Available at www.scientevents.com/proscience/
ScientEvents
ProScience 7 (2020) 70-74
ProScience

Conference Proceedings
International Meeting of Geohealth Scientists - GHC 2020 - Virtual Meeting

Geochemical features of hair of the population of South Kazakhstan

Natalia Baranovskaya[1], Botagoz Sharipova[2*], Anuarbek Kakabayev[2]

[1]*National Research Tomsk Polytechnic University, Tomsk, Russia*
[2]*Ualikhanov Kokshetau State University, Kokshetau, Kazakhstan*
[*]*oralovna82@mail.ru*

Abstract

One of the features of residential areas is the anthropogenic impact on the environment, characterized by intense changes in the natural geochemical background. Chemical compounds actively entering nature due to human production activities are included in biogeochemical cycles and are able to accumulate in living organisms. To assess the degree of this accumulation, the study of the elemental composition of human hair has proven itself well.

A study of 40 heterosexual residents of the region (17 men and 23 women) was carried out using a multielement hair analysis by the INAA method. As a result, the features of the elemental status of the population of the studied region were revealed.

Keywords: Microelement composition, hair, environment, technogenesis

1. Introduction

The territory of South Kazakhstan is very heterogeneous in terms of the degree of technogenic impact, which is associated with the uneven location of enterprises and the heterogeneity of chemical components entering the environment.

The region has large deposits of such minerals as coal, barite, bentonite clays, phosphorite ores, vermiculite, limestone, talc, marble, gypsum, granite, quartz sands,

ISSN: 2283-5954
Selection and peer-review under responsibility of GeoHealth 2020 Scientific Committee
DOI:10.14644/ghc2020.011

fluorspar, ferrous, non-ferrous, noble and rare metals (Geology of the USSR, 1977). In terms of uranium reserves, Kazakhstan ranks second in the world, and in the extraction and processing of uranium product - the first (Sadykov & Tretyakov, 2020). The region is a producer and supplier of table salt, quartz sand, cotton, vegetable oil, fruits, vegetables, grapes, melons, and rice.

There are also large industrial enterprises (Bukaeva, 2012), as a result of which chemical elements accumulate in the environment. That has a negative impact on the life of a living organism, including humans. All this requires constant monitoring of the state of the environment.

The relationship between the state of the environment, its chemical composition, health indicators and quality of life is well known (Agadzhanyan, 2001).

In connection with the need to assess the environmental situation in residential regions, research is becoming increasingly important, which makes it possible to easily and effectively assess the current situation. For these purposes, the elemental composition of human biosubstrates is being studied, the composition of which can act as a geo-indicator of changes in the natural environment under the influence of urbanization and human economic activity. At present, the study of the elemental and mineral composition of the human body is one of the priority directions of modern geochemistry, medical geology and ecology. It is convenient to use hair to study the elemental composition. they reflect in their composition the levels and changes in the intake of many microelements into the body over a long period of time (Baranovskaya et al., 2015; Pozebon et al., 2017).

Human hair is a deposit medium, in their structure, chemical elements can accumulate in high concentrations. Additional advantages of this material in ecological and geochemical studies of a territory with complex processes of natural and technogenic transformation are the simplicity of sampling and easy preparation for analysis. The identification and use of elements-indicators of geochemical anomalies according to the data on the composition of the population's hair makes it possible to establish the technogenic geoecological features of local territories.

The purpose of our research is to study the features of the elemental composition of the hair of the inhabitants of South Kazakhstan, to assess the ecological and geochemical state of the territory.

2. Materials and methods of analysis

The material for the study was 40 samples of human hair taken in the territory of South Kazakhstan. Samples were taken according to the standard technique recommended by the IAEA (International Atomic Energy Agency, 1980). The material was sampled in 2018, from adolescents aged 16-18. Hair was cut with stainless steel scissors close to the root from at least five points of the head (frontal, temporal, parietal and occipital parts). The obligatory parameter was the fixation of gender, age, full name, address of the child's residence. The sample weight was 200-500 g. The samples were placed in plastic bags and delivered to the laboratory. The ratio of boys and girls in the sample was 17:23.

The level of accumulation of chemical elements was determined by instrumental neutron activation analysis performed in the nuclear geochemical laboratory on the basis of the research nuclear reactor of the National Research Tomsk Polytechnic University (analyst Senior Researcher A.F. Sudyko, L.V. Bogutskaya).

The data obtained were processed using Excel and STATISTICA 10 software package.

