Elastic stress interaction between faulting and volcanoes along the Calama-Olacapato-El Toro fault zone, Central Andes

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Abstract

The aim of this work is to describe the relationship between tectonics, earthquakes and volcanism along a Plio-Quaternary fault zone using Coulomb stress-change hypothesis. We investigated how the tectonic motions transferred stresses to nearby faults and volcanoes, using a series of representative models obtained by the Coulomb 3.1 software. We explored the elastic stress interaction between the Negro de Chorrillos and San Jerónimo Quaternary volcanoes, which lie exactly along the longest Quaternary transcurrent fault zone in the Central Andes: the Calama-Olacapato-El Toro (COT) structure. The COT fault zone transversally crosses the Andean chain and the Puna Plateau at about 24°S. This plateau is one of the two largest on Earth, together with the Tibetan Plateau, and has an average elevation of 3.7 km. It mostly resulted from post-Oligocene tectonics with some motions still active during Quaternary times. We identified a series of NW-striking fault segments along the COT structure that offset Pliocene or Pleistocene volcanic deposits with left-lateral strike-slip kinematics and a vertical component of relative uplift of the northeastern tectonic block. These kinematics are confirmed by offset landforms and deposits, as well as by slickenside lineations measured along the fault plane. The geometry in plan view of the fault trace suggests a vertical geometry of the main slip plane. Paleostress tensors have been reconstructed by numerical inversion of the striated fault plane data. These new results have been integrated with other data coming from the World Stress Map in order to have a robust dataset to improve a Coulomb failure model for the studied area. This modelling provides information on the tectonic evolution of the area, on the interaction between motions along the different fault segments, and on how much fault displacement might influence volcanic activity along the COT fault zone. The latter focus has also been investigated in the adjoining northern area where the huge, active Tuzgle volcano lies.