Spatial variations of primordial and recycled noble gases across Iceland

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Spatial variations of primordial and recycled noble gases across Iceland

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Noble gas (He, Ne, Ar, Kr, Xe) compositions of mid-ocean ridge basalts (MORB) and ocean island basalts (OIB) have been widely used to investigate the geochemical structure and evolution of Earth's mantle. Many studies provide evidence for the existence of different mantle domains having distinctive chemical and noble gas signatures. Primordial mantle domains have isotopic signatures that have remained largely unmodified since the Earth's formation, while recycled mantle domains have undergone extensive modification following chemical fractionation during melt extraction and magma degassing, mantle convection, and subduction recycling. Iceland represents a perfect natural laboratory to study the inventory of primordial and recycled noble gases within the mantle thanks to its particular location above a mid-ocean ridge and a mantle plume. In this hybrid setting, melts with a deep OIB-like mantle origin and with near-primordial mantle gas signatures interact and coexist with melts formed at shallower levels that exhibit MORB-like recycled mantle chemical characteristics. On Iceland, chemical and lithological mantle heterogeneities exist on both long and short length scales, and primordial and recycled noble gases signatures can both be present even in a single sample set. We investigated the spatial relationships between Iceland's primordial and recycled mantle components by combining new high-precision noble gas (He, Ne, Ar, Kr, Xe) analyses of basaltic glass with a large existing dataset of noble gas data from subglacially erupted basalts collected across the Iceland. Here, we present noble gas data for the Western Volcanic Zone (WVZ), one of the most geologically interesting areas of Iceland. The data indicate a significant and consistent lateral variability in the noble gas signatures in relation to the distance from the plume centre. We discuss possible explanations for these variations, ways to improve our systematic understanding of mantle volatile distribution beneath Iceland, and outline future directions of this research.