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Application of Some Statistical Procedures on Heavy Metal Status in Agricultural Land Around Aluminum Industrial Compound

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Abstract: {Based on the specific ecological condition in Markazi province, agriculture is one of the most important crafts, which is in the third priority of the industry, has particular place in province. In late decade with development of technology, global consumption of chemical ingredients especially in progressing countries has considerable growth. In such a way from 1940s to early 1980s production of different chemical industrial ingredients becomes 340 folded and million tons of materials that weren't in existence all at once release in the environment} Please transfer this part to the introduction. This study we attempt to identify the concentration of heavy elements around the soil of Iralko complex Markazi province with element resource, bioavailability and intense of pollutant chemically analyzed. The screen 3 software was used and modeling the contamination of air was done and at the end the places under contamination were distinguished. Elements in anthropogenic portions didn't have any significant relation, that this matter expresses different manners in sulfides,organo-metalic,loosely bonded ions and resultant of this portions which is known as anthropogenic porions that is exposed to changes in mentioned grafts. Bioavailability also just mark the existence of elements for absorbance (but this is the plant that decide to absorb or not???). According to the rate of the concentration of elements in bioavailability portions, Sn allocates the maximum concentration to itself.In this way considerable effect of metal contamination in soils of Iralko factory wasn't observed that index of Ipoll confirmed it. PLEASE, REWRITE tHE ABSTRACT AGAIN TO BE MORE INFORMATIVE AND CLEAR, aLSO AVOID TO MENTION THE UNNESSARY PARTS IN THIS ABSTRACT).

Key words: Heavy metals · Iralko · Soil · Ipoll

INTRODUCTION

The accumulation of heavy metals in agricultural soils is of increasing concern due to the food safety issues and potential health risks as well as its detrimental effects on soil ecosystems0..These metals have peculiar characteristics including that [1] they do not decay with time [2]. They can be necessary or beneficial to plants at certain levels but can be toxic when exceeding specific thresholds, [3] they are always present at a background level of non-anthropogenic origin, their input in soils being related to weathering of parent rocks and pedogenesis and [4] they often occur as cations which strongly interact with the soil matrix, [consequently, heavy metals in soils can become mobile as a result of changing environmental conditions THIS IS NOT TRUE}.. Sources of these elements in soils mainly include natural occurrence derived from parent materials and human activities. Anthropogenic inputs are associated with industrialization and agricultural activates deposition, such as atmospheric deposition, waste disposal, waste incineration, urban effluent, traffic emissions, fertilizer application and long-term application of wastewater in agricultural land [3, 5]. Apart from the source of heavy

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metals, the physicochemical properties of soil also affect the concentration of heavy metals in soils. Organic matter and pH are the most important parameters controlling the accumulation and the availability of heavy metals in soil environment [6]. It is necessary then to evaluate the relationship among these parameters and heavy metal accumulation in soil..

The Knowledge of the heavy metal accumulation in soil, the origin of these metals and their possible interactions with soil properties are priority objectives in environmental monitoring. Statistical analysis procedures, as powerful tools, can provide such knowledge and assist the interpretation of environmental data [7-9]. In recent times, the statistical methods (univariate or multivariate) have been applied widely to investigate heavy metal concentration, accumulation and distribution in soils. This is documented by a large number of reported studies which apply statistical methods to heavy metal accumulation in soils, e.g. Modak and others (1992), Arakel and Hangjun (1992), Ratha and others (1993), Chakrapani and Subramanian (1993), Ntekim and others (1993), Henburg and Bruemer (1993) and Cambier (1994) studied the behavior and distribution of heavy metals in soils using multivariate statistical methods [10]. In environmental monitoring and assessment strategies, these methods can be used to predict or estimate the variability of heavy metals and its controlling factor (s) and to highlight the influence of human activities on heavy metal contents of soils [11, 12]. Therefore, statistical analysis of heavy metals in soil can offer an ideal means through which to monitor not only the heavy metal accumulation in soil but also the quality of the overall environment as reflects in soil.

