

ABSTRACT of
thesis research of Umirbayeva Aliya Batukhanovna
«CREATION OF ECOLOGICAL MAPS OF THE SEMIPALATINSK TEST
SITE (STS) BASED ON INNOVATIVE MONITORING METHODS»
prepared for degree of Doctor of Philosophy in the specialty
6D071100 - Geodesy

Research purpose: of the study is to establish the variability of radioactive contamination of the territories of the Semipalatinsk test site (STS) in order to create environmental maps for the safe use of land in the national economy.

Main idea of work is to consider the possibilities of terrestrial and space technologies for mapping radioactively contaminated sites on the territory of the STS based on the results of integrated monitoring.

Object and subject of research. The object of the study is the Semipalatinsk test site. The subject of research is the radioactively contaminated ecosystems of Semipalatinsk test site.

Research objectives. To achieve this goal, following tasks were solved:

1. Analysis of domestic and foreign experience in studying territory of nuclear test sites;
2. Analysis and improvement of methodology for conducting integrated monitoring, including geodetic observations using modern equipment and instruments;
3. Determine the variability of radioactive contamination of STS territories based on the interpretation of the results of integrated monitoring and create environmental maps using GIS;
4. Determine the reasons for the lack of snow and vegetation cover on the STS test sites.

Research methods. To solve these problems, comprehensive research method was used, including analysis of satellite images and other geoinformation, modern technologies for conducting geodetic monitoring; methods of geoinformation mapping, GIS modeling, mathematical-statistical, system analysis.

Relevance of thesis topic. The Semipalatinsk Nuclear Test Site (SNTS) was one of the largest nuclear test sites in the world. It covers an area of 18,300 km² and has carried out 456 tests using 616 nuclear devices. A wide variety of tests were carried out at SNTS, both in terms of nature of test (ground, air, in tunnels, in wells), and in terms of type of nuclear device (nuclear, thermonuclear), which, in combination with various landscape and geological conditions of test sites caused very diverse picture of radioactive contamination.

At the same time, the SNTS territory is rich in minerals, in particular, there are deposits of coal, gold, nickel, iron, copper, etc. After the SNTS was closed, unauthorized activity began to be observed on its territory. Residents of nearby settlements are engaged in grazing, collecting scrap of ferrous and non-ferrous metals, dismantling buildings and structures located at the landfill. All this activity

contributed to the secondary spread of radioactive contamination not only on the territory of test site, but also beyond its borders.

Under the current conditions, urgent task is to ensure safety of territory for human economic activity, which requires assessment and forecast of radioecological situation. Protecting environment, and especially humans, from effects of residual and secondary radioactivity is the main point in solving problems of test site. To do this, it is necessary to use possibilities of using integrated monitoring (space, geodetic, radioecological) for territory mapping with subsequent recommendations development on the land use for the national economy.

The urgency of this problem is due, on the one hand, to significant levels of radioactive contamination of some sites on the territory of the SNTS and, on the other hand, active agriculture in these areas. This confirms importance of solving applied scientific and technical problem related to the safe use of land for the national economy.

Another proof of the relevance of thesis topic is that research was carried out in accordance with scientific and technical program "Ensuring radiation Safety on territory of the Republic of Kazakhstan", carried out by the "Institute of Radiation Safety and Ecology" of the Republican State Enterprise "National Nuclear Center of the Republic of Kazakhstan" with participation of author.

Protected scientific positions:

1. With increasing distance from the border of the test site, the concentration of radionuclides decreases exponentially.

2. The radiation background caused a temperature anomaly, which leads not only to the absence of snow, but also to the absence of vegetation cover. At the same time, there is a constant connection between the location of snowless zones and summer drought centers in the STS area.

Scientific novelty of work results lies in:

- the nature of the variability of long-lived radionuclides exceeding the established standards was established on the basis of the identified patterns of movement of artificial radionuclides, taking into account their numerical parameters;

- the reason for the lack of vegetation cover in the areas of SIP test sites has been established.

The main results of the research:

1. The methodology for conducting complex monitoring of the state of the natural environment, including remote sensing, geodetic support of geoecological studies, has been improved, which allows assessing the state of the modern radiation background of the SNTS territories.

2. An assessment of the radiation-contaminated territories of the Semipalatinsk test site (water environment, air basin and vegetation cover) was carried out, which allows creating ecological maps of the study area.

3. The exponential dependences of long-lived radionuclides exceeding the established standards, depending on the distance of the source, have been obtained, which make it possible to assess the levels of contamination of the soil cover, water bodies, and the air basin with acceptable accuracy;

4. Ecological maps were created, using GIS technologies, displaying the radiological and ecological situation on the territory of the SNTS and contributing to the adoption of effective decisions on the safe use of landfill lands.

5. The results are included in lecture materials and practical exercises for undergraduates ("International Educational Corporation" LLP), as well as in the production process ("National Center for Geodesy and Spatial Information"), which is confirmed by the relevant Implementation Acts.

