

Radiocarbon age of the Khvalynian Manych Passage

Arslanov Kh.¹, Yanina T.²

¹ Saint-Petersburg State University, Geographical and Geoecological Faculty, Russia
arslanovkh@mail.ru

² Moscow State University, Geographical Faculty, Moscow, Russia
didacna@mail.ru

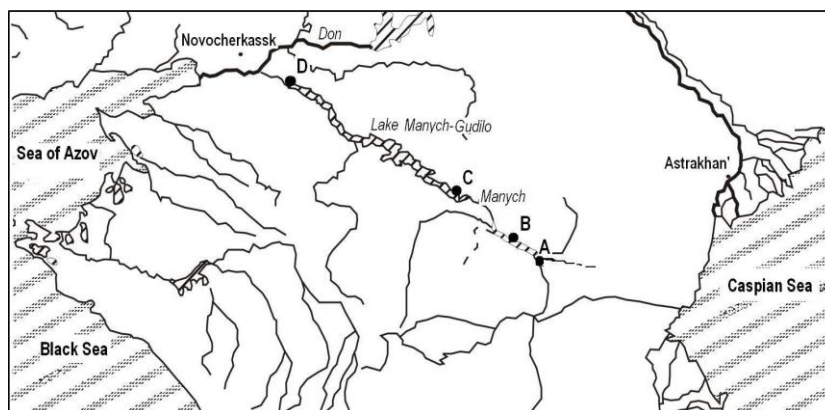
Keywords: Manych, molluscan assemblages, radiocarbon dating, Khvalynian transgression, Neoeuxinian basin

Introduction

The major paleogeographical events of the Pont-Caspian region during the last 30 ka are very disputable. One of them is the problem of "absolute" age of last epoch of the Manych strait existence. It is established during the peak of the Khvalynian transgression Caspian waters flowed via the Manych Strait into the Neoeuxinian basin (Svitoch, Yanina, 2001; Yanina, 2005; Chepalyga, 2005 and other). Faunal composition points to a one-way migration of molluscs from the Caspian to the Black Sea (Fedorov, 1978; Popov, 1983; Svitoch, Yanina, 2001 and other). The age of Manych Strait function during Lower Khvalynian epoch is estimated from 60 ka (Rychagov, 1995) to 30 ka (Popov, 1983) and to 11-14 ka (Svitoch, Yanina, 1997), 11-12 ka (peak of Khvalynian transgression), 10.5 ka (closing of the strait) (Svitoch, 2007). The aim of this paper is to present the new data on radiocarbon dating of Manych Khvalynian fossil molluscs and, on this basis, to present a conclusion about the "absolute" age of Caspian – Black Sea connection during Khvalynian epoch.

Material and results

In 2006-2007 we undertook malacological studies in the Manych Depression. We studied several locations of Khvalynian fauna (Fig. 1), analyzing which by radiocarbon dating method allowed us to educate some ¹⁴C dates and to update the Manych Khvalynian history. Radiocarbon dating was realized in the Laboratory of Quaternary paleogeography and geochronology of the Saint Petersburg University. Calendar age meanings are found on the base of calibration-programme "CalPal" (2006) of B.Weninger, O.Joris, U.Danzeglocke from Cologne University (www.calpal.de).



In the Manych Depression, the marine Lower Khvalynian sediments are bedded on the Burtass-Gudilovian lake's deposits with deep erosion. They include numerous fossil slightly brackish mollusks *Monodacna caspia*, *Adacna vitrea*, *Hypanis plicatus*, *Dreissena*, and brackish *Didacna protracta*, *D. ebersini*. and *D. ebersini* – index fossils for Lower Khvalynian deposits of the Caspian Sea.

Figure 1. Plan of location of sections within the Manych Valley

A – Chogray Dam; B – Zunda-Tolga, C – Levy Island, D – Manych-Balabino

On the right coast of Vostochniy Manych river near the Chogray dam the structure of a terrace is found. Lower Khvalynian deposits contain dominating *Hypanis plicatus*, numerous *Monodacna caspia* and rare *Didacna protracta*, *Dreissena polymorpha*. ¹⁴C date of *Hypanis plicatus* shells is 11.47±0.18 ka BP (LU-5768), calendar age is 13.36±0.20 ka cal BP. To the west, near village Zunda-Tolga in an abrasion escarp of the northern bank of the Chogray reservoir Lower Khvalynian deposits contain dominating *Didacna ebersini* and *Didacna protracta*, rare *Monodacna caspia*, *Dreissena polymorpha*, *Hypanis plicatus* and *Adacna laeviuscula*. The different index fossils were dated. ¹⁴C date of *Didacna ebersini* shells is

11.42±0.22 ka BP (LU-5726), calendar age is 13.32±0.22 ka cal BP. ¹⁴C date of *Didacna protracta* (depressed small shells) is 10.67±0.14 ka BP (LU-5725), calendar age is 12.57±0.17 ka cal BP. On the western end of Levyi Island (Manych Lake) Khvalynian deposits contain bivalve shells: *Didacna protracta* prevails, *D. ebersini*, *Monodacna caspia* and *Dreissena polymorpha* are rarely found and *D. subcatillus*, *Hypanis plicatus*, *Adacna laeviuscula*, *Dreissena rostriformis distincta* are singular. ¹⁴C date of *Didacna protracta* is 10.93±0.37 ka BP (LU-5769), calendar age is 12.75±0.46 ka cal BP.

