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# Unravelling the collapse mechanisms at a Jurassic caldera of the Chon Aike silicic LIP in Southern Patagonia (47º 15´S, 71° 40´W), Argentina

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## Abstract:

La Peligrosa Caldera is located at Sierra Colorada (47º 15´S, 71° 40´ W) in the Chon-Aike silicic Large Igneous Province (Pankhurst *et al*., 1998). This volcanic province has an area of 1.7 x $10^6$ $km^2$, including the continental platform and the Antarctic Peninsula with an estimated volume of 235,000 $km^3$ Middle to Late Jurassic in age (188-153 Ma, Pankhurst *et al*., 2000), this long-lived and widespread volcanism took place in Patagonia along the western margin of Gondwanaland. Remarkably homogeneous in composition (Sruoga, 1989; Pankhurst *et al*., 1998), it is dominated by voluminous ignimbritic plateaus, with granites, lava domes, minor intermediate lavas and epiclastic tuffs. However, collapse calderas have been exceptionally recognized. La Peligrosa Caldera (Sruoga, 1994, 2002) represents an unique window to understand the eruptive mechanisms that prevailed throughout the ignimbritic flare-up in Southern Patagonia during middle to late Jurassic times.

On the northern flank of Sierra Colorada, Tertiary Andean thrusting and intense glacial erosion have helped to expose the roots of the deeply dissected La Peligrosa Caldera. Key pieces of lithologic and structural evidences are taken into account to reconstruct the volcanic structure (Sruoga et al., 2008).

The sequence outcropping between Cerro Ghío and La Peligrosa ranch (Figure 1) allowed us to unravel the collapse mechanisms leading to the caldera formation. Three units

 

may be differentiated in this sequence: La Salina Breccia, Los Acantilados Ignimbrite and Cerro Ghío Ignimbrite (Figure 2).

