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PIXE ANALYSIS OF ATMOSPHERIC AEROSOL PARTICLES IN NORTH-WESTERN CHINA

Seventh International Conference on Atmospheric Sciences and Applications to Air Quality (ASAAQ), 31 October - 2 November 2000, Taipei, Taiwan

Aim and importance of aerosol researches

Aerosol researches in Asia

Sampling and analysis

Results and discussion

Conclusion

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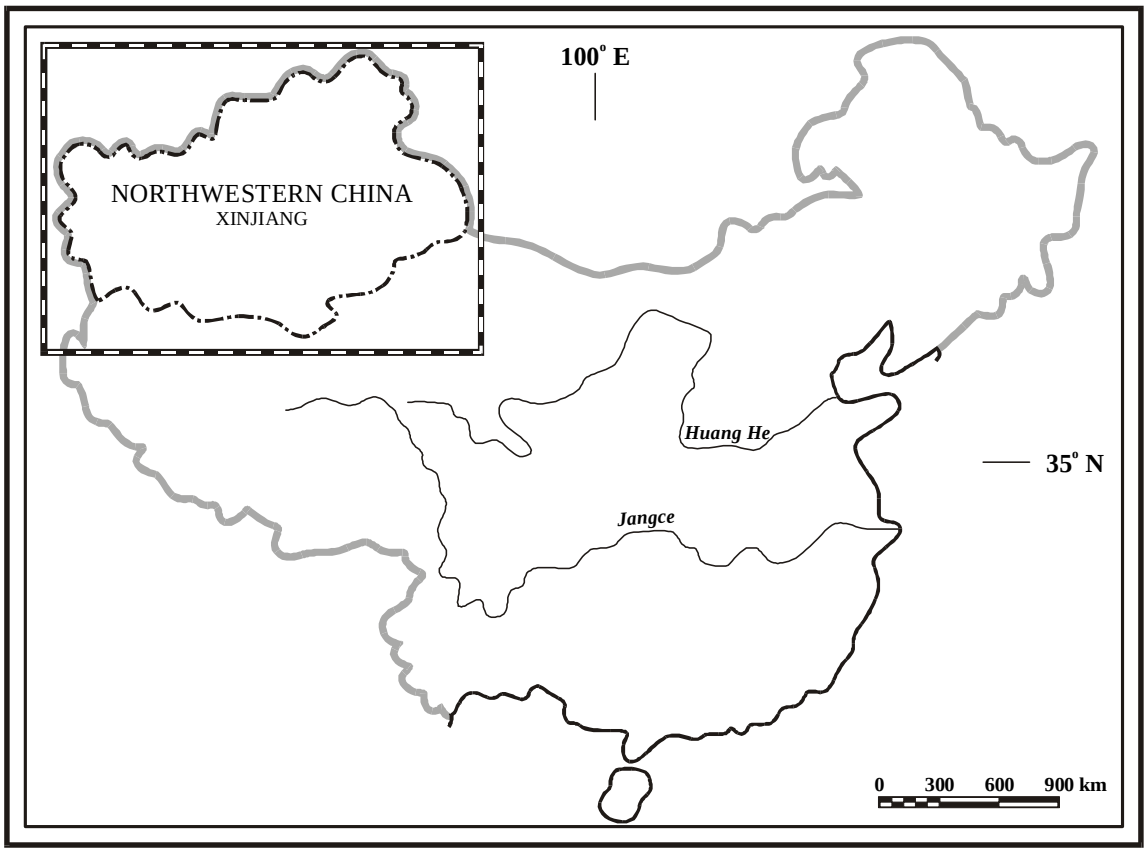
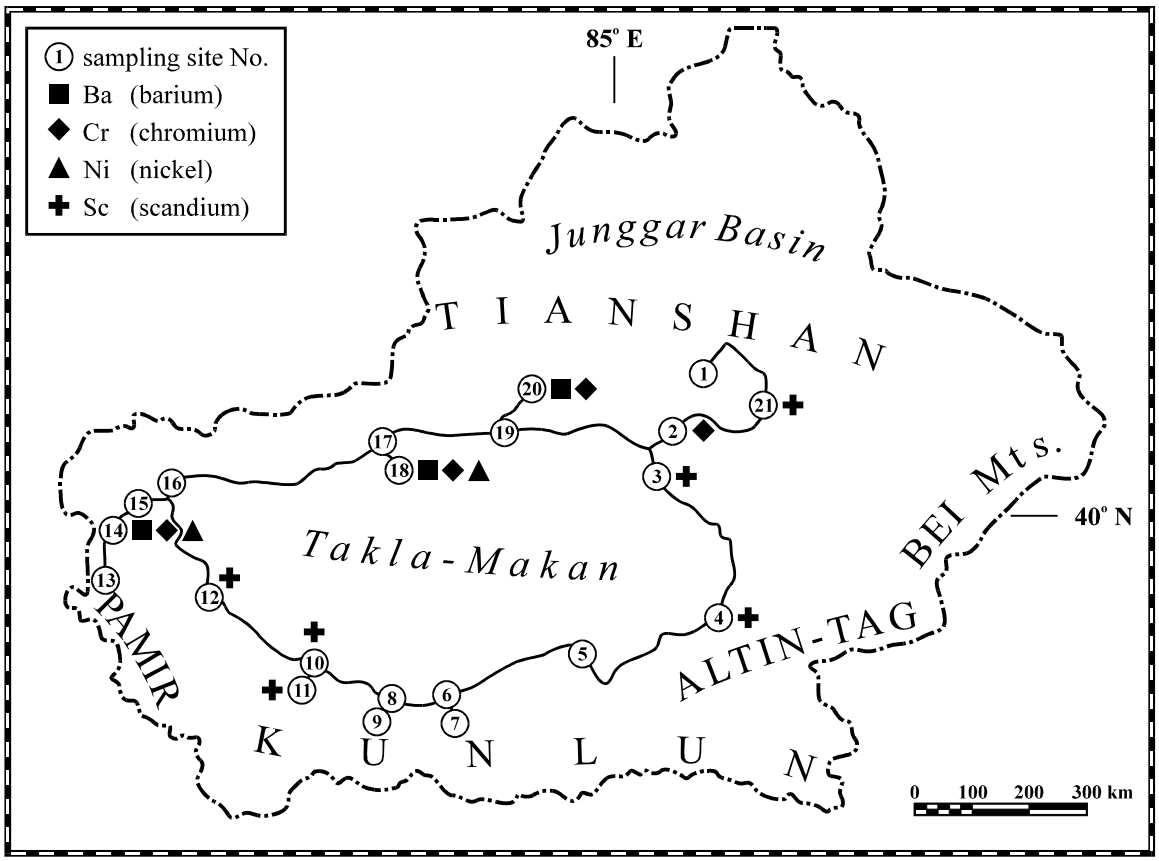
Twenty-one aerosol samples were collected in the air over arid regions of North-western China during a Hungarian expedition in 1994. Atmospheric aerosol particles were collected in each case by means of Nuclepore polycarbonate filters with pore size of 0.4 μm. The elemental composition of the samples was determined by PIXE-method. The samples were irradiated by 2 MeV proton beam supplied by a Van de Graaff nuclear accelerator. Seventeen elements (with atomic number 13 and over) were detected: Al, Si, S, Cl, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Br and Ba. The enrichment of each element relative to average earth crust composition was calculated. Non-crustal fractions of aerosol particles relative to average crust data as well as those of some elements relative to local soil samples were also counted.

