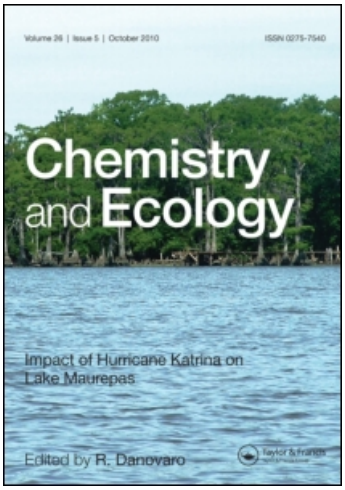

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LEAD-210 AND BERYLLIUM-7 IN THE AEROSOL PARTICLES AROUND TAIWAN OFF-SHORE AREAS

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Distributions of ^{210}Pb and ^{7}Be in the aerosol particles of different size fractions were measured around Taiwan offshore areas from October, 1994 to October, 1995. The size distribution and abundance of the aerosol particles showed both spatial and temporal variations. The particle concentrations off northwestern Taiwan were more than twice as those off northeastern Taiwan both in November and March, and the values were much higher in November than in March for both areas. The measured particle concentrations, except for one sample with an unusually high value, ranged from 10 to 83 $\mu g\,m^{-3}$ in the study areas. The ^{210}Pb concentrations in the aerosol particles filtered from the air mass varied between 20×10^{-3} and 72×10^{-3} $dpm\,m^{-3}$ (1 dpm = 0.45 pCi). The ^{210}Pb concentrations in the area off southwestern Taiwan appeared somewhat higher than in other areas and were probably contributed by the land air from Taiwan which contains higher ^{210}Pb in winter. The ^{210}Pb concentrations off northern Taiwan were low in November when the aerosol concentrations were high, but they were high in March when the aerosol concentrations were low.

Based on the ^{7}Be monitoring records of 20 years on the aerosol particles of the island by the Taiwan Radiation Monitoring Center, the mean settling rate averaged 0.91, 0.79 and 0.68 cm s^{-1}, respectively, in northern, central and southern Taiwan. With these values and the ^{210}Pb concentrations in the aerosols, the ^{210}Pb flux was determined to be between 0.58 and 2.30 dpm $cm^{-2}y^{-1}$, with an average of 1.19 dpm $cm^{-2}y^{-1}$. Excluding the highest value due to its extremely high ^{210}Pb and aerosol concentrations, the average is reduced to 1.05 dpm $cm^{-2}y^{-1}$. The activity median diameters (AMD) for ^{210}Pb in the study areas were between 0.69 and $< 0.49\,\mu m$ with a mean of 0.5 μm based on ^{210}Pb distributions in different particle size fractions. Thus, ^{210}Pb was preferentially adsorbed on to the submicron particles. ^{7}Be in the study areas showed a good correlation with ^{210}Pb in total activity although the two nuclides had different sources.

Keywords: ^{210}Pb; ^{7}Be; aerosol; Taiwan; offshore areas

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INTRODUCTION

Atmospheric ^{210}Pb flux to the surface ocean is a major source term in the study of the behaviour of this nuclide in the upper ocean, such as its removal rate and mean residence time (e.g. Nozaki *et al.*, 1976; Lin and Chung, 1991). As adsorption of this nuclide on to the aerosol particles which fall to the earth surface, can provide a mechanism for ^{210}Pb transfer from the atmosphere to the ocean, the concentration and size distribution of the aerosol particles in the marine atmosphere are important factors in controlling the magnitude and variation of the atmospheric ^{210}Pb flux. In order to determine the spatial and temporal variations of the marine aerosol particles in terms of their size distribution and concentration, and to understand the adsorption characteristics of ^{210}Pb on to different size fractions of the aerosol particles, marine air was filtered in large volume by a cascade impactor filtration system similar to that adopted by Sanak *et al.* (1981).

Figure 1 shows the offshore marine aerosol sampling cruise tracks around Taiwan except for the areas off the east and southeast where no cruises were available for sampling. At least two aerosol samples are available from each of the following offshore areas: northeast, northwest and southwest of the island. There is one sample (OR1-405B) taken along the west coast of Taiwan. The approximate sampling time in month and year of each cruise is indicated in the figure. The sample collection time for each cruise ranged from 2 to 5 days; the volume of the air mass filtered varied from 1900 to 6200 m^3.

