1st GYPSUM ECOSYSTEM RESEARCH CONFERENCE
Gypsum Ecosystems as Biodiversity Hotspots
June 3-9, 2018 Ankara/TURKEY

Investigation of the Availability of Gypsophyte and Gypsovag in Monitoring the Pollution Caused by Çayırhan Thermal Power Plants

[1]Latif Kurt, [1]Aysenur Bolukbasi, [1]Ebru Ozdeniz and [1]Beste Gizem Ozbey
[1]Department of Biology, Faculty of Science, Ankara University, TURKEY

Abstract

The aim of this study is to understand the relationship between the element content in the gypsiferous soil around the Çayırhan Thermal Power Plant and some plant species (gypsophyte and gypsovag) that grow in these areas. Another aim was to observe the change in the content of the main and trace elements in the gypsophyte and gypsovag as they moved away from Çayırhan Thermal Power Plant.

For the analysis, 4 different species were selected as 2 gpsophyte and 2 gypsovag from two different sites. The Gypsophyte was collected 20 km from Çayırhan Thermal Power Plant (aÇTPP) and Gypsovags was collected from 70 km away (bÇTPP). X-ray fluorescence spectrometry and ICP-MS were used to determine the amount of metal in the leaves of the harvested and dried gypsophyte and gypsovag plants. The chemical analysis results of the selected plants (4 species) were compared with each other. X-ray fluorescence (XRF) and ICP-MS methods were used to analyze 13 main elements and 29 trace elements in plant and soil samples.

As a result, apart from the Çayırhan Thermal Power Plant, there was a difference between the element contents and the accumulating elements in the gypsophyte and gypsovag plants. These results suggest that the plant element content may be affected by biological factors in addition to the substrate chemistry. For this reason, gypsophyte plants, which have the characteristics to reduce soil pollution, can be used to improve soil quality and can also be used for passive monitoring of soil pollution.

