Geosistemy perehodnykh zon = Geosystems of Transition Zones / Геосистемы переходных зон

2021, vol. 5, No. 3, pp. 287–304

URL: http://journal.imgg.ru/archive.html ; https://elibrary.ru/title_about.asp?id=64191

https://doi.org/10.30730/gtrz.2021.5.3.287-304

Development of Solontsovskie Lakes as indicator of humidity within Central Sikhote-Alin in the Late Holocene

Nadezhda G. Razjigaeva[1] (https://orcid.org/0000-0001-7936-1797), nadyar@tigdvo.ru

Larisa A. Ganzey[1] (https://orcid.org/0000-0002-2538-6603), lganzey@mail.ru

Tatiana A. Grebennikova[1] (https://orcid.org/0000-0002-5805-391X), tagrebennikova@mail.ru

Tatiana A. Kopoteva[2] (https://orcid.org/0000-0003-4824-9959), kopoteva@ivep.as.khb.ru

Mikhail A. Klimin[2] (https://orcid.org/0000-0003-1329-5437), m_klimin@bk.ru

Marina S. Lyashchevskaya[1] (https://orcid.org/0000-0002-5624-3015), lyshevskay@mail.ru

Alexander M. Panichev[1] (https://orcid.org/0000-0001-5223-443X), sikhote@mail.ru

Khikmatulla A. Arslanov[3] (https://orcid.org/0000-0002-2302-8175), arslanovkh@mail.ru

Fedor E. Maksimov[3] (https://orcid.org/0000-0002-9429-3216), maksimov-fedor@yandex.ru

Aleksey Yu. Petrov[3] (https://orcid.org/0000-0002-7577-9114), petrovalexey1987@gmail.com

[1] Pacific Geographical Institute, Far Eastern Branch, Russian Academy of Science, Vladivostok, Russia
[2] Institute of Water and Ecology Problems, Far Eastern Branch, Russian Academy of Science, Khabarovsk, Russia
[3] Saint-Petersburg State University, Saint-Petersburg, Russia

Abstract PDF ENG Резюме PDF RUS Full text PDF RUS

Abstract. The stages of development of small Solontsovskie (Shanduyskie) Lakes located in the middle mountains of the Central Sikhote-Alin within large landslides, formed on the slopes of the paleovolcano, are identified on the basis of complex study of the sediment section of the Nizhnee Lake. The ecological-taxonomic composition of the diatom flora, the botanical composition of peat have been analyzed, and the tendencies of lacustrine sedimentation depending on the different scale of hydroclimatic changes in the Late Holocene have been established. The age model is based on 6 radiocarbon dates. The temporary resolution for the reconstructions is 30–60 years. A comparison of the development of Nizhnee and Izyubrinye Solontsi Lakes was carried out, the stages of watering and shallowing of lakes were identified on the basis of their dynamics, which made it possible to restore the change in moisture in the middle mountains. Organogenic deposits in lacustrine basins accumulated at high rates (up to 1.7–1.9 mm/year). The most detailed data were obtained for the last 2.6 thousand cal. yr BP based on the study of the sediment section of the Nizhnee Lake, which responded more sensitively to changing climatic conditions. Frequent changes in diatom assemblages and peat-forming plants indicate unstable hydroclimatic conditions with varying degrees of watering and drainage up to complete overgrowth of water bodies. According to the data of diatom analysis, a successive change in the trophicity of the lake was traced. A frequent change of sphagnum mosses of different sections with different trophic preferences was established. The main reason for the change in the hydrological regime of the lakes was variations in precipitation during the short-term climatic changes. The correlation of the identified paleoclimatic events with global data has been carried out. Cooling periods, as a rule, were accompanied by a decrease in moisture, but the Little Ice Age was wet due to an increase in precipitation.