SAMPLING AND ANALYSES

Sampling of Aerosol Particles

The aerosol samples were collected on to pre-cleaned and pre-weighed filters of different pore sizes and weighed under a controlled condition (relative humidity at 30–40%) to avoid effects of moisture variations. The cascade impactor used (maker and model Andersen, series 235) allows collection of aerosols in 6 size stages, each with a specific size range as follows:

Stage 1: > 7.2 μm; Stage 2: 7.2–3.0 μm; Stage 3: 3.0–1.5 μm; Stage 4: 1.5–0.95 μm; Stage 5: 0.95–0.49 μm, Stage 6: <0.49 μm.

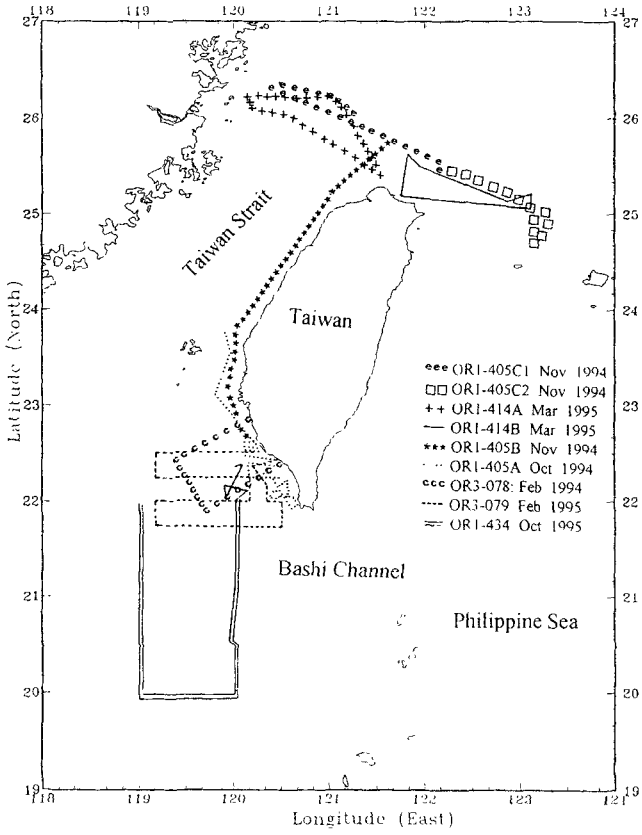


FIGURE 1 Sampling cruise tracks near Taiwan and approximate time of each cruise. OR1 and OR3 indicate cruises conducted with Ocean Researcher 1 and 3.

The sampling device was set up aboard a research vessel on top of the bridge to minimize human interference. The filtered air volume was determined by the flow rate (about $60\,m^3hr^{-1}$) and the filtration time, without any correction for the effect of the air temperature or pressure. The maximum temperature variation during sampling in all cruises was about 10°C (19 ~ 29°C) which could cause an error in air volume no more than 4%. The pressure effect was much smaller.

Each size fraction of an aerosol sample was also weighed under the same controlled condition for its mass or concentration. The concentration of the aerosol sample was the sum of the concentration

of each size fraction, and the percentage of each size fraction was determined.

^{7}Be Measurements

Each size fraction of an aerosol sample was first digested by nitric acid followed by hydrofluoride and hypochloric acid. The sample in solution was stored in a container of specific geometry for gamma counting with a HPGe detector. The standard material used for calibration was a mixed source in jelly form prepared by the Taiwan Radiation Monitoring Center, the Atomic Energy Council of Taiwan. ^{7}Be was determined on the basis of an energy peak at about 477.5 KeV in the gamma energy spectrum. The ^{7}Be concentration of each size fraction was expressed in dpm in 1000 m^3 air filtered, and the total concentration was the sum of the concentration of each size fraction. Since the aerosol concentration of each size fraction was measured, the specific activity of ^{7}Be in each size fraction was also determined, and the specific activity of the sample was obtained by dividing the total ^{7}Be activity by the aerosol concentration, expressed in dpm mg^{-1} of aerosol particles.

^{210}Pb Measurements

The ^{210}Pb activity in each size fraction of an aerosol sample was determined by counting of its energetic beta-emitting daughter, ^{210}Bi. Stable lead in the form of lead nitrate solution was added into the digested sample to monitor the chemical yield. The sample in the form of lead sulphate was deposited evenly on to an aluminium disc for counting, and the counts were corrected for the background and self-adsorption of the lead sulphate. The chemical purification procedure, beta counting and data reduction, mainly followed those of Rama and Goldberg (1961); Koide *et al.* (1972) and Chung and Craig (1983). The counting efficiency based on a ^{210}Pb source traceable to the NIST (National Inst. Science and Technology) averaged at 37.9 $\pm$ 0.5%. The ^{210}Pb activity of each size fraction was also expressed in dpm per 1000 m^3 air filtered, and the total activity of a sample was the sum of the activity of each size fraction. The specific ^{210}Pb activity of each size fraction and the whole sample was also determined.

