Noble gas and trace element geochemistry of Marie Byrd Land xenoliths

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The West Antarctic Rift System (WARS) is an active continental rift zone within the Antarctic Plate that is associated with several long-lasting magmatic provinces at the rift margins, including Marie Byrd Land and the McMurdo Volcanic Group. Both provinces produce highly alkaline and silica undersaturated volcanics with extreme enrichments in light rare earth elements. Most previous geochemical work in these provinces has focused on bulk classification, modal mineralogy, major element composition, trace element chemistry, and radiogenic isotopes (e.g., Sr, Nd, and Pb isotopes), but very few studies have evaluated volatile composition in this region. Though there is no universally accepted hypothesis, previous explanations for WARS volcanism have included a plume beneath Marie Byrd Land, decompression melting of a fossilized plume head, decompression melting of a stratified mantle source, and mixing of recycled oceanic crust with one or more enriched mantle sources from the deep mantle. Unlike trace elements and radiogenic isotopes, which are highly affected by degrees of partial melting, prior melt differentiation, and mantle recycling, noble gases are chemically inert and present in low concentrations, making them reliable tracers of magmatic sources and subsurface processes. Here, we present trace element chemistry as well as preliminary noble gas isotope (e.g., $^{3}He/^{4}He$, $CO_2/^{3}He$, $^{40}Ar/^{36}Ar$, $^{40}Ar^{*}/^{4}He$) data for a suite of mantle xenoliths from Marie Byrd Land. Preliminary results suggest small contributions from a low partial melt MORB mixing with a more radiogenic endmember. Coupling noble gas geochemistry with more traditional geochemical techniques allows us to deconvolve geochemical overprinting related to interactions between the mantle source and the lithosphere. In the WARS, we can use this combination of techniques to better constrain a magmatic source and provide geological evidence that could support or oppose the existence of a mantle or HIMU plume.