SCIENCE OF EARTH

UDC 504.06 DOI 10.23683/0321-3005-2017-2-75-83

HYDROCHEMICAL FEATURES OF THE RIVERS OF ARMENIA DEPENDING ON THE ALTITUDINAL ZONALITY OF LANDSCAPES AND TYPES OF NATURE USE IN THEIR BASINS

G.G. Babayan[1], V.E. Zakrutkin[2], O.S. Reshetnyak[2], G.A. Sahakyan[1]
[1]Center for Ecological and Noospheric Studies, National Academy of Sciences of Armenia, Yerevan, Armenia,
[2]Southern Federal University, Rostov-on-Don, Russia

Gayane G. Babayan – Doctor of Technical Sciences, Senior Researcher, Department of Environmental Geochemistry, Center for Ecological and Noospheric Studies, National Academy of Sciences of Armenia, Abovyana St., 68, Yerevan, 0025, Armenia, e-mail: gayane.babayan@cens.am

Vladimir E. Zakrutkin – Doctor of Geology and Mineralogy, Professor, Head of the Department of Geoecology and Applied Geochemistry, Institute of Earth Sciences, Southern Federal University, Zorge St., 40, Rostov-on-Don, 344090, Russia, e-mail: vezak@list.ru

Olga S. Reshetnyak − Candidate of Geography, Associate Professor, Department of Geoecology and Applied Geochemistry, Institute of Earth Sciences, Southern Federal University, Zorge St., 40, Rostov-on-Don, 344090, Russia, e-mail: olgare1@-rambler.ru

Gevorg A. Sahakyan – Laboratory Assistant-Researcher, Department of Environmental Geochemistry, Center for Ecological and Noospheric Studies, National Academy of Sciences of Armenia, Abovyana St., 68, Yerevan, 0025, Armenia, e-mail: gevorg.sahakyan@cens.am

The results of hydrochemical studies of the largest rivers of Armenia (13 stationary posts) on 29 indicators for 2004-2008 are summarized. There is a pronounced tendency to change the concentration of hydrochemical indicators depending on the zonality of landscapes and the types of nature use in river basins. It is shown that the change in water quality is caused by technogenic pollutant flows from residential urban, residential rural, mining and agro landscapes.

It is shown that 7 indicators are indicative for characterizing the water quality of rivers: electrical conductivity (mineralization), sodium, chlorides, sulfates, copper, zinc and molybdenum content. According to the degree of environmental tension, the Pambak, Agstev, Debed, Razdan and Sevzhur rivers are distinguished, in the basins of which predominantly residential urban and residential rural landscapes prevail, as well as the Vokhchi (Kapan), which can be attributed to the mining landscape system.

Keywords: *rivers of Armenia, chemical composition, water quality, altitudinal zonality of landscapes, nature use type.*

References

1. *Atlas Armyanskoi SSR* [Atlas of the Armenian SSR]. Erevan, Izd-vo AN Arm. SSR i Gl. upr. geodezii SSSR, 1961, 103 p.

2. Perel'man A.I., Kasimov N.S. *Geokhimiya landshafta* [Geochemistry of the landscape]. Moscow, Astreya-2000, 1999, 610 p.

3. *Otchet natsional'nogo statisticheskogo upravleniya za 2008–2014 gg. Okruzhayushchaya sreda i prirodnye resursy* [Report of the National Statistical Office for 2008-2014. Environment and natural resources] (in Armenian). Available at: http://www.armstat.am (accessed 12.02.2017).

4. Nikanorov A.M. *Gidrokhimiya* [Hydrochemistry]. Saint Petersburg, Gidrometeoizdat, 2001, 444 p.

5. *O sozdanii basseinov territorial'nogo upravleniya Respubliki Armeniya i utverzhdenii ikh planov* [On the establishment of basins of territorial administration of the Republic of Armenia and approval of their plans]: Reshenie Pravitel'stva RA No. 1749 ot 09.12.2004 g. (in Armenian).

6. *Resursy poverkhnostnykh vod SSSR. Bassein reki Araks* [Resources of surface waters of the USSR. The basin of the Araks River]. Vol. 9, iss. 2. Moscow, 1973, 471 p.

7. *Resursy poverkhnostnykh vod SSSR. Zapadnoe Zakavkaz'e* [Resources of surface waters of the USSR. Western Transcaucasia]. Vol. 9, iss. 1. Leningrad, 1969, 310 p.

8. *GOST 31861-2012. Voda. Obshchie trebovaniya k otboru prob* [OST 31861-2012. Water. General requirements for sampling]. Available at: http://www.docipedia.ru/document /5153316 (accessed 12.02.2017).

9. *ISO 5667:2006 (E). Sampling*. Part 1–14. Geneva, 2006.

10. *Standard Operating Procedures for Surface Water Quality Sampling, Prepared by the Surface Water Section*. Ed. J.D. Jones. Phoenix, 2012.

11. Lambarkis N., Antonakos A., Panagopoulos G. The use of multicomponent statistical analysis in hydrogeological environmental research. *Water Res*. 2004, No. 38 (7), pp. 1862-1872.

12. Lagutin M.B. *Naglyadnaya matematicheskaya statistika* [Visual mathematical statistics]. Moscow, BINOM, 2007, 471 p.

13. Oldenderfer M.S., Bleshfild R.K. *Faktornyi, diskriminantnyi i klasternyi analiz* [Factorial, discriminant and cluster analysis]. Moscow, 1989, 215 p.

14. Aivazyan S.A., Mkhitaryan V.S. *Prikladnaya statistika. T. 1 : Osnovy ekonometriki* [Applied statistics. Vol. 1. Fundamentals of Econometrics]. Moscow, YuNITI- DANA, 2001, 656 p.

15. Kaiser H.F. The application of electronic computers to factor analysis. *Educ. Psychol. Meas.* 1960, No. 20, pp. 141-151.

16. *Ob opredelenii norm obespecheniya kachestva vody otdel'nykh vodnykh basseinov Respubliki Armeniya v zavisimosti ot osobennostei mestnosti* [On the definition of water quality standards for individual water basins of the Republic of Armenia, depending on the characteristics of the terrain]: Reshenie Pravitel'stva RA No. 75 ot 27.01.2011 g. (in Armenian).

17. Vorob'eva T.I., Gushchina L.P., Zhinzhakova L.Z., Reutova T.V., Cherednik E.A., Mashukov Kh.Kh. [Formation of trace element composition in the river waters of the Central Caucasus]. *Sovremennye fundamental'nye problemy gidrokhimii i monitoringa kachestva poverkhnostnykh vod Rossii* [Modern fundamental problems of hydrochemistry and surface water quality monitoring in Russia]. Materials of the scientific and practical conference with international participation. Azov, July 8-10, 2009. Rostov-on-Don, 2009, ch. 1, pp. 39-42.

