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Survey ofPollution Sourcesinto the Lake Texcoco Ecological Park, Central México

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Abstract. The basin of the former Lake Texcoco is located in the heart of one of the most populous metropolitan areas in the world: Mexico City (MAMC). However, although the lake is a drying vessel of more than 90%, of their geophysical characteristics has not been completely urbanized, making it the ultimate outdoor space for the overcrowded population of the north-east; but at the same time,it is a considerable source of contamination for periphery-urban area by the large dust storms that are generated. And the amount of toxic substances that flow through their channels of wastewater. To reverse the harmful effects on human health and prevent pollution reaching the aquifer, the National Water Commission (NWC) has established the Lake Texcoco Ecological Park (LTEP). The purpose of this study was to have a bio-geochemical diagnosis of the LTEP like background information to develop its comprehensive management plan. So, to know the sources of contamination, identify and quantify contaminants in rivers, sediment and soil were analyzed 27 factors LTEP physicochemical under NOM-001-SEMARNAT-1996, there were 11 vertical electrical soundings, 33 CT Electrical Resistivity. Three sources of pollution produced by human activities (industrial, urban and agricultural) and two sources of mixed origin (natural-anthropogenic) hypersaline water, salinization of soils and sediment were detected. Several parameters measured far exceed the maximum permissible limits established in NOM-001. We found an effect of soil washing in the crevices of saline soils, being more pronounced at south of the polygon PELT.

Keywords: environmental manage, heavy metals, salt lake, Vertical Electrical Soundings.

1. Introduction

The impact important to human health from the large dust storm sand whirlwinds that form during the summer and drag the northeast trade winds to the southwest, degrading air quality considerably the Federal District and the adjacent municipalities of the State of México(1).The multiscale climate and atmospheric chemistry model, reveal that erosion processes of the dried lake region contributes 80% of the total particulate matterPM_{10}airofMAMC(2).Threats such as eye irritation and skin irritation and skin allergies are frequent contamination of atmospheric microparticles in suspension, which may even be carcinogenic when there is heavy exposure to them and its origin comes from salty soils, such as Texcoco(3).Other negative impacts to health are produced by odors and fine organic matter suspended in the air currents coming from the pipes that currently ply the lake dry, which are accompanied by spores anddisease-causingmicroorganismsandenteroinstestinalesrespiratory (4).These diseases are not new to the inhabitants of the region. Since pre-Hispanic times there were sanitation sewage of major cities discharging to the Lake, until the excessive growth of the city, the King Moctezuma asked Nezahualcoyotl Emperor for a permission to use as drinking water from the Chapultepec springs.

On the other hand, the importance of this peri-urban area, from the standpoint of biological conservation, lies, first, that Lake of Texcoco is one of the few salinesoda-lakein the world, and it is located into an endorheic basin (5).And second, that part of the neo-volcanic axis and that the cross stands as a transition zone between two biogeographic regions of North America: Neotropical (South) and the Nearctic(North);this area is also a point of ecological transition among different aquaticeco regions of North America. So, local biodiversityis enhanced by species from each geographic region(6), plus the endemic ones(7).Another important aspect is that Lake of Texcoco, by its natural hydrology, has very marked hydroperiods and water system, providing a haven for large flocks of several species of birds, both migratory and resident.133 species of birds counted (8), with an overall density of population, more than350,000 individual shave come to occupy this habitat(9).The loss of flooded area has affected the biological extinction of many species and many others are listed as threatened or endangered.

The first step to restore ecological functioning of the Lake and surroundings is the creation of the Lake Texcoco Ecological Park. This work is the diagnosis of current physicochemical conditions of this site, in order to improve short-term management and serve as foundations for future work rest aturación and rehabilitation, as mentioned. Actions parallel geophysical surveys, limnological, ecological, are the social, demographic and economic factors, so that while doing work for revegetation, water injection to induce recharge, cleaning floors tohypersaline conditions of old etc. They are the work to stop urban sprawl, prevent the discharge of untreated urban water order the territory to offer residential and industrial areas and provide them with needed services, agricultural areas, and environmental protection(10).In short, we work to reach the sustainable city model(11).

2. Objective

The objective of this study was to determine the sources of pollution impact on the territory of the Ecological Park Lake Texcoco, through the identification and quantification contaminants in rivers, sediment and soil LTEP.

3. Materials and methods

3.1. Sampling

Theoretical sampling for analysis of the environmental quality of the LTEP, was systematic in that it had to choose representative sites for each type of analysis along a well determined transect in the direction north-south, following the natural flow riverbeds and historic salinity gradient. In addition three outstanding points were sampled because of their human health importance :El Caracol, Casas Geo Water Treatment Plant and Thermoelectric discharge duct. The sampling net work and study area location are presented in Figure 1.All samples were specific BSS and TE as well as water quality. Additionally, there were two cycles of24 hours taking water samples every 4 hours in the discharge of WTP and in the Thermoelectric plant.

