Geochemical Characteristics of Heavy Metal Elements and Their Impact on the Environment

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Abstract: With the development of social economy, human beings discharge some heavy metals through industrial production. These heavy metals not only pollute the environment, but also have a serious impact on human health. In order to control this heavy metal pollution, it is necessary for relevant departments to monitor and prevent heavy metals in key discharge areas. In view of this, the paper carries out field monitoring and testing in a certain area containing heavy metals. Geochemical characteristics of heavy metals in this area were analyzed, and the impact of these heavy metals on environmental quality was explored in detail.

1. Research background

1.1 Literature review

Land is the basis of human survival, after a long period of physical and chemical processes continue to interact and integrate. Since the Industrial Revolution, due to technological innovation, human pollution of land has been increasing. In particular, heavy metal emissions in the soil not only affect the local environment, but also have a negative impact on human health. How to assess the environmental impact through geochemical analysis of these heavy metals? In order to provide analysis samples for heavy metal environmental pollution, experience and data can be relied on in the treatment process (Lan et al, 2017). Heavy metal elements are discharged into the environment. Although it contains very little, with the continuous pollution of human environment, these heavy metals can affect human beings through the chemical food chain. In view of this, many geologists, chemists and earth research experts at home and abroad attach great importance to it. These problems have been studied and a large number of references have been provided (Duan et al, 2018). Most of the heavy metals are harmful trace elements. If they are concentrated in a certain area, they will cause serious damage to the local environment. The toxicity of heavy metals can not be biodegraded, but can be enriched by organisms to a certain extent, and may be converted into more toxic metal organic compounds. Greater damage to the environment and human beings (Huang, 2018). Due to the different economic development in different regions, the local climate and environment are different, and the heavy metal pollutants produced are also different. Because of the differences in the spatial distribution of these heavy metals, the degree and ability of these heavy metals to release toxicity to the environment are not only different. Therefore, in the treatment of heavy metal pollution, we should treat it differently according to different situations in different areas. It is very necessary to study the geochemical characteristics of different heavy metal elements, and it is also a necessary process to control heavy metal pollution (Liu et al, 2019). Geochemical characteristics of heavy metals in soils have always been the focus of geochemical characteristics of trace elements. Experts and scholars from different regions have carried out relevant studies on different environments in different regions. The treatment of heavy metal pollution provides a solution. If these pollution is not paid attention to, it will lead to more heavy metal pollution concentration and threaten human health through chemical biological chain. Therefore, these studies are of great significance to the sustainable development of human beings (Zhang et al, 2018).

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1.2 Purpose of research

The pollution of heavy metals to the environment is mainly manifested in the fact that heavy metals in soil are difficult to be biodegraded under natural conditions. And it will increase over time. This situation will result in the supply of microorganisms in the soil being cut off, which will also affect the physical properties of the land. Consequently, the ecological environment is deteriorating, even endangering human health. In this paper, starting from the study of heavy metal pollution to the environment, the experimental method was used to study a certain region, and the pollution intensity of the large amount of heavy metal in the soil was analyzed, and the degree of damage to the local environment as a whole. Therefore, the in-depth study of heavy metal elements is imminent, which can not only provide theoretical basis for environmental pollution, but also effectively guarantee the sustainable development of human beings.

2. Overview of geochemical characteristics of heavy metal elements

2.1 Brief introduction of heavy metals to environmental pollution

Elements are distributed in nature, and different elements have different distributions. However, the distribution of heavy metals in nature is relatively balanced, generally natural concentration, and its content is very low. This will have little impact on human production and life. Since modern times, with the continuous improvement of technology, more and more heavy metals are mined and processed. Many heavy metals accumulate in soil, air and water. For example, mercury, lead and other heavy metals, which will have an important impact on human living environment. Although heavy metals exist in chemical state, they can enter the environment through atmosphere, water, soil and so on. In addition, the elements of nature in the continuous cycle, after a long period of movement, accumulation and so on, will cause serious harm to the environment.

2.2 Brief introduction of research area in this paper

The area chosen in this study is 3256.4 km2, the annual average temperature of the local environment is 15 C, and the precipitation is 1000-1500mm, which belongs to the mesothermal monsoon climate. There are 23 large and small rivers, 1 large reservoir and 8 medium reservoirs in the region, with high forest coverage and abundant arable land resources. Moreover, the area has convenient transportation, many famous scenic spots and rich tourism resources.

2.3 Research materials and methods

The purpose of this study is to detect heavy metals in soils in designated areas. In the study area, the region is divided into 1625 copies in the form of grids, each with an area of 1 km*1 km. Six surface soil samples were collected in each grid area. The depth of soil samples was 0-30 cm, and the weight of each soil sample was 1.0 kg. These soil samples were mixed evenly, and the actual coordinate position of each sampling area was recorded by GPS.