18. Reutova T.V., Dreeva F.R., Reutova N.V. Prostranstvennoe raspredelenie kontsentratsii toksichnykh tyazhelykh metallov v rechnykh vodakh gornoi zony Kabardino-Balkarskoi Respubliki [Spatial distribution of concentrations of toxic heavy metals in river waters of the mountainous zone of the Kabardino-Balkarian Republic]. *Izv. Kabardino-Balkarskogo nauch. tsentra RAN*. 2014, vol. 62, No. 6, pp. 99-105.

19. Onishchenko V.V., Dega N.S., Mamchuev I.M. Ekologo-geograficheskii analiz basseina reki Teberdy v usloviyakh khozyaistvenno-rekreatsionnogo funktsionirovaniya [Ecological and geographical analysis of the Teberda river basin in conditions of economic and recreational functioning]. *Apriori. Estestv. i tekhn. nauki*. 2016, No. 6.

Received ***February 16, 2017***

UDC 911.53 (282.2) DOI 10.23683/0321-3005-2017-2-84-91

METHODOLOGICAL APPROACHES TO LANDSCAPE PLANNING OF SALGIR RIVER BASIN

***A.N. Vlasova*[1]**

[1]*Vernadsky Crimean Federal University, Simferopol, Russia*

Anna N. Vlasova – Master, Lecturer, Taurida College, Vernadsky Crimean Federal University, Kievskaya St., 116 b, Simferopol, 295034, Russia, e-mail: avlas05@mail.ru

The article describes the landscape planning procedure, the features of landscape planning of basin areas as systems integrated by unidirectional flow are considered. It is proposed to supplement the procedure of landscape planning of river basins by researching of position-dynamic structure of the territory; it allows to specify the boundaries of water protection zones taking into account the landscape features. On the basis of analysis of modern landscapes' natural subsystem, landscape structure (different spatial models), researching existing land-use, estimation the significance and sensitivity of landscapes, determining the anthropogenic transformation and ecological condition of Salgir river and its basin, zones of landscape-ecological limitations are allocated. The scheme of landscape planning of Salgir river basin is made (the landscape program), recommendations for improvement of water and ecological situation in the basin territory are offered.

Keywords: *landscape planning, river basin, basin approach, position-dynamic structure of the landscape, estimation of significance and sensitivity of landscape.*

References

1. *Landshaftnoe planirovanie: printsipy, metody, evropeiskii i rossiiskii opyt* [Landscape planning: principles, methods, European and Russian experience]. Eds. A.N. Antipov, A.V. Drozdov. Irkutsk, Izd-vo In-ta geografii SO RAN, 2002, 141 p.

2. Pozachenyuk E.A. Teoreticheskie podkhody k landshaftnomu planirovaniyu [Theoretical approaches to landscape planning]. *Uch. zapiski Tavr. nats. un-ta. Geografiya*. 2011, vol. 24 (63), No. 2, ch. 1, pp. 237-243.

3. Korytnyi L.N. *Basseinovaya kontseptsiya prirodopol'zovaniya* [Basin concept of nature management]. Irkutsk, Izd-vo In-ta geografii SO RAN, 2001, 163 p.

4. *Metodicheskie ukazaniya po landshaftnym issledovaniyam dlya sel'skokhozyaistvennykh tselei* [Methodological guidelines for landscape research for agricultural purposes]. Eds. G.I. Shvebs, P.G. Shishchenko. Moscow, Izd-vo VASKhNIL, 1990, 58 p.

5. Pozachenyuk E.A., Lisetskii F.N., Vlasova A.N., Buryak Zh.A., Marinina O.A., Kalinchuk I.V. Model of position-dynamic structure of river basins. *Research J. of Pharmaceutical, Biological and Chemical Sciences*. 2015, vol. 6, No. 6, pp. 1776-1780.

6. *Landshaftno-tipologicheskaya karta Kryma* [Landscaping and typological map of the Crimea]. Comp. G.E. Grishankov. M : 1:200000. Simferopol, 1997.

7. Gagarinova O.V., Sayadyan O.Ya. Gidrologicheskie osnovy landshaftnogo planirovaniya basseina ozera Sevan [Hydrological bases of landscape planning of Lake Sevan basin]. *Geografiya i prirodnye resursy*. 2009, No. 3, pp. 143-150.

8. Vlasova A.N. [Evaluation of the significance and sensitivity of the Crimean small river basin]. *Ekosistemy malykh rek: bioraznoobrazie, ekologiya, okhrana* [Ecosystems of small rivers: biodiversity, ecology, protection]. Materials of the II All-Russian School-Conference. Yaroslavl, Filigran', 2014, vol. II, pp. 67-70.

9. Shishchenko P.G. *Printsipy i metody landshaftnogo analiza v regional'nom proektirovanii* [Principles and methods of landscape analysis in regional design]. Kiev, Fitosotsiotsentr, 1999, 284 p.

10. Vlasova A.N. [Land use structure and anthropogenic transformation of landscapes of the basins of small rivers of the Salgir system]. *Geograficheskie i geoekologicheskie issledovaniya v Ukraine i sopredel'nykh territoriyakh* [Geographical and geoecological studies in Ukraine and adjacent territories]. Materials of the II International Scientific Conference of Students, Postgraduates and Young Scientists. Simferopol, DIAIPI, 2013, vol. 1, pp. 23-27.

11. Timchenko Z.V. *Vodnye resursy i ekologicheskoe sostoyanie malykh rek Kryma* [Water resources and ecological condition of small rivers of Crimea]. Simferopol, DOLYa, 2002, 152 p.

12. Yatsik A.V., Shevchuk V.Ya. *Entsiklopediya vodnogo gospodarstva, prirodokoristuvannya, prirodovidtvorennya, stalogo rozvitku* [Encyclopedia of water management, nature management, natural reproduction, sustainable development]. Kiev, Geneza, 2006, 1000 p.

13. *Vodnyi kodeks Rossiiskoi Federatsii* [Water Code of the Russian Federation]. Moscow, Prospekt, KnoRus, 2014, 48 p.

14. Vlasova A.N. [Landscape planning of the Maly Salgir river basin]. *Geograficheskie issledovaniya Evrazii: istoriya i sovremennost'* [Geographical investigations of Eurasia: history and modernity]. Proceedings of the International Scientific and Practical Conference of students, postgraduates and young scientists, dedicated to the 160th anniversary of the Semenov expedition in Tien Shan within the framework of the 12th Great Geographical Festival. Moscow, Pero, 2016, pp. 95-100.

