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# Emplacement and accumulation of magmatic products in contractional structures: How does it occur? Insights from Central Andes of northern Chile

F. Martínez [a, *], G. Fuentes [b], C. Torres [c], M. Peña [d], L.D. Barraza [c]

[a] Carrera de Geología, Facultad de Ingeniería, Universidad Andres Bello, Campus República, República 220, Santiago, Chile
[b] Escuela de Geología, Facultad de Ingeniería, Universidad Santo Tomás, Ejército 146, Santiago, Chile
[c] Independent Consultant, Chile
[d] Universidad Mayor, Escuela de Geología, Santiago, Chile

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ABSTRACT

Structural and stratigraphic data demonstrate that the magmatism in northern Chile was accompanied by shortening related to the development of fold and thrust belts. However, how magmatic products were emplaced and accumulated in the contractional structures is an unresolved question. We, therefore, integrated field and seismic data from the regions of the Pampa del Tamarugal, Salar de Punta Negra Basin, and the Hornitos Fold and Thrust Belt to determine the main structures that facilitated the magma accumulation. The syn-kinematic granitic intrusions in the Hornitos Fold and Thrust Belt were preferably emplaced along fold-related thrusts. In this region, magma migrated along thrust ramps and finally accumulated into the core of the anticlines and broken synclines. Subsidiary and vertical tensional fractures controlled the magma accumulation in the hinge zone and at the axis of the folds. The seismic data from the Pampa del Tamarugal and Salar de Punta Negra Basin present evidence of buried volcanoes on inversion anticlines. During the tectonic inversion of the pre-existing Late Paleozoic to Mesozoic half-graben structures in the regions, magma migrated along the master faults and finally accumulated into the core of the inversion anticlines as sills or was expulsed to the surface as volcanoes, as evidenced by the Punta Negra Monogenetic Volcano.

## 1. Introduction

Magmatism and contraction are two frequent processes that occur in subduction-related orogens that result from the shortening and partial melting of the continental lithosphere (Ramos and Mpodozis, 1989; Allmendinger et al., 1997; DeCelles et al., 2009; Ramos and Folguera, 2009; Acocella, 2014; Ramos, 2021). The latter is well observed in the Central Andes (Fig. 1), a doubly verging orogen developed from the Late Cretaceous on the western South American margin due to the continued subduction of the Nazca oceanic plate (Pardo-Casas and Molnar, 1987; Somoza, 1998; Horton, 2018; Ramos, 2021; Quiero et al., 2022, among others; Fig. 1). Its Late Cretaceous to Cenozoic tectonic evolution was marked by regional episodes of magmatism and crustal shortening evidenced in the western slope by structural, stratigraphic, and geochronological data (Ramos and Mpodozis, 1989; Charrier et al., 2007, 2009; Mpodozis and Cornejo, 2012; Jaldín et al., 2023). The tectonic architecture of northern Chile (Fig. 1) consists of several fold and thrust belts (Arriagada et al., 2006; Amilibia et al., 2008; Naranjo et al., 2018; López et al., 2019; Martínez et al., 2016, 2021) exposed in the Domeyko and Frontal cordilleras, Central Depression, and Pre-Andean basins (i.e., Atacama and Punta Negra basins) (Fig. 1). They usually exhibit a mixed or "hybrid" structural style (Martínez et al., 2020) dominated by thick and thin-skinned contractional structures related to the inversion of Mesozoic rift basins and the decoupling of the cover strata (Amilibia et al., 2008; Espinoza et al., 2018; López et al., 2019, 2020; Martínez et al., 2021).

In these regions, intrusions of variable size were emplaced along the thrust and/or reverse fault surfaces and along the axis of folds are commonly observed (Tomlinson et al., 1999; Moscoso et al., 2010; Peña et al., 2013; Fuentes et al., 2018, among others), as well as volcanoes located on the fold-related thrusts (González et al., 2009; Naranjo et al., 2018; Martínez et al., 2018; Tibaldi and Bonaldi, 2018; Jaldín et al., 2023), which provide evidence of the close relationship between contraction and magmatism. The latter is well-recognized along the normal subduction segment (Fig. 1), where some active volcanoes (e.g., Tolonchа and Miscanti) in the easternmost part of the Salar de Atacama Basin (González et al., 2009; Tibaldi and Bonaldi, 2018) are directly emplaced along the east-directed thrust ramps.

* Corresponding author.
*E-mail address:* martinezfjh@hotmail.com (F. Martínez).

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