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Black Point: a peculiar Surtseyan emergent basaltic volcano in the Mono Basin

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Subaqueous to emergent explosive basaltic eruptions, named Surtseyan after the Surtsey eruption in 1963, occupy a peculiar position in the classification of explosive eruptions. The presence of external water clearly affects the eruption dynamics, from magma fragmentation to tephra dispersal. For the present work we selected Black Point volcano, California, USA, which erupted in the Pleistocene Lake Russell about 13,000 years ago, from a depth of 105 m. This volcano provides a rare opportunity to study the entire stratigraphy of a Surtseyan eruption from its edifice deposits (mound and tuff rings) and tephra dispersed at proximal and medial sites in the former host Lake Russell, now vanished. To characterize the Black Point eruption, we adopted a series of techniques never used before in combination for such volcanic activity. These techniques, based on targeted sampling and geological observations in the field, include geochemical characterization of the eruption products, grain size analysis of the ash-size fraction at proximal and medial sites, three-dimensional vesicle characterization of the lapilli-size fraction, and particle shape analysis for ash grains through the recently introduced freeware PARTISAN. The aim of this combined approach is to determine how the eruption evolved through its course, and whether any geochemical or petrological changes took place and affected that evolution. Field observations are consistent with the ash-sheet deposits forming from eruption-fed density currents, fallout through the water column from a subaqueous plume, or fallout through the water column from a subaerial plume. Geochemical correlation links the mound deposits with a stratigraphic sequence at about 2 km from the edifice, with each showing non-linear but consistent geochemical variations during the subaqueous stage of the eruption. There is no systematic change in particle vesicularity upsection through the stratigraphy, but there are small differences between two stratigraphically equivalent deposits, which indicate some textural heterogeneity of the magma. Particle-shape analysis of ash grains from Black Point indicates a wide range of particle convexity and solidity, but these characteristics have not proved useful for identifying the fragmentation style.