Assessment of Chemical Characteristics of Airborne Dust over Shahdad Region, Iran by X-Ray Fluorescence *(*XRF*) Analysis*

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1. Introduction

Dust storm is a natural phenomenon that occurs frequently in the arid and semi-arid regions all over the world (Alijani, 1997). Dust can affect soil fertility, forests, rivers, lakes, and marine ecosystems around the world (McTainsh et al., 2007). Therefore, soil erosion can lead to the loss of the minerals and organic matter of topsoil. Some elements of dust have also an indirect effect on absorption of other elements (Reynolds et al. 2001). It is estimated that each year 2000 Mt dust is emitted into the atmosphere, 75% of which is deposited to the land and 25% to the ocean (Shao et al., 2011). The morphology and elemental composition of the particles can change alone the transportation in reaction to gasses and other particles in the atmosphere (Wang et al., 2007). Identification of the physical properties and chemical composition of dust aerosols is important to determine aerosol sources, mixing processes and transport pathways (Rashki et al., 2013). Chemical analysis of airborne dust can also characterize major and trace elements of airborne dust which is important for quantitative climate modeling, in understanding possible effects on human health, precipitation, ocean biogeochemistry and weathering phenomena (Goudie & Middleton, 2006)

2. Study Area

Shahdad is a region located in west of Lut Desert and South East Kerman province, in centre of Iran. Low precipitation, high temperature, salinity (Alavipanah, 2002) and sever winds are characteristic of this region. Shahdad with a maximum temperature of 71 ° C is one of the hottest regions in the earth (Alavi Panah, 2002, Mildrexler et al., 2006, Ehsani et al., 2008) this region with extensive wind erosion, and intense dust storms, causes adverse effects in regional air quality and human health. To mitigate the impact of these phenomena, it is vital to ascertain the chemical characteristics of airborne and soil dust.

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3. Material and Methods

This paper examines for the first time, the chemical properties of dust over Shahdad region by collecting dust samples at five stations established at 5 villages close to Lut desert downwind of dust source region, from spring 2013 to September 2013. Furthermore, soil samples were collected from topsoil (0-5 cm depth) at several locations in upwind areas. The data was analyzed to investigate the chemical characteristics of dust, relevance of inferred sources. X-ray *Fluorescence* (XRF) analysis of airborne and soil dust samples have been produced to show Chemical properties of dust and characterize major and trace elements.

4. Results and Discussion

Major-element and ion-chemistry analyses provide estimates of mineral components, which themselves may be hazardous to human health and ecosystems and can act as carriers of other toxic substances. X-ray Fluorescence (XRF) analyses of all the samples indicate that the most important oxide compositions of the airborne and soil dust are Silicon dioxide (SiO2) in quartz minerals, Calcium oxide (CaO) in calcite minerals and substantial Aluminum oxide (Al2O3) that exhibiting similar percentages for all samples. Chemical analysis of dust samples showed that the main element of dust in the Shahdad is SiO2 (49.35%), which is close to the average of this element in southeastern Iran(47%) (Rashki et al., 2013) and more than Southwest Iran with (38%) (Zarasvandi et al., 2011). The global average SiO2 is 59.9%. Therefore, amount of Quartz in Iran is lower than Quartz the earth.

Major elements in the dust and soil samples in these analysis are: SiO2 (33.33-55.59%), LOI (12.68-26.31%), CaO (10.12-18.76%), Al2O3 (7.97-10.45%), a small amount of Fe2O3 (3.04-4.34%), Na2O (2.04-13.91%) , MgO (0-3.03%) and K2O (0.85-1.37%), as well as small amounts (<1%) of the elements of P2O5, MnO, TiO2, Cr2O3 and H2O- are in the dust samples. Average of CaO in Shahdad (12.7%) is close to Sistan (12%) and slightly less than Khuzestan (13.6%). However, the global average of CaO is low (3.94%), which is almost a quarter of the areas listed in this study. Rainfall at desert in summer separates calcium compounds and increases Ca in the airborne dust (Wu et al. 2009). Al2O3 has lowest value (9%) in Shahdad while the global average (14.13%) is more than Iran. The global average Fe2O3 (8.6%) is also more than Shahdad, Sistan and Khuzestan (3.7%). The chemical analysis of dust samples at all stations were performed via XRF analysis for the major oxides (Figs.1). Chemical analysis of dust provides valuable information about potentially harmful trace elements such as lead, arsenic and heavy metals (Cobalt (Co), Chrome (Cr), Copper (Cu), Nickel (Ni), lead (Pb), and strontium (Sr)). The results show that there are a significant amount of trace elements Sr and Ba in comparison to other elements in the dust and soil samples but amount of Sr in dust samples are greater than soil samples. Amount of Ba in dust samples is much more than Ba in soil. Estimates of Enrichment Factors (EFs) for all studied elements show that all of them have very low EF values, suggesting natural origin from local materials. The results suggest that a common dust source region can be inferred, which is the eroded sedimentary environment in the extensive western Lut desert, lying to the north of Shahdad.

5. Conclusion

Major elements of SiO2 and LOI include more than 60% of dust samples. Also, CaO, Al2O3, Fe2O3, Na2O and MgO have significant percentage of Shahdad dust components.K2O, P2O5, MnO, TiO2, Cr2O3 and H2O include very small percentage (2 <%) of dust components. Trace elements of Sr and Ba are highest in the dust samples in comparison with the other elements. Results show all dusts have natural origin. The chemical compositions of soil samples are very similar. Therefore, dust may comes from local areas. The amount of trace elements decrease from upwind to downwind so it seems that the main source of dust in this area are at northern Shahdad and close to Kalut which is loss the elements to downwind.

Key Words: Desert dust, XRF analysis, Enrichment Factor, Shahdad.

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