8th International Symposium on Andean Geodynamics (ISAG)

Lower crustal vs. mantle wedge fingerprint in the Ecuadorian arc magmas: Contribution of Pb isotopes from the Cotopaxi volcano

F. Nauret[1], P. Samaniego[1], N. Sainlot[1], P. Mothes[2], I. Vlastélic[1], M. Gannoun[1], M. A. Ancellin[1], S. Hidalgo[2]

[1]Université Clermont Auvergne, CNRS, IRD, OPGC, Laboratoire Magmas et Volcans, F-63000 Clermont-Ferrand, France

[2]Instituto Geofísico, Escuela Politécnica Nacional, Ap. 17-01-2759, Quito, Ecuador

Pb isotopes are very sensitive to continental crustal contamination. With these isotopes, we are able to discriminate the contribution of the lower crust from that of the upper crust. With the objective of constraining the genesis of arc magmas by focusing here on the role of the continental crust, we propose a geochemical study on eruptive products of the Cotopaxi volcano. This choice is based on the fact that Cotopaxi is constructed on a thick continental crust and that its magmatic series span a large geochemical diversity, from basaltic andesites to rhyolites (Garrison et al., 2006, Garrison et al., 2011).

We provide here 23 new high-precision Pb isotope data obtained on tephras, covering the range from andesites to rhyolites, over a period ranging from pre-Holocene to historical times. Isotopes variations are comprised between 18.980 and 18.923 for $^{206}Pb/^{204}Pb$, 15.629 and 15.640 for $^{207}Pb/^{204}Pb$ and 38.717 and 38.765 for $^{208}Pb/^{204}Pb$. Comparing these results with published data, we observe that our data have restricted $^{206}Pb/^{204}Pb$- $^{207}Pb/^{204}Pb$- $^{208}Pb/^{204}Pb$ ranges; nearly constant $^{207}Pb/^{204}Pb$ for variable $^{206}Pb/^{204}Pb$; rhyolites have always higher $^{206}Pb/^{204}Pb$ at a given $^{207}Pb/^{204}Pb$ or $^{208}Pb/^{204}Pb$ than andesites; our samples do not define linear correlations in $^{207\text{-}208}Pb/^{204}Pb$ vs. $^{206}Pb/^{204}Pb$.

With the whole Pb high precision dataset (Ancellin et al., 2017, Nauret et al., 2018), we are able to distinguish volcanoes of the western cordillera (WC), of the inter-Andean valley (IAV), of the eastern cordillera (EC). Each set (WC, IAV, EC) can be represented by a linear correlation in a $^{207}Pb/^{206}Pb$ vs. $^{208}Pb/^{206}Pb$ diagram. These correlations point on the one hend towards the compositions of the upper crust and on the other hand towards values representing jurassic-cretaceous ages terrains or deposits (Bosch et al., 2002, Chiaradia et al., 2004). The slopes of these correlations increase with increasing distance to the subduction trench. These slope variations may reflect either the increase in contamination by the lower crust or the increasing role of the mantle wedge.

Ancellin, M.A., Samaniego, P., Vlastélic, I., Nauret, F., Gannoun, A., Hidalgo, S., 2017. Across-arc versus along-arc Sr-Nd-Pb isotope variations in the Ecuadorian volcanic arc, Geochemistry, Geophysics, Geosystems 18, 1163-1188.

Bosch, D., Gabriele, P., Lapierre, H., Malfere, J.-L., Jaillard, E., 2002. Geodynamic significance of the Raspas Metamorphic Complex (SW Ecuador): geochemical and isotopic constraints, Tectonophysics 345, 83-102.

Chiaradia, M., Fontboté L, Paladines, L., 2004. Metal sources in mineral deposits and crustal rocks of Ecuador (1º N–4º S): a lead isotope synthesis, Economic Geology 99, 1085-1106.

Garrison, J., Davidson, J., Reid, M., Turner, S., 2006. Source versus differentiation controls on U-series disequilibria: Insights from Cotopaxi Volcani, Ecuador, Earth and Planetary Science Letters 244, 548-565.

Garrison, J.M., Davidson, J.P., Hall, M., Mothes, P., 2011. Geochemistry and petrology of the most recent deposits from Cotopaxi Volcano, Northern Volcanic Zone, Ecuador, Journal of Petrology 52, 1641-1678.

Nauret, F., Samaniego, P., Ancellin, M.A., Tournigand, P.Y., Le Penne, J.-L., Vlastelic, I., Gannoun, A., Hidalgo, S., Schiano, P., 2018. The genetic relationship between andesites and dacites at Tungurahua volcano, Ecuador. Journal of Volcanology and Geothermal Research, 349, 283-297.