW) (Atkinson *et al.*, 1977; Blanton and Pietrafesa, 1978; Atkinson *et al.*,

---

1. Institute of Oceanography, National Taiwan University, Taipei, Taiwan, ROC.  
2. Institute of Earth Sciences, Academia Sinica Taipei, Taiwan, ROC.