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Halogen heterogeneity in the subcontinental lithospheric mantle revealed by I/Br ratios in kimberlites and their mantle xenoliths from South Africa, Greenland, China, Siberia, Canada, and Brazil

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Abstract

To investigate halogen heterogeneity in the subcontinental lithospheric mantle (SCLM), we measured the concentrations of Cl, Br, and I in kimberlites and their mantle xenoliths from South Africa, Greenland, China, Siberia, Canada, and Brazil. The samples can be classified into two groups based on halogen ratios: a high-I/Br group (South Africa, Greenland, Brazil, and Canada) and a low-I/Br group (China and Siberia). The halogen compositions were examined with the indices of crustal contamination using Sr and Nd isotopes and incompatible trace elements. The results indicate that the difference between the two groups was not due to different degrees of crustal contamination but from the contributions of different mantle sources. The low-I/Br group has a similar halogen composition to seawater-influenced materials such as fluids in altered oceanic basalts and eclogites and fluids associated with halite precipitation from seawater. We conclude that the halogens of the high-I/Br group are most likely derived from a SCLM source metasomatized by a fluid derived from subducted serpentinite, whereas those of the low-I/Br group are derived from a SCLM source metasomatized by a fluid derived from seawater-altered oceanic crust. The SCLM beneath Siberia and China could be an important reservoir of subducted, seawater-derived halogens, while such role of SCLM beneath South Africa, Greenland, Canada, and Brazil seems limited.

Keywords: Halogens, kimberlite, subcontinental lithospheric mantle, subduction, metasomatism; Halogens in Planetary Systems