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Tectonics of Precambrian crustal anatexis and granite formation, Karelia, Russia

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The Early Precambrian is the beginning of the geological period of the Earth's evolution – the time of the primary formation of the continental-type earth crust. The crust is forming in a cyclic manner from the NE to the SW Fennoscandian Shield by accretion of granitic and upper volcano-sedimentary layers on the protocrust. An important role in crust formation is played by the mantle which is a source of basic magma and a dispersed mantle fluid flow which carries potassium and accompanying rare elements (Rb, Ba, Sr, Li and Cs) to the earth crust. At an early stage of the cycle, plateau-basaltic volcano-plutonism, together with cyclic sedimentation in a shallow-water sedimentation basin environment, forms a volcanic-sedimentary cover which in the final stage is subjected to the collective thermal effect of basic magma and a dispersed mantle fluid flow and suffers metasomatic granitization, migmatization and granite formation. As a result, a granite layer is formed in the earth crust. The upper, volcanic-sedimentary layer (platform cover) is not granitized, as the mantle is depleted at this time.

Together with crust formation the tectonic framework of the Fennoscandian Shield is formed; its modern structure is block-like. The granitic layer of the Karelian domain has a Late Archean age, the age of regional granitization being 2700±100 Ma. In the Svecofennian domain comparable crust forming process began in early Proterozoic time. The svecocarelian volcanic-sedimentary cover in the area of both domains was formed in the same shallow-water basin, the dynamic pattern of volcanism and sedimantation being identical. Here, the mantle was not depleted and regional metasomatic granitization and granite formation finished about 1850 Ma. Crustal processes of Late Archean and Early Proterozoic granite formation in the territories discussed are quite correlatable. The platform volcanic-sedimentary cover on the Svecokarelides was formed in Riphean time.

The mantle is the main source of substance and energy in the formation of Precambrian continental type crust. There is geochemical zonation of granites connected with a mantle diapir.

Dry K-rich granites in the maximum temperature anatexis zone of the earth crust in the epicentre of the mantle diapir have high Ba and Zr concentrations, and give way to low-temperature water-sturated K-Na granites with high B, F, Rb and Li concentrations at the periphery of the diapir. These granites contain Mo, W, Sn and Pb-Zn ore occurences that do not exist in the epicentre of above the diaoiric zone.

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The feldspars record of rock formation process in Tonglu volcanic-intrusive complex

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The Tonglu volcanic-intrusive complex consists of I type acidic to intermediate-acidic rocks, in which there are two different sorts of plagioclases and alkali feldspars. TEM, EPMA and XRD analysis revealed that the evolutionary history of the complex and its dark inclusions was recorded by the variations of feldspar fine-structure and composition.

The two sorts of plagioclases in the complex have very different compositions. One is zoned, showing three different An belts: ①anorthite-high core region with An 70-80, 400-500μm in width; ② anorthite-meduim crystalline region with An 60, 30-35μm in width; ③ anorthite-low rim in the with An 20-35, 200-300μm in width. The other is andesine without zoned structure, it shows small changes in compositions with An from 25 to 40 and width from 300μm to 600μm.

Zoned-plagioclases were also found in dark, monzonitic diorite inclusions, but there are some differences in An content:. Compared with the above plagioclase, they have higher An rims (An 40).

There are two sorts of alkali feldspars coexisting in the complex. One is colorless and transparent and the other is light red. The compositions of the two alkali feldspars are similar, with Or ranging from 60% to 70%, while they are different in structural state and exsolution microstructures. The former is sandidine, its homogeneous exsolution microstructure can be observed by TEM; the latter is orthoclase, whose exsolution microstructure cannot be observed.

According to the microanalysis of compositions, microstructures of feldspars and other related studies, the authors suggest that the Tonglu complex and the dark inclusions were derived from an acidic upper crustal magma, mixed with a mantle-derived magma of monzonitic diorite composition.

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