Fluctuation Activities of ^{210}Po in Water the Water Column at Bagan Lalang, Selangor

Phang Feong Kuan[1], Zaharuddin Ahmad[2] &
Che Abd. Rahim Mohamed[1*]

[1]Marine Science Program, School of Environmental and Natural Resource Sciences, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia

[2]Malaysian Institute of Nuclear Technology Research (MINT), 43000 Bangi, Selangor, Malaysia

[*]Corresponding author: carmohd@pkrisc.cc.ukm.my

ABSTRACT

The activity of ^{210}Po was measured in water samples collected from six stations at Bagan Lalang, Selangor. Results showed that the dissolved and particulate activities of ^{210}Po were varied from 3.03 x 10^{-4} Bq l^{-1} to 16.75 x 10^{-4} Bq l^{-1} and 2.41 x 10^{-2} Bq g^{-1} to 56.69 x 10^{-2} Bq g^{-1} (dry wt), respectively. Overall, the activities of ^{210}Po in dissolved phase are relatively low due to the insoluble of ^{210}Po in water. More than 99% of ^{210}Po in the water column occurred in the particulate phase due to the high affinity of ^{210}Po. In addition, variation of ^{210}Po activities was influenced by the tidal currents and the chemical behavior of ^{210}Po in water column.

ABSTRAK

Aktiviti ^{210}Po telah diukur di dalam air yang disampel daripada enam lokasi di Bagan Lalang, Selangor. Keputusan yang diperolehi menunjukkan aktiviti ^{210}Po yang terlarut dan partikulat masing-masing mempunyai nilai di antara 3.03 x 10^{-4} Bq l^{-1} ke 16.75 x 10^{-4} Bq l^{-1} dan 2.41 x 10^{-2} Bq g^{-1} ke 56.69 x 10^{-2} Bq g^{-1} (berat kering). Secara keseluruhannya, aktiviti ^{210}Po di fasa terlarut adalah lebih rendah di mana disebabkan oleh ketidaklarutan ^{210}Po dalam air. Lebih daripada 99% ^{210}Po di dalam kolum air wujud dalam fasa partikulat yang disebabkan oleh afiniti ^{210}Po yang tinggi. Perubahan variasi aktiviti ^{210}Po berkemungkinan juga dipengaruhi oleh arus pasang surut dan perubahan kimia ^{210}Po di dalam kolum air.

Keywords: ^{210}Po; water column; dissolved phase; suspended particulate matter.

Introduction

Polonium-210 (^{210}Po) is the final alpha-emitting daughter nuclide in the natural ^{238}U decay series entering the marine environment via the natural radioactive decay of ^{222}Rn gas, ^{226}Ra in solution, and through wet and dry atmospheric deposition of ^{210}Bi, ^{210}Pb and ^{210}Po (Wildgust et al. 1998; Turekian et al. 1977). A small amount of ^{210}Po will be formed in-situ in the water column of marine environment as a result of uranium decay (Skwarzec & Bojanowski 1988).

In the water column, ^{210}Po is particle-reactive radionuclides and tend to associate with the particulate phases (Yuang & Lin 1992). Plankton also absorbs polonium and forms as complexes with organic matter, while lead has a strong tendency to be sorbed onto mineral suspended matter (Skwarzec & Bojanowski 1988; Bacon et al. 1976; Bacon et al. 1981; Fellows et al. 1981). ^{210}Po is highly accumulated by marine organisms and it is approximately three times enriched in phytoplankton and 12 times in zooplankton with respect to ^{210}Pb (Shannon et al. 1970).

Bagan Lalang, Selangor is a coastal area located at the edge of Sepang around 15km from the centre town (Figure 1). The major river system in this area is Kuala Sepang Kechil which drains into the Malacca Straits.

The objective of this study is to determine the distribution of ^{210}Po in the water column along the Kuala Sepang Kechil, Selangor.

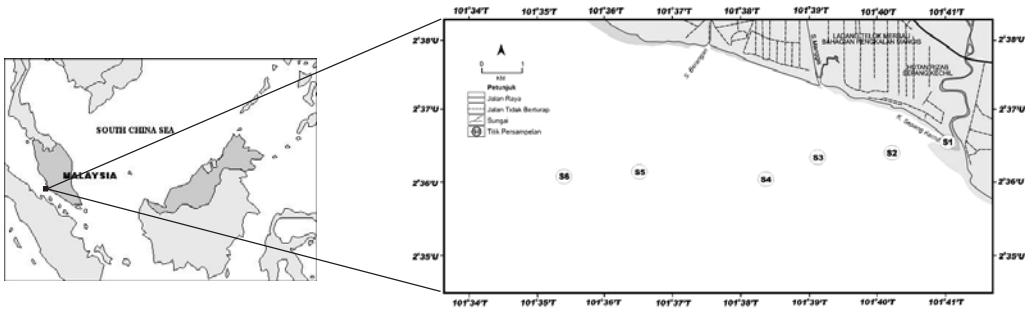

FIGURE 1: Sampling Stations at Bagan Lalang, Sepang

Materials and Methods

Samples were collected at six stations throughout the Bagan Lalang estuary on the 20th Mac and 8th September 2004. About 15 L of water samples were collected using Van Dorn water sampler. In situ parameters such as salinity, pH and water depth were determined using calibrated portable meter (Model: YSI-SCT6810).

