Cities on Volcanoes 9
November 20-25, 2016
Puerto Varas, Chile
'Understanding volcanoes and society: the key for risk mitigation'

Combining satellite, aerial, and field data to distinguish pyroclastic flow vs. block and ash flow deposits at Mount St. Helens and Shiveluch volcanoes.

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Key words: pyroclastic, block and ash flow, morphology, deposits, deposition

Variations in pyroclastic density current deposit morphology of different flow types provide insight into the late stage transportation and deposition processes. Near-real time field-based studies on pyroclastic deposits are rare due to the fact that they are time-consuming, costly, and very dangerous, all of which can be mitigated through quantitative approaches using remote sensing data. Morphological features of deposits at Shiveluch and Mount St. Helens volcanoes are qualitatively and quantitatively described using a combination of satellite, aerial, and field data to identify characteristics indicative of different eruption mechanisms (column collapse and dome collapse) and source materials (pumice and dense dome rock). Both eruption styles produce unsteady flows that form a range of morphologies including sheet-like deposits, channel and levees, transverse compression ridges, lateral ridges, lobate terminations, and retrogressive stacking of deposit pulses. The sequence of deposition is described with several phases recognized with a general trend in decreasing distance from vent/dome: 1) pulsatory sheet-like deposition; 2) development of distinct lobate deposits; 3) retrogressive stacking of deposits with channel and levee systems; 4) deposit remobilization. Some of these phases repeat throughout the eruption and not all are present in each deposit. The two deposit types are distinguished by distinctive lobe morphologies, such as elongate lobes with distinct, steeper lobe and cleft features (pyroclastic flow) vs. fanning deposits with tapering flow fronts containing numerous small toes (block and ash flow). This comparison of variations in deposit surfaces laterally, with distance from the vent/dome, and throughout the duration of the eruption gives new insight into the development of pyroclastic density current deposits in the final moments of deposition. These deposit surfaces are qualitatively and quantitatively described in outcrop-scale in the field and high-resolution aerial and satellite imagery, evaluating the morphologies for the purpose of characterizing deposits and interpreting late-stage flow behavior.