RESULTS AND DISCUSSION

Size Distribution and Abundance of Aerosol Particles

Concentrations of the aerosol particles are listed in Table I in which each size fraction and its weight percent of the total are given. Each sample is identified by its cruise code (Fig. 1) since only one sample was collected in each cruise. The OR3-078 sample with a very high concentration (219 $\mu g\, m^{-3}$) due to an extremely high value at stage 6, is indicated as a questionable value in the table. However, this value is also matched by very high ^{210}Pb and ^{7}Be contents. All the other samples have concentrations varying from 10 to 83 $\mu g\, m^{-3}$. The maximum concentration at 83 $\mu g\ m^{-3}$ is less than a half of the monthly average measured on the land air of the Kaohsiung area, Taiwan, because the land air usually contains high proportion of coarse ($> 3\ \mu m$) particles (unpublished data).

Figure 2 shows the size distributions of all aerosol samples divided into different sampling areas to show their temporal and spatial variations. In the area off southwestern Taiwan, the size distribution of each sample shows a similar pattern with higher concentrations at stages 2 and 5, but the fractional and total concentrations vary. Excluding stage 6 of OR3-078 and OR3-079, each size fraction of every sample has a concentration less than 20 $\mu g\, m^{-3}$. The two samples collected in October (OR1-405A, OR1-434) are similar in both the distribution pattern and the fractional concentrations. Although the two samples collected successively in February (OR3-078, OR3-079) are similar in the distribution pattern, the fractional concentrations differ by a factor of 3 or more.

The size distribution off northwestern Taiwan shows a "flat" pattern, but the fractional concentrations of OR1-405C1 collected in November are all higher than those of OR1-414A collected in March (Fig. 2). A similar size distribution is observed in the area off northeastern Taiwan, and the concentrations in November (OR1-405C2) are also higher than those in March (OR1-414B) except for stages 5 and 6 which are similar for both samples. This is probably due to the northeast monsoon which may have carried higher aerosol concentrations of the Asian continental air mass toward Taiwan during November. Although the northeast monsoon remains persistent in

TABLE I Size distribution and mass concentration of aerosols in the marine atmosphere near Taiwan as measured from different cruises

Cruise	*Total Mass concentration* ($\mu g\, m^{-3}$)	*Stage*	*Mass concentration* ($\mu g\, m^{-3}$)	*Weight percent*
OR1-405A	58.6	1	9.4	16.1
		2	16.0	27.2
		3	5.6	9.6
		4	6.6	11.3
		5	11.7	19.9
		6	9.3	15.9
OR1-405B	82.8	1	10.2	12.3
		2	12.6	15.2
		3	20.7	25.0
		4	26.7	32.2
		5	11.7	14.1
		6	0.9	1.1
OR1-405C1	76.3	1	8.6	11.3
		2	13.6	17.8
		3	14.3	18.7
		4	11.4	14.9
		5	13.0	17.0
		6	15.4	20.2
OR1-405C2	31.1	1	6.5	20.9
		2	8.9	28.6
		3	4.2	13.6
		4	4.2	13.5
		5	4.0	12.9
		6	3.3	10.5
OR3-078	219.2? [?]	1	14.6	6.7
		2	14.0	6.4
		3	9.7	4.4
		4	10.5	4.8
		5	16.1	7.3
		6	154.3[?]	70.4
OR3-079	41.6	1	3.3	7.8
		2	5.1	12.3
		3	1.1	2.7
		4	3.3	8.0
		5	6.6	15.8
		6	22.2	53.5
OR1-414A	28.0	1	4.6	16.5
		2	7.1	25.3
		3	3.9	13.9
		4	4.6	16.4
		5	6.6	23.5
		6	1.2	4.3
OR1-414B	10.1	1	0.5	4.6
		2	2.4	23.7
		3	0.1	1.0

TABLE I (Continued)

Cruise	*Total Mass concentration* ($\mu g\, m^{-3}$)	*Stage*	*Mass concentration* ($\mu g\, m^{-3}$)	*Weight percent*
		4	0.1	1.0
		5	5.4	54.2
		6	1.6	15.5
OR1-434	71.0	1	14.4	20.3
		2	19.8	27.9
		3	6.0	8.4
		4	7.4	10.5
		5	11.4	16.1
		6	12.0	16.8

° questionable value.

March, the continental air mass probably has less aerosol contribution then, and the marine air with low aerosol content from the Pacific may become dominant.