In the labaratory, water samples were filtered through the pre-weighted 0.45 µm membrane filter paper. Both dissolved and suspended particulate matter samples (TSM) were processed using the suggested method by Theng and Mohamed (2005). The activities of ^{210}Po was measured using alpha spectrometer.

Results & Discussions

The dissolved and particulate activities of ^{210}Po from six stations obtained at Bagan Lalang, Sepang were measured and listed in Table 1.

TABLE 1: Activities of ^{210}Po in the Water and Particulate Samples

		20 Mac 2004	8 Sept 2004		
Station (Layer)	Location	Dissolved ^{210}Po x 10^{-4} (Bq l^{-1} ± 1σ)	Particulate ^{210}Po x 10^{-2} (Bq g^{-1} ± 1σ)	Dissolved ^{210}Po x 10^{-4} (Bq l^{-1} ± 1σ)	Particulate ^{210}Po x 10^{-2} (Bq g^{-1} ± 1σ)
1 (S)	02° 36’ 55” N 101° 41’ 07” E	3.11 ± 1.76	23.00 ± 2.65	7.77 ± 4.32	20.64 ± 3.88
2 (S)	02° 36’ 35” N 101° 40’ 22” E	4.28 ± 1.12	17.79 ± 2.39	3.03 ± 7.54	19.36 ± 6.02
3 (S)	02° 36’ 30” N 101° 39’ 19” E	4.17 ± 1.28	19.95 ± 2.94	10.49 ± 2.82	40.41 ± 13.45
4 (S)	02° 36’ 05” N	6.89 ± 2.43	44.95 ± 10.08	6.76 ± 2.55	56.69 ± 22.88
(M)	101° 38’ 36” E	4.82 ± 1.17	12.89 ± 2.56	-	-
(B)		-	-	4.07 ± 2.92	43.48 ± 11.59
5 (S)	02° 36’ 11” N	4.78 ± 1.28	7.71 ± 15.64	16.75 ± 10.39	2.41 ± 24.55
(M)	101° 36’ 56” E	4.53 ± 1.90	26.67 ± 8.40	-	-
(B)		-	-	9.97 ± 3.01	33.31 ± 22.22
6 (S)	02° 36’ 06” N	10.25 ± 2.95	35.99 ± 10.52	10.88 ± 4.28	50.61 ± 23.24
(M)	101° 35’ 38” E	6.60 ± 1.73	34.12 ± 7.13	-	-
(B)		-	-	3.24 ± 3.12	49.17 ± 16.95
Total Activity	49.43 ± 0.61	222.66 ± 2.74	72.96 ± 1.73	316.08 ± 5.89	

(-) – No data

The activity of ^{210}Po varied from 3.11 x 10^{-4} Bq l^{-1} to 10.25 x 10^{-4} Bq l^{-1} and 3.03 x 10^{-4} Bq l^{-1} to 16.75 x 10^{-4} Bq l^{-1} for dissolved phase respectively. Overall, activities of ^{210}Po in dissolved phase are relatively low due to the insoluble of ^{210}Po in water (Tanaka et al. 1987), where ^{210}Po will be adsorbed into particulate phase once it enters into the water column. Besides that, activities of ^{210}Po in the surface layer are higher than in the middle and bottom layers. This was probably due to the supply of atmospheric deposition of ^{210}Pb that originated from the decay of ^{222}Rn (Bacon et al. 1976).

^{210}Po activities in suspended particulate matters varied from 7.71 x 10^{-2} Bq g^{-1} to 44.95 x 10^{-2} Bq g^{-1} (dry wt) and 2.41 x 10-2 Bq g^{-1} to 56.69 x 10-2 Bq g^{-1} (dry wt) for both sampling on 20th March 2004 and 8th September 2004, respectively. The standard deviation values for several stations are higher than the activities in suspended matter samples due to high background value and low concentration of these nuclides in the samples.

Overall, activities of ^{210}Po are higher in particulate phases compared to dissolved phases ($p < 0.01$). The ^{210}Po activities principally occurred in the particulate phases and more than 99% of total activites (dissolved + particulate) of all samples was found to be associated with the particulate fraction (Table 1). This is due to the very insoluble feature of this radionuclide in the seawater (Wildgust et al. 1998; Tanaka et al. 1987) and tends to associate with particles. Moreover, the high value of particulate ^{210}Po in surface water

is related to the deposition of atmospheric ^{210}Pb. Once ^{210}Pb is deposited, it is rapidly absorbed by particles (Helz et al. 1985/86). Besides, the high activities of ^{210}Po in the surface layer was probably due to the dissolution of sinking particles and biological remobilization of ^{210}Po (Bacon et al. 1976; Nozaki & Tsunogai 1976; Thomson & Turekian 1976; Cochran et al. 1983; Chung & Finkel 1988).

The activities of ^{210}Po at the bottom layer are slightly higher than the middle layer. This is probably due to the resuspension of ^{210}Po from the surface sediment (Tanaka et al. 1987) and the decay of ^{226}Ra in the sediments.

Conclusion

Measurement of dissolved and particulate activities of ^{210}Po at water column of Bagan Lalang, Selangor were obtained. Results showed that more than 99% of ^{210}Po were occured in particulate phase due to the high affinity of ^{210}Po to particulate phase. The variation of ^{210}Po activities was influence by tidal current and the chemical behavior of ^{210}Po in water column.

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