The most important result of the study is, revealing highly enriched sulphur, chlorine, chromium, copper and zinc in the atmospheric aerosol over North-western China. It is clearly proved that sulphur and chlorine come from local soil. Concentration data of chromium, copper and zinc in local soil of North-western China are not available. However it is supposed that these elements come from local soil, as well. The origin of sulphur and chlorine here shows a difference from that of other similar lands of the Earth.

Key words: elemental composition, enrichment factor, non-crustal fraction, China, Inner Asia



Map of China (PRC) with the position of North-western China



Position of sampling sites in North-western China with spatial distribution of elements enriched over ten, excluding sulphur, chlorine, copper and zinc

Enrichment factor:

$$EF_{Ti}(X) = (X/Ti)_{air} / (X/Ti)_{crust} ,$$

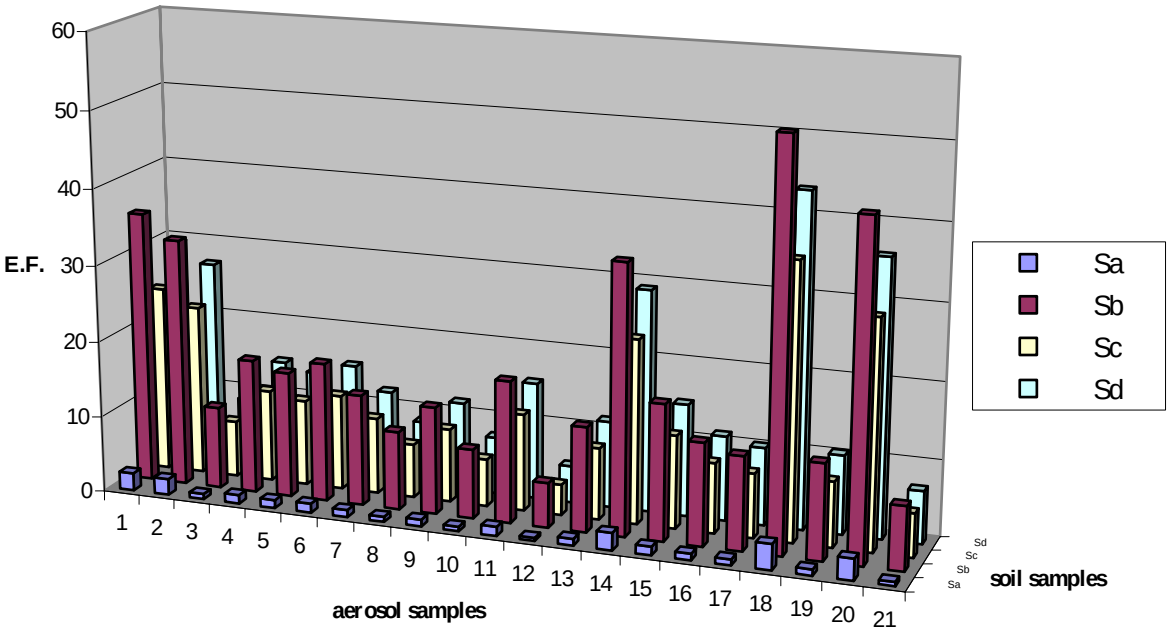
$(X/Ti)_{air}$: concentration ratio of an element X to that of Ti in atmospheric particulates
$(X/Ti)_{crust}$: concentration ratio of an element X to that of Ti in crust

The formula of $(c_x)^*$ fraction of the concentration of an element x, coming from non-crustal contribution (*Mason*, 1966):

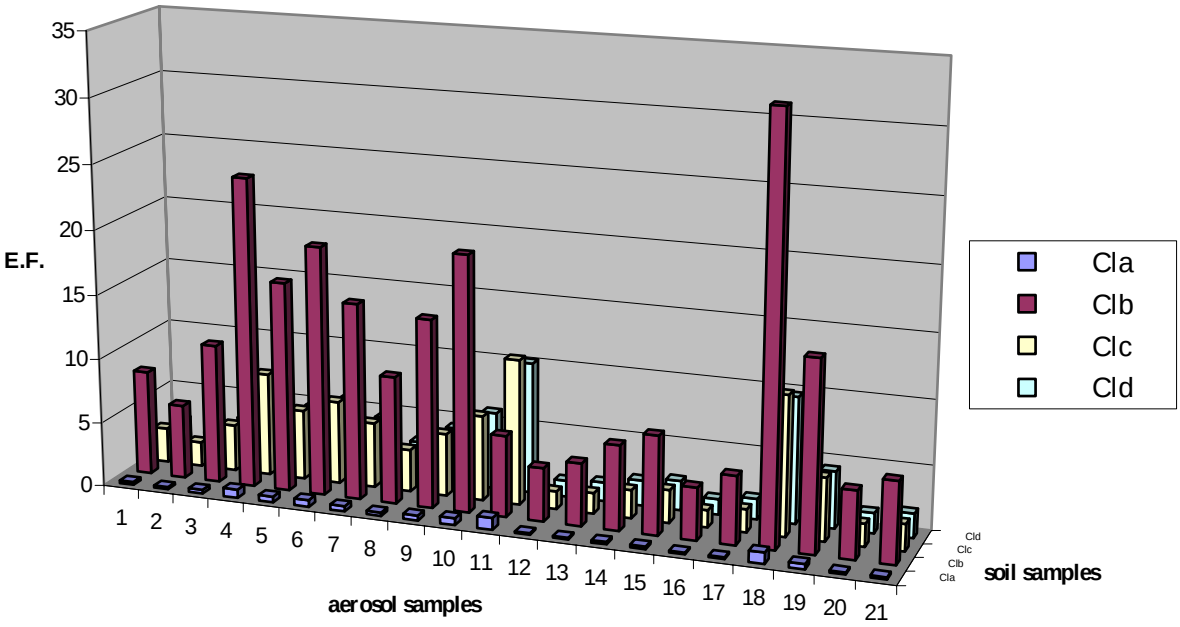
$$(c_x)^* = \frac{(c_x)_{air} - (c_{Ti})_{air} \cdot (\frac{c_x}{c_{Ti}})_{crust}}{(c_x)_{air}} ,$$ where