Keywords:

mountain lakes, peat accumulation, diatoms, botanical composition, climatic changes, Holocene, south Far East

For citation: : Razjigaeva N.G., Ganzey L.A., Grebennikova T.A., Kopoteva T.A., Klimin M.A., Lyaschevskaya M.S., Panichev A.M., Arslanov Kh.A., Maksimov F.E., Petrov A.Yu. Development of Solontsovskie Lakes as indicator of humidity within Central Sikhote-Alin in the Late Holocene. *Geosistemy perehodnykh zon = Geosystems of Transition Zones*, 2021, vol. 5, no. 3, pp. 287–304. (In Russ., abstr. in Engl.). https://doi.org/10.30730/gtrz.2021.5.3.287-304

Для цитирования: Разжигаева Н.Г., Ганзей Л.А., Гребенникова Т.А., Копотева Т.А., Климин М.А., Лящевская М.С., Паничев А.М., Арсланов Х.А., Максимов Ф.Е., Петров А.Ю. Развитие Солонцовских озер как показатель динамики увлажнения в Центральном Сихотэ-Алине в позднем голоцене. *Геосистемы переходных зон*, 2021, т. 5, № 3, с. 287–304. https://doi.org/10.30730/gtrz.2021.5.3.287-304

References

1. Bazarova V.B., Grebennikova T.A., Orlova L.A. **2014.** Natural-environment dynamics within the Amur basin during the Neoglacial. *Geography and Natural Resources*, 35(3): 275–283. https://doi.org/10.1134/s1875372814030111
2. Bazarova V.B., Klimin M.A., Kopoteva T.A. **2018a.** Holocene dynamic of Eastern-Asia Monsoon in Lower Amur Area. *Geography and Natural Resources*, 39(3): 239–247. https://doi.org/10.1134/s1875372818030071

