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Petrogenesis and evolution of the Altar volcano deposits (Ecuador)

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Altar Volcano is located in the Eastern Cordillera of Ecuador, 25 km E of Riobamba. It is considered as an extinct stratovolcano, and no recent deposit associated to its activity has been reported. The objective of this study is to define the magmatic evolution of Altar deposits by means of petrographic and geochemical characterization. During three long lasting field missions we collected samples of lavas, breccias and dikes displaying mainly, andesitic compositions. Nevertheless, gabros and rhyolites were also present. We defined four units in this volcano: 1) Altar breccias (pl + cpx + ol + opx), 2) Collanes breccias (pl + cpx + opx), 3) Gabbro-Diorite (pl + cpx + bt + opx) and 4) Collanes rhyolite (Plg+ Amph + Bio). A total of 56 rock samples and 20 thin sections were analyzed for major and trace elements in whole rock. The compositional variation from andesites (Collanes Breccias, SiO2 = 57-68%) to rhyolites (Collanes Rhyolite, SiO2 = 70-74%) and a lower HREE content of rhyolites with respect to andesites, can be explained by 60 % of fractional crystallization leaving a cumulate comprising plg + anf + opx + cpx + ti-mt ± apt. Also, we analyzed major elements in individual minerals, to define the pre-eruptive conditions of all units. Thus, we obtained the following parameters: 1043 °C and 2.78 kbar for the unit Altar breccias; 945 °C and 3.6 kbar for Collanes breccias and 850°C and 2.3 kbar for Collanes rhyolite, which is consistent with the geochemical composition of each unit. The parent magma of these series should result from partial melting of a metasomatized mantle wedge, as it is the case for other Ecuadorian volcanoes (i.e. Narvaez et al. 2018). In order to better constraint the metasomatizing agent, we looked into Ba/Th and Sr/Th ratios, which enlighten the relationships between mobile (Ba, Sr) and non-mobile (Th) elements in fluids. The most basic rocks of the El Altar Volcano show low ratios, which are related in nearby volcanoes to a mantle source metasomatized by hydrous silicate melts and are produced by the slab melting. This process has been modelled in three steps: 1) partial melting of the Carnegie Ridge basalts, 2) metasomatism of the depleted mantle wedge; and 3) partial melting of this metasomatized source. The analyzed data from Altar volcano leads us to conclude that similar, metasomatism, partial melting, and finally fractional crystallization processes, control the magma genesis and evolution in the Northern Andes of Ecuador.