RADIOCARBON RESERVOIR CORRECTION AGES IN THE PETER THE GREAT GULF, SEA OF JAPAN, AND EASTERN COAST OF THE KUNASHIR, SOUTHERN KURILES (NORTHWESTERN PACIFIC)

Yaroslav V Kuzmin[1] • G S Burr[2] • A J Timothy Jull[2]

ABSTRACT. The radiocarbon reservoir age correction values (R) for the Russian Far East are estimated as 370 ± 26 yr for the northwestern Sea of Japan, and 711 ± 46 yr for the southern Kurile Islands.

INTRODUCTION

The radiocarbon reservoir age (R) is the difference between the conventional ^{14}C age of a marine sample and the ^{14}C age of a sample that grew in the contemporaneous atmosphere (Stuiver et al. 1986). Determination of an R value for the Russian Far East coastal seas is hampered by the lack of pre-World War II marine mollusk shells in museum collections. The determination of an R value for the Sea of Japan and Okhotsk Sea has paleogeographical importance (cf. Taira 1979; Taira and Lutaenko 1993; Kuzmin 1995), in particular because of the strong dependence of coastal human populations, such as the Boisman, Yankovskaya, and Okhotsk cultures, on marine protein sources (cf. Krushanov 1989; Yoneda et al. 1998). When human bones of these cultures are dated with ^{14}C, the underestimation of R may distort their true ^{14}C age by several hundred years. The R values from adjacent regions may also vary due to local oceanographic conditions (cf. Goodfriend and Flessa 1997). Significant changes in R values from a given region may occur during the Holocene (cf. Ingram 1998).

The reservoir correction ages for the coastal northwestern Pacific are still not adequately studied (cf. Stuiver and Braziunas 1993:153–6). Previously, the R value for the Sea of Okhotsk was estimated as 1000 years (Gorbarenko et al. 1998). For the Peter the Great Gulf in the northwestern Sea of Japan, R was estimated as 400 years (Gvozdeva et al. 1997). However, no details were given about the samples used to determine R in both regions.

In order to measure R on the Russian Far East coastal areas, we selected two regions—the northwestern Sea of Japan coast (Figure 1A) and the Kunashir Island (Figure 1B). Modern oceanographic features of these areas are quite different from each other (Figure 1). In the Sea of Japan, the Tsushima warm current (#1) forms one of the branches of the Kuroshio current (#2) and flows northward from the open North Pacific via the Tsushima Strait. Two cold currents, Shrenk (Primorskoye) (#3) and North Korean (#4), also flow into the Sea of Japan. These flow from the Tatarski Strait (Yurasov and Yarichin 1991). In the western part of the Okhotsk Sea, the most important currents are the cold East-Sakhalin (#5), which flows from northwestern part of the Okhotsk Sea (#6), and warm Soya, which flows via the La Perouse Strait as a branch of the Tsushima current (Komsomolsky and Siryk 1967). In the open Pacific Ocean close to the southern Kurile Islands, the Oyashio cold current (#7) strongly affects regional conditions (Gorshkov 1974).

[1]Pacific Institute of Geography, Far Eastern Branch of the Russian Academy of Sciences, Radio St. 7, Vladivostok 690041, Russia. Email: ykuzmin@tig.dvo.ru.
[2]NSF-Arizona AMS Facility, Department of Physics, University of Arizona, Tucson, AZ 85721-0081, USA