3. Bazarova V.B., Lyashchevskaya M.S., Makarova T.R., Orlova L.A. **2018b.** Environments of the middle-late Holocene sedimentation in the river flood-plains of the Prikhanka Plain (southern Far East). *Tikhookeanskaya Geologiya*, 37(1): 94–105. (In Russ.). https://doi.org/10.30911/0207-4028-2018-37-1-94-105
4. Bazarova V.B., Razzhigaeva N.G., Ganzey L.A., Kopoteva T.A., Mokhova L.M., Panichev A.M., Klimin M.A. **2017.** Pyrogenic events in the south of the Far East in the Late Pleistocene–Holocene. *Geography and Natural Resources*, 4: 122–132. (In Russ.). https://doi.org/10.21782/gipr0206-1619-2017-4(122-132)
5. Barinova S.S., Medvedeva L.A., Anisimova O.V. **2006.** [*Biodiversity of the algae serving as environment indicators*]. Tel'-Aviv: Pilies Studio, 498 p.
6. Belyanin P.S., Belyanina N.I. **2018.** Evolution of the valley ecosystems in the Lower reach of the Bikin River in the Late Pleistocene and Holocene. *Geography and Natural Resources*, 39(4): 365–374. https://doi.org/10.1134/S1875372818040108
7. Vasil'ev N.G., Matyushkin E.N. (eds) **1982.** [*Flora and fauna of the Sikhote-Alin nature reserve*]. Moscow: Nauka, 304 p. (In Russ.).
8. Vetrennikov V.V. **1976.** [*Geological structure of the Sikhote-Alin state nature reserve and the Central Sikhote-Alin*]. Vladivostok: Dal'nevost. kn. izd-vo, 168 p.
9. Gleser S.I., Jousè A.P., Makarova I.V., Proschkina-Lavrenko A.I., Sheshukova-Poretzkaja V.S. (eds) **1974.** *Diatoms of the USSR (fossil and modern)*. Vol. 1. Leningrad: Nauka, 403 p.
10. Davydova I.N. **1985.** *Diatoms as indicators of environmental conditions in the Holocene water bodies*. Leningrad: Nauka, 244 p.
11. Ignatov M.S., Ignatova E.A. **2004.** *Moss flora of the Middle European Russia.* Vol. 2: *Fontinalaceae – Amblystegiaceae*. Moscow: KMK Scientific Press Ltd, p. 609–944.
12. Klimenko V.V. **2009.** *Klimat: neprochitannaya glava istorii* [*Climate: unread chapter of history*]. Moscow: MEI, 408 p.
13. Kopoteva T.A., Kuptsova V.A. **2011.** Fire in waterlogged open larch forests in the Amur r. Area. *Bull. of the North-East Scientific Center of FEB RAS*, 3: 37–41. (In Russ.).
14. Korotkiy A.M. **2002.** Palinologicheskie kharakteristiki i radiouglerodnye datirovki verkhnechetvertichnykh otlozheniy Rossiyskogo Dal'nego Vostoka (nizov'ya r. Amur, Primor'e, o. Sakhalin, Kuril'skie ostrova) [Palynological characteristics and radiocarbon dates of the Upper Quaternary deposits of the Russian Far East (the Lower Amur, Primorye, Sakhalin Island, Kuril Islands]. In: *Pozdnechetvertichnye rastitel'nost' i klimaty Sibiri i Rossiyskogo Dal'nego Vostoka (palinologicheskaya i radiouglerodnaya baza dannykh)* [*The Late Quaternary vegetation and climate of Siberia and the Russian Far East (palynological and radiocarbon database)*]. Magadan: SVNTs DVO RAN, p. 257–369.
15. Kulikova G.G. **1974.** *Kratkoe posobie k botanicheskomu analizu torfa* [*A short guide to botanical analysis of peat*]. Moscow: Izd-vo MGU, 94 p. (In Russ.).
16. Kur'ina I.V. **2011.** Ecology of testate amoebae as hydrological regime indicators in oligotrophic peatlands in the southern taiga of Western Siberia. *Izv. Penz. gos. pedagog. univ. im. V.G. Belinskogo*, 25: 368–375. (In Russ.).
17. Mazey Yu.A., Tsyganov A.N. **2006.** [*Freshwater testate amoebae*]. Moscow: KMK, 300 p. (In Russ.).
18. Mazey Yu.A., Tsyganov A.N., Mityaeva O.A., Babeshko K.V. **2013.** [Sphagnum-dwelling testate amoebae (according to the materials of "The Volga steppe nature reserve")]. *Izv. vysshikh uchebnykh zavedeniy. Povolzhskiy region. Estestvennye nauki*, 3: 4–18. (In Russ.).