Comparing the concentrations of the samples collected in the same sampling period, one finds that the area off northwestern Taiwan has values about twice as high as the area off northeastern Taiwan. This probably reflects the fact that the former is closer to the Asian continent than the latter. The size distribution in the Taiwan Strait shows a single-peak over 25 $\mu g\, m^{-3}$ at stage 4, quite different from that in the other areas mentioned above (Fig. 2), presumably derived from the land air of Taiwan.

^{210}Pb Distribution in Aerosol Particles

Table II shows ^{210}Pb activities on different size fractions of the marine aerosol particles around Taiwan. Included in the table are the total activity, activity per unit mass of the aerosol or specific activity, and percent of the total activity in each size fraction. The total activity varies between 20×10^{-3} and 107×10^{-3} dpm m^{-3} among all the samples. The specific activity ranges from 0.26 to 4.46 dpm mg^{-1} of aerosol particles. The uncertainty of the data is generally about $\pm$ 5%, but may be about $\pm$ 10% for the coarser fractions (Stages 1 and 2) of low activities.

Figure 3 shows the ^{210}Pb distributions in the aerosol particles from all the samples divided into different groups or areas as before. That the activity increases with the stage number, i.e. the finer particles have

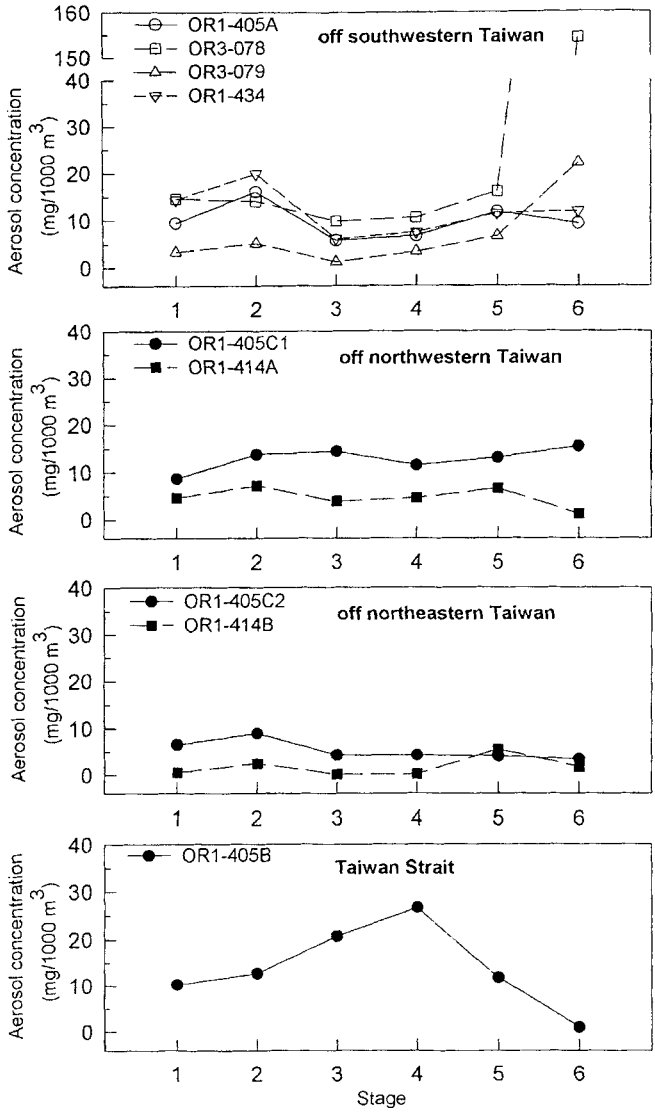


FIGURE 2 Size distribution of aerosols grouped in several areas off Taiwan.

higher ^{210}Pb activities, is a major and general feature for all samples. This feature is consistent with observations by others (e.g. Sanak *et al.*, 1981) and also with the surface adsorption characteristics. In terms of the specific ^{210}Pb activity, the value may increase by an order of

TABLE II ^{210}Pb activity distribution on different size fractions of the marine aerosols near Taiwan