For answer on the question about Khvalynian history of the Manych, our investigations of Manych-Balabino section (Svitoch, Yanina, 2001; Yanina, 2005) are very important. The Khvalynian deposits of the section include abundant fossil molluscs: brakish species (as Caspian origin and Black Sea one), slightly brakish species, fresh-water species and eurihaline marine species. Most of them are re-deposited. Numerous shells of *Monodacna caspia*, *Adacna laeviuscula*, *A. vitrea*, *Dreissena polymorpha*, and rare *Didacna ebersini* (Early Khvalynian species only!) are "in situ". Khvalynian shells were dated in the Laboratory of Pleistocene paleogeography of Moscow State University by O. Parunin. ¹⁴C date is 14.3±0.68 ka BP (MGU-1491). ¹⁴C date of shells composite (Khvalynian shells with *Cerastoderma glaucum*) is lots older – 25.69±3.0 ka BP (MGU-1489). It proves our conclusion on the mixing of shells from different basins in the thanatocoenosis, and on "young" age of the Khvalynian fauna.

Discussion

Two subassemblages are distinguished within early Khvalynian assemblage. Their representatives occur at different stratigraphical position. We have dated the shells from younger subassemblage, corresponding to establishment of "balanced profile" in the passage at the 20 m asl. There ¹⁴C age is 10.93±0.37 ka BP - 11.42±0.22 ka BP. The delicate early Khvalynian shells from 9 sections from different areas of the Caspian region (Dagestan, Azerbaijan, Lower Volga, Lower Ural) have analogic ¹⁴C age (Arslanov et al., 1977, 1988). At the same time the late Khvalynian thick shells have the similar age (Table). We obtained the similar ¹⁴C data - 12.65±0.16 ka BP, 15.01±0.30 ka cal BP (LU-5801) for late Khvalynian *Didacna praetrigonoides* from Azerbaijan. According to expertise of Prof. Arslanov, the perfect preservation of shells, the dating of inside part of shells, the commonality of calibrated ¹⁴C age (the calendar-age) with ²³⁰Th/U dates provide the reliability of late Khvalynian dates. They correspond to ¹⁴C chronological interval Belling-Allered

Table 1. The age of Late Khvalynian shells from Caucasian coast of the Caspian Sea based on ¹⁴C и ²³⁰Th/U dating (Arslanov et al., 1977, 1988)

Location	Lab. Index	¹⁴ C age ka BP	calibrated age ka cal BP	²³⁰ Th/U age ka BP
The northern coast of Malye Turali lake, Dagestan	LU-424B	12.72±0.40	15.44±0.88	38.00±0.44
The village Duvanniy, Azerbaijan	LU -192B	13.20±0.25	16.23±58	
The Amiya Cap, Azerbaijan	LU -193B	12.48±0.15	14.72±0.27	
The Babasan chain, Azerbaijan	LU -423B	12.33±0.14	14.45±0.31	14.44±0.400
48 km Baku-road between Nasosnaya and Yashma, Azerbaidjan, -12 m	LU -479	11.34±0.16	13.25±0.16	12.90±0.35

The chronological data guess the ¹⁴C age of delicate early Khvalynian shells is understated. It may be generated by younger carbonates ingrained in shells by isotope exchange. There are two ways of carbonate pollution of unrecrystallization shells: isotope exchange and diffusion of polluted carbonate inside crystal structure of shells. The isotope exchange is a fast process. It is characteristic for delicate shells. The pollution of thick shells by younger carbonate intervenes too, but the rapidity of diffusion is small. Generally the thick shells comprise about 2% of recent carbon (Arslanov, 1987). We dated by radiocarbon method the thick shells of *Didacna praetrigonoides* from lower Khvalynian deposits (+20 m asl) of Mangyshlak peninsula. The carbon dating of outer fraction is 12.02±0.13 ka BP (ЛУ-5800А), the dating of inner fraction is 12.55±0.21 ka BP, the calibrated age is 14.84±0.45 ka cal BP. Such age can be cleared by small pollution of thick shells by recent carbonate. The inner fraction of shell is steady to pollution, and it has older age than outer fraction. The radiocarbon dating of inner fraction is most real age (a little too young perhaps, on the opinion by Prof. Arslanov). The calibrated age of inner fraction is close to the age of the late Valdai glaciation. The maximum of late Valdai (late Wurm) glaciation is dated as 17.00 ka BP (the calibrated ¹⁴C age) in accordance with MIS 2.2. (Bassinot et al., 1994).