Author's personal contribution consists in setting goals and objectives of research, conducting field expeditionary observations and results processing; participation in the construction of zoning maps based on integrated monitoring data to assess radiation hazard. Generalization and analysis of obtained data was carried out.

Validity and reliability of scientific provisions and conclusions is confirmed by: volume of geodetic measurements made in the conditions of polygon, their mathematical processing; positive assessment and approbation of work results at various conferences and in press; implementation of results obtained in the educational process and production (acts of implementation).

Scientific significance of work is to identify patterns of changes in the level of radiation pollution, on the basis of which the mapping of the STS territory was carried out.

Practical significance of work: the patterns obtained can be used in the compilation of cartographic materials that are necessary for the compilation of a geoinformation mapping methodology. The resulting methodology is used at the Department of "Engineering Geodesy", "Ecology" of the International Educational Corporation.

Approbation of work. Main provisions and results of thesis were reported and discussed at the following scientific, practical and international conferences: "Innovative solutions to traditional problems: engineering and technology" Satpayev's readings (Almaty, KazNITU, 2018, 2019); "Modern problems and prospects for improving rational and safe subsoil use" (Tashkent: Tashkent State Technical University, 2018); "Rational use of mineral and technogenic raw materials in the conditions of Industry 4.0" (Almaty: KazNITU, 2019); "Role of geodesy and mine surveying in the implementation of the Digital Kazakhstan program" Satpayev's Readings (Almaty: KazNITU, 2019); "Digital technologies in geodesy and mine surveying" (Karaganda: KSTU, 2019); "XVII International Mine Surveying Congress (Irkutsk: IRNITU, 2019): Materials of scientific school "Problems of subsoil development in the XXI century through the eyes of young people" (Moscow: IPKON RAS, 2020) and at the scientific seminar of "Mine Surveying and Geodesy" Department (Almaty, KazNITU, 2020).

Publication of work. On the thesis topic 15 scientific papers were published: 2 articles in journal included in the Scopus database and Web of Science database, 4 articles in journals of the Ministry of Education and Science of the Republic of Kazakhstan, recommended by the Committee for Control in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, 7 articles in

the materials of international scientific and practical conferences, 1 patent for invention and 1 co-authored monograph.

Main provisions of thesis are published in the following works:

1. Integrated monitoring-based assessment of deformation and radiation situation of territorial domains //Eurasian mining_№1.2021.- 83-87 p.

2. Ecological mapping of the territory on the basis of integrated monitoring//Biotechnology Research Communications Vol 12 (5) September 2019 Indexed by Thomson Reuters, Analytics USA, 55-66 p.

3. GIS and space monitoring of the territory of the Semipalatinsk test site // Proceedings of the Satpayev's readings-2018 "Innovative solutions to traditional problems: engineering and technology". Almaty: KazUTZU, 2018. - 996-999 p.

4. Comprehensive monitoring of the Semipalatinsk nuclear test site // Proceedings of the international conference - Tashkent: 2018 Tashkent State Technical University, 2018. - 63-74 p.

5. The complex monitoring of the territory of the Semipalatinsk nuclear test site //Almaty: Mining Journal of Kazakhstan, №4, 2018. 14-18 p.

6. Methods of conducting geodetic monitoring of deformations of the earth's surface // Proceedings of the International. Conf. "Rational use of mineral and technogenic raw materials in the conditions of Industry 4.0" - Almaty: KazNITU, 2019.- 83-87 p.

7. Geodetic monitoring of disturbed areas of the Semipalatinsk test site// Bulletin of KazNITU, No. 1, 2019.- 203-207 p.

8. Methodology for creating environmental maps // Proceedings of the international forum Karaganda, KSTU, 2019.- 152-155 p.

9. Creation of ecological maps of the disturbed lands of the Semipalatinsk nuclear test site // Proceedings of the 14th International. scientific "Problems of development of mineral resources in the 21st century through the eyes of the young". -M.: IPKON RAN, 2019 .- 85-88 p.

10. Conducting integrated monitoring for the purposes of mapping the territory // Bulletin of KazGASA, No. 1, 2019.- 212-216 p.

11. Comprehensive study and creation of ecological maps of the territory // M.: Mine surveying and subsoil use, 2019.- 22-29 p.

12. Evaluation of consequences of contamination of the territory from point of view of radiation safety // int. Conf., dedicated 125th anniversary of K.I. Satpayev "The role of geodesy and mine surveying in the implementation of the program" Digital Kazakhstan ". - Almaty: KazNITU, April 12, 2019. -996-1000 p.

13. Ecological research on the territory of STS // Almaty: Bulletin of KazGASA, No. 4, 2019.- 325-330 p.

14. Integrated monitoring of the Semipalatinsk test site (monograph) // LAMBERT, 2020-132 p.

15. "Permanent ground benchmark for geodetic measurements" // patent No. 10 - dated 13.03.2020.