Received ***March 15, 2017***

UDC 553.12+622.822.2 DOI 10.23683/0321-3005-2017-2-92-100

THE MAIN FACTORS AND ECOLOGICAL EFFECTS OF SPONTANEOUS COMBUSTION OF COAL MINE WASTE DUMPS OF THE EASTERN DONBASS

M.I. Gamow[1], I.V. Gordeev[2]
[1]Southern Federal University, Rostov-on-Don, Russia,
[2]All-Russian Scientific Research Geological Prospecting Institute of Coal Deposits, Rostov-on-Don, Russia

Mikhail I. Gamow – Doctor of Geology and Mineralogy, Head of Department of Mineral Deposits, Institute of Earth Sciences, Southern Federal University, Zorge St., 40, Rostov-on-Don, 344090, Russia, e-mail: gamov@sfedu.ru

Ivan V. Gordeev – Deputy Director, All-Russian Scientific Research Geological Prospecting Institute of Coal Deposits, Stachki Ave., 200/1, Rostov-on-Don, 344090, Russia

References

1. Airuni A.T. *Prognozirovanie i predotvrashchenie gazodinamicheskikh yavlenii v ugol'nykh shakhtakh* [Forecasting and prevention of gas-dynamic phenomena in coal mines]. Moscow, Nauka, 1987, 310 p.

2. Lapin A.A., Merkulova A.P., Posyl'nyi V.Ya. Prichiny samovozgoraniya porodnykh otvalov v antratsitovykh raionakh Vostochnogo Donbassa [The causes of spontaneous combustion of piles in the anthracite regions of the Eastern Donbass]. *Tr. ShakhtNIUI*. 1963, vol. III, pp. 86-105.

3. Rylov V.G., Gamov M.I., Vyalov V.I., Nastav-kin A.V. Otsenka pozharoopasnosti shakhtoplastov po dannym izucheniya sklonnosti uglei k samovozgoraniyu [Estimation of the fire hazard of shlatoplast according to the study of the propensity of coals to spontaneous combustion]. *Izv. vuzov. Sev.-Kav. region. Estestv. nauki*. 2012, No. 4, pp. 98-102.

4. Rylov V.G., Meshchaninov F.V. [Typomorphic features of high-carbon fluidites from burnt dumps of the liquidated anthracite mines of the Eastern Donbass]. *Sovremennye problemy razvitiya i osvoeniya ugol'noi syr'evoi bazy Rossii* [Modern problems of development and mastering of the Russian coal resource base]. Materials of the All-Russian Coal Conference. Rostov-on-Don, VNIGRIugol', 2005, pp. 87-89.

5. Trufanov V.N., Gamov M.I., Maiskii Yu.G., Rylov V.G., Trufanov A.V. *Uglevodorodnaya flyuidizatsiya iskopaemykh uglei Vostochnogo Donbassa* [Hydrocarbon fluidization of fossil coals of the Eastern Donbass]. Rostov-on-Don, RGU, 2004, 272 p.

6. Zinchuk A.A., Kalyuzhnyi V.A., Shchiritsa A.S. *Flyuidnyi rezhim gidrotermal'nogo mineraloobrazovaniya Donbassa* [Fluid regime of hydrothermal mineral formation of Donbass]. Kiev, Naukova dumka, 1983, 164 p.

7. Saranchuk V.I., Baev X.A. *Teoreticheskie osnovy samovozgoraniya uglei* [Theoretical basis of self-ignition of coals]. Moscow, Nedra, 1976, 151 p.

8. Veselovskii V.S., Vinogradov L.P. [i dr.]. *Prognoz i profilaktika endogennykh pozharov* [Forecast and prevention of endogenous fires]. Moscow, Nauka, 1975, 159 p.

9. Trufanov V.N., Gamov M.I., Dudkevich L.K., Maiskii Yu.G., Trufanov A.V. *Osnovy prikladnoi termobarogeokhimii* [Fundamentals of applied thermobarogeochemistry]. Rostov-on-Don, YuFU, 2008, 280 p.

10. Zakrutkin V.E., Gibkov E.V. Tekhnogennye geokhimicheskie potoki ugledobyvayushchikh territorii i ikh vliyanie na okruzhayushchuyu sredu (na primere Donetskogo basseina) [Technogenic geochemical flows of coal-mining territories and their impact on the environment (on the example of the Donetsk basin)]. *Izv. vuzov. Sev.-Kavk. region. Estestv. nauki*. 2016, No. 3, pp. 66-72.

11. *Instruktsiya po izucheniyu i otsenke poputnykh tverdykh poleznykh iskopaemykh i komponentov pri razvedke mestorozhdenii uglya i goryuchikh slantsev* [Instructions for the study and evaluation of associated solid minerals and components in the exploration of coal and shale deposits]. Moscow, Nauka, 1987.

Received ***February 22, 2017***

UDC 504.064 DOI 10.23683/0321-3005-2017-2-101-109

MODERN CHEMICAL COMPOSITION AND TRENDS OF SPATIAL-TEMPORAL VARIABILITY OF THE WATER QUALITY OF THE EASTERN DONBASS RIVERS

V.E. Zakrutkin[1], O.S. Reshetnyak[1], G.G. Babayan[2], E.V. Gibkov[1], G.A. Sahakyan[2], V.N. Reshetnyak[1]

[1]Southern Federal University, Rostov-on-Don, Russia,
[2]Center for Ecological and Noospheric Studies, National Academy of Sciences of Armenia, Yerevan, Armenia

Vladimir E. Zakrutkin – Doctor of Geology and Mineralogy, Professor, Head of the Department of Geoecology and Applied Geochemistry, Institute of Earth Sciences, Southern Federal University, Zorge St., 40, Rostov-on-Don, 344090, Russia, e-mail: vezak@list.ru

Olga S. Reshetnyak − Candidate of Geography, Associate Professor, Department of Geoecology and Applied Geochemistry, Institute of Earth Sciences, Southern Federal University, Zorge St., 40, Rostov-on-Don, 344090, Russia, e-mail: olgare1@rambler.ru

Gayane G. Babayan – Doctor of Technical Sciences, Senior Researcher, Department of Environmental Geochemistry, Center for Ecological and Noospheric Studies, National Academy of Sciences of Armenia, Abovyana St., 68, Yerevan, 0025, Armenia, e-mail: gayane.babayan@cens.am

Eugenyi V. Gibkov – Candidate of Geography, Senior Lecturer, Department of Geoecology and Applied Geochemistry, Institute of Earth Sciences, Southern Federal University, Zorge St., 40, Rostov-on-Don, 344090, Russia, e-mail: irvict@mail.ru

Gevorg A. Sahakyan – Laboratory Assistant-Researcher, Department of Environmental Geochemistry, Center for Ecological and Noospheric Studies, National Academy of Sciences of Armenia, Abovyana St., 68, Yerevan, 0025, Armenia, e-mail: gevorg.sahakyan@cens.am

Victor N. Reshetnyak – Student, Institute of Earth Sciences, Southern Federal University, Zorge St., 40, Rostov-on-Don, 344090, Russia, e-mail: vnresh3@gmail.com

Results of the assessment of the modern chemical composition and trends in the spatial and temporal variability of the quality of the Eastern Donbass river waters (the Tuzlov and Seversky Donets basins) was presented in the article. It is shown that surface waters are stably contaminated by a wide range of macro- and microcomponents. There are sulfates, ions of Na, K and Mg, and among from microcomponents - Fe, Al, Mn, Cu, Sr. A comparative assessment of the chemical composition of the surface waters of the two basins has shown that the rivers of the Tuzlov basin outperform the rivers of the Seversky Donets basin for the content of all macro- and microcomponents.

