Crustal and Subcrustal Magmatic Components of Cenozoic Andean Arc Magmas in Central Chile (32°45'-34°30'S)

Marcia A. Muñoz-Gómez[1], C. Mark Fanning[2], Ítalo Payacán[3], Felipe Tapia[4–5], Reynaldo Charrier[6]

(1) Universidad Andres Bello, Carrera de Geología, Facultad de Ingeniería, Campus República, Santiago, Chile
(2) Australian National University, Research School of Earth Sciences, Canberra, Australia
(3) Universidad Mayor, Escuela de Geología, Santiago, Chile
(4) Universidad de Buenos Aires, Departamento de Ciencias Geológicas, Facultad de Ciencias Exactas y Naturales, Buenos Aires, Argentina
(5) Consejo Nacional de Investigaciones Científicas y Técnicas, Instituto de Estudios Andinos (IDEAN), Buenos Aires, Argentina
(6) Universidad de Chile, Departamento de Geología, Facultad de Ingeniería, Santiago, Chile

In Central Chile (32°45'-34°30'S) there is a protracted Cenozoic arc magmatic activity that developed almost uninterruptedly between, at least, the middle Eocene and up to the present. This is recorded in extensive continental and mainly volcanic deposits, intrusive units, and the current volcanics which are widely distributed from the axis of the main Andes Cordillera to the west up to the eastern portion of the Central Depression. The evolution of the margin throughout this period was initially framed by an extensional event, between (middle Eocene?) Oligocene - early Miocene, characterized by an intra-arc rift system developed over a thin crust (~35 km; Charrier et al., 2002; Nyström et al., 2003; Kay et al., 2005). The system was then inverted in the early Miocene under a compressional regime that was active until today and responsible for the constructional processes of the modern Andes in the region (e.g. Giambiagi & Ramos, 2002; Farías et al., 2010). Overall, arc igneous rocks associated with this evolution show compositional variations that are marked by an increasing crustal signal, with a progressive migration of the magmatic loci to the east, from the westernmost Oligocene frontal arc deposits (current Central Depression) up to the Holocene active arc axis (Andean drainage divide, ~80 km in current distance; Charrier et al., 2002; Nyström et al., 2003; Kay et al., 2005).

Along with new determinations presented herein, the numerous studies developed in Central Chile in the last decades provide an extensive compositional characterization of Cenozoic arc magmas in terms of whole rock geochemistry and Sr, Nd, Hf and O isotopic compositions. This allows for a comprehensive interpretation of the major magmatic components, the crustal vs subcrustal sources, and the dynamic variations recorded throughout the evolution of the Andean margin. Four major components involved in the magma genesis of this arc segment have been identified: (i) the subcrustal Subduction Modified Depleted Mantle, which sources the juvenile arc magmatic additions prompting extensive MASH-type magmatic processes in the deep continental crust, (ii) a crustal Deep Evolved Component, here ascribed to the Cuyania terrane Grenvillian basement, (iii) a Juvenile Low-δ18O Component, which likely corresponds to an oceanic crust type domain located deep within the continental crust, and (iv) a Late Paleozoic – Early Triassic Component, like the Frontal Cordillera crystalline basement, located at medium to upper crustal levels underneath the Mesozoic cover of the main Andes Cordillera in this region. The influence of these components is variable depending on the time and location of the arc magmatic units. In order to evaluate their relative contributions, geochemical models are being tested based on thermodynamic simulations of mineral phase equilibrium, melt compositions and isotope partitioning models. Overall, the composition of Cenozoic arc magmas in Central Chile is strongly controlled by the continental crust, both after (i) the constitution and architecture of this domain and its reshaping throughout the evolution of the Andean margin and by (ii) the governing tectonic regime.

Keywords: Cenozoic Andean Arc, Central Chile, Magmatic Components, Arc Sources.

Financing: This work was supported by the ANID (Agencia Nacional de Investigación y Desarrollo, Chile) under the grants ANILLO-ACT18, FONDECYT 1120272, and PAI79160139.

References:

- Charrier et al. (2002). Journal of South American Earth Sciences 15: 117-139.
- Nyström et al. (2003). Geological Society of America Bulletin 115: 1523-1537.
- Kay et al. (2005). Geological Society of America Bulletin 117: 67-88.
- Giambiagi et al. (2002). Journal of South American Earth Sciences 15: 101-116.
- Farías et al. (2010). Tectonics 29: TC3006.