Fe isotopes and the contrasting petrogenesis of A-, I- and S-type granite.

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Results from new Fe isotope data from 42 S-, I- and A-type (ferroan) granites provide significant insights into the processes of granite formation. These data indicate that magmatic processes result in complex Fe-isotopic differentiation trends that can lead some granites to evolve to isotopically heavy iron with δ^{57}Fe > 0.35‰. These variations are similar to those previously reported (Poitrasson and Freydier, 2005; Heimann et al., 2008; Telus et al., 2012). Contrary to some interpretations (Beard and Johnson, 2006; Heimann et al., 2008), heavy values are not necessarily the product of late-stage hydrothermal fluid loss, though this process can be important.

A-type (ferroan) granites reach very heavy δ^{57}Fe values (0.4-0.5‰) whereas I-types are systematically lighter (δ^{57}Fe = ~0.2‰). S-type granites show a range of intermediate values, but also tend to be heavy (δ^{57}Fe ≈ 0.2-0.4‰). Our results show that the iron isotopic values and trends are signatures that reflect granite generation *processes,* in particular whether or not the system is oxygen-buffered (ie 'Open' or 'Closed'). Ferroan A-type granite results from protracted, closed magma chamber fractionation. I-type systems originate with oxygen-buffered, open-system AFC processes in the lower crust. S-type magmas originate under buffered reduced conditions initially imposed at their crustal sources. Individual plutons from each class of granite may have a final "closed-system" evolution stage adding or amplifying a final trend towards δ^{57}Fe enrichment.