For 2010-2015 the water quality of the most sections of rivers is practically unchanged, and the pollution level remains stably high (grade 5 quality is "extremely dirty"). In some parts of the rivers there is a tendency to improve the water quality (for the Kalitva river, the upper reaches of the Bolshoi and Malyi Nesvetai rivers, the mouths of the Grushevka, Bolshaya Kamenka and Likhaya rivers). Some decline in water quality was recorded in the central part of the Eastern Donbass in the upper reaches of the small rivers of the Tuzlov basin (Ayuta, Malyi Nesvetai and Grushevka) and is most likely associated with the influence of coal industry objects.

Keywords: *chemical composition, water quality, water quality trends, river water, Eastern Donbass.*

References

1. Zakrutkin V.E., Ivanik V.M. [State of pollution of the rivers of the Rostov Region in the areas of technogenic influence of the liquidated mines of the Eastern Donbass (the Tuzlov river basin)]. *Sovremennye fundamental'nye problemy gidrokhimii i monitoringa kachestva poverkhnostnykh vod Rossii* [Modern fundamental problems of hydrochemistry and monitoring of the quality of the surface waters in Russia]. Proceedings of the Scientific and Practical Conference with international participation. Ch. 1. Rostov-on-Don, 2009, pp. 88-91.

2. Zakrutkin V.E., Ivanik V.M., Gibkov E.V., Sklyarov V.V. Otsenka vliyaniya likvidiruemykh shakht Vostochnogo Donbassa na gidrokhimicheskii sostav malykh rek basseina Severskogo Dontsa [Assessment of the impact of the liquidated mines of the Eastern Donbass on the hydrochemical composition of small rivers in the Seversky Donets Basin]. *Izv. vuzov. Sev.-Kavk. region. Estestv. nauki*. 2010, No. 3, pp. 84-87.

3. Zakrutkin V.E., Gibkov E.V., Sklyarenko G.Yu., Reshetnyak O.S. Sravnitel'naya otsenka kachestva poverkhnostnykh i podzemnykh vod Vostochnogo Donbassa po gidrokhimicheskim pokazatelyam [Comparative assessment of the quality of the surface and groundwaters of the Eastern Donbass on hydrochemical indicators]. *Izv. vuzov. Sev.-Kavk. region. Estestv. nauki*. 2016, No. 2, pp. 91-99.

4. Nikanorov A.M., Zakrutkin V.E., Reshetnyak O.S., Gibkov E.V., Reshetnyak V.N. [Variability of the chemical composition and quality of surface waters of technogenically disturbed geosystems of the Eastern Donbass]. *Fundamental'nye problemy vody i vodnykh resursov* [Fundamental problems of water and water resources]. Proceedings of the Fourth All-Russian Scientific Conference with International Participation. Moscow, September 15-18, 2015. Moscow, IVP RAN, 2015, pp. 186-188.

5. Reshetnyak O.S., Nikanorov A.M., Zakrutkin V.E. [Modern chemical composition of river water in the territory of the Eastern Donbass]. *Sovremennye problemy gidrokhimii i monitoringa kachestva poverkhnostnykh vod* [Modern problems of hydrochemistry and surface water quality monitoring]. Materials of a scientific conference with international participation. Ch. 2. Rostov-on-Don, 2015, pp. 263-267.

6. Reshetnyak O.S., Nikanorov A.M., Zakrutkin V.Ye., Gibkov Ye.V. The Chemical Composition of Surface Waters of Techno-genically Affected Geo-Systems in the Eastern Donbas Region. *European Researcher*. 2014, vol. (86), No. 11-1, pp. 1978-1992.

7. Privalenko V.V. [Pollution of surface water]. *Problemy i perspektivy kompleksnogo osvoeniya mineral'nykh resursov Vostochnogo Donbassa* [Problems and prospects of integrated development of mineral resources of the Eastern Donbass]. Rostov-on-Don, 2005, pp. 143-147.

8. Reshetnyak O.S., Zakrutkin V.E., Gibkov E.V. [Microelements in the river waters of the Eastern Donbass]. *Geoekologicheskie problemy uglepromyshlennykh territorii* [Geoecological problems of coal-mining territories]. Collection of proceedings of a Scientific Conference with international participation. Rostov-on-Don, Izd-vo YuFU, 2015, pp. 283-295.

9. *Ekologicheskii monitoring likvidatsii neperspektivnykh shakht Vostochnogo Donbassa* [Ecological monitoring of the liquidation of unpromising mines of the Eastern Donbass]. Ed. V.M. Eremeev. Shakhty, 2001, 182 p.

10. *RD 52.24.643-2002. Metodicheskie ukazaniya. Metod kompleksnoi otsenki stepeni zagryaznennosti poverkhnostnykh vod po gidrokhimicheskim pokazatelyam* [RD 52.24.643-2002. Methodical instructions. The method of integrated assessment of the degree of contamination of surface waters by hydrochemical indicators]. Saint Petersburg, Gidrometeoizdat, 2002, 49 p.

11. Reshetnyak V.N., Reshetnyak O.S. [Trends in the variability of water quality in the Tuzlov River]. *Aktual'nye problemy nauk o Zemle* [Actual problems of Earth Sciences]. Collection of proceedings of a Scientific Conference of students and young scientists with international participation. Rostov-on-Don, Izd-vo YuFU, 2015, pp. 404-407.

12. Zakrutkin V.E., Gibkov E.V., Reshetnyak O.S., Sklyarenko G.Y. Changing hydrochemical indicators of the rivers of East Donbassin a consequence the liquidation of the unprofitable coal mines. *15th International Multidisciplinary Scientific GeoConference. Surveying Geology and Mining Ecology Management. SGEM*. 2015, pp. 113-120.

13. Zakrutkin V., Sklyarenko G., Reshetnyak O., Gibkov E. Comparative evaluation of surface water and groundwater quality of the Eastern Donbass by hydrochemical indicators. *16th International Multidisciplinary Scientific GeoConference SGEM*. 2016, b. 3, vol. 1, pp. 177-188.

