Source variations in Bransfield Strait and relation to nearby Phoenix Ridge

D.W. ANDERSON[1,*], A.E. SAAL[1], T.R. RILEY[2], R.A. KELLER[3], K.M. HAASE[4], S. MALLICK[1], J. WANG[5], J.S. BOESENBERG[1]

[1]Department of Earth, Environmental, and Planetary Sciences, Brown University, Providence, RI 02912, USA
[2]British Antarctic Survey, Cambridge CB3 0ET, UK
[3]Department of Geosciences, Oregon State University, Corvallis, OR 97331, USA
[4]GeoZentrum Nordbayern, Universität Erlangen-Nürnberg, Erlangen, D-91054, Germany
[5] Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, DC 20015, USA
*corresponding author: danny_anderson@brown.edu

The Bransfield Strait (BS) is considered an extending marginal basin along the tip of the Antarctic Peninsula (AP) formed ~4 Mya related to the subduction of the Phoenix Plate and subsequent arc volcanism. How it opened and how the area's mantle has evolved since the strait's inception are disputed. This study reports major, trace and volatile contents, along with new and published isotopes, of 108 fresh submarine glasses from across the BS and the nearby Phoenix Ridge (PR) to evaluate the compositional end-members of the BS mantle, as they compare to the unmodified PR mantle. Comparisons of trace elements and isotopes between lavas from the PR and BS indicate that there are at least three distinct groups in the BS: 1) normal, similar to the PR N-MORBs, 2) enriched, similar to the PR E-MORBs, and 3) arc-like, marked by high LILE/HFSE ratios. Not surprisingly, the PR E-MORB lavas have lower Nd and higher Sr and Pb isotope ratios than the N-MORB lavas. Interestingly, arc-like and normal BS samples form a continuum in Nd-Sr-Pb space, with the most arc-like samples having the most radiogenic Sr and least radiogenic Nd. Furthermore, these BS lavas span the range of $^{143}Nd/^{144}Nd$ values of all PR samples, with relatively constant Pb isotopes. By comparison, the third BS group, the enriched lavas, align closely with PR E-MORB samples in isotope space. Volatiles again indicate BS samples cluster into the same groups. Comparisons between calculated equilibrium pressures (from H_2O and CO_2 solubility) and collection pressures reveal that nearly every sample was either in equilibrium or slightly CO_2-H_2O over-saturated at their collection depth. The only exception is sample 26DR-1, the only enriched BS sample fresh enough to analyse for volatiles so far. The calculated saturation pressure of the sample is 7.5 bars, despite being collected at a pressure of 177 bars. It is possible that this sample, and perhaps the enriched BS samples in general, are subaerial material from the nearby AP that slumped into the strait; however, more samples need to be analysed before any solid conclusions can be drawn.