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Could the Liquiñe-Ofqui fault zone promote the 2011 Cordon Caulle eruption ?

Camila Novoa Lizama[1], Muriel Gerbault[1], Dominique Rémy[1], José Cembrano[2], Luis Lara[3], Andres Tassara[4], riad Hassani[5], Juan Carlos Baez[6], and Javiera Ruz[6]

[1]Geosciences Environnement Toulouse, (IRD CNRS UPS OMP) Toulouse, France (muriel.gerbault@get.omp.eu)
[2]Pontifical universidad Chile, Dpto Ingeniera & Geologia, Santiago Chile
[3]Sernageomin, Santiago, Chile
[4]Universidad de Concepcion, Concepcion Chile
[5]Geoazur (UNSA), Valbonne, France
[6]Universidad de Chile, Santiago, Chile

The 2011-2012 Cordon-Caulle eruption was the largest subaerial eruption of the 21th century. An inflation captured from InSAR between 2007 and 2009 was related to a volume of magma injection too small to have triggered this eruption. Here, we benefit from SAR imagery acquired by ALOS-1, ENVISAT and SENTINEL-1 data, to analyze the temporal and spatial behavior of ground displacements before, during and after the eruption. We find that a similar prolate spheroidal source explains the data for the pre-eruptive and post-eruptive periods. Then we explore two tectonically-related hypotheses to explain the observed displacements during the explosive phase of the eruption. Therefore, first we model InSAR data using standard inversion models to evaluate how slip motion along specific structures explain surface observations. Our results show that the explosive phase's ground displacements could have been produced either by the collapse of the caldera and the graben overriding the reservoir, or by slip motion along a dextral-strike slip fault zone related to the North-South trending Liquiñe-Ofqui fault zone. Second, we use 3D numerical models and elasto-plasticity to assess the failure conditions along both structures resulting from an overpressure applied at the wall of the prolate-spheroidal reservoir. Our results show that a magma injection consistent with the 2007-2009 inflation signal rather promotes constriction at the roof of the reservoir, which tends to impede fluid flow towards the surface. The presence of a relatively weak graben-caldera structure in our models show that this constrictional area is enhanced. On the other hand, the elasto-plastic pattern resulting from the application of a dextral-slip motion along the LOFZ branch-fault generates a dilatational plastic zone that connects the reservoir wall to the surface, where it coincides with the location of the 2011 eruption. Hence we propose that the LOFZ branch-fault, weakened during the pre-eruptive inflation phase, destabilized and slipped two years later in a way that it served as open channels for fluid migration from the magma reservoir up to the surface.