Received ***March 20, 2017***

UDC 616-036.22+574.224 DOI 10.23683/0321-3005-2017-2-110-117

INTERRELATION OF ENVIRONMENTAL POLLUTION AND ENVIRONMENTALLY CAUSED MORBIDITY IN THE TERRITORY OF TECHNOGENIC POLLUTION

S.I. Leshchuk[1], I.V. Surkova[2], N.V. Senkevich[3]

[1]Irkutsk Institute (Branch), All-Russian State University of Justice, Irkutsk, Russia,
[2]Siberian Academy of the Law, Economy and Management, Irkutsk, Russia,
[3]Irkutsk Department of Hydrometeorology and Environmental Monitoring, Irkutsk, Russia

Svetlana I. Leshchuk – Doctor of Biology, Professor, Department of Natural and Information Technologies, Irkutsk Institute (Branch), All-Russian State University of Justice, Nekrasova St., 4, Irkutsk, 664011, Russia, e-mail: leschuk.swet@yandex.ru

Irina V. Surkova – Postgraduate, Department of Ecology, Siberian Academy of the Law, Economy and Management, Surikova St., 21, Irkutsk, 664025, Russia, e-mail: suririna07@mail.ru,

Natalia V. Senkevich – Leading Specialist, Irkutsk Department of Hydrometeorology and Environmental Monitoring, Partizanskaya St., 76, Irkutsk, 664047, Russia

The purpose of the article was to study the effect of environmental factors and the anthropogenic impact on the health of the population of Irkutsk. The analysis of climatic conditions is made, as well as the anthropogenic load on the studied territory. The main air pollutants are presented (transport and energy companies), detail designated air pollutants. The impact of pollutants on human health described. The state of population health is analyzed and found the prevalence of environmentally induced disease.

The degree of closeness of the relationship between emissions of stationary sources of pollution of the city of Irkutsk for the 2008-2011, have established correlation coefficient r. If the values $0.1<r<0.3$, then the connection is weak if $0.3<r<0.5$, the bond reasonable if $0.5<r<0.7$ - rather strong dependence if the values $0.7<r<0.9$ - bond is high, if the values $0.9<r<0.99$ - the connection is very high. Indicators closeness of the connection between emissions calculated to Excel, given by the Cheddok's scale.

Research objects:

1. Natural and climatic terms of territory of the Irkutsk area.

2. Morbidity of population of the Irkutsk area.

3. To describe the state of population health and educe prevalence of the ecologically conditioned morbidity on the studied territory.

Article of research: *state of health of population, formed under act of natural and ecological factors.*

Keywords*: air pollution, pollutants, sources of pollution, morbidity of the population.*

References

1. Petrov S.B. Ekologo-epidemiologicheskaya otsenka vliyaniya vzveshennykh veshchestv v atmosfernom vozdukhe na razvitie boleznei sistemy krovoobrashcheniya [Ecological and epidemiological assessment of the influence of suspended solids in the atmospheric air on the development of diseases of the circulatory system]. *Ekologiya cheloveka*. 2011, No. 2, pp. 3-7.

2. Savilov E.D. Proyavleniya infektsionnoi patologii v usloviyakh zagryazneniya okruzhayushchei sredy [Manifestations of infectious pathology in environmental contamination]. *Byul. Vostochno-Sibirskogo nauch. otdela SO RAMN*. 2007, No. 2, pp. 84-89.

3. *Gosudarstvennyi doklad o sostoyanii i ob okhrane okruzhayushchei prirodnoi sredy Irkutskoi oblasti (2000–2015 gg.)* [State report on the state and protection of the environment of the Irkutsk region (2000-2015)]. Irkutsk, 2001-2016.

4. Petrov S.B., Onuchina E.N., Petrov B.A. Ekologo-epidemicheskoe issledovanie vliyaniya atmosfernykh vybrosov gorodskogo promyshlenno-energeticheskogo kompleksa na zdorov'e naseleniya [Ecological and epidemiological study of the influence of atmospheric emissions of urban industrial-energy complex on public health]. *Ekologiya cheloveka*. 2012, No. 3, pp. 11-15.

5. Semechkina V.S. Vliyanie tekhnogennogo pressinga na pokazatel' zabolevaemosti tuberkulezom organov dykhaniya [Influence of technogenic pressure on the incidence rate of respiratory tuberculosis]. *Izv. YuFU. Tekhn. nauki.* 2009, No. 7, pp. 7-12.

6. Orlova G.P., Demidova S.V., Fridman K.B., Lim T.E. Vliyanie aeropollyutantov na sootnoshenie nespetsificheskogo i atopicheskogo protsessov pri formirovanii boleznei organov dykhaniya v ekologicheskikh usloviyakh Sankt-Peterburga [Influence of airplants on the ratio of nonspecific and atopic processes in the formation of respiratory diseases in the environmental conditions of St. Petersburg]. *Biosfera*. 2010, vol. 2, No. 4, pp. 566-575.

7. Strukova E.B., Balbus Dzh., Golub A.A. [Risk to health and economic assessment of damage from air pollution in Russia]. Klimat, kachestvo atmosfernogo vozdukha i zdorov'e moskvichei [Climate, air quality and health of Muscovites]. Moscow, 2006, pp. 141-176.

8. Surkova I.V., Leshchuk S.I. *Ekologo-ekonomicheskaya otsenka poter' zdorov'ya naseleniya* [Ecological and economical assessment of public health losses]. LAP Lambert Academic Publishing, 2014, 72 p.

Received ***February 2, 2017***

UDC 504.454 DOI 10.23683/0321-3005-2017-2-118-127

POLYCYCLIC AROMATIC HYDROCARBONS IN THE AQUATIC LANDSCAPES OF THE DON RIVER DELTA IN WINTER

T.S. Koshovskii[1], O.V. Tkachenko[1], A.N. Tkachenko[1], A.S. Tsibart[1], M.Yu. Lychagin[1]
[1]Lomonosov Moscow State University, Moscow, Russia

Timur S. Koshovskii – Engineer, Faculty of Geography, Lomonosov Moscow State University, Leninskie Gory, 1, Moscow, 119991, Russia, e-mail: tkzv@ya.ru

Oleg V. Tkachenko – Laboratory Assistant, Faculty of Geography, Lomonosov Moscow State University, Leninskie Gory, 1, Moscow, 119991, Russia, e-mail: tov1989@ya.ru

Anna N. Tkachenko – Candidate of Geography, Researcher, Faculty of Geography, Lomonosov Moscow State University, Leninskie Gory, 1, Moscow, 119991, Russia, e-mail: tkachenkomsu@yandex.ru

Anna S. Tsibart – Candidate of Geography, Researcher, Faculty of Geography, Lomonosov Moscow State University, Leninskie Gory, 1, Moscow, 119991, Russia, e-mail: tsibann@gmail.com

Michail Yu. Lychagin – Candidate of Geography, Associate Professor, Faculty of Geography, Lomonosov Moscow State University, Leninskie Gory, 1, Moscow, 119991, Russia, e-mail: Lychagin2008@gmail.ru

The content and composition of polycyclic aromatic hydrocarbons (PAHs) are evaluated in suspended matter, ice, snow cover and bottom sediments of aquatic landscapes of the Don River delta. PAHs were studied by spectrofloutimetry at low temperatures. Atmospheric dust in snow cover had concentration from 8 000 to 100 000 ng/g. PAH content in the water ranges from 4 to 77 ng/l in the suspended matter from 700 to 15500 ng/g. Higher values of PAH content are typical for weakly running streams. Major shipping channels have lower concentrations, PAH content in the ice higher than in the water, because of their accumulation on the ice surface due to freezing in a hydrocarbon film. PAH content in the bottom sediments is about 33 ng/g, which is significantly less than the concentration in the suspended matter. The upper layer of sediments with the oxidizing atmosphere has reduced levels of PAH as compared with the lower layers. Individual PAHs are grouped by their ability to conservation in the bottom sediment: (i) benzo(ghi)perylene and anthracene have maximum

degradation rate; (ii) phenanthrene, naphthalene and benzantracene have an average degradation rate, (iii) benzo(a)pyrene and chrysene are the most stable. The level of the Don River delta pollution by polycyclic aromatic hydrocarbons estimated as low.

