Source and sinks of iodine in the hyperarid Atacama Desert of northern Chile

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Iodine is a strongly biophilic element. and its global distribution is dominated by marine sediments. In continental settings, the occurrence of iodine minerals is restricted to hyper-arid environments. The Earth's largest iodine crustal anomaly is hosted in the Atacama Desert where the occurrence of iodine minerals is constrained to the nitrate-iodine deposits located along the eastern side of the Coastal Cordillera, and the supergene zones of copper deposits in the Central Depression and Precordillera.

The iodine ocurrence, source and mechanism(s) of enrichment in this region have been scarcely studied. In this work, we present iodine concentrations and isotopic ratios (^{129}I/I) of the nitrate deposits, supergene copper ores, marine sedimentary rocks, geothermal fluids, groundwater and meteoric water of the Atacama Desert.

Iodine is highly enriched in the nitrate deposits, with a mean concentration of ~700 ppm. These anomalous values are followed by soil samples above supergene copper deposits, and Mesozoic shales and limestones averaging ~50 ppm. Regarding the aqueous reservoirs the highest concentrations were measured in groundwater below nitrate deposits (3.5-10 ppm) and in geothermal fluids (1-3 ppm). In nitrate ores, the calculated ^{129}I/I ratios range from ~300 to ~400x10^{-15}. Supergene iodine minerals in copper deposits present values between 200 and 550x10^{-15} and ratios obtained from marine rocks vary from 300 to 400x10^{-15}. Isotopic ratios of groundwater below nitrate deposits is ~200x10^{-15}.

Results show a strong iodine enrichment in Atacama reservoirs compared to average crustal values. Three essential processes are required to reach such concentrations: (1) the presence of an enriched iodine source, (2) the removal of iodine by fluids from the source to the surficial reservoirs, and (3) the accumulation and preservation of iodine in these reservoirs. Isotopic ratios in nitrates and supergene iodine minerals are in agreement with previously reported ^{129}I/I ratios in crustal fluids derived from organic material (200-400x10^{-15}). Mesozoic shales are the most probable source for iodine because of the similar ^{129}I/I ratios with rock reservoirs, high organic content and regional occurence.

Origin of felsic microgranular enclaves from Salto Pluton, SE, Brazil

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The 590 Ma Salto Granite Pluton, part of the post-orogenic Itu Rapakivi Province (590-580 Ma), SE Brazil, is mainly composed of coarse-grained hornblende-biotite red granite. This main unit was invaded by a body of zoned rapakivi granite which varies from a porphyritic facies dominated by fine-grained matrix (porphyry granite) to a cumulate granite in the eastern deeper portions. Abundant felsic microgranular enclaves (fme) with ellipsoidal shape and dimensions up to 4 m occur within both the red granite and the rapakivi granite, and are interpreted as products of a recharge event of the chamber by a hotter comparetively more mafic magma.

The fme are modally and chemically similar to their host granites. However, they show a slightly more primitive character with SiO_2 contents of ~ 70% against 72-75% observed for the granites and higher Fe, Mg, Ti and Ca contents. These evidences suggest that the enclaves might represent thoroughly hybridized liquids similar to those that gave origin to the porphyry granites. The hypothesis is also supported by the fact that enclave increase in number and size towards the porphyry unit.

Xenocrysts in textural disequilibrium show LREE patterns different from those observed for the whole rock samples. In general, there is a significant superiority in La/Sm_N ratios and liquids calculated to be in equilibrium with such xenocrysts represent more mafic magmas, depleted in such elements.

A similar scenario is suggested for Ba and Sr contents of liquids. It is noteworthy that analyzed crystals from the porphyry unit also show indicatives of a pre-crystallization story in more mafic liquids. However, the modeled liquids show normalized profiles that are parallel to those of their whole rocks, suggesting that the granite magma was the significantly superior in volume compared to the more mafic endmember.

A MELTS model was designed for the investigation of the origin of the abundant rapakivi texture observed in xenocrysts whitin the fme. The predicted amount of LREE expected to be found in plagioclase rims are considerably superior to the observed values, suggesting that the rapakivi texture was probably developed in the more mafic magma, therefore in a stage previous to the thorough hybridization of the mafic and the felsic endmenbers.

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