3. Results and their discussion

We have studied the content of 28 elements in the hair of adolescents in South Kazakhstan using the INAA method. When normalizing the content of elements in the hair of children to the clarke of the noosphere (Glazovskaya, 2007), the highest coefficients were obtained for Zn, Ba and Au (Fig. 1).

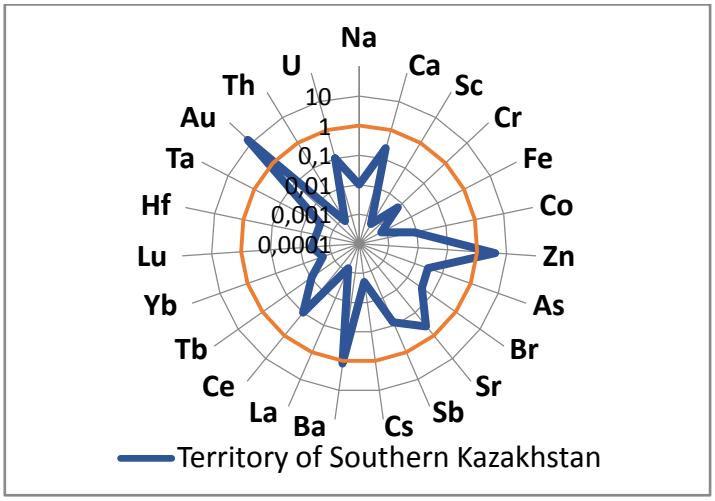

Fig. 1. Coefficient of the concentration of elements in the hair of the population of South Kazakhstan

A comparative analysis by gender showed that most of the elements are equally concentrated in the male and female bodies of adolescents in South Kazakhstan (Fig. 2). However, elements such as Ba, Tb, Yb, Hf, Ta tend to accumulate in the male body, while the elements Cr, Zn, Sr, Ag, Ce accumulate in the female body.

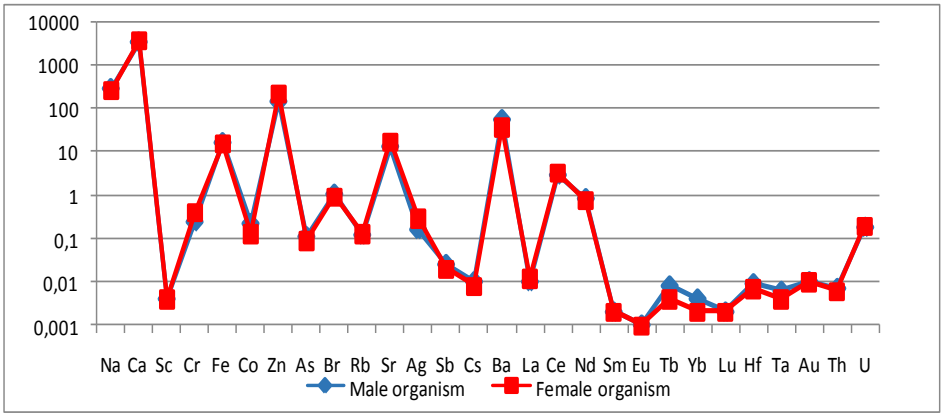

Fig. 2. Estimation of the average content of elements in the hair of adolescents in South Kazakhstan by gender

Correlation analysis has shown a close relationship of many elements. The highest coefficient of positive pair correlation (r = 0.99) belongs to the Ba-Nd pair (critical coefficient r = 0.30, p = 0.05). In addition, 10 pairs are characterized by strong bonds with a correlation coefficient of 0.6 to 0.5, these include: Sc-Hf, Sc-U, Ba-Th, Nd-Th, Zn-Ag, Tb-Yb, Sc- La, La-U, Rb-Ba, Rb-Nd. Negative correlation coefficients belong to the pairs La-Ta (r- = 0.4), Ce-Sm, Ce-As (r- = 0.3).

