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Can glacial retreat-related landslides trigger volcanic eruptions? Insights from Mount Meager, British Columbia

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Volcanoes deform under their own weight, and glaciers further weaken them by loading, unloading, and incising them. These processes reduce the strength of volcanic slopes, increasing the likelihood of a catastrophic failure. Unloading of volcanic edifices during glacier retreat, erosion, and catastrophic mass movements can affect the magmatic plumbing system and potentially cause an eruption. Mount Meager is an ice-clad volcanic complex in British Columbia, Canada, known for its large landslides and an eruption about 2430 years ago. In 2010 a major collapse associated with glacier retreat occurred on the south flank of Mount Meager, and in 2016 fumaroles formed ice caves in one of its glaciers. This glacier is bordered by a large unstable slope moving about 4 cm/month. If this slope failed, a long run-out debris avalanche would reach the floor of Lillooet River valley, with possible destructive effects on downvalley infrastructure. The unloading of the volcanic edifice from an abrupt failure would also have unknown consequences on the magmatic plumbing system. Based on numerical model simulations carried out to constrain the stress change, the failure would affect the stress field to depths of 6 km, with changes in effective stress up to 4 MPa. From geochemical, geophysical, and petrological data, we infer the presence of a magmatic chamber at 3-6 km depth. We conclude that the change in effective stress following the landslide has the potential to destabilize the magmatic chamber and trigger an eruption. Changes in glacier cover can thus influence the magmatic processes through a chain of events involving deep erosion, oversteepening, unloading, landsliding, and depressurization.