ERUPTIVE MECHANISM OF PHREATOMAGMATIC VOLCANOES FROM THE PINACATE VOLCANIC FIELD: COMPARISON BETWEEN CRATER ELEGANTE AND CERRO COLORADO, MEXICO

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Abstract

The Pinacate Volcanic Field is located just near the northern end of the Gulf of California (Sea of Cortez) in Sonora, Mexico. Extensive lava flows cover an area similar to 2000 km² and which is cut through by more than 400 vents, predominantly scoria cones. Eight of the vents are known that erupted immediately after emplacement of pre-maar lava flows, which are exposed in the crater wall. Two of the phreatomagmatic vents are especially spectacular by their size and volume, and their corresponding architecture: Crater Elegante and Cerro Colorado. Crater Elegante is about 1600 m across and has a crater that is about 250 m deep, which is surrounded by a few tens of metres complete crater rim. Its age is inferred to be 11.5 Ma, and its pyroclastic deposits are dispersed more than 1 km away from the crater rim. They form a gently sloping blanket over pre-maar lava flows exhibiting phreatomagmatic effects over deposits such as pressured clasts and tuff breccia blocks of the pre-maar layers. Pyroclastic units are predominantly lapilli tuffs but are rich in fine ash, rounded angular, non-vesicular volcanic lithics, showinglapilli tuff composition. The fine lapilli tuff and tuff units about a few hundred metres away from the rim are especially rich in angular quartz fragments that are loosely packed. Scoriicrater floors from the pyroclastic succession are calcite cemented. There is a notable trend in a quick reduction in the volume of lapilli tuff and pyroclastic lithic fragments with the distance from the pyroclastic succession in the lapilli tuffs from the crater rim towards distal areas. Bedding characteristics of the pyroclastic succession are predominantly massive in bedded near vent settings that quickly change to dune bedded to septae with dunnes having a few dm amplitude over metre wavelengths. These are characteristics of deposition from sudden blast triggered base surges. The Cerro Colorado crater is built on the lee of the crater from which the eruption was triggered. The crater rim is just a few tens of metres below the inferred syn-eruptive surface and forms a ~400 m wide depression. The crater is almost entirely filled by collapsed blocks of lava breccia and lapilli tuff that fed small-volume volcanic lakes here. The pyroclastic succession of Cerro Colorado is significantly coarser-grained, and thinner bedded than the Crater Elegante succession. Lapilli tuffs and tuffs are rich in amoeboid shaped sideromelane in highly vesicular volcanic lithic lapilli and coarse with lapilli in composition that are termed by gel palagonite. Intact gravel/pellets of mud and/or ash are the main volcanic lithic fragments. The entire difference in area, vesicularity, shape and texture of the ejecta are the effect of the edifice's shape, the ratio between juvenile to accidental lapilli reflects the difference of the depth of fragmentation and/ or source of water interacted with the magma.

Volcan Elegante

The Crater Elegante maar basin from the north rim. Volcan Santa Clara straddles volcanoes in the background (VSC). Note the inner depression in the outer basin (B). The platform is inferred to be either a top set of a delta from (VSC) to a top set of a maar lake basin (B). The inner depression makes a 1600 m wide slumped lapilli tuff bed. It has no accretionary lapilli but armoured lapilli are seen lacking in the crater rim. This section has no secondary lapilli but armoured lapilli are seen lacking in the crater rim. The Crater Elegante maar basin from the north rim. Volcan Santa Clara straddles volcanoes in the background (VSC). Note the inner depression in the outer basin (B). The platform is inferred to be either a top set of a delta from (VSC) to a top set of a maar lake basin (B). The inner depression makes a 1600 m wide slumped lapilli tuff bed. It has no accretionary lapilli but armoured lapilli are seen lacking in the crater rim. This section has no secondary lapilli but armoured lapilli are seen lacking in the crater rim. The Crater Elegante maar basin from the north rim. Volcan Santa Clara straddles volcanoes in the background (VSC). Note the inner depression in the outer basin (B). The platform is inferred to be either a top set of a delta from (VSC) to a top set of a maar lake basin (B). The inner depression makes a 1600 m wide slumped lapilli tuff bed. It has no accretionary lapilli but armoured lapilli are seen lacking in the crater rim. This section has no secondary lapilli but armoured lapilli are seen lacking in the crater rim.

Volcan Cerro Colorado

The crater wall is still present. Two of the phreatomagmatic vents are especially spectacular by their size and volume. The crater floor is just a few tens of metres below the inferred syn-eruptive surface and forms a ~400 m wide depression. The crater is almost entirely filled by collapsed blocks of lava breccia and lapilli tuff that fed small-volume volcanic lakes here. The pyroclastic succession of Cerro Colorado is significantly coarser-grained, and thinner bedded than the Crater Elegante succession. Lapilli tuffs and tuffs are rich in amoeboid shaped sideromelane in highly vesicular volcanic lithic lapilli and coarse with lapilli in composition that are termed by gel palagonite. Intact gravel/pellets of mud and/or ash are the main volcanic lithic fragments. The entire difference in area, vesicularity, shape and texture of the ejecta are the effect of the edifice's shape, the ratio between juvenile to accidental lapilli reflects the difference of the depth of fragmentation and/ or source of water interacted with the magma.

Microtextures

SEM photo of a lapilli tuff from the Crater Elegante. Note the bright coloured phreatomagmatic fragments and the eutaxitic arrangement (empty voids are black fields).

SEM photo of a sideromelane glass shard from a lapilli tuff from the Cerro Colorado. Note the rounded vesicles in the glass shard.
Eruptive mechanism of phreatomagmatic volcanoes from the Pinacate Volcanic Field: comparison between Crater Elegante and Cerro Colorado, Mexico.

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