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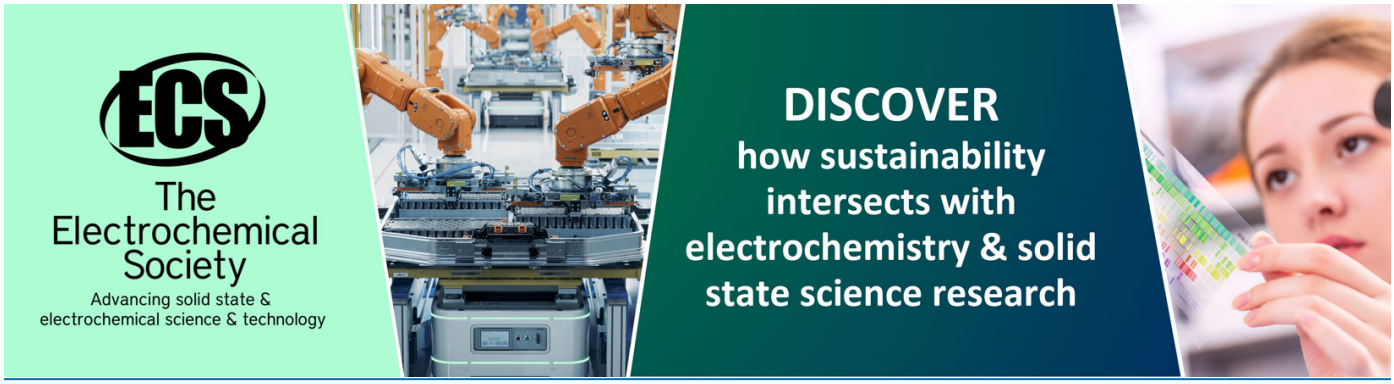
To cite this article: Minard L Hall and Patricia A Mothes 2008 *IOP Conf. Ser.: Earth Environ. Sci.* **3** 012004



IOP Conf. Series: Earth and Environmental Science **3** (2008) 012004 doi:10.1088/1755-1307/3/1/012004

THE CHACANA CALDERA COMPLEX IN ECUADOR

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Keywords: caldera formation, tuff, ignimbrite, rhyolite

Abstract

The Chacana caldera complex lies 50 km east of Quito, the capital city, in the Eastern Cordillera of Ecuador's Andes. In order to bring potable water from the eastern slopes of the Eastern Cordillera to the Quito area and the InterAndean Valley, a 20 km-long tunnel is planned that must pass directly through the center of the caldera; this has prompted a detailed geological study of the tunnel alignment. This caldera was suspected and reported upon earlier by Hall and Beate (1991) and Hall and Mothes (1997).

The Pleistocene caldera (3300 - 4200 m elevation) is underlain by a complex metamorphic basement, and both geologic regimes are affected by on-going tectonic activity that includes NE-trending transpressive faulting as well as eastward-trending thrust faulting. The caldera's dimensions are large: the N-S diameter across the entire structure measures 50 km and the E-W width is truncated, but measures at least 30 km (Fig. 1). Outward-sloping packages of ignimbrites, lava flows, and tuffs comprise the north, west, and southwest outer flanks. The caldera rim is irregular in shape and height, but where best developed on the west side it has a height of 500 m. The central depression is everywhere filled, first by ignimbrites, tuffs, and breccias of siliceous nature associated with the volcanism of the outer flanks, and later by post-collapse volcanism consisting of lava emissions of intermediate composition and subsequently by detrital sediments. Post-collapse resurgence began sometime after 0.44 Ma and has uplifted these infilling sediments to heights that define the present continental divide (4200 m). The rhyolitic units associated with early caldera development are 2.5 - 2.7

Ma in age, while the youngest activity corresponds to two andesitic lavas from the 1700's AD.

