Resolving AFC trends with single mineral Pb isotope analysis (Pichincha volcano, Ecuador)

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Continental arc magmas often undergo extensive transformation within the arc crust which hampers the identification of primitive magmas geochemical signature. Melt inclusions (MI) studies lead to a better understanding of deep magma sources but isotope measurements of MI lack precision. An alternate approach is based on the study of minerals which record major steps of melt differentiation. Our approach includes hand picking, dissolution, and major-trace element and Pb isotope analysis of individual minerals. We present data for 42 minerals, including 20 amphiboles, 18 plagioclases and 4 orthopyroxenes, from two hand-sized samples of the Guagua Pichincha volcano (Ecuadorian arc).

Firstly, minerals show a wide range of isotopic composition ($^{206}Pb/^{204}Pb$: 18.82-19.02; $^{207}Pb/^{204}Pb$: 15.59-15.60; $^{208}Pb/^{204}Pb$: 38.61-38.82) extending on both sides of the whole rock composition for one, and on the unradiogenic side for the second one. Plagioclase and pyroxenes minerals have homogeneous isotopic compositions while amphibole composition varies more widely. Plagioclases plot at the radiogenic end of the trend ($^{206}Pb/^{204}Pb$: 19.00-19.02; $^{207}Pb/^{204}Pb$: 15.59-15.60; $^{208}Pb/^{204}Pb$: 38.77-38.81) while pyroxenes display slightly less radiogenic compositions ($^{206}Pb/^{204}Pb$: 18.93-18.97; $^{207}Pb/^{204}Pb$: 15.59-15.60; $^{208}Pb/^{204}Pb$: 38.68-38.73) than the whole rock. Secondly, amphiboles isotopic composition varies along the whole trend. Plotting incompatible elements contents and Eu anomaly against isotopes show that all the isotopic variability is inherited from the most primitive melts that are registered within the mineral signatures and that the melt(s) homogenize at shallow depths. There is no mean to depict if this variability is inherited from the continental crust or the mantle but data suggest that melts are issued from an isotopically heterogeneous source and/or react with heterogeneous material on their extraction pathway and that no homogenization happens at greater depth than plagioclase stability pressure. Thus, we draw a detailed record of the geochemical evolution of the magma, from the primary melt through crystallisation and migration in the arc crust.