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Proglacial lake sedimentation from jökulhlaups, Blåmannsisen, northern Norway

Mengzhen Xu (1,2), Jim Bogen (1), Truls E. Bønsnes (1), and Stine Gytri (1)

(1) Norwegian Water Resources and Energy Directorate, 5091 Majorstuen, 0301 Oslo, Norway, (2) State Key Laboratory of Hydroscience and Engineering, Tsinghua University, Beijing 100084, China(xumz07@gmail.com)

Abstract

Outbursts from glacier dammed lakes are important events associated with glacier retreat, thinning and volume reduction. This type of lake is formed when a part of a glacier melt away faster than the main glacier. This paper focuses on a glacier dammed lake at the Blåmannsisen glacier in northern Norway. A large amount of water that was dammed by this glacier, flowed suddenly under the glacier and caused a jökulhlaup into the proglacial lake Rundvatnet. A study of sediment cores taken from the bed sediments in Rundvatnet revealed that deposits from jökulhlaups are recognizable as distinct sand layers embedded in varved silt. It is assumed that the sand fractions are carried in suspension because of the extreme hydraulic conditions caused by the jökulhlaups. The thickest sand layer was deposited by the jökulhlaup recorded in 2001. The total volume of this flood was 40 $\times 10^6$ m^3 draining over 3 days. The inflow increased from a normal amount of 3-4$\times 10^6$ m^3 to a maximum of 19.7$\times 10^6$ m^3 on 7 September. Outburst floods also occurred during the years 2005, 2007, 2009, 2010, and 2011. The total volume of these floods varied from 20 to 35$\times 10^6$ m^3. Sedimentation rate increased from a normal value of 1 mm yr^{-1} to around 5 mm yr^{-1} during the largest jökulhlaup outburst flood.

Based on the assumption that sand layers are formed during large magnitude outburst floods, at least 2 other jökulhlaup periods were indentified: 1925-1938, and 1856-1871 in addition to the period of 2001-2011, indicating that jökulhlaups occurred every 70 years after 1856. In these periods the glacier receded from its maximum extension in the Little Ice Age, and its volume decreased considerably. During each jökulhlaup period, outburst floods occurred every 2-3 years, resulting in 4-6 jökulhlaups in the period. Outburst floods from the lake were observed to occur when the reduction of the glacier volume allowed a tunnel to be formed beneath the glacier. Factors affecting jökulhlaup and sediment transport during outburst floods and the identification of jökulhlaup events from sediment record are discussed.

Key words: jökulhlaup, outburst flood, proglacial lake, sedimentation, varves