The obtained data evidence an opening time of Khvalynian Manych Passage during the late Valdai glaciation (the beginning of late Valdai deglaciation). The epoch of the Manych Passage existence

was ended from ~12 ka BP, ~14 ka cal BP – at the close of early Khvalynian stage and the beginning of late Khvalynian stage of Khvalynian epoch.

Acknowledgements

The authors are very grateful to Chernov S.B., Maksimov F.E., Tertychnaya T.V., Tertychny N.I., Lokshin N.V. and Gerasimova S.A. for realization of dating of mollusk-shells by radiocarbon and uranium-thorium methods. The part of the work was realized with RFBR (Project 08-05-00113, 00114) financial support.

References

- Arslanov Kh.A. 1987. Radiouglerod: geokhimiya i geokhronologiya [Radiocarbon: Geochemistry and Geochronology]. Publishing house of Leningrad University, 300 p. (In Russian).
- Arslanov Kh.A., Gerasimova S.A., Leontiev O.K. et al. 1978. O vozraste pleistocenovyyh i golocenivyyh otlozheniy Kaspiyskogo morya [On the age of Pleistocene and Holocene deposits of Caspian Sea (on radiocarbon and U-Th methods)]. In *Bulleten' Komissii po izucheniyu Chetvertichnogo perioda* [Bulletin of Commission for study of the Quaternary], № 48, p. 39-48. (In Russian).
- Arslanov Kh.A., Lokshin N.V., Mamedov A.V. et al. 1988. O vozraste khazarских, khvalynских i novokaspiyskikh otlozheniy Kaspiyskogo moray [On the age of Chazarian, Chvalynian and Novocaspian deposits of the Caspian Sea (on radiocarbon and U-Th methods)]. In *Bulleten' Komissii po izucheniyu Chetvertichnogo perioda* [Bulletin of Commission for study of the Quaternary], № 57, p. 28-38. (In Russian).
- Bassiot F.C., Labeir L.D., Vincet E. et al. 1994. The astronomical theory of climate and the age of the Brunhes-Matuyama magnetic reversal. *Earth and Planet. Sci. Lett.* 126, p. 91-108.
- Chepalyga A.L. 2005. Epokha ekstremal'nogo zatopeniya kak prototip Vsemirnogo Potopa [Epoch of extreme flooding as a prototype of the Noah's Flood]. In *Materialy IV Vserossiyskoy konferentsii po izucheniyu Chetvertichnogo perioda* [Proceedings of the IV All-Russia Conference on the Quaternary Studies]. Geoprint Publishers, Syktyvkar, pp. 445–447. (In Russian)
- Fedorov P.V. 1978. Pleistocen Ponto-Caspiya [The Pleistocene of the Caspian and Pont basins], Moscow, Nauka, 165 pp. (in Russian).
- Popov G.I. 1983. Pleistocen Ponto-Caspiyskikh prolivov [Pleistocene of the Black Sea–Caspian straits]. Nauka Press, Moscow, 215 pp. (in Russian).
- Rychagov G.I. 1995. Pleistocenovaya istoriya Kaspiyskogo moray [Pleistocene history of the Caspian Sea]. MSU Press, Moscow, 270 pp. (in Russian).
- Svitoch A.A. 2007. Neoeuxinian basin of the Black Sea. In Yanko-Hombach V., Buynevich I., Chivas A., Gilbert A., eds, *Extended Abstracts of the 3rd Plenary Meeting and Field Trip of IGCP-521 Project "Black Sea - Mediterranean corridor during the last 30 ky: Sea level change and human adaptation"*, 2007, Gelendzhik, Russia, pp. 125-126.
- Svitoch A.A., Yanina T.A. 1997. Chetvertichnye otlozheniya poberezhnykh Kaspiyskogo morya [Quaternary deposits of the Caspian Sea coasts]. Rossel'hozakademiya Press, Moscow, 240 pp. (in Russian).
- Svitoch A.A., Yanina T.A. 2001. Novyye dannyye po malakofaune morskogo pleistocena Manycheskoy depressii [New data about malacofauna of marine Pleistocene of the Manych Depression]. In *Doklady Rossiyskoy Akademii nauk* [Doklady of the Russian Academy of Science], 380, 4, pp. 570-573. (in Russian).
- Yanina T.A. 2005. Didacny Ponto-Caspiya [The Didacnas from the Pont-Caspian region], Moscow-Smolensk, Madzhenta, 300 p. (in Russian).