Keywords: *polycyclic aromatic hydrocarbons, river delta, aquatic landscapes, ice sheet, bottom sediments, suspended matter, dissolved organic matter.*

References

1. Nemirovskaya I.A., Brekhovskikh V.F., Kazmi¬ruk V.D. Alifaticheskie i poliaromaticheskie uglevodorody v donnykh osadkakh ust'evogo vzmor'ya r. Volgi [Aliphatic and polyaromatic hydrocarbons in bottom sediments of the estuary seashore of the Volga River]. *Vodnye resursy*. 2006. vol. 33, No. 3, pp. 300-310.

2. Opekunov A.Yu., Mitrofanova E.S., Sanni S., Kommedal R., Opekunova M.G., Bagi A.S. Politsiklicheskie aromaticheskie uglevodorody v donnykh otlozheniyakh rek i kanalov Sankt-Peterburga [Polycyclic aromatic hydrocarbons in bottom sediments of rivers and canals of St. Petersburg]. *Vestn. Sankt-Peterburgskogo un-ta.* 2015, vol. 4, No. 7, pp 98-109.

3. Romanenko V.D., Lyashenko A.V., Afanas'ev S.A., Konovets I.N., Kipnis L.S., Zorina-Sakharova E.E., Terletskaya A.V., Milyukin M.V., Demchenko V.Ya., Byurges R.M., Kho K.T. Kompleksnaya kharakteristika donnykh otlozhenii raznotipnykh vodnykh ob"ektov avandel'ty Kiliiskogo rukava Dunaya [Complex characterization of bottom sediments of various types of water bodies in the avandelty of the Kilian sleeve of the Danube]. *Gidrobiol. zhurn*. 2011. vol. 3, No. 47, pp. 3-20.

4. Kuznetsov A.N., Fedorov Yu.A. Neftyanye komponenty v ust'evoi oblasti r. Don i Azovskom more (rezul'taty mnogoletnikh issledovanii) [Oil components in the estuary region of the river Don and the Sea of Azov (the results of many years of research)]. *Vodnye resursy*. 2014, vol. 41, No. 1, pp. 49-59.

5. Matishov G.G., Stepan'yan O.V., Khar'kovskii V.M., Soier V.G. Neftyanoe zagryaznenie Azovskogo i Chernogo morei rastet [Oil pollution of the Azov and Black Seas is growing]. *Priroda*. 2016, No. 5, pp. 64-69.

6. Khovanskii A.D. *Geokhimiya akval'nykh landshaftov* [Geochemistry of aquatic landscapes]. Rostov-on-Don, Izd-vo RGU, 1993, 240 p.

7. Pikovskii Yu.I., Ismailov N.M., Dorokhova M.F. *Osnovy neftegazovoi geoekologii* [Fundamentals of oil and gas geoecology]. Moscow, INFRA-M, 2015, 400 p.

8. *Nauchno-prikladnoi spravochnik po klimatu SSSR. Ser. 3 : Mnogoletnie dannye* [Scientific and applied handbook on the climate of the USSR. Ser. 3. Perennial data]. Ch. 1-6, iss. 13. Leningrad, Gidrometeoizdat, 1990, 725 p.

9. Wang D.G., Yang M., Jia H.L., Zhou L. Polycyclic aromatic hydrocarbons in urban street dust and surface soil: Comparisons of concentration, profile, and source. *Arch. Environ. Contam. Toxicol*. 2009, vol. 56, No. 2, pp. 173-180.

10. Zhang X.L., Tao S., Liu W.X., Yang Y., Zuo Q., Liu S.Z. Source diagnostics of polycyclic aromatic hydrocarbons based on species ratios: A multimedia approach. *Environ. Sci. Technol*. 2005, vol. 39, No. 23, pp. 9109-9114.

11. Nemirovskaya I.A. *Uglevodorody v okeane (sneg – led – voda – vzves' – donnye osadki)* [Hydrocarbons in the ocean (snow - ice - water - suspended matter - bottom sediments)]. Moscow, Nauchnyi mir, 2004, 318 p.

12. Tkachenko A.N., Gerasimova M.I., Lychagin M.Yu., Kasimov N.S., Kroonenberg S.B. Bottom sediments in deltaic shallow-water areas – are they soils? *Geography, Environment, Sustainability*. 2016, No. 3, pp. 39-52.

13. Krylov V.A., Mosyagin P.V., Krylov A.V., Bochkareva L.V., Matkivskaya Yu.O. Vliyanie sveta lyuminestsentnykh lamp na stabil'nost' obraztsov, soderzhashchikh politsiklicheskie aromaticheskie uglevodorody [Influence of light of fluorescent lamps on the stability of samples containing polycyclic aromatic hydrocarbons]. *Vestn. Nizhegorodskogo un-ta im. N.I. Lobachevskogo*. 2010, vol. 4, No. 1, pp. 79-85.

14. Khaustov A., Redina M. Polyaromatic hydrocarbons: Identification of sources of environmental pollution at the sites of production, storage and transportation of oil using the pah indicator ratios. *Pet. Abstr*. 2015, vol. 55, No. 47, p. 105.

15. Fedorov Yu.A., Stradomskaya A.G., Kuznetsov A.N. Zakonomernosti transformatsii neftyanogo zagryaz-neniya v vodotokakh po dannym mnogoletnikh nablyudenii [Regularities of the transformation of oil pollution in watercourses according to the data of long-term observations]. *Vodnye resursy*. 2006, vol. 33, No. 3, pp. 327-337.

