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LETTER TO THE EDITOR

A reply to the paper by Austin and Green

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We would like to clarify that the mixed-layer depth (h) and the vertical coefficient (K) in our paper (Li et al. (1984)) were obtained simultaneously by curve fitting. Our purpose was not to elucidate actual mixing mechanisms taking place in the ocean but rather to provide a practical interim means of calculating CO_2 uptake, heat buffering, pollutant dispersal ... in the sea. We observed that the shapes of horizontally averaged tritium profiles for large regions of the sea could be adequately approximated by the diffusion of tritium from a well-mixed reservoir into a semi-infinite half space. We were very careful to state that we do not believe that vertical eddy mixing was responsible for the actual oceanic transport. Thus the Austin and Green criticism is misdirected. Contrary to their implication, we used no oceanographic information to obtain our value of h (the mixed-layer depth). It was chosen to fit the shape of the horizontally averaged tritium profiles.

We have emphasized that our K is a purely empirical parameter to reproduce the mean distribution of tritium in the surface ocean (0-2000 m). Our K takes into account all the physical processes which transfer tritium across density horizons in the oceanic thermocline. Therefore, the mixing due to baroclinic eddies is included in addition to mixing and advection along isopycnal horizons which outcrop at surface ocean. The ventilation of thermocline through outcrops of isopycnal horizons is well documented by tritium and ^{3}He data (Jenkins, 1980). However, it is only one of many possible tritium transport mechanisms and has nothing to do with our model calculation of K and h as suggested by Austin and Green. We have no argument with the obvious temporal and spacial variations of h and K in the ocean suggested by Austin and Green.

The very reason why we averaged the tritium profile data in a large regional scale is to smooth out the subsurface tritium maxima which often occur in individual profiles and which cannot be fitted by a simple one-dimensional representation. In order to fit the tritium profile data in a finer scale, one needs at least a two-dimensional diffusion-advection model. It was not our intention to make such a model.

We admit that our model fit to the north Atlantic data is less than perfect, especially with regard to the slight tritium minimum around 700–900 m. The tritium minimum was caused by the northward penetration of the high silica but low tritium antarctic circumpolar intermediate water (Broecker and Peng, 1982, Figs. 1–14). However, that our K for the north Atlantic is actually a maximum estimation is clear from our Fig. 1. We define the mixed-layer depth as the depth of the well-mixed surface water with near constant salinity and tritium concentration. Since the tritium concentration in the North Atlantic decreases with depth beneath the base of our mixed layer, we do not accept the claim that the mixed-layer depth in a one-dimensional representation should be 700 m. Also, to correct the record, the main release of tritium was about 9 to 10 years (1962–1963) before the Atlantic GEOSECS (1972–1973) instead of Austin and Green's 7 years. The use of a shorter time raised their K estimate.

We would like to take this opportunity to correct a referencing error in our paper. The cruises GS 7307 and GS 7205 were USA cruises and the tritium data were obtained by the Tritium Laboratory of the University of Miami.

REFERENCES

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