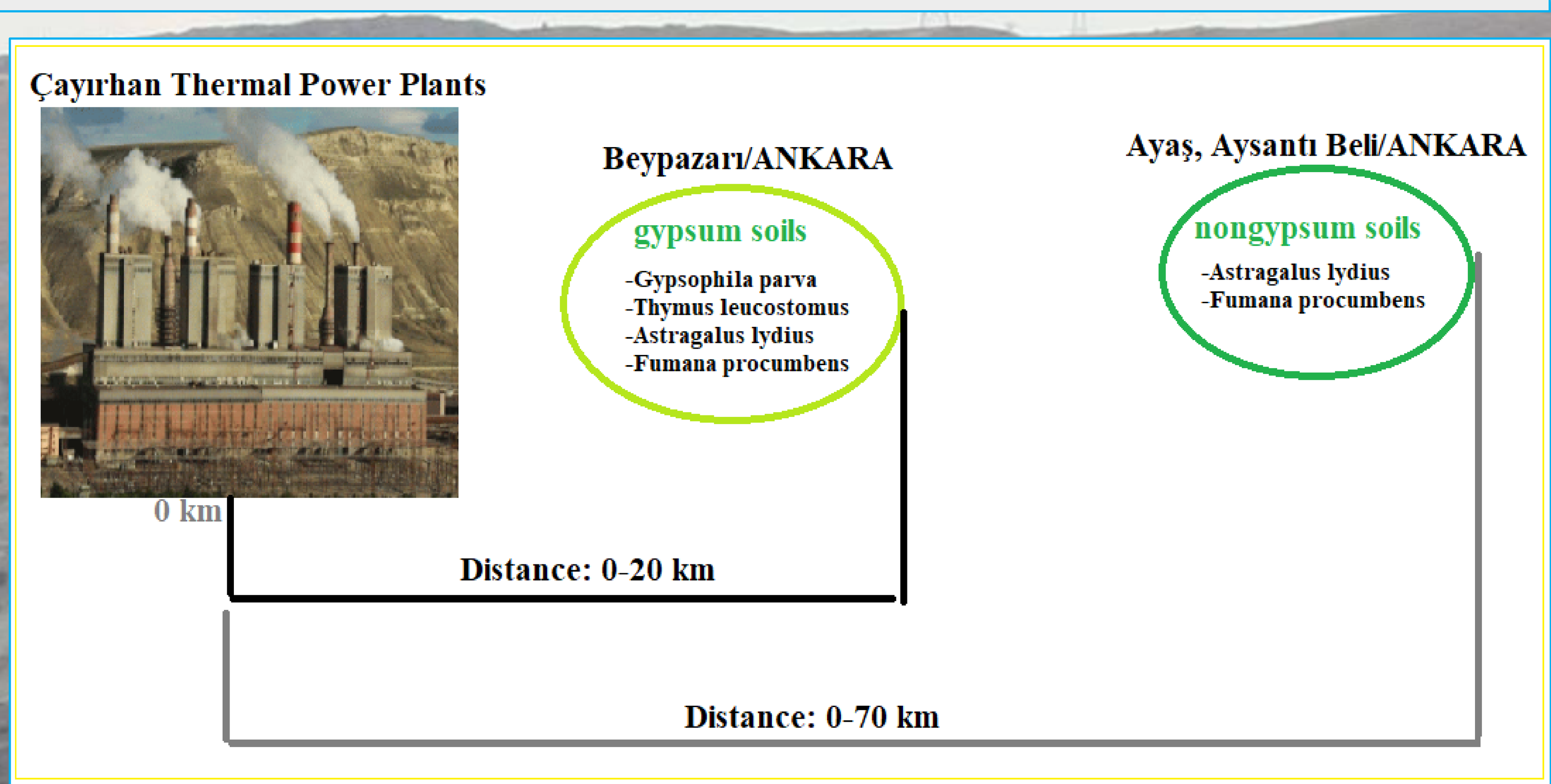
Keywords: Gypsovag, Gypsophyte, air pollution, biomonitoring, Çayırhan Thermal Power Plants, Turkey.

Material and Method

For the analysis, 4 different species were selected as 2 gpsophyte and 2 gypsovag from two different sites. The Gypsophyte was collected 20 km from Çayırhan Thermal Power Plant (aÇTPP) and Gypsovags was collected from 70 km away (bÇTPP) (Figure 1). Plants were collected in May-June 2011, matching the end of the vegetative period. This was intended to minimise chemical variability due to differences in phenological stage of plants.

Five whole individuals of each species were collected from the field and immediately taken to the laboratory, where they were washed with tapwater and distilled water before the leaves were separated. Dried or damaged leaves were discarded. Leaves were dried at 60 °C to a constant mass for 12 h and subsequently milled with grinder. Soil samples were collected at 0-20 cm depth from each study site to characterise substrata. Soil samples were dried at room temperature and sieved through a 2-mm pore sieve prior to analysis.

X-ray fluorescence (XRF) and ICP-MS methods were used to analyze 13 main elements (V, Mn, Cr, Ti, Fe, Na, P, S, Mg, Ca, Al, K, Si) and 29 trace elements (Se, Bi, Tl, Hg, Cd, Pb, Ta, Ga, U, Th , Hf, Sn, Y, Co, Mo, Ni, Nb, Cs, W, Cu, As, Sb, Zn, Rb, La, Ba, Zr, Ce, Sr) in plant and soil samples.



Results

As a result, apart from the Çayırhan Thermal Power Plant, there was a difference between the element contents and the accumulating elements in the gypsophyte and gypsovag plants. Comparison with aÇTPP and plants growing on these areas revealed that concentrations of several of the elements under investigation reached high values in the selected plant species and the gypsum soils on which they grew. Concentrations of Na, Si, S, Ca, Ti, Cd, Ln, V, Cr, Mn, Co, Fe, Sb, Sn, Ni, Ga, Ge, Se, Rb, Te, Cs, Sr, Y, Zr, Nb, Mo, Hf, Ta, W, Hg, Tl, Pb, Bi, Th and U in the aÇTPP were higher than the gypsophyte and gypsovag plants.

