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Sources and Processes of Intraplate Volcanism near an Abandoned Spreading Center: A Case Study of Socorro Island, Mexico

MAURO A MINGO[1], ELISABETH WIDOM[1], DAVID KUENTZ[1], ALEX SCHWEITZER[1], CLAUS SIEBE[2], SERGIO SALINAS[3], REBECCA LIPPITT[4], KATHERINE KELLEY[4] AND STEVEN CAREY[4]

[1]Miami University
[2]Universidad Nacional Autónoma de México
[3]División de Ingeniería en Ciencias de la Tierra, Facultad de Ingeniería, Universidad Nacional Autónoma de México, Ciudad Universitaria, Ciudad de México C.P. 04510, Coyoacán, Mexico
[4]University of Rhode Island

Presenting Author: mingoma@miamioh.edu

Intraplate volcanism is often associated with hot spots originating from deep within the mantle. However, numerous studies present examples of non-conventional intraplate volcanism, such as volcanic activity that persists following ridge failure. A case example is Socorro Island, part of the Revillagigedo archipelago situated in the Eastern Pacific Ocean, near a failed spreading center known as the Mathematician Ridge (MR). Socorro island has been active for >540 Ka, with the latest event in 1993 as a submarine eruption. The submarine regions of the island are dominated by basaltic rocks, while trachytes and rhyolites with peralkaline affinities dominate the terrestrial parts of the island. Prior work suggests that Socorro basalts are generated from a heterogeneous mantle source and variably impacted by crustal assimilation, and that the evolved peralkaline magmas are produced by partial melting of pre-existing basement rocks, followed by assimilation of altered silicic basement and hydrothermally altered crust containing Fe-oxyhydroxides (Bohrson and Reid, 1995; 1997). This study aims to further evaluate the petrogenesis of Socorro Island mafic and peralkaline silicic magmas, and to better constrain the nature of the mantle source, to determine whether magmatism is linked to the MR or a distinct hotspot or petit spot source.

We have conducted Sr-Pb-Nd-Hf isotope analysis on a suite of samples collected from the subaerial portion of Socorro Island, as well as samples from the 1993 submarine vent and other nearby submarine vents. The lack of correlation of isotopic signatures with SiO_2 and the overlap in compositions of subaerial and submarine samples argue against a significant role for crustal assimilation in the petrogenesis of the Socorro magmas. Furthermore, the lack of a significant Ce anomaly and Hf-Nd isotope signatures that fall on the low side of the mantle array argue against hydrothermally altered basement rocks as a source for Socorro magmas. Our preliminary results indicate that the Socorro Island basalts exhibit a FOZO/HIMU-type signature distinct from the MR, but similar to some OIB, suggesting a hotspot or petit spot source for the magmatism of Socorro Island and nearby submarine volcanism.