$(c_x)_{air}$: concentration of an element x in the air
$(c_{Ti})_{air}$: concentration of titanium in the air
$(c_x)_{crust}$: concentration of an element x in the crust
$(c_{Ti})_{crust}$: concentration of titanium in the crust.

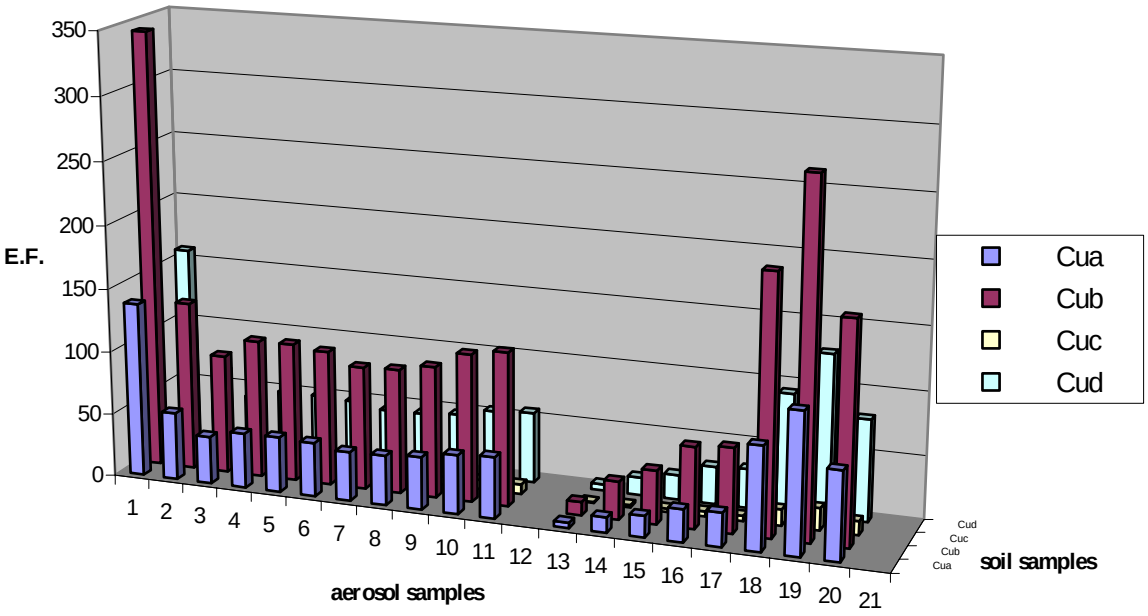
Enrichment factor of sulfur relative to local soil samples