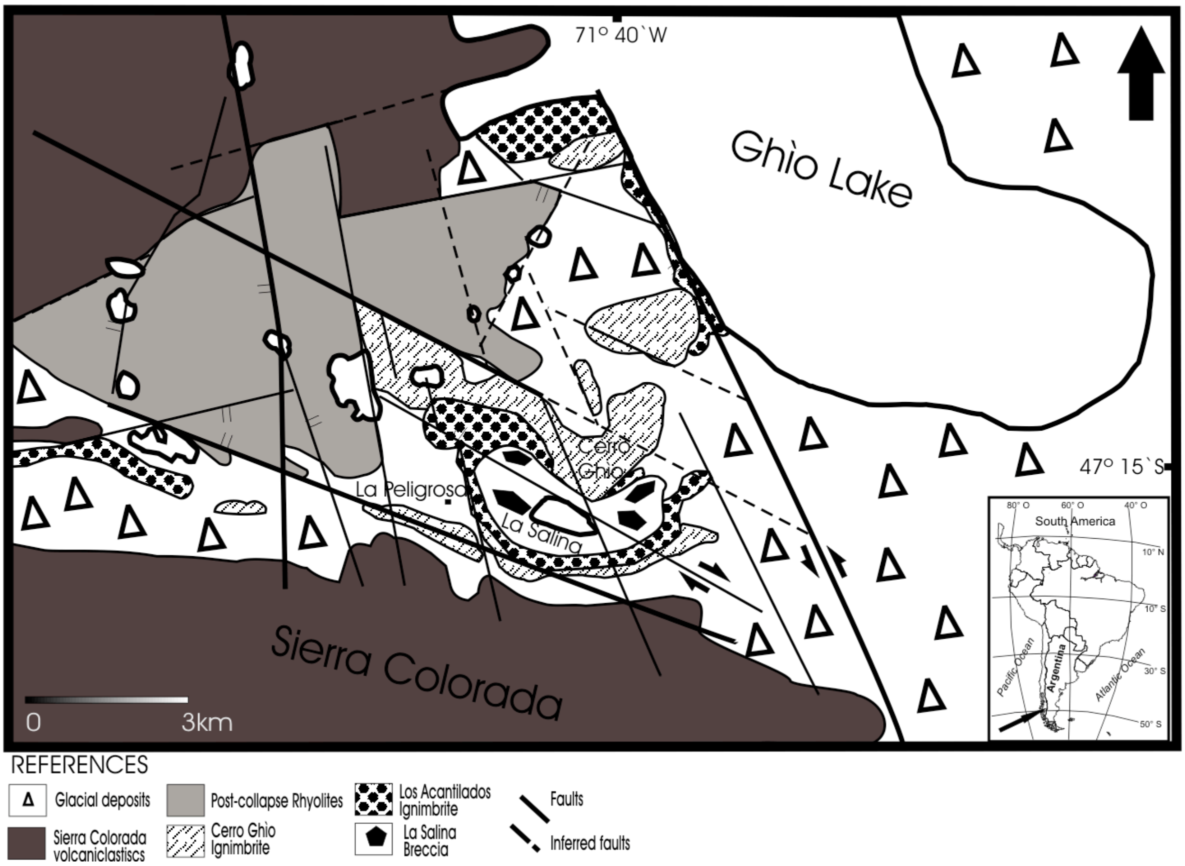


Figure 1: Geologic map

At the base, La Salina Breccia constitutes a chaotic deposit, *ca.*100 m thick, with blocks up to 300 m across, immersed in a pyroclastic matrix. The breccia includes different types of lithics: Paleozoic basement schists, phyllites, quartzites and granites, Jurassic (?) andesites, rhyolites and ignimbrites, and laminated and deformed lacustrine sediments. This mega- to mesobreccia (Lipman, 1976) thins out to the west, accompanied by strong variation in lithic size and content. In the upper part, a transition to the overlying unit may be recognized, based on lithic depletion and strong size reduction. The Los Acantilados Ignimbrite may be described as poorly to moderately welded lithic ignimbrite. This *ca.* 300 thick whitish and massive deposit is characterized by a large proportion of lithics, up to 0.50 m in size. It shows vertical zonation, with green fiamme layers developing eutaxitic textures. In the upper part of this deposit two lithic-rich layers are recognized.The uppermost unit is the Cerro Ghío Ignimbrite. It corresponds to a *ca.* 400 meters thick, massive, dark green, crystal-rich and densely welded cooling unit.It shows an order of magnitude decreasing thickness at the suspected caldera margins. South and westwards, the ignimbritic deposit thins to *ca.* 40-60 m.

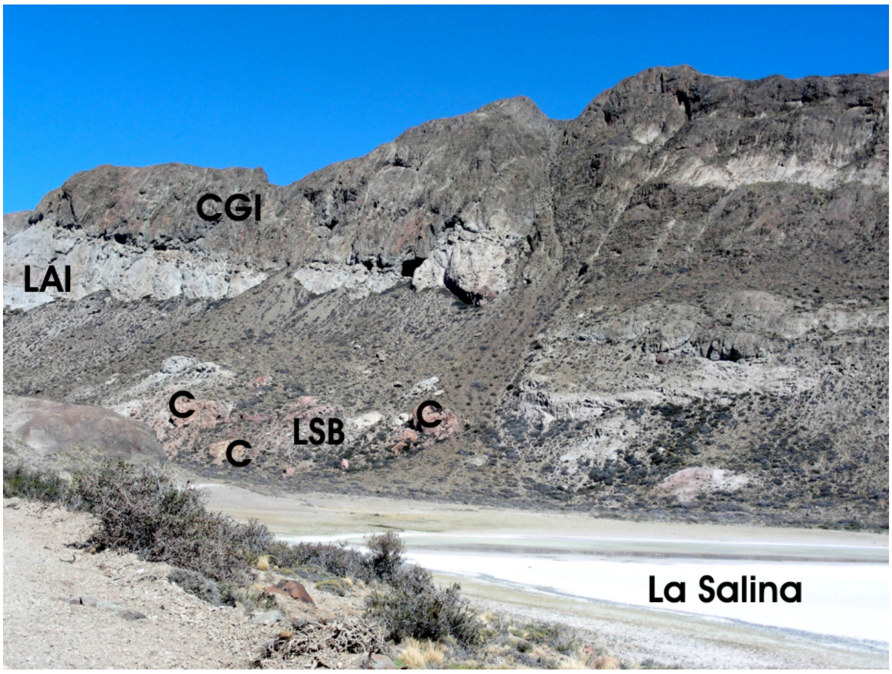


Figure 2- Northwestern flank of Sierra Colorada. LSB: La Salina Breccia (C: lithic clasts), LAI: Los Acantilados Ignimbrite, CGI: Cerro Ghío Ignimbrite

The described section records at least two caldera collapse events. The first one is represented by the La Salina Breccia. The megabreccia at the bottom and the vertical and lateral variation in lithic size and concentration suggest that the collapse cannot be described as a single piston-like event. The lithic concentration levels at the upper part of Los Acantilados represent minor local incremental adjustments during the rapid collapse. The emplacement of this large-volume lithic ignimbrite records the initial filling of the caldera. Shortly afterwards, due to the absence of reworked epiclastics, the collapse continued with the reactivation of normal faults and the emplacement of the Cerro Ghío Ignimbrite. Rhyolitic lava domes and flows correspond to post-collapse volcanism.

A prevailing transtensional regime controlled the eruption of the silicic large-volume ignimbrites and lava flows. La Peligrosa Caldera formed after a dilatational zone related to a releasing step-over associated with a left hand *en-échèlon* array of N-S to NNW regional faults. Caldera collapse is dominated by NNW sinistral and WNW dextral transtensional faults (Fig.1). Overprinting caldera structures, and later ENE extensional faults are linked to the rhyolitic post-collapse volcanism and indicate a temporal change in stress conditions.

The relationship between volcanic facies (megabreccia and two intracaldera ignimbrites) and main normal faults allow us to propose a piecemeal-trapdoor type caldera, with the deepest part located between Cerro Ghío and the northwestern flank of Sierra Colorada. Although many pieces are lacking to fully support this model, future studies will provide new elements for better understanding the collapse mechanisms of La Peligrosa Caldera and test its application to the rest of the Chon Aike silicic LIP.

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