Petrogenesis of peraluminous granites from deep crustal sources

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The study of exhumed high-grade continental crust formed at convergent plate margins reveals important details about the petrogenesis of granites and contributes to a better understanding of processes responsible for the differentiation of the continents. The Fosdick migmatite–granite complex, West Antarctica, records evidence of two melting events, during the Devonian–Carboniferous and in the Cretaceous. A Devonian–Carboniferous calc-alkaline granodiorite suite emplaced into a Lower Paleozoic metasedimentary sequence (outside the complex) and their granulite facies equivalents (inside the complex) represent the sources and make this region ideal for the study of processes and mineral behavior during polycyclic anatexis at granulite facies conditions using a combined petrologic and geochemical approach. We report 20 new LA–ICP–MS U–Pb zircon ages extending the age ranges as follows: protolith granodiorite suite 377–339 Ma; Devonian–Carboniferous anatectic granites 369–350 Ma; and, Cretaceous anatecic granites 119–96 Ma. The discovery of Devonian anatectic granites suggests that melting occurred earlier than previously thought. New geochemical data for 48 samples extends a limited dataset from earlier work. The major and trace element geochemistry of paragneisses and orthogneisses is consistent with the hypothesis that they are the high-grade equivalents of the metasedimentary sequence and granodiorite suite respectively. The metasedimentary sequence has K_2O of 2.15–4.32 wt%, Sr of 95–207 ppm and Rb of 96–216 ppm, whereas the calc-alkaline granodiorite suite has K_2O of 2.23–5.01 wt%, Sr of 90–418 ppm and Rb of 88–381 ppm. Devonian–Carboniferous granites are either high Sr (225–363 ppm) or low Sr (95–108 ppm) types with variable K_2O (2.73–6.85 wt%) and Rb (131–284 ppm). Cretaceous granites are either high Sr (207–298 ppm) or low Sr (90–167 ppm) types with variable K_2O (3.21–8.89 wt%) and Rb (80–284 ppm). Limited isotope data indicates that Devonian–Carboniferous granites were derived primarily from the granodiorite suite, whereas Cretaceous granites were derived from mixed sources (the metasedimentary rocks, the granodiorite suite, or their high-grade equivalents). Additional Sr and Nd isotope and REE data currently being collected will better constrain the sources of the granites and allow an evaluation of the role of accessory minerals such as apatite and monazite during crustal melting events.

Beneficial uses of engineered nanoparticles and the behavior of natural and engineered nanoparticles in the environment

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Engineered nanoparticles (ENPs), including Ag(0), Au(0), C-nanotubes, ZnO, TiO_2, Fe_3O_4, have many beneficial uses ranging from catalysts used for efficient production of chemicals (e.g., Au(0)) and photocatalytic degradation of organic pollutants (e.g., TiO_2) to water treatment to remove As (e.g., Fe_3O_4)) and use as antibacterial agents (e.g., Ag(0) and ZnO). Here we will review some of these uses, as well as some of the transformations that ENPs undergo in different environments (e.g., sulfidation of Ag(0) and ZnO ENPs), which can significantly alter their properties (e.g., solubility) and result in lowered risk. We will also review some of the lessons learned about the behavior of ENPs from microscopic studies of engineered and natural nanoparticles, in particular the sorptive properties of Fe_3O_4 ENPs in removing As from drinking water. We will also discuss some insights about the use of nanoparticles as environmental indicators gained from ab initio thermodynamics studies of the morphologies developed by NPs under different environmental conditions.

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