MATERIALS AND METHODS

Company of Aluminum Production of Iran (Iralko) is placed in 5th kilometer of Arak. In this Alumina (aluminum Oxide) is carried to the factory and in reduction hall in several stages it is change to aluminum metal and in moulding is changed into ingot and exit from the factory. In this study we use screen3 soft ware product of EPA America to choose the studying region according to the maximum concentration of the issued contaminants from point resource. According to the rate of the issued contaminants from the factory chimney, maximum concentration of Co, Nox and Sox in 500-1500 m distance was observed. The study region at this distance in direction of dominant wind by the angle of 75m from the chimney was chosen. Soil samples in lands of Arak around Iralko complex all the samples were excavated from 0-25 depth. For this reason one stainless steel tube with entrance diameter about 4m and length of 1m equipped with piston was used to extract soil. To achieve comprehensive information about the contamination the sampling was done on land soil of 11 region and each 2 -3 samples were mixed together. Then their humidity, electric conduction and pH measured in the laboratory. All the samples were dried in 70°C and after isolation about 5 g from particles smaller than 63 micron powdered in agate mortar. HClO4, HF, HCl, HNO3 in sand bath were used to assimilate in 125°C [31-34].

Acid ascetics, hydroxylamine, H2O2 were used to assign the loosely, sulfides and organio-metalic bonded ions respectively. To study the bioavailability we use NaOH and Acid Ascetic. Then heavy elements in soil samples analyzed with Atomic Absorption [35].

Cluster analyses are one of the multi variate analysis that are used in this study to originate statistics of elements by Cluster software [37].

Coefficient of correlation which is one of the approaches of exploring software was used to achieve the similarity coefficient and dendogram. Cluster tree joins the treasure of the same weight with together to make bigger cluster [38]. Then it assigns the similarity of the samples. Finally by using Ipoll index compared with the intensity of the contamination the elements were analyzed (EXPLAIN IN DETAILS).

RESULTS

Entrance parameters to Screen 3 software are followed (Table 1). Results of the entrance parameters are followed (Table 2). To be more accurate in these researches ternery diagram of soil texture (Figure 1) in sampling station were designed and results presented in Table (3).

Biavailability, anthropogenic,lithogenous portions and kind of elements grafting with soil and their average in 11 sampling stations around the Iralko complex is presented in Table (4). Static of these tables show that the average concentration of all the heavy metals compared to the average of earth crust are unstable. It is expected that Al is considered as the contamination index of the factory but according to the results of the chemical separation analysis Al is not present in anthropogenic portions in soils of Iralko so we use this element as an lithogenous index to analyse the dominant relation on elements.

Table 1: Input parameters for modeling software Screen3 Iralko complex air pollution

Unit Name	*The old anode baking Manufactory*	*New anode baking Manufactory*
Stack length (m)	60	60
Chimney diameter (m)	5	5
Number of chimney	1	1
Average ambient temperature K°	284	284
So2 (ppm)	0	160.5
NOx (ppm)	21	32
CO (ppm)	1.2	3.79
Exhaust Gas speed (m/s)	16.8	4.1
Gas temperature Output K°	343	342.6
Air Stability Class	4	4
Pollutant (g/s) So2	0	0.035
Pollutant (g/s)nox	0.003	0.005
Pollutant (g/s)CO	0.0025	0.170

Table 2: Result analysis from the software Screen3

	Min distance (m) 585	*Max distance (m) 1115*
Max concentration Nox Anode baking old	0.003	
Max concentration Nox New anode baking		142
Max concentration Co Anode baking old	0.0219	
Max concentratin Co New anode baking		0.4828
Max concentration Sox New anode baking	0.099	

