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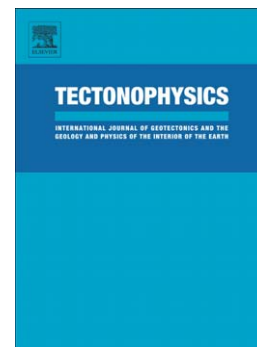
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The central Andes case

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Structural control on volcanoes and magma paths from local- to orogen-scale: The central Andes case

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Abstract

Assessing the parameters that control the location and geometry of magma paths is of paramount importance for the comprehension of volcanic plumbing systems and geo-hazards. We analyse the distribution of 1518 monogenic and polygenic volcanoes of Miocene-Quaternary age of the Central Volcanic Zone of the Andes (Chile-Bolivia-Argentina), and reconstruct the magma paths at 315 edifices by analysing the morphostructural characteristics of craters and cones. Then we compare these data with outcropping dykes, tectonic structures and state of stress. Most magma paths trend N-S, NW-SE, and NE-SW, in decreasing order of frequency. The N-S and NW-SE paths coexist in the northern and southern part of the study area, whereas N-S paths dominate east of the Salar de Atacama. Outcropping dykes show the same trends. The regional Holocene stress state is given by an E-W greatest horizontal principal stress. N-S and NNE-SSW reverse faults and folds affect deposits of 4.8, 3.2 and 1.3 Ma BP, especially in the central and southern study areas. A few NW-SE left-lateral strike-slip faults are present in the interior of the volcanic arc, part of which belong to the Calama-Olacapato-El Toro fault. The volcanic chain is also affected by several N-S- and NW-SE-striking normal faults that offset Pliocene and Quaternary deposits. The results indicate different scenarios of magma-tectonic interaction, given by N-S normal and reverse faults and N-S fold hinges that guide volcano emplacement and magma paths. Magma paths are also guided by strike-slip and normal NW-SE faults, especially in the northern part of the study area. Zones with verticalized strata, with bedding striking NE-SW, also acted as preferential magma paths. These data suggest that at convergence zones with continental crust, shallow magma paths can be more sensitive to the presence and geometry of upper crustal weakness zones than to the regional state of stress.

Key words: Tectonic structures, volcano morphometry, Andes, magma pathway, state of stress.

1. Introduction

This paper focuses on understanding which are the conditions that allow magma uprising in the uppermost crust in a compressional chain like the Andes. Magma storage and ascent are tightly linked to the structure and state of stress of the crust (Chaussard and Amelung, 2014; Tibaldi,

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