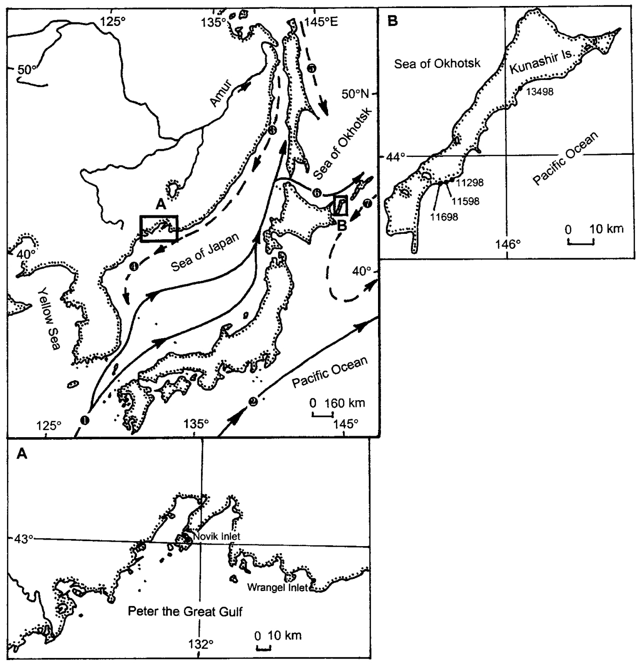

Figure 1 The position of areas under study and modern currents of the northwestern Northern Pacific (current numbers correspond to those in the text): 1–Tsushima warm current; 2–Kuroshio current; 3–Shrenk (Primorskoye) cold current; 4–North-current. A–Peter the Great Gulf; B–Kunashir Island.

MATERIALS AND METHODS

We obtained marine mollusc shell samples from "pre-bomb" shellmiddens [i.e. artificial accumulations of empty shells after handicraft exploitation of oyster (*Crassostrea gigas*) banks and food waste disposals] for two regions: 1) Peter the Great Gulf, northwestern Sea of Japan coast, and 2) eastern coast of the Kunashir Island, open Pacific Ocean shore (Figure 1A,B). In Peter the Great Gulf, shells were collected in 1998 from the shellmidden in the Novik Inlet (43°06′N latitude, 131°54′E longitude) created in the late nineteenth century. Also, one sample was originally collected alive in 1932 by AI Razin in the Wrangel Inlet, Nakhodka Bay (42°44′N, 133°05′E), and was later obtained from the malacological collection at the Zoological Institute, Russian Academy of Sciences, St. Petersburg (Jones et al. 1996). On the Pacific shore of the Kunashir, shells were collected in 1998 from several Japanese waste disposals, created between 1900 and 1945 and labeled as localities #13498 (44°14′N, 146°05′E), #11298 (43°55′N, 145°43'E), #11598 (43°54′N, 145°42′E), and #11698 (43°54′N, 145°41′E). ^{14}C measurements were performed at the NSF-Arizona AMS Facility.

RESULTS AND DISCUSSION

The results are given in Table 1 as conventional ^{14}C ages (Stuiver and Polach 1977), along with R and ΔR values (terminology of Stuiver et al. 1986). For the Peter the Great Gulf, the new R value from the Novik Inlet, 406 ± 41 yr, consistent with the previous estimate for the Wrangel Inlet at 505 years. The average R value for the whole region, northwestern Japan Sea, is calculated as 370 ± 26 yr. For the eastern shore of the Kunashir Island, the R values measured on different mollusk spe-

Table 1 Radiocarbon ages of mollusk shells (collected live) from the Russian Far East coastal seas

Sample code	Year collected	Species	Lab code	^{14}C age[a]	Atmospheric ^{14}C age[b]	R (^{14}C yr)	Marine model age[c]	ΔR (yr)
Peter the Great Gulf, Sea of Japan								
Wrangel Inlet	1932	*Yoldia johanni*	OS3024	505 ± 30	154 ± 5	351 ± 30	460 ± 5	45 ± 30
Novik Inlet	1880–1900	*Crassostrea gigas*	AA36301	500 ± 40	94 ± 9	406 ± 41	465 ± 5	35 ± 40
				Average R for region[d]:		370 ± 26		
Kunashir Island, Kurile Islands, Northwestern Pacific								
#11298	1900–1945	*Spisula sakhalinensis*	AA36298	950 ± 40	119 ± 16	831 ± 43	455 ± 2.5	495 ± 40
#11598	1900–1945	*Swiftopecten swifti*	AA36299	800 ± 45	119 ± 16	681 ± 48	455 ± 2.5	345 ± 45
	1900–1945	*Neptunea bulbaceae*	AA38298	895 ± 45	119 ± 16	776 ± 48	455 ± 2.5	440 ± 45
	1900–1945	*Mizuhopecten yessoensis*	AA36300	915 ± 40	119 ± 16	796 ± 43	455 ± 2.5	460 ± 40
#11698	1900–1945	*Crepidula grandis*	AA36088	725 ± 40	119 ± 16	606 ± 43	455 ± 2.5	270 ± 40
#13498	1900–1945	*S. sakhalinensis*	AA36296	670 ± 45	119 ± 16	551 ± 48	455 ± 2.5	215 ± 45
				Average R for region[d]:		711 ± 46		

