

The Sacarosa Tephra-fall Deposit Emplaced by a Plinian Eruption of Misti Volcano, Southern Peru at ≤ 33.7 ka

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Misti volcano is one of eight active volcanoes in southern Peru and is within the Central Andean Volcanic Zone. The volcano's summit is located about 17 km northeast of the historic city center of Arequipa, Peru, a city with a population surpassing one million inhabitants. During the past 40 ky, Misti's eruptive activity has been dominantly explosive, generating pyroclastic-density currents and tephra falls, but the volcano has also experienced dome growth and collapse and produced voluminous lahars. During this period of eruptive activity, Misti produced an explosive eruption which emplaced a well-sorted tephra-fall deposit informally called the Sacarosa. Few eruptions or their deposits, such as the Sacarosa have been investigated in detail at Misti. We provide the first comprehensive description of the Sacarosa and the eruption that emplaced it. The deposit contains a notable quantity of loose crystals of plagioclase, amphibole, biotite (sometimes bronzy), and scant Fe-Ti oxides, which combined can be 65–70 vol.% of the deposit's fine matrix. The unit's bright white, sub-angular pumice are dacite (65 wt.% SiO₂), have sub-rounded vesicles, and a phenocryst assemblage of 7–10 vol.% plagioclase, 5–7 vol.% amphibole, 2–3 vol.% biotite, and trace Fe-Ti oxides. Altered and rare fresh lithics compose <1 vol.% of the deposit and are usually only present in outcrops most proximal to the volcano. Similar to many of Misti's other tephra-fall deposits, the Sacarosa has a dispersal axis to the southwest and crops out in Arequipa's districts of Mariano Melgar, Alto Selva Alegre, Cayma, Cerro Colorado, and Yura. Along its dispersal axis, the unit is 1.2 m thick at about 10 km from Misti's crater, thinning to 0.24 m thick at about 20 km from the vent. From the unit's pumice isopleths, an eruption column of ~19 km above sea level is inferred with a wind velocity of about 18 m/s. From the unit's isopachs, a volume between 0.5 km³ and 2.5 km³ is calculated, allowing the eruption to be classified as a Volcanic Explosivity Index (VEI) 5 Plinian eruption. Charcoal collected at two locations from within the upper 10 cm of a paleosol underlying the Sacarosa yielded uncalibrated ¹⁴C ages of 33.7 kBP. The Sacarosa is younger than 33.7 kBP, but the proximity of the charcoal to the paleosurface suggests that emplacement occurred probably within several thousand years or less of the constraining age. There are many tephra-fall deposits at Misti younger than the Sacarosa, including many from likely Holocene eruptions. Compared to these other deposits, the Sacarosa eruption is representative of the volcano's larger magnitude eruptions. Undoubtedly, Misti will erupt again in the future. If such an eruption were to be a VEI 5, like that inferred to have produced the Sacarosa, it would severely impact Arequipa and result in economic losses on a local, regional, and national scale.