Genetic linkage between calc-alkalic andesites and continental crusts

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The occurrence of two types of andesites, calc-alkalic and tholeiitic, typifies magmatism in subdcution zones. Examination of geochemical characteristics of those andesites in the NE Japan arc and the bulk continental crusts reveals marked compositional similarity between calc-alkalic andesites and continental crusts. One of the principal mechanisms of production of calc-alkalic andesites, at least those on the NE Japan arc, is mixing of two magmas, having basaltic and felsic compositions and being derived from partial melting of the mantle and the basaltic crust, respectively. It may be thus suggested that this process would also have contributed greatly to continental crust formation. If this is the case, then the melting residue after extraction of felsic melts should be removed and delaminated from the initial crust in order to form 'andesitic' crust compositions. These processes are examined by geochemical modeling of dehydration, partial melting, and fluid-solid reactions, suggesting that such processes can explain both the major and trace element compositions of the andesitic bulk continental crust. Isotopic modeling further shows that an inferred pyroxenitic delaminated component produced at 3-4 Ga possesses Sr-Nd-Pb isotopic compositions similar to those of the EMI reservoir in the mantle. Continental crust formation and complementary accumulation of the EMI reservoir in the deep mantle may thus have taken place simultaneously in Archean subduction zones.

The subduction factory:

Its role in the evolution of the mantle reservoirs

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Subduction zones, where the oceanic lithosphere is foundering into the Earth's interior, have been working as factories and have contributed significantly to the evolution of the solid Earth. Dehydration processes and associated element transport, which take place in both the subducting lithosphere and the downdragged hydrated peridotite layer at the base of the mantle wedge, are largely responsible for production of arc basalt magmas. On the other hand, one of the principal mechanisms of generation of calc-alkalic andesites, and possibley the continental crusts, is mixing of two magmas, having basaltic and felsic compositions and being derived from partial melting of the mantle and the overriding basaltic crust, respectively. These processes of generation of basaltic and andesitic magmas in subdcution zones necessarily cause accumulation of residual materials, such as delaminated crust materials and dehydrated, compositionally modified subducting oceanic crusts and sediments, in the deep mantle. The geochemical modeling suggests that such residual components have evolved to form enriched mantle reservoirs such as HIMU, EMI, and EMII.