Quantifying crustal assimilation in historical to recent (1329 – 2005) lavas at Mt. Etna, Italy: Insights from thermodynamic modeling

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The nearly continuous volcanic eruption record at Mt. Etna dating back ~700 years provides an excellent opportunity to investigate the geochemical evolution of a highly active volcano. Of particular interest is elucidating the cause of a selective enrichment in alkali elements (K, Rb, Cs) and $^{87}Sr/^{86}Sr$, which accelerated after 1971, and is accompanied by an increase in eruption volume, frequency, and explosivity. To explain this enrichment, two major arguments are invoked: (1) crustal contributions (e.g., assimilation of skarn/flysch basement) [1, 2], and (2) changes in the mantle source, possibly due to increased interaction between the mantle source and subduction-related fluids [3, 4]. This study quantitatively examines the extent of skarn/flysch basement assimilation via the Magma Chamber Simulator [5], on the basis of published and unpublished whole rock and mineral compositional data. Over 100 models were run with varying pressures, fO_2 buffers, and parent magma and wallrock compositions, masses, and temperatures. Best-fit results indicate that whole rock major oxide trends can be reproduced via the assimilation + stoping of skarn/flysch wallrock. K_2O behaves incompatibly in skarn/flysch wallrock melts, and assimilation of 15–20% of the wallrock mass replicates the post-1971 K_2O whole rock trend. Additionally, the whole rock CaO trend is reproduced when a Ca-rich block of skarn is stoped. Neither trend is reproduced by fractional crystallization alone. Trace element and isotope models informed by best-fit major element results are ongoing.

[1] Clocchiatti *et al*. (1988) *JVGR* **34**, 241-249. [2] Condomines *et al*. (1995) *EPSL* **132**, 25-41. [3] Tonarini *et al*. (2001) *EPSL* **192**, 471-483. [4] Armienti *et al*. (2007) *GSA: Special Paper 418*, 265-276. [5] Bohrson *et al*. (2014) *JP* **55**, 1685-1717.