Geophysical Research Abstracts
Vol. 20, EGU2018-7022, 2018
EGU General Assembly 2018

Analysis of the ongoing uplift observed in the Laguna del Maule area (Chile)

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Laguna del Maule (LdM) is a rhyolitic volcanic field located in the Southern Volcanic Zone of the Andes (Chile), which erupted for the last time 2200 years ago, but has been actively deforming since 2007. In this study, we analyzed the surface displacements observed on this volcanic field from a large InSAR dataset including ENVISAT, ALOS1-2 and SENTINEL data acquired from 2003 to 2017. InSAR time series highlight that the surface displacement pattern remains nearly constant over the studied period but with an amplitude decreasing gradually with time. The maximum cumulative displacement is about 2 m with a rate of about 0.23 m/y from 2007 to 2011 and 0.15 m/y from 2015 to 2017. Two displacement source models embedded in an elastic medium are considered: a volume of intruding magma in the form of sill, and a pressurized large magma chamber. Both models fit the observed InSAR data equally well, yielding to a χ^2 of about 1.1, but residual maps reveal localized patterns indicating that none of these models completely explains the ground displacement field. This suggests that either the source geometry is more complex or that the observed displacements are related to more than a single source. For a source embedded in an elastic medium, the volume change estimate is between 230 to 450×10^6 m^3 depending on the compressibility of the magma. The decrease in amplitude of the surface displacement rates over time is likely related to a decrease in the internal pressure. We also explored the possibility that this gradual decrease in surface deformation rate could be due to a viscoelastic relaxation mechanism of a long lived crystal rich reservoir below the LdM. First results using a three-dimensional finite element method (ADELI) for modeling time-dependent ground deformation due to a volcanic pressure source embedded in a viscoelastic medium are presented.