Cruise	*Total ^{210}Pb activity* (10^{-3}*dpm* m^{-3})	*Activity per unit mass* (*dpm* mg^{-1})	*Stage*	*Measured activity* (10^{-3}*dpm* m^{-3})	*Percent of the total activity*	*Activity per unit mass* (*dpm* mg^{-1})
OR1-405A	29.51±0.69	0.50±0.01	1	0.38±0.04	1.3	0.04
			2	1.15±0.09	3.9	0.07
			3	0.58±0.05	2.0	0.10
			4	3.55±0.17	12.0	0.54
			5	10.82±0.32	36.7	0.93
			6	13.03±0.58	44.2	1.39
OR1-405B	40.75±1.14	0.49±0.01	1	0.56±0.06	1.4	0.05
			2	4.58±0.31	11.3	0.36
			3	0.78±0.08	1.9	0.04
			4	2.14±0.19	5.2	0.08
			5	8.99±0.51	22.1	0.77
			6	23.70±0.94	58.2	26.35
OR1-405C1	20.07±0.43	0.26±0.01	1	0.55±0.05	2.8	0.06
			2	0.79±0.07	3.9	0.06
			3	0.92±0.07	4.6	0.06
			4	1.78±0.12	8.9	0.16
			5	5.59±0.24	27.8	0.43
			6	10.45±0.31	52.0	0.68
OR1-405C2	21.12±0.49	0.68±0.02	1	0.32±0.03	1.5	0.05
			2	0.59±0.05	2.8	0.07
			3	0.86±0.07	4.1	0.20
			4	2.18±0.15	10.3	0.52
			5	5.70±0.24	27.0	1.42
			6	11.47±0.38	54.3	3.51
OR3-078	107.09±1.97	0.49±0.01	1	0.51±0.05	0.5	0.03
			2	1.39±0.13	1.3	0.10
			3	2.02±0.17	1.9	0.21
			4	10.85±0.52	10.1	1.03
			5	35.23±1.01	32.9	2.19
			6	57.10±1.59	53.3	0.37
OR3-079	62.54±1.08	1.51±0.03	1	0.80±0.07	1.3	0.25
			2	1.50±0.12	2.4	0.30
			3	1.60±0.12	2.6	1.43
			4	8.05±0.33	12.9	2.43
			5	22.79±0.59	36.4	3.48
			6	27.79±0.82	44.4	1.25
OR1-414A	47.87±0.89	1.70±0.03	1	1.36±0.11	2.8	0.29
			2	2.61±0.18	5.4	0.37
			3	4.69±0.27	9.8	1.20
			4	7.14±0.31	14.9	1.55
			5	14.37±0.47	30.0	2.17
			6	17.70±0.61	37.0	14.64

TABLE II (Continued)

Cruise	*Total ^{210}Pb activity* ($10^{-3}dpm\ m^{-3}$)	*Activity per unit mass* ($dpm\ mg^{-1}$)	*Stage*	*Measured activity* ($10^{-3}dpm\ m^{-3}$)	*Percent of the total activity*	*Activity per unit mass* ($dpm\ mg^{-1}$)
OR1-414B	44.73±0.93	4.46±0.09	1	1.17±0.11	2.6	2.51
			2	1.42±0.13	3.2	0.60
			3	1.37±0.13	3.1	14.20
			4	3.35±0.23	7.5	33.31
			5	12.26±0.50	27.4	2.26
			6	25.17±0.71	56.3	16.13
OR1-434	72.17±0.87	1.02±0.01	1	0.52±0.05	0.7	0.04
			2	1.49±0.10	2.1	0.08
			3	2.11±0.13	2.9	0.35
			4	8.81±0.30	12.2	1.18
			5	26.23±0.53	36.3	2.30
			6	33.01±0.60	45.7	2.76

Note: dpm = 0.45 pCi.

magnitude or more from stages 1 and 2 (> 3 μm) to stages 5 and 6 (< 0.95 μm) (Tab. II).

In the area off southwestern Taiwan, the ^{210}Pb concentrations of finer aerosol particles (> stage 4 or < 1.5 μm) vary greatly even if the stage 6 value of OR3-078 sample is excluded. The other areas also show an increase in ^{210}Pb concentrations toward finer particles. In the areas off northwestern and northeastern Taiwan, the ^{210}Pb activities in March are higher than those in November, especially for finer particles. This is just opposite to the aerosol concentrations which are higher in November but lower in March (Figs. 2 and 3). Thus the specific ^{210}Pb activity of each size fraction as well as the total for each aerosol sample in March is much higher than that in November. This suggests that the aerosols collected in November may have been derived from regions of more land air component. These particles were probably transported from the continental area with a short residence time. The aerosols collected in March had lower concentrations in all size fractions and were probably transported from the open ocean with a long residence time. This would allow accumulation of ^{210}Pb by adsorption on to finer particles as indicated in Figure 3.

