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Systematics and Recent Applications of 210Po-210Pb Radioactivity for Development of Submarine Eruption Chronologies

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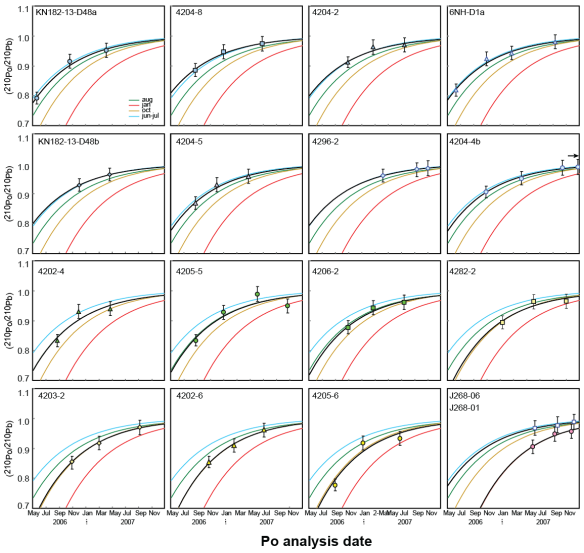

Since its first application to determining the timing of the 1991-92 eruption on the East Pacific Rise (EPR) [1] to the present day, the ^{210}Po-^{210}Pb chronometer (half-life=138.4 days) has played a significant role in quantifying the duration and eruptive event frequency of multiple submarine eruptions at mid-ocean ridge, hotspot, and arc volcanoes in the Pacific Ocean. The eruption clock is set by volatilization of Po before and during eruption; eruption timing is determined by repeat analysis of the same volcanic rock specimens to chart ^{210}Po in-growth to grand parental ^{210}Pb after eruption, along with assumptions about syn-eruptive degassing behavior of Po. This presentation discusses refinements of the chronometer to best determine eruption chronologies using large sample sets, statistical data analysis tools, coupled volatile (H_2O and CO_2) analysis, known age (i.e., molten when collected) specimen analysis, and numerical experiments to refine uncertainties. I will also discuss results of the application of this chronometer to 4 submarine eruptions this century (West Mata, 2009 [2], as well as three as yet unpublished data sets from Axial Volcano eruptions in 2011 and 2015, and the 2005-06 EPR eruption at 9° 50'N. Collectively these eruptions, where nearly 60 specimens were analyzed at least thrice in time-series, provide significant constraints on eruption styles and duration, that in some cases match well with, and in others diverge significantly from, geophysically inferred eruption signals. The image shows time series analyses and inferred eruption intervals (different colors of in-growth curves) for the 2005-06 EPR eruption at 9° 50'N, which was a multi-event eruption sequence lasting nearly 1 year.

References

[1] Rubin K. H., et al, 1994 210Po-210Pb dating of recent volcanic eruptions on the sea floor, Nature 368, 841-844, https://doi.org/10.1038/368841a0.

[2] Embley, R.W., et al, 2014, Eruptive modes and hiatus of volcanism at West Mata seamount, NE Lau basin: 1996-2012, Geochemistry, Geophysics, Geosystems. 15, 4093-4115, DOI: 10.1002/2014GC005387