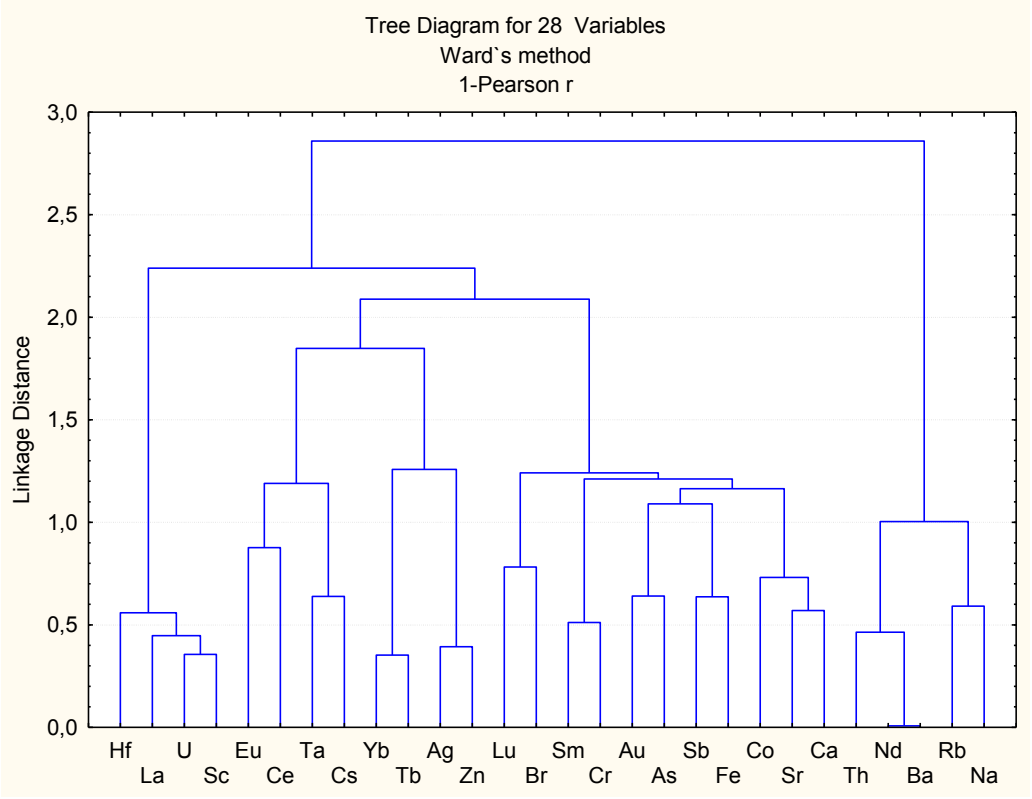

Fig. 3. Cluster analysis diagram

The results of cluster analysis (Fig. 3) made it possible to distinguish several groups of elements, which may have a different source and mechanism of accumulation. As a result, the following groups of closely related elements in the hair of adolescents in South Kazakhstan can be distinguished:

- U, Sc, La, Hf;
- Nd, Ba, Th, Rb, Na;
- Ta, Cs, Eu, Ce;
- Lu, Br, Sm, Cr, Au, As, Sb, Fe, Co, Sr, Ca;
- Yb,Tb, Ag, Zn.

We have studied 28 chemical elements in the hair of adolescents living in the territory of South Kazakhstan. According to the results of the study, it is possible to draw some conclusions about the specificity of the accumulation and distribution of chemical elements. Probably the spectrum of accumulation of such elements as Cr, Zn, Sr, Ag, Ba, Ce, Tb, Yb,

Hf, Ta, Au is associated with the extraction of uranium and polymetallic ores, rare earth metals. Nevertheless, the source of the studied elements in the organism of the inhabitants of South Kazakhstan is not fully determined and requires additional research.

This work has been supported by the RSF grant (№ 20-64-47021).

References

Agadzhanyan N.A. (2001). Chemical elements in the environment and the ecological portrait of a person. *N.A. Agadzhanyan, A.V. Rocky – Moskow - 83 pp.*

Baranovskaya N.V., Rikhvanov L.P., Ignatova T.N. and others (2015). Essays on human geochemistry: monograph; *Tomsk Polytechnic University, Tomsk: TPU Publishing House, 378 pp.*

Bukaeva A.D. (2012). Production of non-ferrous metals in Kazakhstan. *Theory and practice of social development No.12, pp 561-563.*

International Atomic Energy Agency (1980). Element analysis of biological materials. Current problems and techniques with special reference to trace elements. *App. II. Technical reports series № 197, Vienna: pp 351–367.*

Geology of the USSR (1977). Chief editor A.V. Sidorenko. T. XL. South Kazakhstan. Minerals. Ed. volumes of Sh.E. Yessenov. M., "Nedra", 403 p. (Ministry of Geology of the Kazakh SSR).

Glazovskaya M.A. (2007). Geochemistry of natural and technogenic landscapes: Textbook M.: Faculty of Geography, Moscow State University, 350 p.

Pozebon D., Scheffler G.L., Dressler V.L. (2017). Elemental hair analysis: A review of procedures and applications, *Analytica Chimica Acta, Vol. 992, pp 1-23.*

Sadykov M.P., Tretyakov S.Yu. (2020). Perspectives for the development of uranium mining by in-situ leaching. *Scientific and practical research, 1-3(24), pp 227-229.*