

Palaeoenvironmental variations of the past 3000 years in Russian Altai: insights from ^{14}C and $^{210}\text{Pb}/^{137}\text{Cs}$ dating and elemental records of Lake Kolyvanskoe

Satabdi Misra^{1#}, Larisa Frolova^{2,3#}, Tzu-Tsen Shen¹, Vera Strakhovenko⁴,

Hong-Chun Li^{1*}

¹Department of Geosciences, National Taiwan University, Taipei 10617, Taiwan, ROC

²Department of Zoology and General Biology, Institute of Fundamental Medicine and Biology, Kazan (Volga region) Federal University, Kazan 420008, Russia

³Institute of Archaeology & Ethnography, Russian Academy of Sciences, Siberian Branch, 15 Lavrentieva Ave., 17, 630090 Novosibirsk, Russia

⁴Sobolev Institute of Geology and Mineralogy Siberian Branch Russian Academy of Sciences, 630090 Novosibirsk, Russia

#: Shared first authors. *Corresponding author: hcli1960@ntu.edu.tw

Abstract

The 20 AMS ^{14}C dates on a 96-cm long core (22-AI-02A) from Kolyvanskoe Lake in the Altai Krai, exhibit nuclear bomb ^{14}C influence in the upper 13 cm part. However, the bomb ^{14}C curve may have changed its shape owing to old carbon influence (OCI). An age-depth model (with selected ^{14}C ages having less OCI) has been established for the past 3000 years by using the Bayesian statistical Bacon model approach. However, the Bacon model cannot provide good age estimation with the nuclear bomb ^{14}C influenced age and often smoothed out rapid sedimentation changes. Therefore, $^{210}\text{Pb}/^{137}\text{Cs}$ dating results are used for the chronology of the upper 13 cm part. A sedimentary hiatus seems to have existed during the Little Ice Age (1850-1550 CE) perhaps owing to the frozen condition under cold climate. Elemental concentrations in 0.5N HCl leach fractions as well as organic C, N and C/N provide detailed climate and environmental changes in nine periods: I (1180~930 BC): high productivity and lower surface runoff; II (930~510 BC): lower productivity and surface runoff indicating a sudden cooler period; III (510~170 BC): increased surface runoff and organic activity owing to high moisture content; IV (170 BC~ 900 CE): reduced surface input reflecting prolonged frozen conditions; V (900~1160 CE): elevated detritus and organic productivity indicating wet and warm conditions, hence representing medieval warm period (MWP); VI (1160~1270 CE): reduced land input and organic productivity reflecting cold conditions; VII (1270~1460 CE): elevated surface runoff and organic productivity possibly because of sudden wet period; VIII (1460~1950 CE): abrupt sedimentation hiatus possibly because of cold conditions led to freeze the top surface of the lake during little ice age (LIA) period; IV (1950 CE ~ Present): high organic yield and terrestrial input, elevated organic content and heavy metal input showing human impact.

Keywords: ^{14}C and $^{210}\text{Pb}/^{137}\text{Cs}$ dating; elemental concentrations; palaeoclimatic reconstruction; Russian Altai Lake Kolyvanskoe