



Metamorphic and magmatic processes in the central part of the Lapland granulite belt: correlation of geological and petrological study with results of isotopic dating

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Based on geological and petrological study the sequence of magmatic and metamorphic events in the central part of the Lapland granulite belt (the Lotta river area, Kola Peninsula, Russia) has been reconstructed, that allows to reveal physical and chemical conditions of individual episodes in the history of the studied region, and make a correct correlation of petrological data with the results of isotopic dating. It was established that all metapelitic associations found within the studied region, are products of allochemical alterations of "felsic" quartz-feldspar granulites and embedded basic rocks.

First granulite moderate-pressure metamorphism ($T = 630\text{--}730^\circ\text{C}$, $P = 4.0\text{--}5.7$ kbar) occurred 1.97 - 1.96 Ga. The crystallization temperature of metamorphic zircons of this stage (according to Ti contents) is $709\text{--}742^\circ\text{C}$ - consistent with petrological data.

Basic magmatism - intrusion of small bodies and dykes of gabbro and gabbro-norites took place 1.96 Ga and clearly separates two episodes of granulite facies metamorphism.

Granulite HP metamorphism ($780\text{--}860^\circ\text{C}$ and $6.8\text{--}9.5$ kbar) and syncollision diathecic S-granitoid formation occurred 1.92-1.91 Ga. The beginning of metamorphism associated with the crystallization of synmetamorphic enderbites - 1929-1925 Ma. The age of metamorphic granulite zircons is 1921-1917 Ma. Crystallization temperature of these zircons is $756\text{--}856^\circ\text{C}$, also consistent with petrological data. Polyphase inclusion in zircons: Kfs + Qtz, Kfs + Qtz + Pl and inclusion of Bt suggest that the formation of zircon occurred simultaneously with the formation of the paragenesis Grt + Bt + Pl + Sil + Qtz (\pm Kfs). Sm-Nd isochrone for Grt-Cpx-WR-Pl gave an age of 1918 ± 30 Ma. According to petrological data Grt and Cpx growth occurred at isothermal decompression stage with the pressure drop up to 6 kbar. Central parts of clinopyroxene contain up to 10% jadeite component and rims of about 2%. U-Pb garnet age 1925-1932 Ma coincides well with Sm-Nd garnet age. The fact that different minerals and different isotopic systems show the same ages speaks about rapid cooling, when the isotopic system closed soon after mineral formation and the obtained age is crystallization age but not cooling age. Formation of leucogranites as a result of sillimanite-garnet gneiss melting occurred at 1915 - 1910 Ma. Zircons in leucogranites contain the same inclusion (Kfs, Sil and Qtz) as granulite zircons, which means, that they have been formed simultaneously with the formation of Sil and the presence of Kfs in paragenesis. Crystallization temperatures of these diathecic zircons - $801\text{--}826^\circ\text{C}$ overlaps with the crystallization temperature of granulite zircons, as well as an age range of their crystallization. Analysis of the geochemical characteristics of zircons (content and distribution of incompatible elements) and U-Pb dating showed that the formation of granulite and diathecic zircons crystallized from the melt during the same diathecic process. Crystallization temperatures, as determined by Ti contents, are in good agreement with the metamorphic temperatures, defined by generally accepted geothermometers.

Isobaric cooling to 657°C and 6.5 kbar in conditions of amphibolite and epidote-amphibolite facies occurred 1912-1906 Ma ago.

The final stage of the complex evolution - intrusive granite magmatism (veins and small body of enderbites, granites, plagiopelmatites) was 1.89 - 1.88 Ma.

The further cooling history of the belt was determined by U-Pb dating of titanites and rutiles (1.88-1.87 Ga) and last low-T hydrothermal alterations are fixed by Rb-Sr system of minerals (1.72 Ga).

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