Geochemistry of the Orthogneisses from the Strzelin Crystalline Massif (SW Poland, Fore-Sudetic Block)

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Introduction

The Strzelin crystalline massif crops out in the eastern part of the Fore-Sudetic Block (SW Poland). The massif is composed of four rock series of which the orthogneisses are the most common one. Unfortunately, there is only one radiometric datum (U-Pb method on zircons) obtained from the least widespread variety of the gneisses, the so- called Gościęcice gneisses, which yielded an age of 504±3 Ma (Oliver et al. 1993). Mica schists and paragneisses of unknown, probably Neoproterozoic age (Oberc 1966) - called the older schist series - together with the so-called Jegłowa Member (believed to be an equivalent of the Devonian Vrbno Group known from the Jeseníky Mts.) are tectonically alternated with the gneisses. Metamorphic rocks are intruded by Variscan granitoids dated at ca. 330 and 347 Ma (Oberc-Dziedzic et al. 1996). The Strzelin crystalline massif is considered a metamorphic core complex developed in the East/West Sudetes contact zone during late orogenic extension (Szczepański and Józefiak 1998).

Petrography

The studied gneisses are fine-grained rocks. Most of the samples contain both micas and one sample contains only biotite. Matrix of the gneisses is composed of fine-grained aggregate of quartz and feldspar. Larger quartz grains form 1 mm thick bands which alternate with mica bands. Some biotite plates are chloritized. Very often feldspars (both K-feldspar and plagioclase) form porphyroclasts. Some feldspar grains show alteration effects (sericitization and saussuritization). Zircon (both euhedral and anhedral grains), apatite and opaque minerals are common accessory phases.

Geochemistry

Discrimination plots show that the analysed gneisses have a composition of peraluminous, calc-alkaline granites. They are characterised by molar proportion of $Al_2O_3/(CaO+Na_2O+K_2O) > 1$ and value of normative corundum >1, which is characteristic of S-type granites (White and Chappell 1974). Both the Y+Nb vs. Rb and Y vs. Nb discrimination diagrams (Pearce et al. 1984) suggest that the protolith of the analysed rocks was formed in a geotectonic environment of a collisional zone or volcanic arc. Additionally, the Rb/Zr ratio of the gneisses is specific for volcanic arc granites (Tischendorf and Förster 1992). This conclusion is moreover confirmed by careful inspection of the spider plots normalised to ocean ridge granites. The discussed spider diagrams show a prominent enrichment in K_2O, Rb, Ba and Th, positive Ce anomaly, a slightly positive Sm anomaly and very low (<< 1) normalised value of Y and Yb. All these features are characteristic of volcanic arc and collisional granites (Pearce et al. 1984). Chondrite-normalised values of the gneisses from the Strzelin crystalline massif show enrichment in HREE, slightly negative Eu anomaly and flat LREE pattern. Compared to the composition of the lower continental crust the analysed rocks show enrichment in K_2O, Rb, Ba and Th. However, concentrations of K_2O, Rb and Ba may result from the mobility of these elements during metamorphism, Th is believed to behave stable. The analysed gneisses show very flat pattern on the spider plot normalised to an average greywacke (Floyd et al. 1991). This suggests that granitic protolith of the gneisses from the Strzelin crystalline massif was produced by melting of greywackes.

Conclusions

On the basis of presented data the protolith of the studied gneisses were peraluminous, calc-alkaline, mostly two mica granites. They probably represent metamorphosed and deformed instrusion of S-type granites. This is also confirmed by the morphology of zircon crystals (Klimas-August 1991). Chemical composition of the rocks suggests their emplacement in a subduction-related geotectonic environment (e.g., a collisional zone or a volcanic arc). Unfortunately, there are no radiometric data obtained for the representative orthogneisses from the Strzelin crystalline massif. This does not permit constructive discussion regarding the age of subduction, which is recorded by the origin of these metagranites. On the other hand, metabasites occurring within the older schist series were interpreted as created within a continental rift environment (Szczepański and Oberc-Dziedzic 1998). This implies a change in the geotectonic regime from within-plate to subduction-related during Early Palaeozoic times.

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