Noble gas isotope and halogen analyses of Cr-spinels within beach sand from Gorgona Island to constrain the origin of volatiles in the youngest komatiite magmatism on the Earth

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Gorgona Island, Colombia, is a ~90 Ma volcanic island where picrites and the youngest komatiites known on the Earth are present. The origin of magmatism of Gorgona is considered a part of the Caribbean–Colombian Oceanic Plateau resulting from the initial melting stages of the Galapagos mantle plume head (Trela et al., Nature Geo. 2017). Shimizu et al. (EPRL 2009) reported high chlorine concentrations in melt inclusions in chromian spinels (Cr-spinels) separated from beach sand on the eastern coast of Gorgona Island. The melt inclusions were also characterized by high CO2 and low H2O contents. However, the origin of the volatiles remains unknown. We report noble gas isotopes and halogens in the beach-sand-collected Cr-spinels from Gorgona to constrain the volatiles’ origin.

3He/4He ratios of crush-released noble gas from Cr-spinels showed a systematic decrease from 20 Ra to 3 Ra (where Ra denotes atmospheric 3He/4He ratio) with the progress of crushing. This seems to result from more significant contributions of matrix-hosted radiogenic He in the latter crushing steps, confirmed by the low 3He/4He ratio (0.3 Ra) obtained with the melting of the crushed Cr-spinel powder. Therefore the original 3He/4He value of the magmatic He is higher than 20 Ra, showing good agreement with the reported 3He/4He ratios of olivines separated from gabbro and peridotites from the island (8-18 Ra, Révillon et al., EPSL 2002). The high 3He/4He value of the Gorgona komatiite and/or picrite magma is consistent with the involvement of the Galapagos mantle plume, where the highest 3He/4He of 29 Ra has been reported (Kurz et al., EPSL 2009), to their mantle source. The halogen compositions, Br/Cl and I/Cl ratios were close to those of MORB and OIB sources, indicating the mantle origin of halogens and other volatiles. The C/K and Ba/K ratios were similar to those reported for individual melt inclusions in Cr-spinels. Combined with the high 3He/4He ratio, volatiles in the Gorgona komatiites and/or picrites would be derived from a less-degassed reservoir in the deep mantle, possibly in the core-mantle boundary.