Towards field measurements of $^{3}He/^{4}He$: a key parameter in volcano monitoring

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The only definitive tracer of mantle-derived volatiles is helium due to its rare isotope, ^{3}He, which is primordial and stored in Earth's mantle. Thus mantle $^{3}He/^{4}He$ ratios are much higher than crustal values which are dominated by radiogenic ^{4}He. Variations in $^{3}He/^{4}He$ can reveal changes in the balance of mantle to crustal He, and be premonitory to seismic unrest [1] and volcanic activity [2]. To date, however, He isotope measurements have been the preserve of the laboratory due to severe analytical constraints. A prototype instrument for measurements of He isotopes remotely and in near real-time has been designed. The instrument is capable of attended or autonomous operation, with internal recording and real-time communication from remote sites. He (and H) isotopes are accumulated into an ultra-high vacuum (UHV) through a heated quartz glass window of optimized wall thickness and surface area. Automated or manually controlled exposure to ion pumps is used to clean the UHV before/after analysis. Using a bench-top prototype with a conventional quartz glass window, we demonstrate 4 orders of magnitude of He accumulation from lab air (5 ppm). Here, we report on progress on resolving and/or correcting ^{3}He from interfering peaks at mass 3 and linearity characteristics of collectors over many orders of magnitude variation in ion beam intensity.

[1] Italiano *et al* (2001) *GRL* **28**, 839–842 [2] Sano *et al* (1984) *Science* **224**, 150-151