Trends in igneous rocktypes from shipboard analysis with LIBS

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Compositional analysis by Laser Induced Breakdown Spectroscopy (LIBS) is ideal for exploratory work since it does not require sample dissolution or powdering [1]. Given the similar use of emission spectra, data quality similar to ICP-OES is possible. The most precise data result from a least squares regression to the emission spectrum of a laser-induced plasma, calibrated with a range of standards. This allows for ~90% correct classification of igneous rocks [2]. Medium precision quantitative measurements can also be made (rms errors of 2-8% vs. known values [2-4]).

In this study we used a portable system (PORTA-LIBS 2000, 200-800nm, 0.2nm resolution) for shipboard analysis of dredge samples to augment hand sample descriptions used for sample selection. Matlab was used to 1) calibrate each major element across the spectrum; 2) measure SiO_2 and Na_2O+K_2O on dredge samples. Three 10-shot analyses per sample result in a 2sd SiO_2 precision of <3.5 wt% for 95% of the 560 samples. The average values also overlap with electron probe micro-analysis (EPMA) of 15 glasses. Repeat analysis of standards suggest ultimate precision better than 1 wt% can be achieved with >100 shots per sample.

Our results show that about 80% of the analysed samples straddle the basalt and basanite fields. The samples that plot outside these fields are mainly part of a handful of dredges that range from these fields toward phonolitic (and trachytic) compositions. These dredges sample volcanoes that may not be related to the same process causing volcanism (2 located across Vitiaz Lineament), or are significantly younger (much higher occurrence of glass). Overall, the data quality thus allows for observation of trends between (and within) dredges, and thus improves shipboard sample selection.

[1] Cremers & Radziemski (2006), 10.1002/0470093013.ch2 [2] Clegg *et al* (2009), *Spectrochim. Acta B* **64**, 79-88 [3] Gondal *et al* (2009), *J. Env. Sci. Health* **44**, 528-535 [4] Wang *et al* (2011), *JAAS*, **10**.1039/c1ja10041f