19. Marchenko N.A. **1991.** [Vertical gradients of meteoelements in Primorye and possibilities of extrapolating the weather stations data]. *Geografiya i prirodnye resursy*, 3: 138–143. (In Russ.).
20. Nazarova L.B., Razjigaeva N.G., Golovatyuk L.V., Biskaborn B.C., Grebennikova T.A., Ganzey L.A., Mokhova L.M., Diekmann B. **2021.** Reconstruction of environmental conditions in the eastern part of Primorsky Krai (Russian Far East) in the Late Holocene. *Contemporary Problems of Ecology*, 14(3): 218–230.https://doi.org/10.1134/S1995425521030094
21. Mikishin Yu.A., Gvozdeva I.G. **2016.** Late Subatlantic in the south of Sakhalin Island. *Advances in Current Natural Sciences*, 9: 137–142. (In Russ.).
22. Mikishin Yu.A., Petrenko T.I., Popov A.N., Orlova L.A. **2007.** [Paleogeography of Khanka Lake in the Late Holocene]. *Nauchnoe obozrenie* [*Scientific Review*], 2: 7–13. (In Russ.).
23. Mikishin Yu.A., Petrenko T.I., Gvozdeva I.G., Popov A.N., Kuz'min Ya.V., Rakov V.A., Gorbarenko S.A. **2008.** [Holocene of the Southwestern Primorye coast]. *Nauchnoe obozrenie* [*Scientific Review*], 1: 8–27. (In Russ.).
24. Panichev A.M., Popov V.K., Chekrijov I.Yu., Golokhvast K.S., Seryodkin I.V. **2012.** Kudurs of paleovolcano solontsoviy in the Tayojnaya river basin, East Sikhote-Alin. *Achievements in the Life Sciences*, 5: 7–28. (In Russ.).
25. Razzhigaeva N.G., Ganzey L.A., Mokhova L.M., Makarova T.R., Panichev A.M., Kudryavtseva E.P., Arslanov Kh.A., Maksimov F.E., Starikoiva A.A. **2016.** The Development of Landscapes of the Shkotovo Plateau of Sikhote-Alin in the Late Holocene. *Izvestiya RAN. Seriya Geograficheskaya*, 3: 65–80. (In Russ.). https://doi.org/10.15356/0373-2444-2016-3-65-80
26. Razzhigaeva N.G., Ganzey L.A., Grebbennikova T.A., Kopoteva T.A., Mokhova L.M., Panichev A.M., Kudryavtseva E.P., Arslanov Kh.A., Maksimov F.E., Petrov A.Yu., Klimin M.A. **2017.** Environmental changes recorded in deposits of the Izyubrinye Solontsi Lake, Sikhote-Alin. *Contemporary Problems of Ecology*, 4: 441–453. https://doi.org/10.1134/S1995425517040096
27. Razzhigaeva N.G., Ganzey L.A., Grebbennikova T.A., Kopoteva T.A., Klimin M.A., Panichev A.M., Kudryavtseva E.P., Arslanov Kh.A., Maksimov F.E., Petrov A.Yu. **2019a.** Paleoflood Records within Sikhote-Alin foothills during Last 2.2 ka. *Izvestiya RAN. Seriya Geograficheskaya*, 2: 85–99. (In Russ.). https://doi.org/10.31857/S2587-55662019285-99
28. Razzhigaeva N.G., Ganzey L.A., Grebennikova T.A., Mokhova L.M., Kopoteva T.A., Kudryavtseva E.P., Arslanov Kh.A., Maksimov F.E., Petrov A.Yu., Klimin M.A. **2019b.** Development of the natural environment of midlands of the Southern Sikhote-Alin recorded in the Sergeev Plateau peat bogs. *Russian J. of Pacific Geology*, 13(1): 11–28. https://doi.org/10.1134/S1819714019010056
29. *Razjigaeva N.G., Grebennikova T.A., Ganzey L.A., Gorbunov A.O., Ponomarev V.I., Klimin M.A., Arslanov Kh.A., Maksimov F.E., Petrov A.Yu.* **2020.** Reconstruction of paleotyphoons and recurrence of extreme floods in south Sakhalin Island in Middle–Late Holocene. *Geosistemy perehodnykh zon = Geosystems of Transition Zones*, 4(1): 46–70. (In Russ.). https://doi.org/10.30730/2541-8912.2020.4.1.046-070
30. Kharitonov V.G. **2010.** [*Summary of diatom (Bacillariophyceae) flora of the northern coast of the Sea of Okhotsk*]. Magadan: SVNTs DVO RAN, 189 p. (In Russ.).

