Gabbro-Nepheline Syenite-Quartz Syenite Complexes: AFC or Melted Fenites?

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In many alkaline provinces syenitic complexes occur which are composed of intrusions of gabbro (or diorite), quartz syenites and nepheline syenites. Typically, Sr isotopic ratios correlate with degree of silica saturation in the syenites i.e. 87Sr/86Sr generally lower in the nepheline syenites than the syenites or quartz syenites. As a result, the quartz seyenites in these complexes are commonly interpreted to be derived from the nepheline syenites through the assimilation of continental crust. The undersaturated syenites are commonly modelled as differentiates of the mafic component of the complexes.

Several problems exist in such models, not least the apparent necessity to bridge thermal divides in phase diagrams.

The range of chemical and isotopic compositions produced during the alkali metasomatism of granitic protoliths adjacent to the Spitskop and Dorowa carbonatite complexes span the entire compositional range from granite through syenite to nepheline syenite and even ijolite. Being carbonatite-sorced, the metasomatic fluids have unradiogenic 87Sr/86Sr with the result that a strong covariance is established in the fenites between silica content and isotopic ratio. Were these fenites to melt, through the heat provided from a mafic intrusion, say, the compositions of the melts would be controlled by the minima at either side of the feldspar join in the *Q-Ne-Kp* system.

It is argued that at least some of the composite syenitic intrusions reported in the literature could be the result of melting continental crust previously metasomatised by fluids derived from carbonatite melts crystallising in the upper mantle or lower crust.