

Environmental reconstruction of basaltic glaciovolcanic deposits at Askja Volcano, Iceland, using lithofacies and geomorphology

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Askja volcano, Iceland, consists of basaltic glaciovolcanic complexes, at least three calderas, and numerous Holocene lava flows. The deposits of the glaciovolcanic Austurfjöll complex, the eastern most massif of the volcano, have been described in detail in order to reconstruct the environmental conditions during its construction. This complex was constructed by two phases of Pleistocene ice-confined volcanism indicating maximum ice thicknesses for both phases between 600-900 m. (Ages are presented in companion abstract by McGarvie and eruptive evolution of the massif is discussed by Skilling). Ice thickness calculations are based on morphological constraints (i.e. elevation and distribution of subaqueous lithofacies) and volatile analysis of pillow lava glass rinds. Key deposits for environmental reconstruction of the glaciovolcanic Austurfjöll complex include subaqueously emplaced effusive and explosive volcanic deposits, subaerial pyroclasts and lavas and lava breccias, glacial erratics, and putative glacial tillites. The massif is dominated by subaqueously emplaced sequences; consequently, it is the subaerial and glacial deposits that are critical indicators of variability within the ice-confined system. Subaerial lavas are identified as having scoriaceous tops (which can be glacially scoured), iron (reddened) oxidation, and characteristic at Austurfjöll, high density relative to subaqueous lavas. Subaerial pyroclastic deposits contain red scoria and armored lapilli. Blocks of subaerial lavas occur in both subaerial pyroclastic deposits, and subaqueous / emergent breccias. Glacial tillites are composed of poorly sorted massive deposits with rounded, and scoured clasts of varying compositions in a ashy matrix. The occurrence of such units allows the reconstruction of periods of ice presence and associated water levels around the complex.

The timing of these events relative to the overall growth of the massif is reconstructed based on their facies associations with subaqueous units. Subaerial deposits between two subaqueous units likely represent temporary periods of exposure including rapid drainage events. Those subaerial and subaerial-component deposits on top of subaqueous units near the top of the complex (along the Öskjuvatn caldera rim) suggest the emergence, or near-emergence of the complex. Additionally, the position of glacially scoured lavas with putative tillites at the base of the sequence allows the reconstruction of ice advance prior to the major eruptive periods of the Austurfjöll eruptive activity. Such detailed mapping and lithofacies investigations reveal the dynamic nature of ice-confined lake water levels produced by a long lived basaltic ice-confined volcano. These data, in conjunction with new K/Ar dates, provide important new data on the thickness of the ice sheet in this part of central Iceland during the early to mid-Weichselian.