Source conditions and eruptive processes governing the injection of volcanic ash during the 2009 eruptions of Redoubt volcano, Alaska

Alexa R Van Eaton[1], Larry G Mastin[2], Amanda B Clarke[3], Kristi L Wallace[4], David P Schneider[4], Michael Herzog[5]

[1]USGS, Cascades Volcano Observatory, Vancouver, WA and SESE, Arizona State University, Tempe, AZ, USA, [2]U.S. Geological Survey, Cascades Volcano Observatory, Vancouver, WA, USA, [3]School of Earth and Space Exploration, Arizona State University, Tempe, Arizona, USA, [4]U.S. Geological Survey, Alaska Volcano Observatory, Volcano Science Center, Anchorage, Alaska, USA, [5]Centre for Atmospheric Science, University of Cambridge, UK

E-mail: alexa.vaneaton@gmail.com

We present an integrated dataset combining information from field deposits, remote sensing and eruption column modeling of the 2009 eruptions from Redoubt volcano, Alaska. The nineteen major ash-generating explosions between 15 March and 4 April 2009 deposited a bulk ash volume of approximately 0.05 km^3. Explosive events 5 and 19, in particular, were documented with high-resolution satellite, airborne thermal infrared, and Doppler radar, and then linked with field deposits to establish the spatial distribution and vertical structure of the volcanic plumes. A key focus of this study is to establish the impact of magma-water interaction, followed by abundant ash aggregation, on the overall ascent of the volcanic clouds and corresponding ash transport. Additional near-vent processes, such as partial column collapse and interaction between buoyant and non-buoyant cloud components are also assessed. Using detailed analysis of radar and satellite imagery, local weather conditions and examination of preserved ash aggregates, we develop a comprehensive picture of the eruption source conditions and plume dynamics that impacted volcanic ash dispersal. Preliminary simulations using the Active Tracer High-resolution Atmospheric Model (ATHAM) provide insights into the microphysical structure of the Redoubt clouds, highlighting links between the volcanic and meteorological feedbacks (e.g., surface water versus atmospheric moisture and volcanic exit velocities versus ambient wind fields) involved in ash cloud injection, transport and sedimentation.