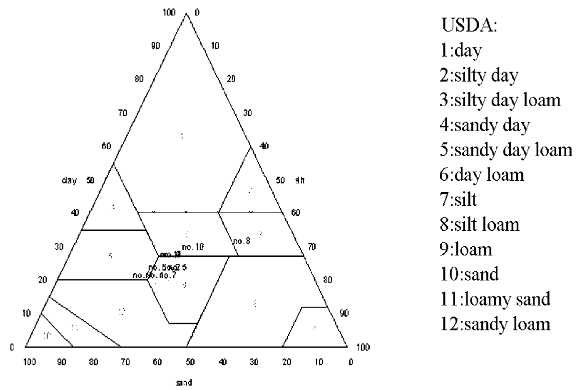


Fig. 1: Ternery diagram showing soil texture

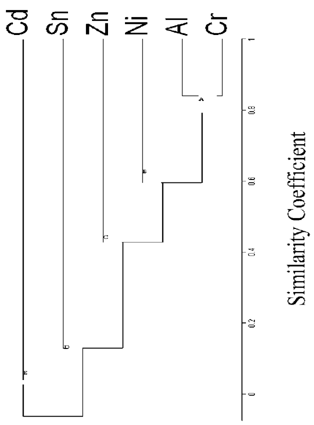
Coefficient correlation of heavy elements was used to static explanation of metals relation and origination of them, then coefficient correlation changed to cluster dendogram and its name changed into similarity coefficient. Results of the cluster analysis present in chart. Dendogram of cluster analysis has 5 distinct branches with the name A, B, C, D and E. In branch A,Al and Cr exist and these two elements under similarity coefficient that mentioned above connect each other. So we can say that Cr originate in the lithogeneous sources and Zn,,Ni under mostly high similarity coefficient connect to the elements of branch A. {This fact shows that origin of Zn, Ni to some extent is equal with

Table 3: Result analysis 11soil samples in the study area

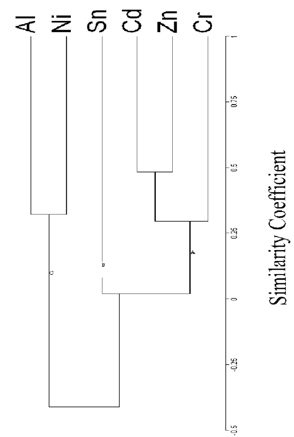
Sample Profile Description	*Place Name*	*Depth cm*	*Saturation S. P.*	*Guidance ElectricalECX10^3*	*pH*	*Organic carbon%*	*$CO^{-2}3$*	*C.E.C Meq/100 Soil*
Region 1	Iralko Vicinity	25	30.8	3.5	7.5	0.34	0.0	6.0
Region 2	Iralko Vicinity	25	31.8	3.2	7.5	0.38	0.0	14.0
Region 3	Iralko Vicinity	25	31.9	3.8	7.5	0.57	0.0	13.0
Region 4	Iralko Vicinity	25	32.2	3.3	7.4	0.65	0.0	8.0
Region 5	Iralko Vicinity	25	31.4	1.0	7.7	0.91	1.2	9.0
Region 6	Iralko Vicinity	25	32.6	2.6	7.4	1.5	1.5	12.0
Region 7	Iralko Vicinity	25	26.9	0.96	7.8	0.53	1.2	4.0
Region 8	Iralko Vicinity	25	41.6	0.62	7.8	0.61	0.8	6.0
Region 9	Iralko Vicinity	25	27.8	1.0	7.7	0.57	0.8	6.0
Region 10	Iralko Vicinity	25	31.9	0.59	7.8	0.53	1.2	12.0
Region 11	Iralko Vicinity	25	31.8	0.58	7.8	0.49	0.8	15.0

Table 4: Amounts of heavy metals,bioavailability,anthropogenic, lithogenous portions and the type of link elements in soil and their average soil

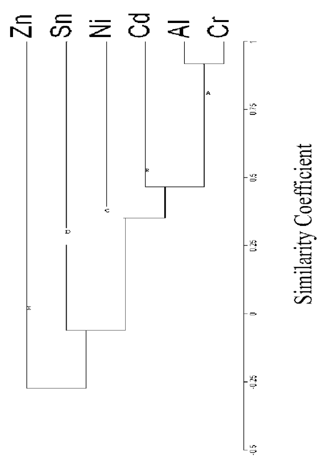
Day 11 sample	*Cr*	*Ni*	*Sn*	*Zn*	*Cd*	Al
Total concentration Ions	125	85	5	107	0.25	65137
Loosely bonded Ions	2.5	6.7	1.25	6.09	0.06	293.09
Sulfides bonded Ions	1.2	11.5	1.25	1.09	0.06	420
Organo-metalic Ions	1	1	1.25	1.7	0.06	15
Lithogenous Portions	120.6	65.7	1.25	88.8	0.07	4409.1
Anthropogenic Portions	4.8	19.18	3.75	8.09	0.18	728.5
Bioavailability	0.2	0.2	5	0.9	0.05	3
Minimum	71	55	5	79	0.25	43250
Maximum	159	168	5	121	0.25	92500