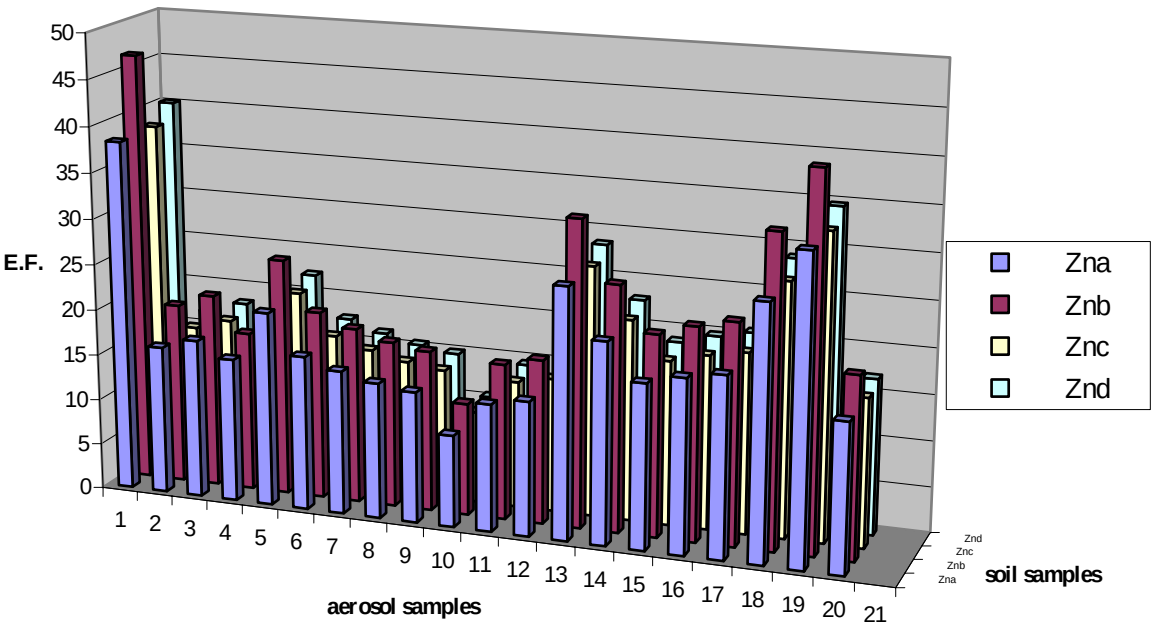
Enrichment factor of chlorine relative to local soil samples



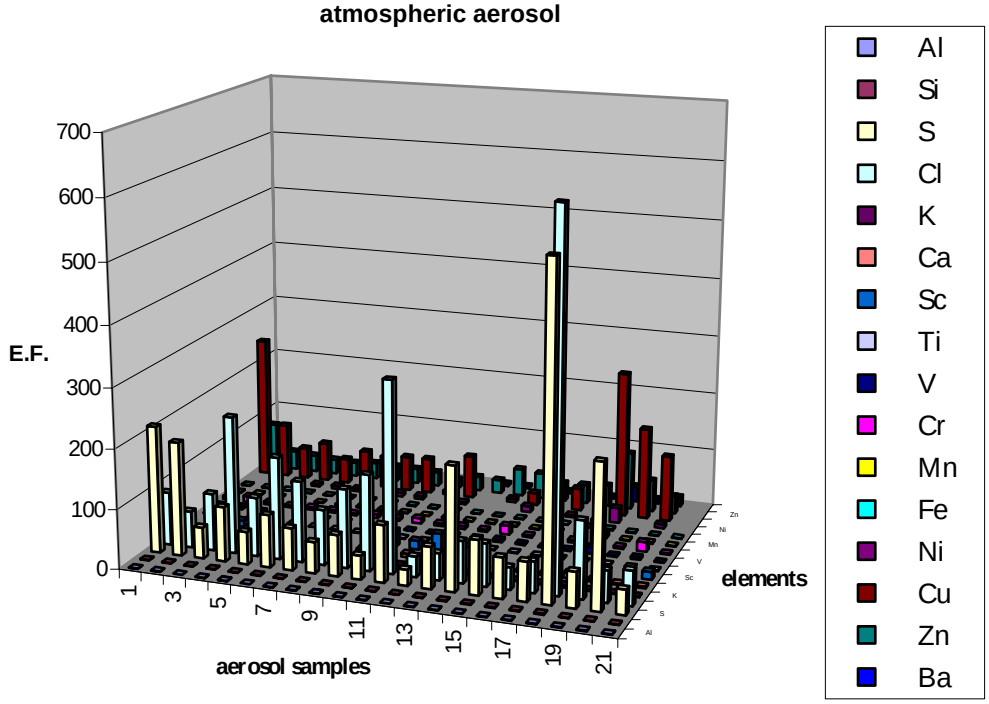
Enrichment factor of copper relative to local soil samples