The collected soil samples were analyzed and determined by the National Geological Experimental Center, and the data were compared by referring to the relevant national standards of soil environmental quality. The contents of Ni, V, Cr, Pb, Zn, SiO2, AlO3 and FeO3 were determined by X-ray fluorescence spectrometry (RS-1818, HORNGJAAN). Graphite furnace atomic absorption spectrophotometry (AA6810SONGPU) was used to determine the content of Cd, and atomic fluorescence spectrometry (XGY-1011A) was used to determine the content of Hg and As. Relevant quality assurance and quality control (QA/QC) measures should also be taken in the determination process. The recoveries of each standard sample were between 95% and 113%, and 30% of them were tested in parallel. The standard deviation was controlled within 4%.

The Kriging interpolation method in MapGis 6.7 is used for spatial mapping. Pearson correlation analysis, principal component analysis (PCA) and cluster analysis (CA) in SPSS16.0 were used to analyze the data. The principal component analysis (PCA) adopted the maximum variance rotation method.

The single factor index method is widely used to evaluate the pollution of single heavy metal

element in soil at present. The calculation formula is as follows:

$$P(i) = G_i \times S_i$$

P (i) is the environmental quality index of pollutants (i is element) in soil. Ci is the measured concentration of heavy metals in soil. Si is the standard value for evaluating heavy metals in soils. In this paper, the background values of urban soils near the studied area are used as the evaluation criteria for heavy metals in soils. P(i) value subsection evaluation criteria: P(i) = 1 means no pollution, 1 < P(i) = 2 means light pollution, 2 < P(i) = 3 means medium pollution, P(i) > 3 means heavy pollution.

In addition, the potential ecological hazard index method proposed by Hakanson, a Swedish scholar in 1980, was used to evaluate soil environmental risk. The calculation formula was as follows:

$$E(i) = T_i \times (C_i / C_0)$$

E (i) is the potential ecological risk factor of single heavy metal. Ti is the toxicity response coefficient of a single heavy metal, and the toxicity coefficients of each metal are Ni=Pb=5, Cr=V=2, As=10, Cd=30, Zn=1, Hg=40; Ci represents the concentration of heavy metals in soil. C0 is the standard value for evaluating heavy metals in soil. In this paper, the background value of soil in this city is used as the standard for evaluating heavy metals. The sum of the potential ecological risk coefficients E (i) of each element is the potential ecological risk index (RI) of the region. The calculation formula is as follows:

$$RI = \sum E(i)$$

According to the potential ecological risk coefficient of each element and the comprehensive potential ecological risk index. Soil quality can be divided into five grades: light ecological pollution, moderate ecological pollution, intensive ecological pollution, very strong ecological pollution and very strong ecological pollution.

2.4 Characteristics of heavy metal content in soil in the study area

The average contents of Hg, Ni, V, Cr, Cd, As, Pb and Zn in the studied area were 0.032, 19.735, 69.564, 53.241, 0.125, 4.983, 21.638 and 63.954 mg/kg, respectively. After determination, the average values of As, Ni, Cr, V and Hg elements were slightly lower than the background values of the urban soils near the studied area.

3. Effects of heavy metal elements on environment

In this study, the sampling points of Hg, Ni, V, Cr, Cd, As, Pb and Zn were analyzed. The results showed that the sampling points were not polluted by heavy metals. Among them, the average content of single element of cadmium is the highest, and the pollution is the highest, followed by zinc and pb, but their average value is below 1.50. According to the conclusions of previous studies, it is similar to this measurement. The average individual pollution index of the remaining five elements is below 1, which indicates that the land in this study area has not been polluted by heavy metals.

Hakanson evaluation method was used to evaluate the potential pollution of eight heavy metals in the studied area. The E(i) values of these eight heavy metals were all below 40, indicating that the ecological pollution risk of single element was low. The study also draws the ecological risk index map by GPS. From the map drawn, we can see that the RI value of more than 90% sampling points in the study area is lower than 150, which further indicates that the ecological pollution index of the area is low. Strictly speaking, the region is below the level of mild pollution, the content of these heavy metals has no impact on the residents of the region, and the local environmental protection is in a good state.

4. Conclusion

In summary, the geochemical characteristics of heavy metals in soils and their impact on the environment of the studied area were studied by measuring the studied area. The results showed that all kinds of heavy metal elements in soil in this region were relatively low, and the local environment was under the level of mild pollution. However, protection should be strengthened to prevent future disasters and to maintain a good ecological environment in the region for a long time.

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