Received ***January 23, 2017***

UDC 553.98; 550.812 DOI 10.23683/0321-3005-2017-2-128-135

THE FEATURES OF FORMING OF HYDROCARBON RESERVOIRS AND PETROLEUM PROSPECTS OF THE MESOZOIC DEPOSITS OF KARPINSKY RIDGE AND EAST-MANYCH TROUGH IN THE REPUBLIC OF KALMYKIA

Yu.V. Kuranov[1], V.F. Sharafutdinov[1], V.V. Kalabin[1], E.S. Sianisyan[2], D.A. Shlygin[1]
[1]OOO «LUKOIL-Engineering», Moscow, Russia,
[2]Southern Federal University, Rostov-on-Don, Russia

Yury V. Kuranov – Leading Specialist, Geological Exploration Department, OOO «LUKOIL-Engineering», Pokrovskii Blud, 3, build. 1, Moscow, 109028, Russia, e-mail: Yury.Kuranov@Lukoil.com

Vadim F. Sharafutdinov – Doctor of Geology and Mineralogy, Head of Lithofacies Analysis Division, Geological Exploration Department, OOO «LUKOIL-Engineering», Pokrovskii Blud, 3, build. 1, Moscow, 109028, Russia

Vasily V. Kalabin – Leading Specialist, Geological Exploration Department, OOO «LUKOIL-Engineering», Pokrovskii Blud, 3, build. 1, Moscow, 109028, Russia

Eduard S. Sianisyan – Doctor of Geology and Mineralogy, Professor, Department of Oil and Gas Geology, Institute of Earth Sciences, Southern Federal University, Zorge St., 40, Rostov-on-Don, 344090, Russia, e-mail: edward@sfedu.ru

Dmitrii A. Shlygin – Geological Exploration Department, OOO «LUKOIL-Engineering», Pokrovskii Blud, 3, build. 1, Moscow, 109028, Russia

This article describes the features of forming of hydrocarbon reservoirs of the Mesozoic age on the south of Kalmykia in the areas of East-Manych Trough and Karpinsky Ridge. The sediments of Mezozoic age included here as a significant part of already discovered fields in Kalmykia, so too a considerable number of promising structures, which has not yet been investigated by drilling. Using all available geological and geochemical data let to analyze geothermal environment and the level of catagenesis of organic substance, to determine estimated time and conditions for forming deposits of Mesozoic age, to propose schematic diagram of possible directions of migration and zones of accumulation of hydrocarbons. According to the authors, the potential of Mesozoic deposits is not fully disclosed on the territory of Republic. Authors suggest prospective areas for further exploration in the southern part of Kalmykia. These areas include as additional exploration of traditionally productive on this territories sediments of the Jurassic and Cretaceous systems, so too the Triassic complex, which insufficiently studied previously in Kalmykia.

Keywords: *petroleum prospects, Kalmykia, Karpinsky Ridge, East-Manych Trough, forming of Mesozoic deposits.*

References

1. Odoleev O.G., Kalinin V.V., Odoleev G.O. *Geologiya i neftegazonosnost' Kalmykii* [Geology and oil and gas content of Kalmykia]. Volgograd, Izd-vo VolGU, 2008, 158 p.
2. Volozh Yu.A., Antipov M.P., Leonov Yu.G., Morozov A.F., Yurov Yu.A. Stroenie kryazha Karpinskogo [The structure of the Karpinsky Ridge]. *Geotektonika*. 1999, No. 1, vol. 33, pp. 28-43.
3. Kapustin N.I., Kiryukhin A.G., Bembeev V.E. *Geologicheskoe stroenie i neftegazonosnost' Kalmykii* [Geological structure and oil and gas potential of Kalmykia]. Elista, Kalm. kn. izd-vo, 1986, 156 p.
4. Gasanguseinov G.G., Sharafutdinov F.G., Mirzoev D.A., Votsalevskii Z.S. [i dr.]. O neftegazonosnosti permskikh i triasovykh otlozhenii Yuzhnoi Kalmykii [About oil and gas content of Permian and Triassic sediments of Southern Kalmykia]. *Geologiya neftegazonosnykh kompleksov mezozoya Dagestana.* 1979, iss. 4 (23).
5. Glumov I.F., Malovitskii Ya.P., Novikov A.A., Senin B.V. *Regional'naya geologiya i neftegazonosnost' Kaspiiskogo morya* [Regional geology and oil and gas potential of the Caspian Sea]. Moscow, Nedra, 2004, 342 p.

6. Kuranov Yu.V. Otsenka perspektiv neftegazonosnosti i resursnoi bazy Kalmykii na osnove noveishikh geologo-geofizicheskikh dannykh [Estimation of prospects of oil and gas potential and resource base of Kalmykia on the basis of the newest geological and geophysical data]. *Izv. vuzov. Sev.-Kavk. region. Estestv. nauki*. 2017, No. 1, pp. 101-109.

7. Kaminov V.E-G. *Sostavlenie paleotektonicheskikh kart osadochnogo chekhla territorii Kalmytskoi ASSR v svyazi s prognozom perspektiv promyshlennoi neftegazonosnosnosti* [Compilation of paleotectonic maps of the sedimentary cover of the territory of the Kalmyk ASSR in connection with the forecast of the prospects of industrial oil and gas bearing]. PGO «Nizhnevolzhskgeologiya». 1983, 125 p.

8. Zolova I.V., Shlygin D.A., Sharafutdinov V.F., Kataev O.I., Musikhin V.A., Kalabin V.V. Neftegazomaterinskie otlozheniya Srednego Kaspiya i ego obramleniya (Sredne-Kaspiiskii neftegazonosnyi bassein) [Oil and gas maternal deposits of the Middle Caspian and its surroundings (Middle Caspian oil and gas basin)]. *Tr. In-ta geologii Dag. nauch. tsentra RAN*. 2016, iss. 66, pp. 56-59.

9. Skripnyuk O.V. *Geologo-geokhimicheskie usloviya neftegazonosnosti mezozoiskikh otlozhenii zony Manychskikh progibov i yuzhnogo sklona kryazha Karpinskogo* : avtoref. dis. … kand. geol.-min. nauk [Geological and geochemical conditions of oil and gas content of the Mesozoic deposits of the Manichsky trough zone and the southern slope of the Karpinsky ridge]. Krasnodar, 2010, 24 p.

10. Mirzoev D.A., Pirbudagov V.M., Saidova S.A. [Dissipated organic matter and geochemical formations of the Mesozoic deposits of the Eastern Ciscaucasia]. *Organicheskoe veshchestvo nefteproizvodyashchikh porod – osnovnoi UV nefti i gaza* [Organic matter of oil-producing rocks is the main hydrocarbon oil and gas]. Tashkent, Izd-vo SAIGNMS, 1975, pp. 233-245.

11. Sharafutdinov V.F., Bembeev A.V., Kuranov Yu.V., Kalabin V.V., Bembeev V.A. [Oil and gas bearing complexes of the East Manych trough of Kalmykia]. *Prirodno-resursnyi potentsial Prikaspiya i sopredel'nykh territorii: problemy ego ratsional'nogo ispol'zovaniya* [Natural and resource potential of the Caspian and adjacent territories: problems of its rational use]. Elista, 2016, pp. 17-27.

12. Sivtsova L.F. *Primenenie rezul'tatov sporo-pyl'tsevogo analiza dlya resheniya voprosov neftyanoi geologii na primere mezozoiskikh neftegazonosnykh kompleksov Vostochnogo Predkavkaz'ya* : avtoref. dis. … kand. geol.-min. nauk [Application of the results of spore-pollen analysis to solve the problems of petroleum geology on the example of the Mesozoic oil and gas bearing complexes of the Eastern Ciscaucasia]. Grozny, 1974, 18 p.