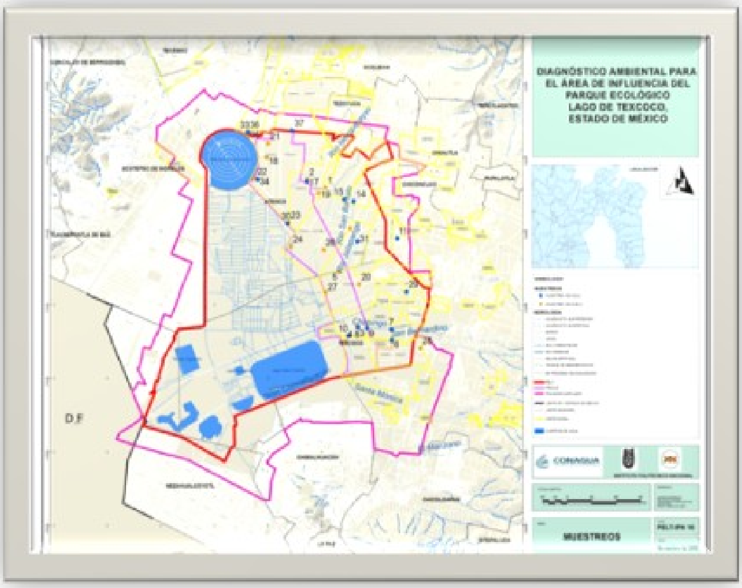

Figure 1. Location of the study area and the sampling sites.

Eleven SEV's were conducted with these parameters: AB distance: 290mor AB180mand 33scans of variable depth: 3 CT in each of the locations of the SEV's, one of them making center in the center of the BSS's and guidelines on the survey line and the other way to cut the ends to the first perpendicular (EAEG 1980).The distance between electrodes was3mand have higher saturation data for the TE (12).The length of the scanswas31.5msettlementwithSchlumberger, reaching a depth of 8 to9m.Thedata processing was carried out with the programsandIPI2WinRES2DINV(13).

3.2. Data analysis

The methodological approach of thisproject is based on Geo-environmental studies. Such studies include the analysis of physical and chemical properties of water (both discharge and industrial urban complex),resistivity substrates (vertical electrical sounding and electrical tomography) and, the determination of trace metals. The results are integrated and interpreted in Geo-environmental indicators, which distinguish natural and anthropogenic chemical compounds, as well as highlight the sedimentological origin of materials, metals and finally, these model sallow the development of geo-environmental indicators of environmental risk (14). The methods used to characterize the factors that can endanger human health were approved by the Mexican authorities through the Standard and the maximum permissible limits were obtained from the Mexican Official Standard of Health, to be more stringent than environmental Official Mexican Standard(NOM127-SSA1-1993). The other parameters were taken with the procedures authorized bytheNOM-001-SEMARNAT-1996, which is specific to environmental quality, designed to preserve life and ecological functions in environmental systems.

4. Result discussed

4.1. Water quality analysis

The parameters ofBOD5and COD factor were presented indifferent sources of pollution but not in the thermal discharge. In all cases these parameters were higher than those of NOM. Physicochemical parameters that characterize the contribution of the agricultural areawereSulfate1269mg/L,phosphate13mg/L and Total Suspended Solids(TSS) 262mg/L. In these cases the valuesare higher than those of environmental NOM. Factor Total Dissolved Solids(TDS) was present in all sources of pollution. Total Suspended Solids(TSS) occurred in the waters of agricultural water from two reservoirs Snail and the south of the polygon LTEP, in all cases exceeded the permissible limits of environmental NOM. The bacteriological analysis detected the highest number of colonies of total coliforms in the stations associated with stagnant water(8)of low activity(9): 2400 and 1100MPN/100mlmg/L respectively.

4.2. Sediment and soil

The trace metals that were detected were Cu, Ni, Co, Cd, Pb, Cr, Zn and Hg. We identified the highest concentrations of Zn, Co and Cu in the discharge of water from the development of GEO-ARA House and the Caracol. Hg and Cr were located in the geographical center of the LTEP and Hg are also located north of LTEP. Thereportedconcentrationsare0.751mg/ g Zn, 0.245mg/ g Cu, 0.057mg/ g Ni, 0.094mg/ g Pb, 0.013 mg/ g Co, 0.0047mg/ g Cd, 0.003 mg/ g As and, 0.0013mg/ g Hg for points of urbanization GEO-ARA. While for the stations located in the centeroftheLTEPwere0057-0066mg/ g Zn, 0.019 mg/ g Co, 0.036 mg/ gCr;of0017-0018mg/ g Cu, and Hg from 0.0009 to 0.0014. The concentration of metals found inCaracolwas0021-0053mg/ g Zn, 0.012 mg/ g Co, and0017-0073mg/ g Cu. The amount of the heavy metals measured exceed national and international standards. According to Geo indicators, the soils and sediments denoted moderate to heavily contamination for the specific case of Cu, followed by Ni, Cd, Pb, Co and Cr, all in the category of moderately polluted soil in station discharge GEO-ARA Construction. The characterization of soil and sediment was carried out by correlating the resistivity resulting from the SEV and TER and the results of the geochemical composition(major metals and elements) of the sediments. The results indicate four areas in the strip comprising the LTEP, two in the north, one in the center and one in southern LTEP (Figure 2).