Atmospheric ^{210}Pb Flux

One of the major parameters in studying the behaviour of ^{210}Pb in the upper ocean is the atmospheric ^{210}Pb flux. Direct measurements were

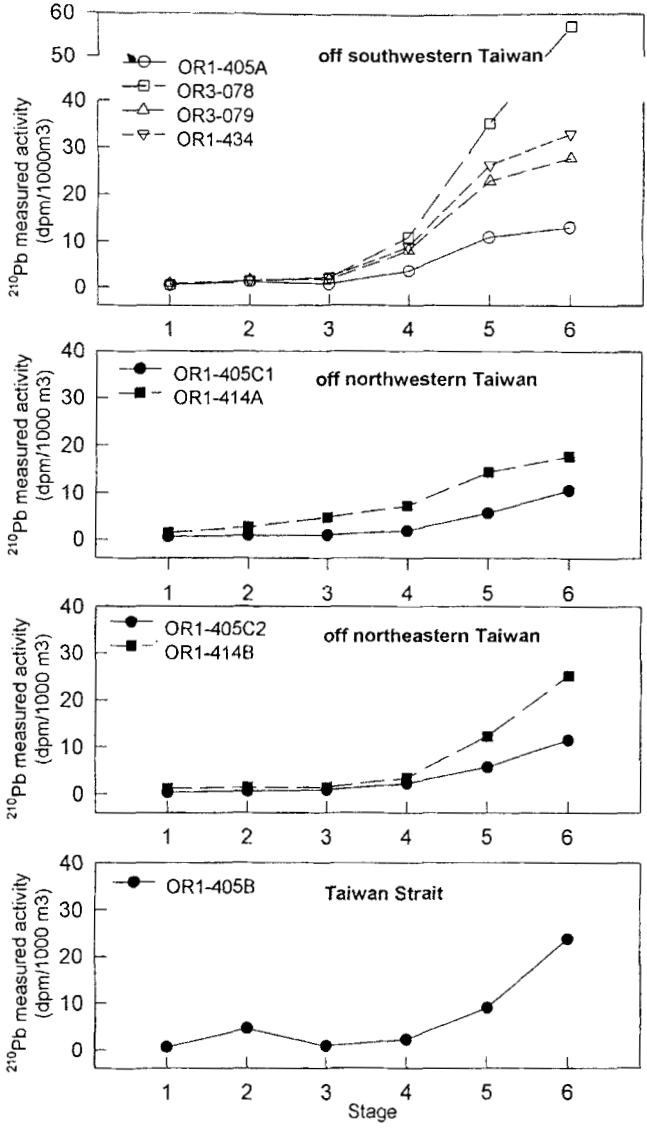


FIGURE 3 ^{210}Pb distribution on different size fractions of the marine aerosols grouped in areas off Taiwan.

conducted and various values were reported (e.g. Turekian *et al.*, 1977). An atmospheric ^{210}Pb flux of 2 dpm cm^{-2}y^{-1} was often used in studying the upper ocean ^{210}Pb in the western Pacific or marginal seas

(Lin and Chung, 1991). One of the purposes of this study is to estimate the temporal and spatial variations of the atmospheric ^{210}Pb flux around Taiwan so that a more realistic value may be adopted for ^{210}Pb study in the surface ocean of the same area. However, since a direct shipboard measurement for the atmospheric ^{210}Pb flux is not practical, an indirect approach is sought. With the measured ^{210}Pb activity in each aerosol sample, we need to have information on the mean settling rate of the associated aerosols.

The mean settling rates of aerosols at 4 stations in Taiwan as determined by the Taiwan Radiation Monitoring Center (TRMC) based on ^{7}Be measurements over 20 years were reported by Lin *et al.* (1996). These values were averaged and weighted to give 0.91, 0.79 and 0.68 cm s^{-1} respectively, for the northern, central and southern Taiwan. The atmospheric ^{210}Pb flux was thus calculated on the basis of the measured ^{210}Pb concentration of each aerosol sample and the mean settling rate of the aerosol particles closest to the sampling area. The results of such calculations are listed in Table III. There are four samples each collected off northern and southwestern Taiwan, and one collected in the Taiwan Strait from south to north, and so the three mean settling rates are used accordingly. The calculated ^{210}Pb fluxes vary between 0.6 and 2.3 dpm cm^{-2}y^{-1}, a factor of 4. The average is about 1.2 dpm cm^{-2}y^{-1}. If the extremely high ^{210}Pb content measured

TABLE III Atmosphere ^{210}Pb depositional fluxes calculated from the mean aerosol deposition velocities and observed ^{210}Pb concentrations

Cruise	*^{210}Pb Concentration* (10^{-3}*dpm m*$^{-3}$)	*Mean deposition velocity** (*cm s*$^{-1}$)	*Calculated ^{210}Pb flux* (10^{-3}*dpm m*$^{-3}$)
OR1-405C1	20.07	0.91	0.58
OR1-405C2	21.12	0.91	0.61
OR1-414A	47.87	0.91	1.37
OR1-414B	44.73	0.91	1.28
OR1-405B	40.57	0.79	1.01
OR1-405A	29.51	0.68	0.63
OR3-078	107.09	0.68	2.30
OR3-079	62.54	0.68	1.34
OR1-434	72.17	0.68	1.55
Average	49.52		1.19

* Values based on ^{7}Be data measured respectively from the northern, central and southern Taiwan by TRMC.

from OR3-078 is excluded, the mean is reduced slightly to about 1.1 dpm $cm^{-1}y^{-1}$. This value appears to be significantly lower than the commonly used value of 2 dpm $cm^{-1}y^{-1}$. As the limited aerosol samples collected around Taiwan show both temporal and spatial variations in the aerosol and ^{210}Pb concentrations, further measurements on these parameters and settling rates are required to evaluate the atmospheric ^{210}Pb flux in the study areas.