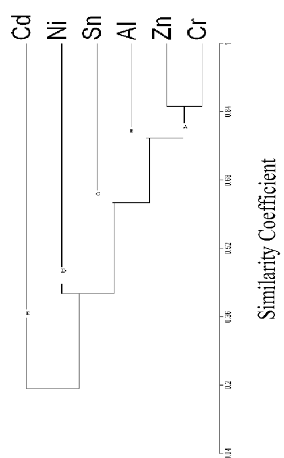
Scheme 1: Dendogram of cluster analysis for metals in total concentration Ions



Scheme 3: Dendogram of cluster analysis for metals in anthropogenic portions



Scheme 2: Dendogram of cluster analysis for metals in bioavailability



Scheme 4: Dendogram of cluster analysis for metals in lithogenous portions

the originate of the branch A, Cd, Sn exist in branch D and E that under insignificant similarity coefficient connect to branches A, B, C. So we can not state directly. But approximately we state that originate of these elements are from lithogeneous sources (Scheme 1).} REWRITE THIS PARAGRAPH MORE CLEARLY TO BE EASILY UNDERSTOOD.

In dendogram of bioavailability, 5 branches are presented. In branch A Cr, Al, in branch B, Cd exist that these elements under similarity coefficient of the above connect to Al. This fact shows that these elements. originate from lithogenous sources. Ni, Zn, Sn form C, D and E branches that under the following similarity coefficient connect to A and B branches. So we can approximately state that origin of these elements is not equal with the origination of A and B branches (Scheme2). Elements in anthropogenic portions have no significant relation (Scheme3).

This shows that elements treat differently in loosely, sulfides and organio-metalic portions and their resultant is known as anthropogenic portions which is exposed to changes in the mentioned bonds.

In identifying the dendogram of the lithogenous portions is emphasized on lithogenous ogination of Zn, Sn and Cr while this relation is not seen for Ni and Cd (scheme 4).

Result and discussion (WHAT DO YOU MEAN BY THIS PART ? Is trhis discussion for the previous part?)

In statistical finding of the heavy elements origination elements like Al and Fe are considered as lithogenous indexes. According to the chemical separation we can come to conclusion that Cr, Ni, Zn originates from lithogenous sources and about other elements we can state directly.

Table 5: The result of research and based formula and the average Ipoll concentration and severity of the shell elements in soils around Iralko

Elements	Cr	Ni	Sn	Zn	Cd	Al
Poll	0.04	0.36	2	0.27	1.83	0.15
Average element in 11 samples(mg/kg)	125	85	5	107	0.25	6.5%
Severity element region	N.P	N.P	L.P	N.P	L.P	N.P
ee&yao1970(mg/kg)	110	89	-	94	0.2	-
Taylor1964(mg/kg)	100	75	2	70	0.2	8.2%
AlinaKabata2007(mg/kg)	100	20	2.5	70	0.1	-

N.P: No pollution L.P: Low pollution

To assign the contamination intensity of the mentioned region we use Ipoll geochemical index which is based on formulation(36):

$$I_{Poll} = Log_2\left[\frac{Cn}{Bn}\right]$$

Ipoll: geochemical index or intensity of contamination in sediments.

Cn: concentration of the heavy and poisonous elements in sediments with less than 63micron in diameter.

Bn: concentration of heavy metals in lithogenous portions.

Based on the Ipoll formulation and according to the average concentration of elements in crust and contamination of the Iralko around soils are calculated and compared with each other (Table5).

According to this, contamination intensity is defined 0-5 which 0 and 5 express no and high level of contamination respectively. And other digits express the low, medium, high and severe rate of contamination.

According to this contamination intensity, elements like Cr, Ni, Al and Zn are in range around 0-1 and Sn, Cd in range 1-2. Which are categorized uncontaminated and low contaminated respectively. Based on the above subjects the achieved concentration related to average land crust is variant but cluster analysis shows that origination of elements like Zn, Cr, Ni mainly are from lithogenous sources in the zone and we can not state directly about Cd and Sn. Element concentration in bioavailability portions have allocated the maximum rate of concentration.

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