

Geomorphology and Quaternary Geology of the Issyk-Kul Basin

Krивonogov Sergey

Novosibirsk State University, Novosibirsk, Russia

Institute of Geology and Mineralogy SB RAS, Russia

Issyk-Kul is a terminal lake in the Kyrgyz Republic in Central Asia. The lake has a length of 182 km and a width of up to 60 km, an area of 6236 km² and a volume of 1736 km³. It is the second-largest mountain lake in the world, the third-largest brackish-water lake (salinity 6g/L), the seventh-deepest lake (maximum depth 668 m), and the tenth-largest lake by volume (Podrezov et al., 2020). The lake is located in a tectonic basin between the Terskey-Alatoo and Kungey-Alatoo Ranges of the Tien-Shan Mountains. The oldest Mesozoic sediments in the basin were uplifted during the Cenozoic collision of the Indo-Australian and Eurasian tectonic plates, which activated its fault tectonics; the region is now very seismically active. The sediment accumulation in the lake probably began in the Miocene, and the lake has its current appearance since mid-Pleistocene (Trofimov, 1990). The current water level of Lake Issyk-Kul is referenced to 1606 m a.s.l. on the topographic maps. The lake level change history is known from the late Pleistocene, when the highest lake level was at 1640 m a.s.l.. The lake dropped to 110 m from the modern level at the end of the late Pleistocene. The lake became high in the Holocene with the highest stands 8.3-6.9 and 1.4-1.2 ka BP, while the level could not be higher than 1620 m a.s.l. – the Chu River outflow from the basin. The most recent rise occurred around the XVIII century AD according to historical maps, and the lake level has been steadily declining since then.

Our study contributes to a better understanding of the latest transgression of the Issyk-Kul, whose traces are represented by a wave-erosion scarp at an altitude of 1619 m a.s.l. and 10-13 accumulative coastal bars on the beach. Two sites were studied in detail on the south-eastern and south-western shores of the lake in 2021 (see Figure). Site 1 gave us opportunity to date the mollusk shells collected from the oldest (10), middle (5), and pre-modern (2) shorelines. The calibrated ages (median values) were 1337, 1420, and 1772 AD, respectively. The effect of old carbon (freshwater reservoir effect) of Issyk-Kul has been estimated by dating shells of dead mollusks from modern shoreline and carbonates precipitated on modern water plants; their ¹⁴C ages are 94 ± 38 and 83 ± 40 BP, respectively. These dates are outside the IntCal20 (95 yrs BP) and MARINE20 (603 yrs BP) calibration curves. So we used 95-year value and the IntCal20 curve, which

returned the calibrated age of 1835 AD. The value of 186 years (the difference between 2021 and 1835) was subtracted from the above dates to correct this effect. Thus, the adjusted ages are 1523 AD for the maximum of the last transgression, 1606 AD for the middle level of the transgression, and 1958 AD for the pre-modern shoreline.

Our new geochronological results paint the following picture of the latest transgression of Lake Issyk-Kul. The lake was lower than today in the Middle Ages and earlier times. We cannot reconstruct the rise of the level with certainty and assume that it was lower than 1600 m a.s.l. in the late XV century AD. The rapid, over 30-40 years, transgression to 1619 m a.s.l. led to flooding of populated shores and strong wave erosion formed the 10-m high above the coastal zone. The peak of the transgression was in the early XVI century AD and then the lake went into a regressive phase. The lake became eight meters lower during the next one hundred years and reached 1611 m a.s.l. in the early XVII century AD. The rate of the subsequent lowering was slower, and the lake reached 1608 m a.s.l. in the middle of the XX century AD. That is three meters of decrease took about 350 years. The rate of decrease by two meters in the last 65 years looks about the same as in the first stage of the regression.

The study was supported by the Russian Science Foundation (project no. 21-77-20022).

Podrezov, A.O., Ari J. Mäkelä, A.J., Mischke, S., 2020. Lake Issyk-Kul: Its History and Present State.

In: Mischke, S. (ed), Large Asian Lakes in a Changing World. Natural State and Human Impact. Springer, Cham.

Trofimov, A.K., 1990. Quaternary deposits of the Issyk-Kul depression related to its tectonics. Proc. Acad. Sci. Kirghiz SSR, 1, 87–95 (in Russian).