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ARABIAN SEA GEOSECS STATIONS REVISITED: TRACER-DEPTH PROFILES REVEAL TEMPORAL VARIATIONS?

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In March-April 1998, the Physical Research Laboratory and the Regional Research Laboratory (Ahmedabad, India) together with the IAEA Marine Environment Laboratory, Monaco, participated in the research mission to visit GEOSECS (Geochemical Ocean Sections Study) stations in the Arabian Sea. The main objective was to reoccupy these stations which were sampled in the early seventies to observe possible time variations in trace behaviour in this region.

It is generally accepted that both natural (climate variations) and anthropogenic (greenhouse effect) changes can cause modifications of the oceanic characteristics and properties of deep waters on yearly and decadal scales [1]. For long time-scales (100 to 1000 years) one needs to look at the sediments where these changes are subtly recorded. Tracers such as ^{14}C and ^{3}H (deep waters) and ^{228}Ra surface waters are useful markers of water circulation patterns and changes. Also man-made radiotracers such as ^{90}Sr, ^{137}Cs, ^{99}Tc, ^{238}Pu, $^{239,240}Pu$ and ^{241}Am, can give information on air-sea exchange as well as penetration (vertical change) rates in the open ocean [2].

We visited GEOSECS stations 415 to 419. In each station, CTD profiles, ^{3}H, ^{14}C, ^{90}Sr, ^{137}Cs, Pu and Am profiles, nutrients, Be, TOC and oxygen were determined from surface to bottom. Also uranium and trace elements were sampled in function of the oxygen minimum zone. In this paper we report the findings on the physical properties as well as the variations in water circulation patterns and also vertical exchange rates in the Arabian Sea.

PSU profiles collected in this mission compared with those PSU profiles measured in 1974 (GEOSECS) showed marked differences in those stations located in the southeast part of the Arabian Sea (Fig. 1). In contrast, those located more towards the north (415-416) showed little temporal variation. We think these changes may be real given that the PSU values at depth are comparable and reflect the presence of deep Antarctic bottom waters in this region.

After examining vertical variations in the water column in this region, we could compare our ^{137}Cs and ^{3}H data (Fig. 2) with GEOSECS data. In both cases some changes were discovered over the 15 year interval. We found that at the three stations there appears to be a net outflow of water masses from the Arabian Sea to the Southern Ocean.

This observation is particularly true for surface waters down to 100-200 m and deeper at GEOSECS station 416. We have also found a similar pattern with ^{3}H vertical profiles (not shown here). Possible temporal variations regarding oceanographic settings due to climate changes and/or anthropogenic changes such as global warming will be further discussed in more detail.

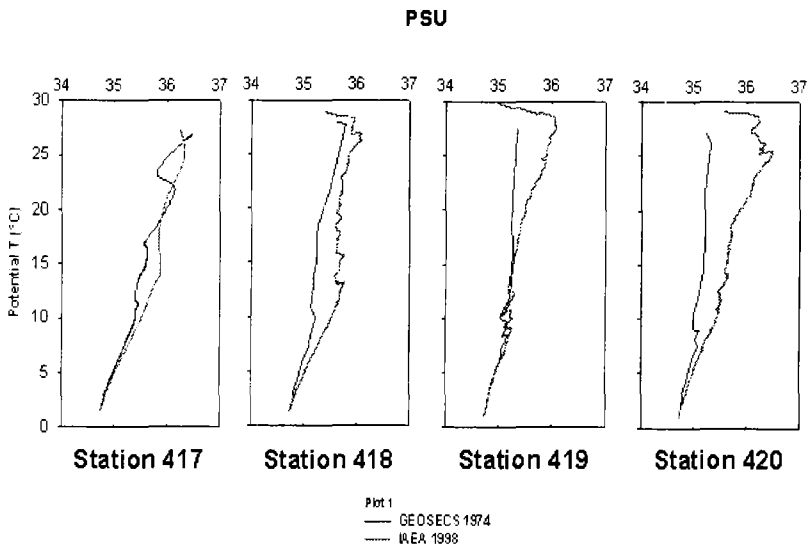

FIG. 1. PSU vertical profiles measured at 4 GEOSEC stations. The profiles are comparable and the differences may reflect temporal variations while sampling during 1974 (GEOSECS) and 1998 (this study).

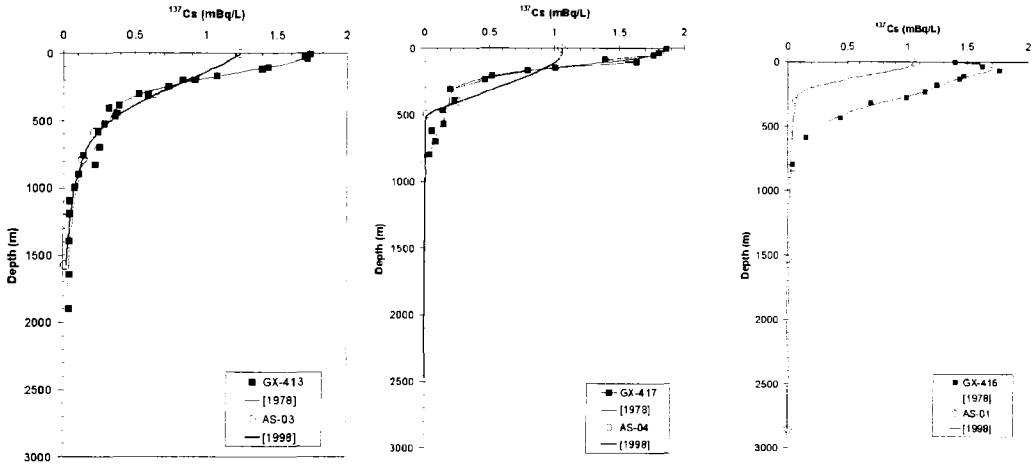

FIG. 2. ^{137}Cs depth profiles of some of the revisited stations. All data have been decay corrected to April 1, 1998. The biggest differences are between 0-200 m. At depth, the values are similar.

REFERENCES

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