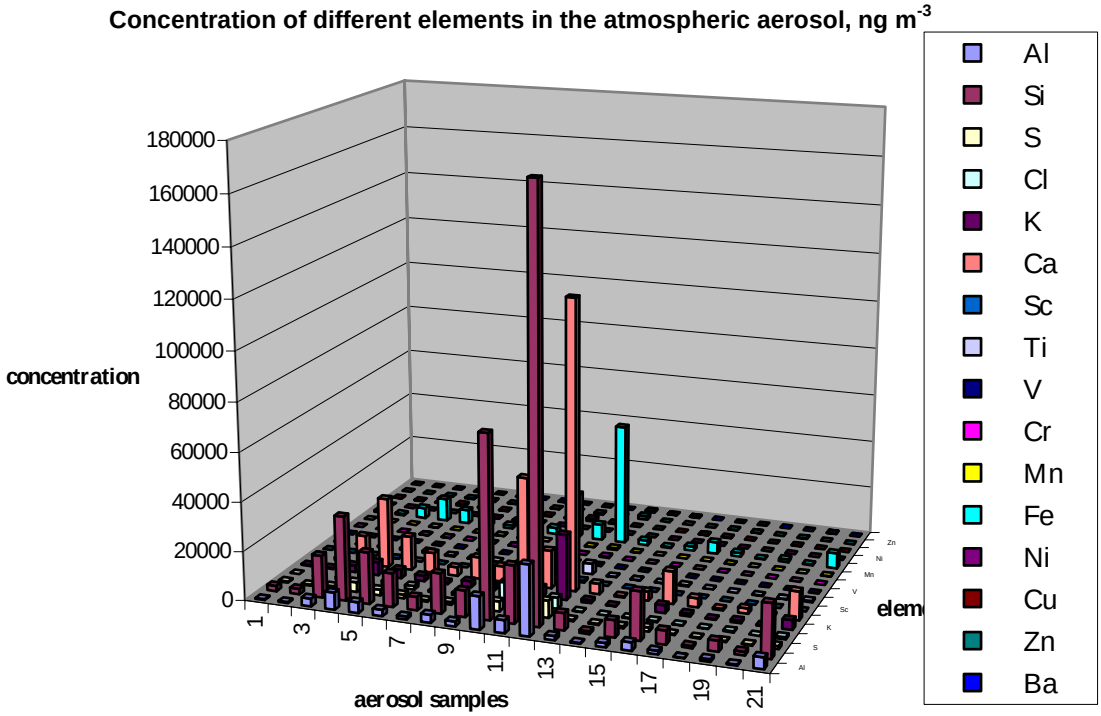
Enrichment factor of zinc relative to local soil samples



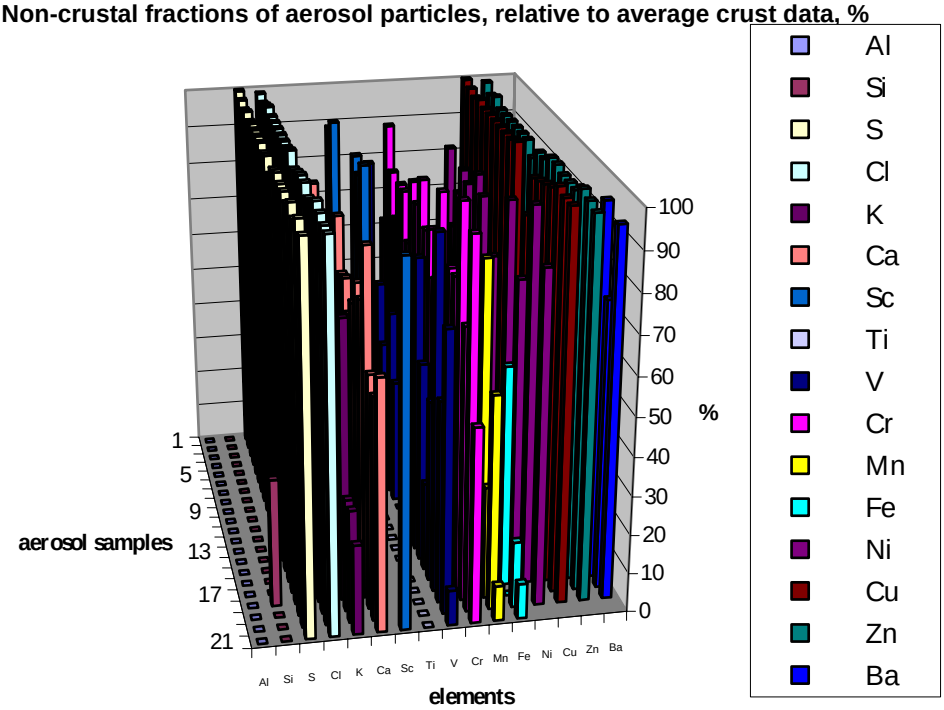
Enrichment factor of different elements, relative to average crust data, in the atmospheric aerosol



