2. Chronology, sediment composition, and magnetic susceptibility

Radiocarbon and OSL dating suggest the basal sands and gravels were laid down ~13,300 cal BP, followed by rapid deposition of 1.5 m of silts and sands within a few centuries. The charcoal in these deposits is poplar wood (Populus sp.), indicating a climate warmer than today. The faintly visible paleosol (paleosol) is present about midway up the profile, and other more diffuse paleosols may be present. A well-developed late Holocene soil marks the top of the profile.

The proportion of silts and sands fluctuates through the lowest 1.5 m, trending toward greater silt content. Increased sand deposition occurs immediately above the paleosol, but silts dominate the uppermost meter. A high proportion of sand (and larger median grain size) may indicate localized overbank deposition, but may also signal greater winds and winter monsoon strength (An et al. 1993).

Magnetic susceptibility, an index of summer monsoon strength, suggests low summer monsoon intensity from about 13,000 cal BP through the period of paleosol formation, and increasing summer monsoon strength after 6500 cal BP.

3. Regional comparisons

At Qinghai Lake, strengthening summer monsoons and greater precipitation after ~14,100 cal BP initiated river flow and a rising lake, leading to rapid deposition of silts and sands at Heima He at 13,000 cal BP. The Heima He paleosol formed under enhanced monsoon as well. From about 12,800-11,900 cal BP the summer monsoon weakened and the region became more arid (coeval with Younger Dryas), corresponding with the rapid deposition of sand and silt above the paleosol. Subsequently, the summer monsoon front migrated west and Qinghai Lake filled to reach its Holocene elevation of 3194 masl at ~14,100 cal BP.

The Heima He sequence fits well with other local exposures, and the paleosol's position and age correlates broadly with the Baxie paleosol in western Gansu. At Heima He, however, evidence of additional early Holocene soils is scant. The absence of such soils, coupled with low magnetic susceptibility readings, might suggest a weaker early Holocene monsoon in the Qinghai Basin than in Gansu, though sufficient to feed higher lake levels. In the Qinghai Basin, magnetic susceptibility may reflect sedimentation source and pedogenic process more strongly than summer monsoon intensity, but this proposition, and Heima He’s Holocene record, requires further study.

References

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Latest Pleistocene/Holocene Paleoenvironments at Heima He, southern Qinghai Lake, western China

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ABSTRACT

A 3.5-meter deep section of Latest Pleistocene and Holocene loess and fluvial sediments was exposed as part of archaeological excavations of Heima He at an elevation of 3270 m on the southeast side of Qinghai Lake, Qinghai Province, western China (1986 elevation 3194 masl). Analysis of the sediment sequence includes magnetic susceptibility, carbonate content, and grain size. The sequence provides evidence for Holocene palaeoenvironmental change directly associated with a record of human occupation in the Qinghai Lake basin. Radiocarbon dating of natural or anthropogenic burned layers, augmented by OSL dates on silt and sand, provides a preliminary chronostratigraphic sequence. The base of the sequence contains coarse-grained sand and charcoal dated to 11,040 ± 70 14C BP. A coherent block of fine grained sands and silts located within this matrix, interpreted to be a chaotic collapse of overbank deposits, contained charcoal dated to 11,040 ± 70 14C BP (11,384-12,717 cal BP at 2σ), and fine grained sands and silts overlie this basal fluvial deposit. Charcoal from this buried layer, within these times, up to 1 m in above the fluvial layer, returned ages that suggest a local depositional transition from a low-intensity fluvial environment to the buildup of a meter or more of fine grained eolian sands and silts within a brief interval between about 13,500-12,500 calendar years ago. The cultural deposit is securely dated within this brief time frame as well. Above the fluvial layer, returned ages that suggest a local depositional transition from a low-intensity fluvial environment to the buildup of a meter or more of fine grained eolian sands and silts within a brief interval between about 13,500-12,500 calendar years ago. The cultural deposit is securely dated within this brief time frame as well. Above the fluvial layer, returned ages that suggest a local depositional transition from a low-intensity fluvial environment to the buildup of a meter or more of fine grained eolian sands and silts within a brief interval between about 13,500-12,500 calendar years ago. The cultural deposit is securely dated within this brief time frame as well.

We exposed a 14-meter long, 3.5-meter deep profile exhibiting multiple layers of loess-like sediments built up atop a bed of low-energy fluvial sands and gravels. Sediments appear to be a mix of eolian silts and sands, punctuated by layers of fine-grained overbank (?) sediments. At least one weathering zone (paleosol) is present about midway up the profile, and other more diffuse paleosols may be present. A well-developed late Holocene soil marks the top of the profile.

1. Heima He profile

At Qinghai Lake, strengthening summer monsoons and greater precipitation after ~14,100 cal BP initiated river flow and a rising lake, leading to rapid deposition of silts and sands at Heima He at 13,000 cal BP. The Heima He paleosol formed under enhanced monsoon as well. From about 12,800-11,900 cal BP the summer monsoon weakened and the region became more arid (coeval with Younger Dryas), corresponding with the rapid deposition of sand and silt above the paleosol. Subsequently, the summer monsoon front migrated west and Qinghai Lake filled to reach its Holocene elevation of 3194 masl at ~14,100 cal BP.

3. Regional comparisons

The Heima He sequence fits well with other local exposures, and the paleosol’s position and age correlates broadly with the Baxie paleosol in western Gansu. At Heima He, however, evidence of additional early Holocene soils is scant. The absence of such soils, coupled with low magnetic susceptibility readings, might suggest a weaker early Holocene monsoon in the Qinghai Basin than in Gansu, though sufficient to feed higher lake levels. In the Qinghai Basin, magnetic susceptibility may reflect sedimentation source and pedogenic process more strongly than summer monsoon intensity, but this proposition, and Heima He’s Holocene record, requires further study.