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Palaeoglacial lake and outburst flood reconstructions along the southern late-glacial Cordilleran Ice Sheet margin: implications for ice sheet reconstruction and landscape evolution

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Proglacial lakes are crucial in controlling the meltwater and sediment flux from decaying ice margins, affect local ice dynamics, and can influence local and regional weather and climate. They are also potential sources of outburst floods, which can have major impacts on regional geomorphology and drainage networks. As such, proglacial lakes are important components of deglacial environments, and reconstructing proglacial lakes during decay of past ice sheets will improve understanding of their potential influence in the future. The presence of palaeo-ice-dammed lakes in valleys dissecting the southern Interior Plateau of British Columbia (BC), is evident in abundant lake-bottom sediments, deltaic deposits and shorelines. To date, the palaeogeography of these lakes have not been well constrained, and the damming ice margins have been proposed under a paradigm of Cordilleran Ice Sheet (CIS) stagnation – lakes dammed by dead-ice lobes in valleys where ice was thickest; this paradigm has been challenged by recent studies elsewhere on the Interior Plateau that support generally active, systematic retreat of the ice margin to the north and west. This project reinvestigated glacial Lake Nicola (gLN) on the northern Thompson Plateau, the key site for development of the stagnation paradigm, to improve palaeogeographic and palaeohydrological reconstructions of this basin.

Five lake stages for gLN have been identified on the basis of shoreline and delta elevations and the extent of lake-bottom sediments. Glacioisostatic tilts were reconstructed for the four most extensive stages of between 1.6 and 1.9 m/km up to the north-northwest. Areal extent and lake volume for each lake were extracted by plotting lake planes onto DEMs adjusted to these reconstructed tilts; maximum volumes for each stage are in the order of 10 km3, with the largest reconstructed at 260km3. These lakes expanded and lowered to the northwest, as progressively lower outlets were opened by ice recession in this direction. Investigations within these outlets reveal outburst flood sediments and landforms, including recessional cataracts, boulder bars and terraces, trough- and antidune cross-bedded sand and gravel, and slackwater sediments. Estimated peak discharge for these floods, using empirical and time-step models, range from 104 to 106 m3s-1 depending on lake volume and outflow dimensions. For the largest flood, peak velocity of 5 ms-1, peak shear stress of 1000 Pa and peak stream power at 5,000 Wm-2, have been estimated using empirical models for flood-transported boulders.

Palaeogeographic reconstructions of gLN support recent reinterpretations of systematic CIS recession to the northwest over the southern interior of British Columbia. Further, catastrophic outburst floods from this lake were a major process in post-glacial landscape and drainage system evolution.