Typify areas mainly saturated soils, unsaturated and a buffer zone or transition, their characteristics are low resistivities to saturated soils and higher for unsaturated soils with low concentrations of Al, Fe and Zn and high Mg and Kin soils saturated. And high concentrations of Al, Fe and Zn and lower Mg and K in the unsaturated soils (Figure 3). The transition zone of intermediate concentrations observed concentrations described above.

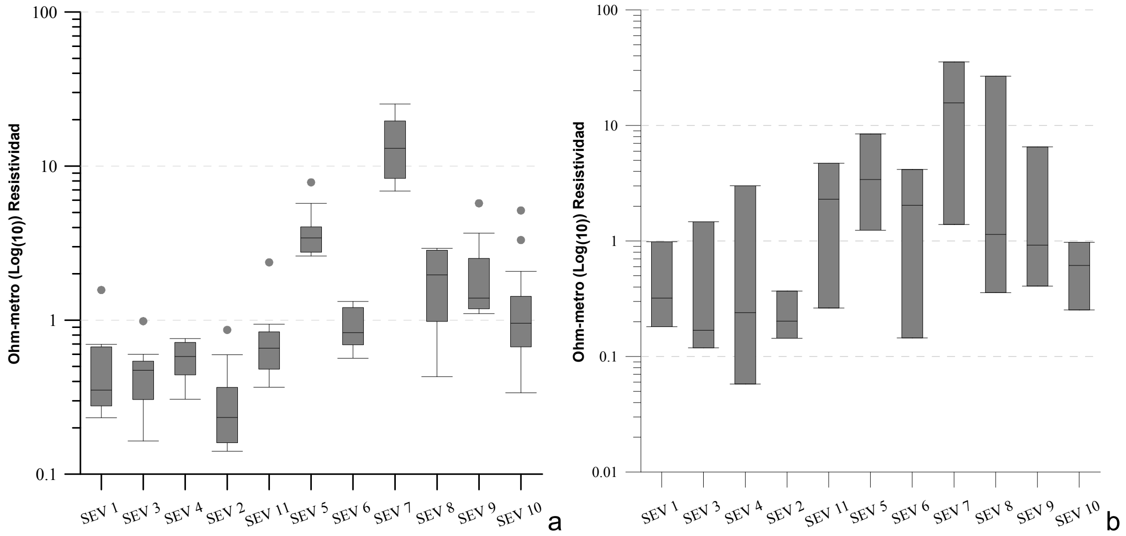

Figure 2. Apparent resistivities (a) and real resistivities (b) recorded in the SEV.

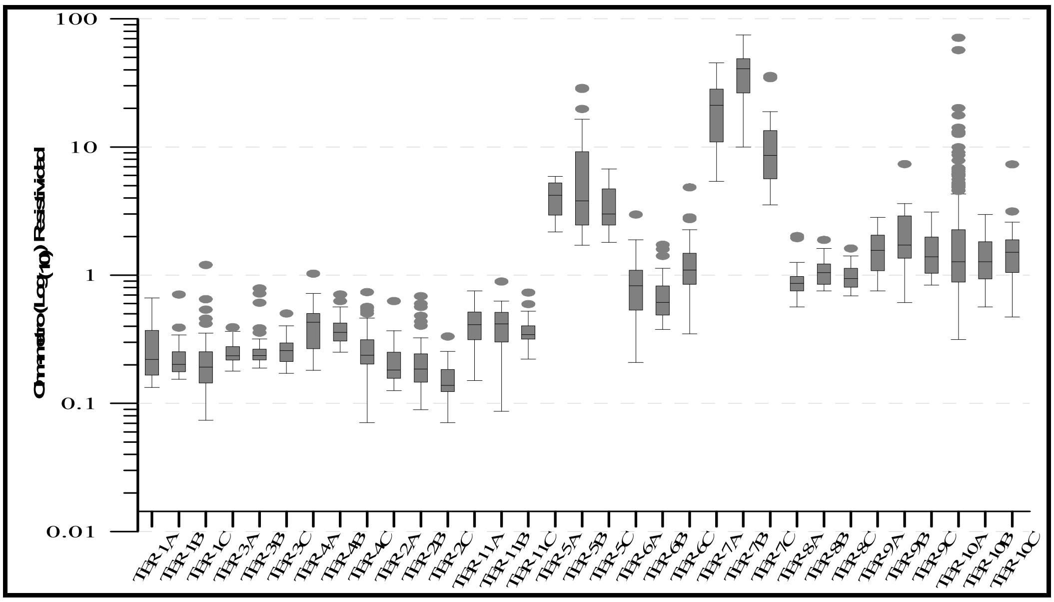

Figure 3. Apparent resistivities recorded in the Tomography (TER)

5. Conclusions

According to the integrated results we can infer that the LTEP is located in a transition zone between sediment saturation and salt into a zone of unsaturated soils. The increase in resistivity of soil becomes evident towards the NE of the study area indicates that the soil is saline or very little salt. On the contrary, towards the NW, east and south, the resistivities are very low indicating high soil salinity. The above data are directly correlated with the geochemical results of Al, Mg, Fe, Zn and K.

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