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Pleistocene lake level changes in Western Mongolia

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Global cooling in the Early Pleistocene caused extensive continental glaciation in the northern hemisphere including the arid areas of Central Asia. The reduction of temperatures (particularly summer temperatures) reduced evaporation and strengthened the importance of precipitation. The simultaneity of "lakes periods" (pluvials) and stages of glaciation is established experience confirmed by investigations in the west of North America and Russia. In the Mongolian Great Lakes Depression new evidence for similar conditions is found. The Great Lakes Depression is one of the largest in Central Asia, and is divided into 2 main Lakes basins: Hyargas Lake Basin and Uvs Lake Basin. The basin is 600-650 km in length with a width of 200-250 km in the north and 60-100 km in the south. Total catchment area is about 186600 km2. The elevation of the basin floor is from 1700 m a.s.l. to 760 m a.s.l., decreasing to the north and south-east. The depression extends south-north and is bounded by mountains: Tannu-Ola to the north, Hangai to the east; Gobi Altai to the south and Mongolian Altay to the west. The maximum elevation of the mountains is 4000 m a.s.l. There are some mountains with an elevation between 2000 and 3000 m a.s.l in the lake catchment. These mountains are not glaciated today.
The geological record [1] suggests the Great Lakes Depression already existed in the Mesozoic, but assumed its modern form only during the Pliocene-Quaternary when tectonic movements caused the uplift of the surrounding mountains. A phase of tectonic stability occurred during the Late Quaternary. The depression is filled by Quaternary fluvial, aeolian and lacustrine deposits (e.g. sand, pebbles). The Neogene deposits are represented by coloured clay, marl, sand and sandstone [1]. Hyargas Lake is the end base level of erosion of the lake group consisting of the Hara-Us Nur, Dorgon, Hara Nur and Airag lakes. Hyargas is one of the largest lakes in Mongolia, with a water surface of 1,407 km2. The lake is 75 km long and 31 km wide. Its mean depth is 47 m, with the deepest point reaching 80 m, and its total water volume is 66,034 km3 and drainage basin 115,500 km2. The only water flowing into it is Galbiyn Hooloi. Hara-Us Nur Lake is a fresh-water (mineralization ca 107-348 mg/l, pH -7.8) basin situated in the Mongolian Great Lakes Depression [2]. Hara-Us Nur is fed by the Kobdo and Buyant rivers, which start in the Mongolian Altay, and outflows via the Chano-Hairkhan River into Hara-Us Nur Lake. Hara-Us Nur is divided by the Ak-Bashi Island into two subbasins. It has a water area of 1857 km2 with a length of 72.2 km and a maximum width of 27 km [4]. The maximum depth is 4 m and the average depth is ca 2 m [5,6]. The terraced lake shores are covered by steppe and desert vegetation. Pharagmites is abundant in the river deltas and close to the shore-line and the shallow-water littoral is covered by rich aquatic vegetation, including Myriophyllum verticulatum, Zannichelia pedunculata, Utricularia vulgaris [3]. Hara-Nur Lake is situated in the desert steppe subzone of the Mongolian Great Lakes Depression. The fresh-water Hara-Nur Lake receives inflow from Hara-Us Nur Lake via the Chano-Hairkhan River. There are two outflows from the lake one outflow is via a 10 km-long channel which flows to the Dzabhan River, which in turn flows into the closed Hyargas Lake. The other outflow is a small semi-permanent stream with flows southward into the closed brackish-water Dorgon Lake. Hara-Nur has a water area of 57,500 ha, with a length of 37 km and a maximum width of ca 24 km. The maximum depth is 7 m and the average depth is ca 4 m. The mean water mineralization is 260 mg/l and the pH is 8.0 [5]. The catchment area is ca 7,200,000 ha. Lake Ureg located in the Mongolian Altay at an altitude of 1425 m.a.s.1., this lake has an area 237.6 km2 and maximum depth of 48 m. Secchi disk transparency is to 8 m. Macrophyte beds cover up to 20 per cent of the lake area, with the common cane sedges and horsetails dominant. The benthic fauna is poor, and only single pecimens of molluscs and amphipods are met. The ichtyofauna is represented by Oreoleuciscus Pewzowi.
Previous and modern investigations of these lakes, their morphologies and deposits, allow to specify periods of extension of the lakes and palaeogeographical conditions. Two clear extension periods can be determined in the Mongolian Great Lakes Basin, corresponding to Mid-and Late Pleistocene transgressions. During the

Mid-Pleistocene transgression the current Lakes Har-Us Nur, Dorgon Nur, Hara Nur, Airag Nur and Hyargas were integrated to a united lake, with a maximal level at 1265 m. and total water area about 23 158 km2 . The maximal thickness of Mid-Pleistocene lake deposits is 70 m. Late Pleistocene lake sediments are investigated in sections near Dzabhan River and Hyargas Nuur shorelines. They consist of laminated sand, clay and gravel with cryogenic structures at the base and upper part of sections. The mean thickness of Late Pleistocene lake deposits is 20-35 m. The main characteristics of Late Pleistocene lake features are represented by a very bright "lake relief" — obvious steps of shorelines, gravel bands, bars and spits. The specific structure of Late Pleistocene lake cross-sections allows to separate two transgressions within this period. In the first half of the Holocene a minor regression of several meters occurred. Elements of the modern time aeolian relief were still inundated on the north shore of Lake Har-Us Nur.

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