Helium isotopes, C/3He ratios, and radiogenic isotopes in the northern Lau and north Fiji basins

*John E Lupton¹, Allison Price², Matt Jackson², Richard Arculus³, Oliver Nebel⁴

1. NOAA/PMEL, Newport, Oregon, USA, 2. U.C. Santa Barbara, Santa Barbara, California, USA, 3. Australian National Univ, Canberra, Australia, 4. Monash Univ., Melbourne, Australia

The northern Lau Basin is host to a complicated pattern of volcanic activity, including the volcanoes of the Tofua Arc and several back-arc spreading centers such as the NE Lau Spreading Center (NELSC), the NW Lau Spreading Center (NWLSC), as well as various "rear-arc" volcanoes. We have employed helium isotopes, $C/^{3}He$ ratios, and radiogenic isotope signatures to distinguish between various arc, back-arc, and hotspot affinities in the region. Along the NWLSC elevated ³He/⁴He ratios in the seafloor lavas (12 -28 Ra) suggest that an OIB or mantle plume signature, possibly from Samoa, has influenced this extensional zone. However this hotspot helium is absent in the NE Lau Basin which has mid-ocean ridge (MOR) type helium (~8 Ra). In the NE Lau Basin, 3 He/ 4 He –C/ 3 He systematics indicate varying degrees of subduction influence among the volcanic centers. For example, the recently erupting West Mata submarine volcano in the NE Lau has a C-He signature indicating strong arc affinities. We have analyzed helium isotope ratios in 40 additional submarine rock samples which extend the geographic coverage farther west into the Fiji Basin. Surprisingly, several samples have elevated 3He/4He in the range of 12 -20.9 Ra, including a 14.4 Ra value on the NE Fiji Triple Junction ~1000 km to the west of the NWLSC. One might assume that these elevated 3He/4He ratios are related to the same OIB influence detected along the nearby NW Lau backarc spreading system. When radiogenic isotopes (Sr, Nd, Hf) are added to the picture, samples from the Futuna Volcanic Zone and from the NE Fiji Triple Junction fall on a mixing trend between depleted MORB mantle and FOZO, as do samples from the Rochambeau Rifts and NWLSC. However, this trend is distinct from that of Samoa proper, suggesting that only a restricted (FOZO) portion of the Samoan plume is responsible for the elevated 3He/4He in the northern Lau and Fiji basins.

Keywords: Helium isotopes, northern Lau basin, north Fiji basin, radiogenic isotopes, C/3He ratios