Concentrations of Na, S, Ca, Ge, Sr, Te and Hg in the aÇTPP were higher than the bÇTPP. Concentrations of Sr in the in the aÇTPP were quite higher than the bÇTPP. Concentrations of Na, S, Ca, Ge, Sr, Te and Hg in the aÇTPP were higher than the bÇTPP (Figure). Concentrations of Sr in the in the aÇTPP were quite higher than the bÇTPP (Figure 3). *Gypsophila parva* significantly accumulated the Sr element. Gypsophyte species accumulated most higher V, Ni, Zr and Pb elemets.

Figure 2. Plants evaluated in this study:
a) *Astragalus lydius*,
b) *Fumana procumbens*,
c) *Thymus leucostomus* var. *gypsaceus*,
d) *Gypsophila parva*.

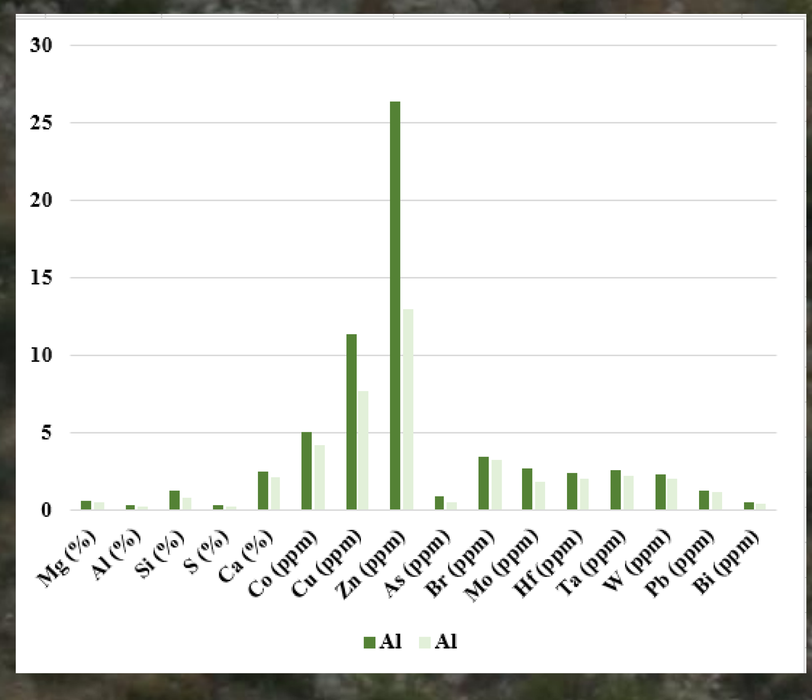
Discussion and Conclusion

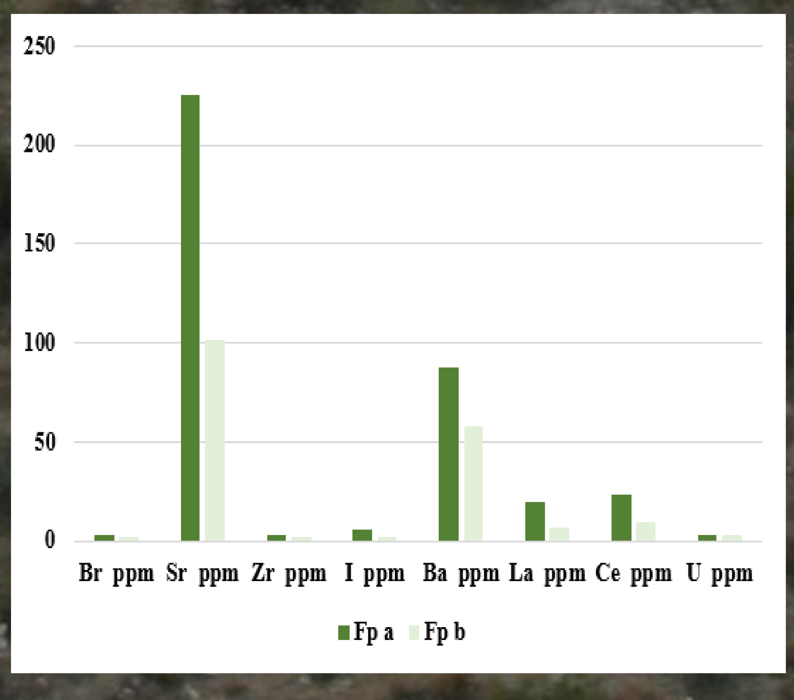
Sustrate chemistry and, even more predominantly, some biologic factors might affect element accumulations in plants. It is known that plants have a strong affinity to some elements. For example, there are some plants (e.g., Gypsophila parva) that grow on gypsum soils that have Ca and S content was very high. The increase in concentrations of Ca and S indicates a gypsum source since Ca and S are the main alteration products of pure gypsum (CaSO4.2H2O) at gypsophyte plants growing on these areas and gypsiferous soils max 20 km away from the Çayırhan thermal power plant (aÇTPP). Among the trace elements at aÇTPP, Sr, Zn, Cd, Te and U showed the highest increase.

Most of the elements in the periodic table may be accumulated in plants by uptake from the soil (Takada et al., 1997). Some plants uptake certain elements (Wenzel et al., 1993; Kumar et al., 1995; Adriano et al., 1997). Plant analysis is also used in geochemical surveys for the exploration of mineral deposits (Brooks, 1972; Kovalevsky, 1979; Brooks et al., 1995). The major factors aff ecting plant chemistry are their habitat or substrate, the rocks and soils on which they grow, weathering, and microclimate. Anthropogenic impacts may also be included. Different anatomical, morphological, and physiological properties of the roots, leaves, and bodies of plants make element accumulation in plants a complex process.

