The A-type granitoids: A review of their occurrence and chemical characteristics and speculations on their petrogenesis

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Abstract

A variety of granitoid suites, which have been classified as A-types, are reviewed in this paper. Based on this review, the general characteristics of the A-type granitoids are summarized as follows. The A-type granitoid suites vary in composition from quartz syenites to peralkaline granites and their respective volcanic equivalents. These suites are emplaced into non-orogenic settings — both within plate and along plate margins during the waning stages of subduction-zone-related magmatism. With respect to I- and S-type granitoids, the A-types are characterized by their relatively high alkali contents and low CaO contents (at SiO_2 = 70%: $Na_2O + K_2O$ = 7−11%, CaO < 1.8%), high FeO_T/MgO ratios (at SiO_2 = 70%: FeO_T/MgO = 8−80), and often elevated halogen, particularly F, contents (F = 0.05−1.7%). The major element chemistry is reflected in the mineralogy by the occurrence of iron-rich micas, amphiboles and pyroxenes and in the peralkaline varieties by the occurrence of alkali-rich amphiboles and pyroxenes. Trace element abundances, particularly elevated concentrations of high-field-strength cations, are distinctive.

Y/Nb and Yb/Ta ratios are relatively constant for each A-type suite and thus serve as useful indices for chemical comparisons. A-type suites with Y/Nb<1.2 are derived from sources chemically similar to those of oceanic island basalts while suites with Y/Nb>1.2 are derived from sources chemically similar to island arc or continental margin basalts. In combination with isotopic and other trace element data, these

relationships suggest that A-type granitoids are generated by a variety of processes including fractionation from mantle-derived basaltic magmas, interaction between these mantle-derived magmas and continental crust and in some cases by the formation of anatectic, halogen-rich, melts during the remelting of a terrane from which a previous melt had been extracted.