Received ***February 16, 2017***

UDC 502.574.5: 574.64 DOI 10.23683/0321-3005-2017-2-136-141

FEATURES OF WATER «FLOWERING» OF BLUE-GREEN ALGAE IN TSIMLYANSK RESERVOIR

N.A. Martysheva[1], T.A. Khoruzhaya[1,2]
[1]Hydrochemical Institute, Rostov-on-Don, Russia,
[2] Institute of Water Problems RAS, Rostov-on-Don, Russia

Natalia A. Martysheva – Junior Researcher, Hydrochemical Institute, Stachki Ave., 198, Rostov-on-Don, 344090, Russia, e-mail: natalia.ghi@yandex.ru

Tatyana A. Khoruzhaya – Doctor of Biology, Professor, Hydrochemical Institute; Main Researcher, Southern Department, Institute of Water Problems RAS, Stachki Ave., 198, Rostov-on-Don, 344090, Russia, e-mail: khorugajat@mail.ru

The analysis of biomonitoring materials of Roshydromet for 1984-1991 and reseaches of authors for 2009-2015 reveals a number of regularities in phytoplankton development and spatial distribution in Tsimlyansk Reservoir. It is shown that in recent time as before blue-green algas, including toxigenic species, occupy a dominant position in the phytoplankton community. The spatial distribution of blue-green algae in Tsimlyansk Reservoir varied with time, although there was a trend of flowering extension in the direction from the top part to the bottom. The results are being discussed in view of recent publications on biotesting of water toxicity in Tsimlyansk Reservoir and the relationship of toxicity with blue-green algae and the presence of algae toxins.

Keywords: *Tsimlyansk Reservoir, flowering, blue-green algae, toxigenic species, toxicity of water.*

References

1. Nikanorov A.M., Khoruzhaya T.A. Vnutrivodoemnye protsessy v krupnykh vodokhranilishchakh yuga Rossii: zagryaznenie, evtrofirovanie, toksifikatsiya [Intra-water processes in large reservoirs of the South of Russia: pollution, eutrophication, toxification]. *Geografiya i prirodnye resursy*. 2014, No. 2, pp. 35-43.

2. Nikanorov A.M., Khoruzhaya T.A., Martysheva N.A. Sovremennye kharakteristiki i tendentsii mnogoletnikh izmenenii ekologo-toksikologicheskogo sostoyaniya Tsimlyanskogo vodokhranilishcha [Modern characteristics and trends of long-term changes in the ecological and toxicological state of the Tsimlyansk Reservoir]. *Meteorologiya i gidrologiya*. 2012, No. 4, pp. 75-85.

3. Nikanorov A.M., Khoruzhaya T.A., Minina L.I., Martysheva N.A. Opasnost' «tsveteniya» Tsimlyanskogo vodokhranilishcha [The danger of Tsimlyansk Reservoir "flowering"]. *Vodoochistka. Vodopodgotovka. Vodosnabzhenie*. 2011, No. 2, pp. 70-74.

4. Bakaeva E.N., Ignatova N.A., Chernikova G.G. Ekotoksichnost' vod priplotinnogo uchastka Tsimlyanskogo vodokhranilishcha [Ecotoxicity of the waters of the dam of the Tsimlyansk Reservoir]. *Global'naya yadernaya bezopasnost'*. 2012, No. 3, pp. 5-11.

5. Lavrova O.Yu., Solov'ev D.M., Strochkov A.Ya., Shendrik V.D. Sputnikovyi monitoring intensivnogo tsveteniya vodoroslei v Rybinskom vodokhranilishche [Satellite monitoring of intense algae blooms in the Rybinsk Reservoir]. *Sovremennye problemy distantsionnogo zondirovaniya Zemli iz kosmosa*. 2014, vol. 11, No. 3, pp. 54-72.

6. Kalinina S.G., Khodyakov E.A., Yakovlev S.V. Uluchshenie ekologicheskogo sostoyaniya priplotinnogo plesa Tsimlyanskogo vodokhranilishcha metodom al'golizatsii [Improvement of the ecological state of the dam of the Tsimlyansk Reservoir by the algalization method]. *Global'naya yadernaya bezopasnost'*. 2012, No. 3, pp. 72-82.

7. Voloshko L.N., Plyushch A.V., Titova N.N. Toksiny tsianobakterii Cyanophyta, Cyanobacteria [Toxins of cyanobacteria Cyanophyta, Cyanobacteria]. *Al'gologiya*. 2008, vol. 18, No. 1, pp. 3-20.

8. Kozhevnikov I.V., Kozhevnikova N.A., Skorobogat'ko N.E. Izuchenie potentsial'noi mikrotsistin-toksichnosti sine-zelenykh vodoroslei Krasnoyarskogo vodokhranilishcha [A study of the potential microcystin toxicity of the blue-green algae of the Krasnoyarsk Reservoir]. *Antropogennoe vliyanie na vodnye organizmy i ekosistemy* [Anthropogenic impact on aquatic organisms and ecosystems]. Materials of the III All-Russian Conference on Aquatic Toxicology, dedicated to the memory of B.A. Flerov. Borok, Yaroslavskii pechatnyi dvor, 2008, ch. 3, pp. 47-51.

9. Matishov G.G., Kovaleva G.V. «Tsvetenie» vody v vodoemakh yuga Rossii i sboi v vodosnabzhenii (na primere g. Volgodonska) ["Flowering" of water in the reservoirs of the South of Russia and disruptions in water supply (by the example of Volgodonsk)]. *Vestn. YuNTs RAN*. 2010, vol. 6, No. 1, 129 p.

10. Sidelev S.I., Golokolenova T.B., Chernova E.N., Russkikh Ya.V. Analiz fitoplanktona Tsimlyanskogo vodokhranilishcha (Rossiya) na nalichie tsianobakterial'nykh gepato- i neirotoksinov [Phytoplankton analysis of the Tsimlyansk Reservoir (Russia) for the presence of cyanobacterial hepato- and neurotoxins]. *Mikrobiologiya*. 2015, vol. 84, No. 6, pp. 732-742.

11. Khoruzhaya T.A., Martysheva N.A. Svyazana li toksichnost' vody vodokhranilishch s sine-zelenymi vodoroslyami? [Is the toxicity of the reservoir water related to blue-green algae?]. *Voda: khimiya i ekologiya*. 2014, No. 7, pp. 110-114.

12. Bakaeva E.N., Nikanorov A.M., Ignatova N.A., Chernikova G.G. [Ecological and toxicological situation of the Tsimlyansk Reservoir in the modern period]. *Voda i vodnye resursy: sistemoobrazuyushchie funktsii v prirode i ekonomike* [Water and water resources: system-forming functions in nature and economy]. Materials of the All-Russian Scientific Conference (Tsimlyansk, July 23-28, 2012). Novocherkassk, YuRGTU (NPI), 2012, pp. 151-157.

13. [On the state of the environment and natural resources of the Rostov Region in 2003: the state report]. *Ekol. vestn. Dona* [The Ecological Herald of the Don]. Rostov-on-Don, Administration of the Rostov Region, Committee for Environmental Protection and Natural Resources of the Administration, 2004, 262 p.

Received ***January 31, 2017***