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THE AIRBORNE INHALABLE PARTICLES OF SÃO PAULO

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SUMMARY

THE BEHAVIOR OF TRACE CONSTITUENTS OF FINE (<2.5μm) AND COARSE (2.5-15μm) PARTICLES HAVE BEEN INVESTIGATED IN ORDER TO OBTAIN A BETTER UNDERSTANDING OF SOME CHARACTERISTICS OF TIME VARIATION CONCENTRATIONS OF INHALABLE PARTICLES OF THE ATMOSPHERIC AEROSOL OF SÃO PAULO, IN THE PERIOD 1983-85. COARSE AND FINE PARTICLES HAVE BEEN WEEKLY SAMPLED BY STACKED FILTER (NUCLEPORE) UNIT SAMPLERS. COLLECTED SAMPLES HAVE BEEN ANALYZED GRAVIMETRICALLY, FOR FINE AND COARSE PARTICLE CONCENTRATIONS, AND BY PIXE (PARTICLE INDUCED X-RAY EMISSION), FOR TRACE ELEMENT CONCENTRATIONS. IT WAS FOUND THAT, WHILE THE AVERAGED CONCENTRATIONS OF THE FINE PARTICLES REMAIN PRACTICALLY CONSTANT DURING THE WHOLE YEAR, CONCENTRATIONS OF THE COARSE PARTICLES INCREASE BY FACTOR 2 COMPARING SUMMER TO WINTER. NO CORRELATION ($\bar{r}$=0.06) BETWEEN THESE TWO COMPONENTS OF THE INHALABLE PARTICLES WAS FOUND IN WINTER BUT SOME CORRELATION ($\bar{r}$=0.6) WAS FOUND IN SUMMER. GENERALLY SPEAKING, THESE AND OTHER CHARACTERISTICS MIGHT BE EXPLAINED BY MECHANISMS OF METEOROLOGICAL NATURE (BASICALLY THE HEAVY RAINS IN SUMMER AND THE FREQUENT RADIATION THERMAL INVERSIONS IN WINTER).

INTRODUCTION

This work follows in sequence papers previously presented at the 5th Clean Air Congress (Buenos Ayres, 1981)[1], and 6th World Congress on Air Quality (Paris, 1983)[2]. Since 1976 the GEPA has been performing experiments to investigate properties of the atmospheric aerosol of São Paulo city, through the analysis of elemental structure of its fine and coarse particles (FP and CP).

The investigations, initially centered on a characterization

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of SP-aerosol by means of their trace element spectra, are now including source apportionment directions through the use of receptor models.

This particular work focusses attention on time variation data of fine particle (FP) and coarse particle (CP) concentrations, but also considers some results on trace element concentrations in order to derive a coherent interpretation of the behavior of inhalable particles in the atmospheric aerosol of the city of São Paulo.

EXPERIMENTAL

The sampling for FP (<2.5μm) and CP (2.5-15μm) herein considered was obtained from 1983 to 1985, on the campus of USP, in the periphery of the city of São Paulo, by means of stacked filter (nuclepore) unit[3]. The whole procedure is described in detail elsewhere[4]. All samples have been gravimetrically analyzed for a determination of FP and CP concentrations, and some have been analyzed by the PIXE method to determine their constituent trace element concentrations. Both analyses have been performed at IFUSP laboratories.

RESULTS AND DISCUSSION

The temporal variations in FP and CP concentrations are presented graphically in Figure 1. In order to analyze these temporal data we have also considered two tables on seasonal average concentrations (Tables 1 and 2).

Table 1 - Seasonal arithmetic averaged concentrations (with their standard deviations, in parenthesis), in $\mu g/m^3$.

	FINE PARTICLE		COARSE PARTICLE	
	Winter(*)	Summer(*)	Winter	Summer
1983	31(17)	33(12)	59(74)	41(13)
1984	29(16)	21 (8)	66(57)	27(18)
1985	28 (9)	-	71(63)	-
Arithm. Average	30	27	62	34

(*) - Winter here means the period May to October, and Summer November to April.

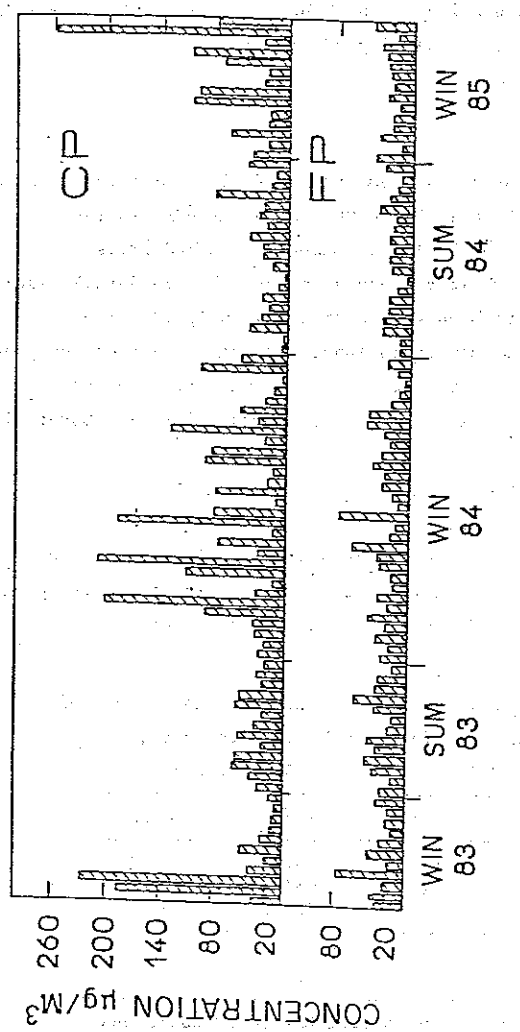

Fig.1. Time variation of fine and coarse particle concentrations (WIN means winter and SUM summer). In 53 out of 87 cases presented, the inhalable particle concentration (FP + CP) surpassed the standard of about 55µg/m^3 proposed by the E.P.A.(U.S.A.)