These results may suggest that plant element content may be affected by biological factors in addition to substrate or substrate chemistry. Thus, especiallay gypsophyte plants with suitable traits at soil pollution attenuation may be used for improve soil quality and at the same time such plants may be utilized for passive monitoring of soil pollution.

Figure 3. Comparison of main elements (%) and trace elements (ppm) of the plant and aÇTPP (aÇTPP > plants evaluated)





Kaynaklar

- Adriano DC, Chlopeca A, Kaplan DI, Clijsters H & Vangronsveld J (1997). Soil contamination and remediation: philosophy, science, and technology. In: Prost R (ed.) Contaminated Soils: 3rd International Conference on the Biogeochemistry of Trace Elements, pp. 465-504. Paris: INRA
- Brooks RR (1972). Geobotany and Biogeochemistry in Mineral Exploration. New York: Harper & Row.
- Brooks RR, Dunn CE & Hall G (1995). Biological Systems in Mineral Exploration and Processing. New York: Ellis Horwood.
- Kovalevsky AL (1979). Biogeochemical Exploration for Mineral Deposits. Moscow: Nedra.
- Kumar P, Dushenkov V, Motto H & Raskin I (1995). Phytoextraction the use of plants to remove heavy metalsfrom soils. Environmental Science & Technology 29: 1232-1238.
- Takada J, Nishimura K, Akaboshi M, Matsubara T & Katayama Y (1997). Element content in a number of plant leaves and accumulation of some elements in typical plant species: a case of Okayama. Prefecture Journal of Radioanalytical and Nuclear Chemistry 217: 65-70.
- Wenzel WW, Sattler H & Jockwer F (1993). Metal hyperaccumulator plants: a survey on species to be potentially used for soil remediation. Agronomy Abstracts 52: 42-52.