

Reconnaissance earthquake studies at nine volcanic areas of the central Andes with coincident satellite thermal and InSAR observations

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Abstract

We record non-eruptive background seismicity at eight potentially active volcanoes and one geothermal area in Chile and Bolivia for the first time in order to set a baseline for future episodes of unrest. We also compare seismicity to coincident new regional observations of ground deformation from InSAR and satellite observed thermal anomalies from the ASTER instrument. We deploy small temporary seismometer networks (1 to 5 stations each) of short and intermediate period instruments for 3–27 months at the nine areas between the years 2004 and 2012 at: Parinacota, Guallatiri, Isluga, Irruputuncu, Olca–Paruma, Ollagüe, Sol de Mañana, Putana, and Láscar. Despite the lack of shallow earthquakes in the global catalogs at these volcanoes, we find that all have volcano-tectonic events with at least 27 earthquake swarms — the most active are Putana, Guallatiri and Ollagüe. We find two examples where changes in seismicity are likely related to either deformation (in 2009 at Putana) or an increase in temperature (in 2012 at Isluga). Further, we document for the first time ground deformation at a Pliocene volcano called Sillajhuay, located in the Holocene volcano gap (i.e., 70 km from the nearest active volcano Isluga). We find that the four deforming volcanoes between 18 and 24°S are seismically active, but that seismic activity does not imply measurable ground deformation. Similarly, the seismically active volcanoes have satellite thermal hotspots, but there is no correlation between relative amounts of seismic activity and hotspot temperature. Because several of the volcanoes show variations in seismic activity, temperature, and deformation over the course of a few years unrelated to eruptions, decadal and longer observations are needed to constrain background activity in the central Andes..

Keywords

Volcano earthquakes, Central Andes, InSAR, Volcano thermal anomalies.