[a]Conventional ^{14}C date
[b]Atmospheric ^{14}C age interpolated to nearest year of averages over collection interval, from INTCAL 98 (Stuiver et al. 1998a)
[c]Marine model age as above from 1998 marine calibration dataset (Stuiver et al. 1998b)
[d]Uncertainties on the average R values are the larger of internal or external precision

cies range from 551 to 831 yr. The weighted average R value for the southern Kuriles is estimated as 711 ± 46 yr.

Thus, there is a significant difference in R value (about 300 year) between the northwestern Sea of Japan and the southern Kurile Islands, northwestern Pacific. The reason most probably has to do with different oceanographic conditions in both areas. The coastal waters of the Peter the Great Gulf are under the strong influence of cold Shrenk current, originated in the Amur River estuary with quite low salinity, about 10‰ (Gorshkov 1974). The eastern coast of the Kunashir Island is being affected by cold Oyashio current, originating in the northern northwestern Pacific, with normal ocean water salinity, about 35‰.

To estimate possible changes in the R value throughout the Holocene, we have two pairs of mollusk and terrestrial material from the Peter the Great Gulf area. For the Okeanskaya section (43°15′N, 132°02′E), the age of mollusk (*Anadara inaequivalvis*) is 4340 ± 35 BP (OC-3020) (Jones and Kuzmin 1995), and the age of fruit Manchurian walnut (*Juglans mandshurica*) is 3535 ± 45 BP (AA-23127). The difference in ages is about 800 years, and greater than the R value for the region of 400 years. However, possible re-deposition of the walnut may have caused this discrepancy. For the core in the Boisman Bay (42°47′N, 131°16′E), at a depth of 3.15–3.20 m the age of mollusk (*Crassostrea gigas*) is 6600 ± 55 BP (AA-32674) and the age of a sample of conifer bark is 6195 ± 60 BP (AA-32675). The difference in ages is about 400 years.

The Boisman 2 shell midden on the Peter the Great Gulf coast (Jull et al. 1994; Kuzmin 1995; Yoneda et al. 1998) is the most promising object to study the R value during the Holocene Climatic Optimum, at about 6500–5000 BP. The pairs of mollusk (*Crassostrea gigas*) and charcoal samples from the Boisman 2 were collected during 1994–1999 in order to compare the ^{14}C age of marine and terrestrial material from the same layer. The ongoing research will allow us to obtain in the near future more precise information about the ^{14}C reservoir age correction for the northwestern Sea of Japan in the second part of the Holocene.

CONCLUSIONS

The results presented allow us to estimate provisionally the ^{14}C reservoir age correction values for the northwestern Sea of Japan as 370 ± 26 yr, and for the southern Kurile Islands as 711 ± 46 yr. The R value for the northwestern Sea of Japan is close to the average ocean R value, estimated as about 400 years (Stuiver and Braziunas 1993). A significant difference is observed for the southern Kurile Islands shore, where the observed R values are about 300 years greater than the average ocean. This information should be taken into account when marine carbonates and bones of marine animals and coastal prehistoric people are being dated with the ^{14}C method.

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