31. Tsyganov A.N., Babeshko K.V., Malysheva E.A., Payne R.J., Mazei Y.A., Novenko E.Yu. **2017.** Quantitative reconstruction of peatland hydrological regime with fossil testate amoebae communities. *Russian J. of Ecology*, 48(2): 191–198. https://doi.org/10.1134/S1067413617020084
32. Blaauw M., Christen J.A. **2011.** Flexible paleoclimate age-depth models using an autoregressive gamma process. *Bayesian Analysis*, 6: 457–474. https://doi.org/10.1214/11-BA618.30
33. Buczkó K., Ognjanova-Rumenova N., Magyari E. **2010.** Taxonomy, morphology and distribution of some *Aulacoseira* taxa in glacial lakes in the South Carpathian region. *Polish Botanical J.*, 55(1): 149–163.
34. Chen R., Shen J., Li C., Zhang E., Sun W., Ji M. **2015.** Mid- to late-Holocene East Asian summer monsoon variability recorded in lacustrine sediments from Jingpo Lake, Northeastern China. *The Holocene*, 25: 454–468. https://doi.org/10.1177/0959683614561888
35. Dam H., van, Mertens A., Sinkeldam J. **1994.** A coded checklist and ecological indicator values of freshwater diatoms from the Netherlands. *Netherlands J. of Aquatic Ecology*, 28: 117–133. https://doi.org/10.1007/bf02334251
36. Fagan B. **2000.** *The Little Ice Age. How climate made history 1300–1850.* New-York: Basic Books, 146 p.
37. Krammer K., Lange-Bertalot H. **1986.** *Bacillariophyceae. Teil 1: Naviculaceae, in Süßwasserflora von Mitteleuropa*. Stuttgart: Gustav Fischer Verlag, 876 p.
38. Krammer K., Lange-Bertalot H., **1991a.** *Bacillariophyceae. Teil 3: Centrales, Fragilariaceae, Eunotiacceae.* Stuttgart: Gustav Fischer Verlag, 576 p.
39. Krammer K., Lange-Bertalot H., **1991b.** *Bacillariophyceae. Teil 4: Achnanthaceae, Kritische Erganzungen zu Navicula (Lineolatae) und Gomphonema.* Stuttgart: Gustav Fischer Verlag, 437 p.
40. Leipe C., Nakagawa T., Gotanda K., Müller S., Tarasov P. **2015.** Late Quaternary 731 vegetation and climate dynamics at the northern limit of the East Asian summer monsoon and 732 its regional and global-scale controls. *Quaternary Science Reviews*, 116: 57–17. http://dx.doi.org/10.1016/j.quascirev.2015.03.012
41. Li C., Wu Ya., Hou X. **2011.** Holocene vegetation and climate in Northeast China revealed from Jingbo Lake sediment. *Quaternary International*, 229: 67–73. http://dx.doi.org/10.1016/j.quaint.2009.12.015
42. Lim J., Yang D-Y., Lee J-Y., Hong S-S., Um I.K. **2015.** Middle Holocene environmental change in central Korea and its linkage to summer and winter monsoon changes. *Quaternary Research*, 82(1): 37–45. https://doi.org/10.1016/j.yqres.2015.04.003
43. Ljungqvist F.C. **2010.** A new reconstruction of temperature variability in the extratropical Northern Hemisphere during the last two millennia. *Geografiska Annaler*, 92A: 339–351. http://dx.doi.org/10.1111/j.1468-0459.2010.00399.x
44. Ramsey B.C. **2017.** Methods for summarizing radiocarbon datasets. *Radiocarbon*, 59(2): 1809–1833. https://doi.org/10.1017/RDC.2017.108
45. Razjigaeva N.G., Ganzey L.A., Mokhova L.M., Makarova T.R., Kudryavtseva E.P., Panichev A.M., Arslanov Kh.A. **2019.** Climate and human impact on vegetation in the upper part of the Ussuri River basin in Late Holocene, Russian Far East. *Geography, Environment, Sustainability*, 2(12): 162–172. https://doi.org/10.24057/2071-9388-2018-44
46. Reimer P. **2020.** Letter from the Guest Editor. *Radiocarbon*, 62(4): v–vii. https://doi.org/10.1017/rdc.2020.99
47. Sakaguchi Y. **1983.** Warm and cold stages in the past 7600 years in Japan and their global correlation. *Bull. of the Department of Geography of the University of Tokyo*, 15: 1–31.
48. Stebich M., Rehfeld K., Schlütz F., Tarasov P.E., Liu J., Mingam J. **2015**. Holocene vegetation and climate dynamic of NE China based on the pollen record from Sihailongwan Maar Lake. *Quaternary Science Reviews*, 124: 275–289. http://dx.doi.org/10.1016/j.quascirev.2015.07.021
49. Wanner H., Beer J., Bütikofer J., Crowley T.J., Cubasch U., Flückiger J., Goosse H., Grosjean M., Joos F., Kaplan J.O., Küttel M., Müller S.A., Prentice I.C., Solomina O., Stocker T.F., Tarasov P., Wagner M., Widmann M. **2008.** Mid- to Late Holocene climate change: an overview. *Quaternary Science Reviews*, 27: 1791–1828. https://doi.org/10.1016/j.quascirev.2008.06.013
50. Wanner H., Solomina O., Grosjean M., Ritz S.P., Jetel M. **2011.** Structure and origin of Holocene cold events. *Quaternary Science Reviews*, 30: 3109–3123. https://doi.org/10.1016/j.quascirev.2011.07.010