Table 2 - Correlation between seasonal FP and CP concentrations

	1983	1984	1985
Winter	0.055	0.071	(-0.18)
Summer	0.651	0.608	-

From this set of data and results (Fig. 1 and Tables 1 and 2) some characteristics related to annual behavior of atmospheric aerosol of the city of São Paulo might be delivered:

1. CP concentrations are usually larger than FP concentrations, averagely by factor 2.2 in winter, and 1.3 in summer;
2. Season effect: CP concentrations are strongly affected by changing from summer to winter, while FP concentrations are not;
3. FP are weakly correlated to CP in summer ($\bar{r}$=0.6) but not in winter ($\bar{r}$=0,06);
4. The fluctuations in the CP concentrations (as measured by the standard deviations) are about four times those for FP in winter and they are about the same in summer.

Our next step is to show that the main mechanisms controlling the behavior of the airborne inhalable particles of São Paulo are of meteorological nature, or specifically, the heavy rains in summer, and the radiation thermal inversions in winter. To do this, we first look to time variation graphs of the concentrations of some typical trace element constituents of FP and CP, as presented in Fig. 2.

In fact, we observe in Fig. 2 that among the temporal variation of trace elements of coarse particles those which are of typical constituents of soil dust (Si and Fe) follow strictly the correspondent time variation behavior of CP (Fig. 1), while the variations of other elements (as Na, S, V, Cu and Ni) do not. This behavior might be explained partially by the strong reduction of soil dust emissions caused by heavy rains in summer.

On the other hand, it might be expected that winter thermal inversions should cause a simultaneous increase in both concentrations

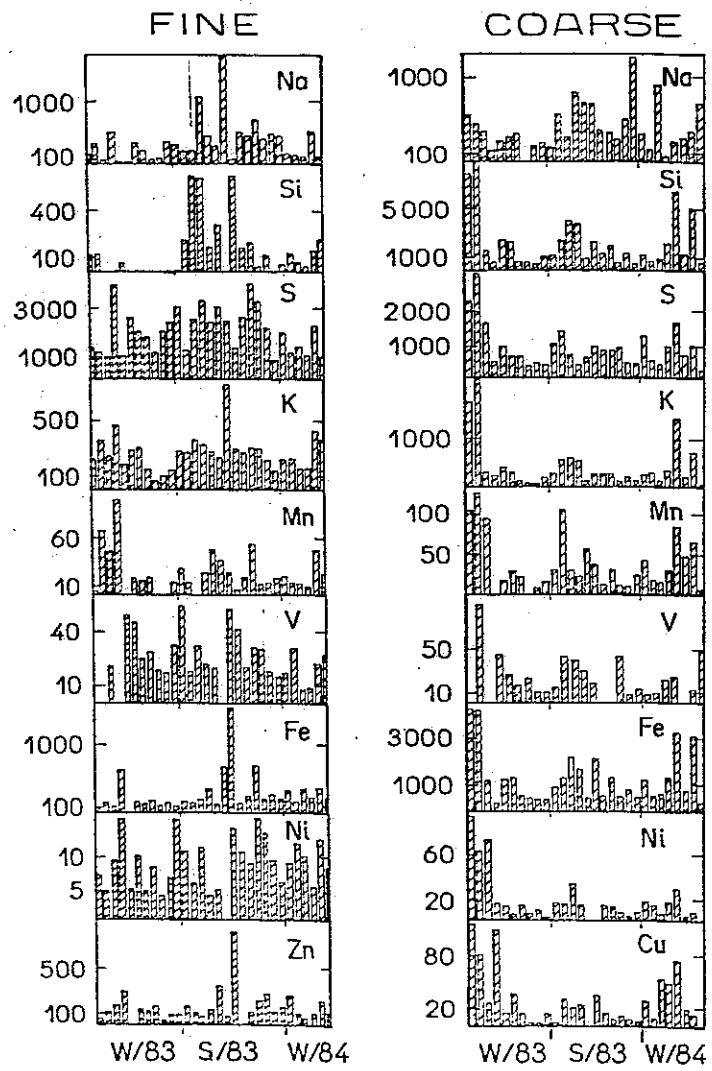

Fig.2. Time variation of elemental concentrations, in ng/m^3.

of CP and FP, and, of course, in their respective trace elements. That is not the case, however, for the FP and their element constituents as can be seen in Figs. 1 and 2. We do not have an explanation for these unexpected behaviors up to now, but we hope to obtain it soon, with application of receptor models to these data set which are being performed in our laboratory[4].

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