

## An active magmatic hydrothermal system at Copahue volcano, Argentina

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Copahue (Argentina) is an andesitic volcano with a crater lake and acid hot springs that feed the Rio Agrio river system. Primary glass inclusions in plagioclase and olivine have 1110-1670 ppm Cl, 90-400 ppm S and low water contents (0.4 - 1.5 percent). The hydrothermal fluids have S/Cl = 2, whereas the glass inclusions have S/Cl = 0.2, indicating preferential sulfur degassing. The hydrothermal fluids, with 6 % sulfate, are rich in rock-forming elements, with up to 2200 ppm Mg. The stable isotope composition of the spring waters ( $\delta^{18}\text{O} = -2.1$  to  $+3.6$  ‰;  $\delta\text{D} = -49$  to  $-26$  ‰) indicates that these fluids consist of up to 70% of volcanic brine and 30% glacial melt water. Dilution of the Rio Agrio produces values closer to local meteoric waters ( $\delta^{18}\text{O} = -11$  ‰;  $\delta\text{D} = -77$  ‰), whereas evaporation in closed ponds led to very heavy water (up to  $\delta^{18}\text{O} = +12$  ‰). The  $\delta^{34}\text{S}$  value of dissolved sulfate is  $+14.2$  ‰, whereas the  $\text{S}^0$  has values of  $-8.2$  to  $-10.5$  ‰. The isotopically heavy sulfate formed when  $\text{SO}_2$  disproportionated into bisulfate and liquid native sulfur at about 300 °C.

The bulk-rock removal rate in the hydrothermal system through dissolution, calculated from river flux data and crater lake energy modelling, is on the order of 25,000 m<sup>3</sup>/yr. That void space is filled with a mixture of hydrothermal silica, liquid  $\text{S}^0$ , and possibly minor anhydrite and Cu-sulfides. Stored liquid sulfur was ejected as pyroclastic sulfur during the 1995/2000 eruptions. Estimated annual metal fluxes for Copahue are 10 tonnes Zn, 5 tonnes Pb, 3 tonnes Ni, 7 tonnes Cr and 15 tonnes As. Copper tends to be highly depleted in these fluids, suggesting precipitation of Cu minerals in the underlying hydrothermal system. The isotopic signature of the magmatic  $\text{SO}_2$  is estimated at  $\sim +7$  ‰, which is a source signature with superposed effects of shallow degassing. Lead isotope and  $^{129}\text{I}$  data from the fluids indicate the presence of subducted components in the Copahue magmas.

## Petrology and Geochemistry of Çamlidere Volcanic Rocks, Central Anatolia, Turkey: Preliminary Results

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The Galatean Volcanic Province is a large volcanic zone developing as a result of Miocene continental rifting, at the south of the North Anatolian Fault Zone, northwestern Anatolia, Turkey. The Çamlidere volcanic rocks are located at the northern central parts of this province and we herein report the preliminary results on their petrology and geochemistry whose characteristics are poorly known. We observe that domes, lava flows, pyroclastic flow and fall deposits are the eruptive products of Çamlidere volcanic complex. Pyroxene, amphibole, plagioclase, biotite and oxides are dominant phenocrysts in volcanic rocks and quartz is an accessory phenocryst in dacites and rhyolites. Çamlidere volcanic rocks exhibit a wide range of  $\text{SiO}_2$  content (49 to 76 wt%) and are composed of trachybasalt, basaltic trachyandesite, trachyandesite, trachyte, andesite, dacite and rhyolite. Pyroclastics are predominantly rhyolitic in composition. Total alkali-silica diagram shows alkaline and calcalkaline character. The variation diagrams of  $\text{SiO}_2$  versus major elements are consistent with fractional crystallisation process.