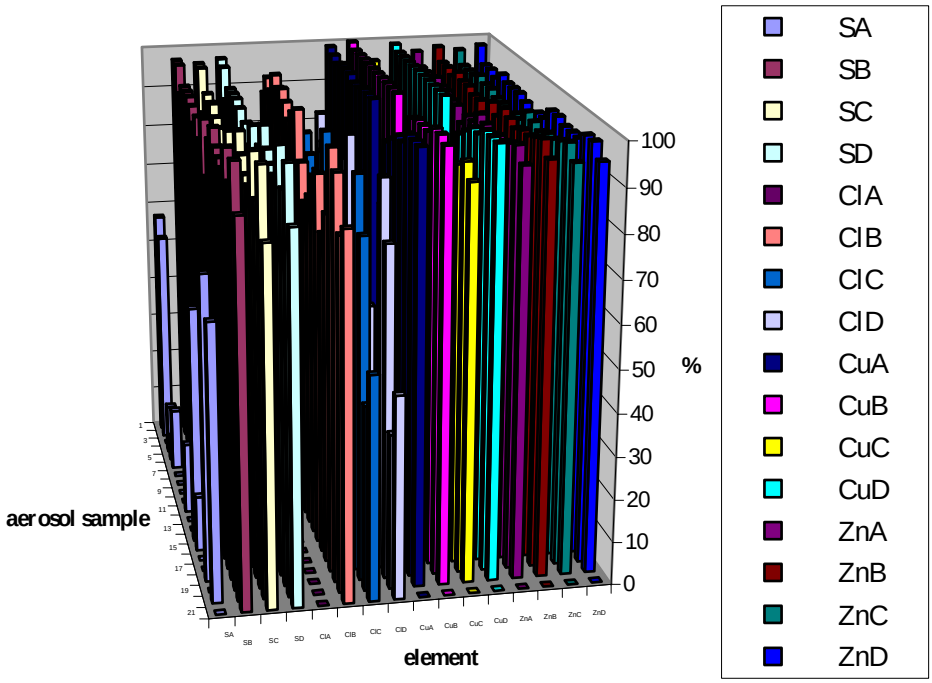
Concentration of different elements in the atmospheric aerosol, ng m^{-3}



Non-crustal fractions of aerosol particles, relative to average crust data, %



Non-crustal fractions of S, Cl, Cu and Zn relative to local samples of soil, %



CONCLUSION

E.F.					
to crust (Mason, 1966)			**to local soil (Suzuki et al., 1993)**		
E.F. < 10	10<EF<100	E.F. > 100	E.F. < 10	10<EF<100	E.F. > 100
crustal origin			soil origin		
proved	to be examined		proved	supposed	
Al, Si, K, Ca, V, Mn, Fe	Cr, Ni, Zn	S, Cl, Cu	**S, Cl,**	**S,** Cu, **Zn**	Cu,

ENRICHMENT OF ELEMENTS OVER SOME REGIONS

element	**region**
S, Cl	Xinjiang, Northern-China
S	Xizang,
S, Cr	Lake Baikal

Comparative values of elemental concentration ratios and average enrichment factors related to Fe

Site	S/Fe				Cl/Fe			
	ratio	$EF_{Fe}(S)$			ratio	$EF_{Fe}(Cl)$		
		to crust	to local soil			to crust	to local soil	
Earth's crust[1]	0.0052	1			0.0026	1		
A*	0.370		1.070[2]	1.270[3]	0.810		0.310[2]	0.341[3]
B*	0.024		16.500[2]	19.583[3]	0.022		11.409[2]	12.545[3]
C*	0.035		11.314[2]	13.429[3]	0.066		3.803[2]	4.182[3]
D*	0.029		13.655[2]	16.207[3]	0.073		3.438[2]	3.781[3]
Takla Makan Desert (atmospheric aerosol)[2]	0.396	76.154			0.251	96.538		
Takla Makan Desert (atmospheric aerosol)[3]	0.470	90.385			0.276	106.154		
Namib Desert (dust from soil)[4]	0.22	134.615	3.182		0.15	1000	17.333	
Namib Desert (atmospheric aerosol)[4]	0.7				2.6			

[1]: Mason, 1966
[2]: Molnár et al., 1993
[3]: present paper
[4]: Eltayeb et al., 1993
*: A and B sampling regions are found at the North-eastern part, while C and D at the South-western part of the Takla Makan Desert (Suzuki et al., 1993)