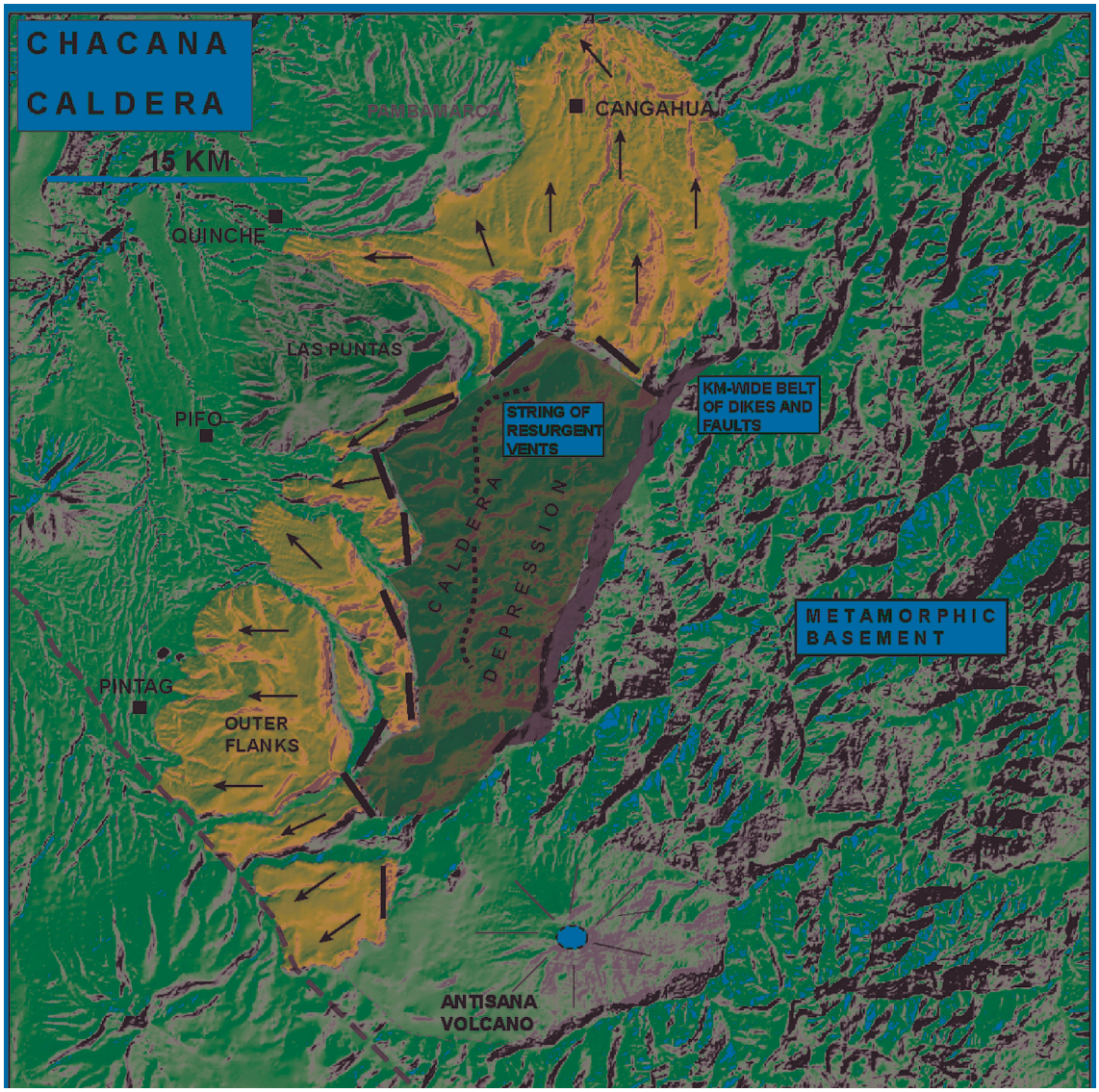

Figure 1: The Chacana caldera depression, outlined by heavy bars, is completely filled by post-collapse volcanism and sediment accumulation. The black belt is the fracture zone comprised of many dikes, breccias, and faults. The out-sloping flanks of ignimbrites are identified by arrows. Pambamarca and Las Puntas are pre-caldera andesitic cones, while Antisana is a young, active cone. Intense erosion on the Andes' east flank has left only scarce remnants of the caldera sequence.

The geologic history of the caldera is comprised of four lithologic groups. First and oldest, is the belt of numerous dikes, associated faults, and breccias that form the presumed ring fracture structure along the caldera's eastern margin. The 1 km-wide belt, bounded by metamorphic rocks on the outer east side, is comprised of at least 6 vertical dikes of intermediate and siliceous compositions. On the caldera side of the

belt are found two types of breccias exposed as steeply-dipping layers: a breccia made up of andesitic and dacitic clasts in a tuffaceous matrix and a coarse breccia of only andesitic clasts and matrix. Fewer but similar dikes occur at the inner foot of the western caldera rim. The second group corresponds to the caldera's outer flank sequence, more than 1250 m thick, that dips 15-20º away from the caldera rim and depression for as much as 18 km, before disappearing under the InterAndean Valley fill. It is chiefly made up of ignimbrites, welded tuffs, vitrophyres, and tuffs, mostly of dacitic to rhyolitic composition, bearing plagioclase, sanidine, biotite, and quartz as phenocrysts. These are inter-bedded with subordinate lavas of andesitic to dacitic composition. The total sequence ranges in age from 2.7 to 0.8 Ma and has a volume crudely estimated at 670 km^3.

Figure 2: The Potrerillos lava flow (0.26 Ma) with its undulating morphology descended from a resurgent dome vent within the caldera depression. The western caldera rim forms the dark ridge seen in the background, and the outward-sloping western flanks lie behind.

The caldera-infilling makes up the third group, comprised of three rock units: a) below, a thick tuff and breccia unit that has suffered widespread alteration of low to

medium intensity, b) a thick series of black porphyritic andesitic lavas dated at 1.5 to 1.9 Ma in age that covered the tuff and breccia unit. These lavas are transitional up section to c) a volcanic sand to gravel to conglomerate succession of fluvial origin that implies progressively more energetic depositional conditions with time and that we interpret to represent the gradual arching of the resurgent area. The fourth group is represented by a long period of lava emissions from a series of vents aligned on a 19 km-long arc that crosses the western half of the caldera depression. Most of these flows have a young morphology, are several kilometers in length, and are siliceous andesites to dacites in composition (Fig. 2). These range in age from 0.45 to 0.16 Ma, however more recent lavas occurred from 30 to 20 ka. The most recent rhyolitic emissions, estimated at 0.22 Ma in age, include major ignimbrites that traveled down valleys on the west flank and out into the InterAndean valley, and a climatic eruption that deposited an 8 m-thick pumice fall unit and a 7 km-long obsidian flow, dated at 0.16 to 0.17 Ma.

In conclusion, although petrologic studies have yet to be completed, the overall Chacana caldera complex has many of the structural and petrographic characteristics of the San Juan Mtns., Colorado, calderas and other rhyolitic calderas. It is part of a grouping of scattered rhyolitic edificies, consisting of both large caldera structures as well as smaller centers, that extend from the Chacana caldera in the north to the Chalupas caldera to the south, a distance of 100 km.

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