^{7}Be Distribution in Aerosol Particles

The measured ^{7}Be activities in each size fractions of the aerosol samples are listed in Table IV. Two samples (OR1-405A, OR1-434) are not listed because ^{7}Be is not measured. ^{7}Be appears to be enriched in fine particles: all the stages 1 and 2 size fractions are below the detection limit; some of the stage 3 fractions also lack ^{7}Be. Two samples (OR1-414A and B) show no ^{7}Be in stage 6 fraction due to extremely low aerosol content in this size fraction (Fig. 2). The ^{7}Be activity of OR3-078 is highest among all the samples due to a large contribution (> 50%) from the stage 6 fraction which contains about 70% of the total aerosol mass (Tab. I). The ^{7}Be activities of the other samples vary from about 80 to 220 $\times 10^{-3}$ dpm m^{-3}. These values are comparable to the averages observed in Taiwan over 20 years (Lin *et al.*, 1996). Since the aerosol concentrations are significantly higher in land air than in marine air, the specific ^{7}Be activities are higher in marine air. ^{210}Pb behaves similarly because these nuclides are controlled mostly by fine particles. The land air has higher aerosol content due to presence of more coarse particles. The measured ^{7}Be distributions are not plotted because some of its size fractions are not measurable or below the detection limit. Similar to ^{210}Pb, the ^{7}Be activities are higher in March (OR1-414A and B) than in November (OR1-405C1 and C2) off northern Taiwan, but the difference is much greater in ^{7}Be off the northeast. These variations also reflect changes in source areas and meteorological conditions.

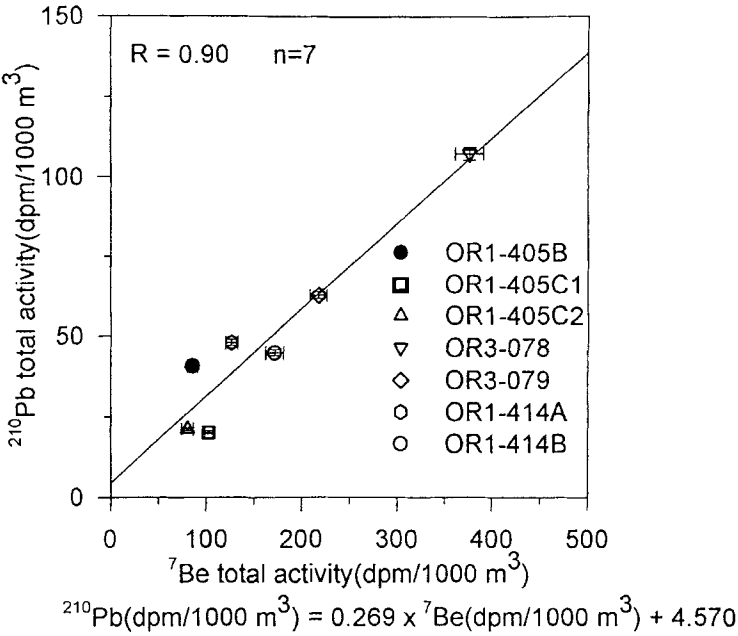
Correlation Between ^{210}Pb and ^{7}Be in Aerosol Particles

Since both ^{210}Pb and ^{7}Be reside preferentially on fine particles of the aerosols, these two nuclides may be correlated to each other. Figure 4

TABLE IV ^{7}Be distribution on different size fractions of the marine aerosols collected near Taiwan

Cruise	*Total ^{7}Be activity* (10^{-3}*dpm m*$^{-3}$)	*Activity per unit mass* (*dpm mg*$^{-1}$)	*Stage*	*Measured activity* (10^{-3}*dpm m*$^{-3}$)	*Percent of the total activity*	*Activity per unit mass* (*dpm mg*$^{-1}$)
OR1-405B	85.7±5.4	1.03±0.07	1	–	0	–
			2	–	0	–
			3	–	0	–
			4	–	0	–
			5	55.1±4.5	64	4.70
			6	30.6±3.1	36	34.0
OR1-405C1	102.8±4.1	1.35±0.05	1	–	0	–
			2	–	0	–
			3	17.4±1.1	17	1.22
			4	10.8±0.8	11	0.95
			5	51.5±3.3	50	3.96
			6	23.1±2.0	22	1.50
OR1-405C2	80.5±6.4	2.58±0.21	1	–	0	–
			2	–	0	–
			3	–	0	–
			4	27.4±3.3	34	6.51
			5	51±5.5	63	12.7
			6	2.1±0.2	3	0.63
OR3-078	376.1±14.9	1.72±0.07	1	–	0	–
			2	–	0	–
			3	25.3±4.0	7	0.04
			4	47±3.4	12	0.07
			5	109.9±7.3	29	6.84
			6	193.9±11.9	52	1.26
OR3-079	218.2±9.1	5.25±0.22	1	–	0	–
			2	–	0	–
			3	5.1±1.2	2	0.08
			4	36.2±3.1	17	0.18
			5	72.8±5.0	33	11.1
			6	104.1±6.9	48	0.08
OR1-414A	126.1±6.5	4.48±0.23	1	–	0	–
			2	–	0	–
			3	43.6±4.3	35	0.19
			4	37.4±3.2	30	0.14
			5	45.1±3.7	36	6.81
			6	–	0	–
OR1-414B	172.2±9.6	17.16±0.96	1	–	0	–
			2	–	0	–
			3	–	0	–
			4	46.2±4.1	27	7.67
			5	126±8.7	73	23.2
			6	–	0	–

–: below detection limit.



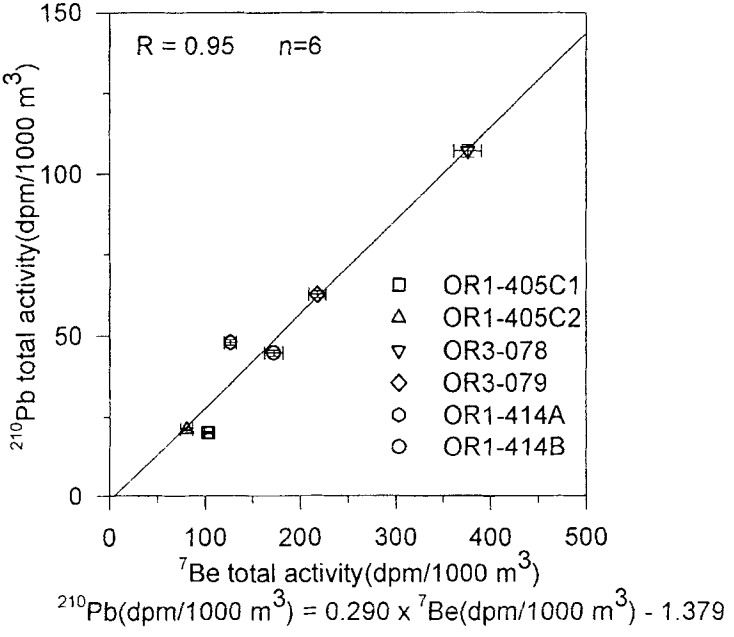


FIGURE 4 Correlations between ^{210}Pb and ^{7}Be in the marine aerosols off Taiwan.

shows plots of the total ^{210}Pb versus the total ^{7}Be concentrations for the seven aerosol samples in which both nuclides were measured. One sees a linear relation with a slope of about 0.27 (top of the figure). Since OR1-405B sample of the Taiwan Strait has larger particle size (maximum at stage 4) of land origin, it is excluded from the linear regression, and the slope becomes 0.29 or slightly higher (bottom of the figure). Because ^{210}Pb is produced by the atmospheric ^{222}Rn decay and has a long half-life, while ^{7}Be is cosmogenic, mainly produced in the stratosphere and has a short half-life, a linear correlation between the two nuclides suggests that they have a similar adsorption characteristics and a relatively rapid transport of the fine aerosol particles.

CONCLUSIONS

The size distribution and abundance of marine aerosol particles around Taiwan as determined by a cascade impactor filtration system in 6 size grades show significant temporal and spatial variations, reflecting different sources and changes in meteorological conditions. ^{210}Pb distribution in the aerosol particles shows that the nuclide increases toward submicron particles with an average activity mean diameter of 0.5 μm. ^{7}Be in the aerosol particles is distributed similarly, but it is absent in the coarser fractions (> 3 μm) in most samples. These observations are consistent with the surface adsorption characteristics. These two nuclides are linearly correlated in the collected marine aerosol samples although their source functions are different. This suggests that they are regulated by the same adsorption mechanism and transported mainly by submicron aerosol particles.

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