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NON-PUPIN`S ZIRCONS OF TONALITE FROM THE KC-1 BOREHOLE IN THE STRZELIN MASSIF, FORE-SUDETIC BLOCK, SW POLAND

The Strzelin Massif is situated 35 km south of Wrocław in the NE part of the Bohemian Massif. It is composed of the following metamorphic rocks: gneisses of 600-568 Ma (Oberc-Dziedzic et al. 2001) and 504 Ma (Oliver et al. 1993), Proterozoic amphibolites, mica schists, calc-silicate rocks and Lower-Middle Devonian quartzites. These metamorphic rocks were intruded by quartz diorites, tonalites, biotite granites and biotite-muscovite granites (granites respectively: 347 Ma and 330 Ma, Oberc-Dziedzic et al., 1996) which form small bodies, mostly stocks and flat dykes, up to tens of metres thick (Oberc-Dziedzic 1991).

The KC-1 borehole was situated in the middle part of the Strzelin massif, 2 km west of Jegłowa. The drilled tonalite body, 35 m thick, is surrounded by gneisses

PETROGRAPHY

Tonalite from the KC-1 borehole is grey, fine-grained rock composed of plagioclase (40%), quartz (17.8), K-feldspar (1%), biotite (15.9%), hornblende (19.5%) and accessory minerals (1.7%). It also contains chlorite (1.7%), formed after-biotite and hornblende.

The presence of sphene crystals of 1 mm in size rimmed by plagioclase and quartz +/- K-feldspar grains is a characteristic feature of the KC-1 tonalite. Such a texture is considered to have originated in response to mixing of more felsic and more mafic magma systems (Hibbard 1991).

ZIRCON MORPHOLOGY

Zircon crystals of the KC-1 tonalite (from a depth of 111.0 m), have their morphology, distinct from granite-derived zircons, and occur in very small amount. After preliminary investigations of zircon concentrates, the all shape of grains was regarded as angular and anhedral (Klimas-August 1991). The zircons are often “splintered” with pointed edges or curved crystal faces. Their length ranges from 0.12 mm to 0.04 mm, with the mean length equal 0.08 mm and mean width equal 0.04 mm. The elongation of the zircons varies between 3.6 and 1.2, with the

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mean equal 2.3. Longer and more elongated zircon crystals can be recognized in thin sections, but they probably break up in the course of the separation processes.

PETROGENETIC IMPLICATIONS

The unusual morphology is not typical of zircon crystals from granitoides and have not been taken into account in the widely used zircon typology (Pupin, 1980).

Similar morphology of zircons in a dioritic dyke and norite was reported e.g. by Krogh (1982) and Bossart et al. (1986). They explained the elongated, curved crystals as a result of rapid growth from a supersaturated liquid. Growth of the resembling exceptional zircons from a supersaturated (undercooled) liquid of a magma mingling origin (Elburg 1996) have been found in the microgranitoid enclaves of the Wilsonn`s Promontory Batholith (Lachlen Fold Belt, Australia). Although partial dissolution (corrosion) can be another process that gives rise to anhedral crystal shapes, this process is likely to produce more regular, rounded shapes, such as the ovoid crystals within some enclaves of that region. Often the dendritic of zoning patterns, seen in zircons from the microgranitoid enclaves, reflects a high cooling rate and/or low diffusivity of Zr in the melt. The former interpretation is a preferred one (Elburg 1996).

To explanation of origin the unusual zircon forms of the KC-1 tonalite fit well with the magma mingling/mixing processes. This mingling can be accompanied or preceded by magma mixing, in which the mafic magma is hybridised by incorporation of zircon crystals from the granitic magma. A few similar anhedral zircon grains accompanied with the large, long-prismatic euhedral crystals, often with elongated liquid inclusions, and needle-like zircons were described in the sample of monzodiorite from the KL-1 borehole (at a depth of 222.1 m) (Klimas-August 1991, Klimas and Szczepański, in press).

It should be explained whether the anhedral zircons are “splintered” zircon fragments, which fell into pieces during the contact of the hot mafic magma with the earlier crystallised granitic magma or they were formed during the crystallisation of zircons in mafic magma in the contact with cooler, more acid liquid. More samples and application of other techniques (e.g. investigations of inclusions, cathodoluminescence imaging) could highlight the genesis of splinteration.

REFERENCES

BOSSART P.J., MEIER M., OBERLI F., STEIGER R.H., 1986: Morphology versus U-Pb systematics in zircon: high-resolution isotopic study of a zircon population from Variscan dike in the Central Alps. Earth Planet. Sci. Lett., 78: 339-354.

ELBURG M.A., 1996: U-Pb ages and morphologies of zircon in microgranitoid enclaves and peraluminous host granite: evidence for magma mingling. Contrib. Mineral. Petrol., 123: 177-189.

HIBBARD M.J., 1991: Textural anatomy of twelve magma-mixed granitoid systems. In: Didier J., Barbarin B. (eds.) Enclaves and granite petrology. Elsevier: 431-444.
KLIMAS-AUGUST K., 1991: Wstępne wyniki petrogenetycznych badań cyrkonów z wybranych gnejsów i granitoidów strzelińskich.[Preliminary results of petrogenetic investigations of zircons from chosen Strzelin gneisses and granitoides] Acta Universit. Wratislav., 1374, Pr. Geol.-Miner. XXIX: 271-293.(in Polish, with English abstract).
KLIMAS K., SZCZEPAŃSKI J., 2003: Petrogenetic comparative study of needle-like zircons from selected crystalline rocks eastern part of the Fore-Sudetic block (SW Poland): petrological implications. Pol. Tow. Min., Prace Specjalne,in press.
KROUGH T.E., 1982: Two high precision U-Pb zircon ages for the Sudbury Nickel Irruptive. Can. Journ. Earth Scien.,19: 723-728.
OBERC-DZIEDZIC, T., 1991: Pozycja geologiczna granitoidów strzelińskich. [Geological setting of the Strzelin granitoids]. Acta Universit. Wratislav.,1375, Pr. Geol.-Miner., 29: 295-324 (in Polish, with English abstract).
OBERC-DZIEDZIC, T., KLIMAS, K., KRYZA, R., FANNING, M., 2001: SHRIMP zircon geochronology of the Neoproterozoic Strzelin gneiss: evidence for Moravo-Silesian zone affinity of the Strzelin massif, Fore-Sudetic Block, SW Poland. Geolines, 13: 96-97.
OBERC-DZIEDZIC, T., PIN, C., DUTHOU, J.L.. COUTURIE, J.P., 1996: Age and origin of the Strzelin granitoids (Fore-Sudetic Block, Poland): $^{87}Rb/^{86}Sr$ data. N. Jahrb. Mineral. Abh., 171: 187-198.
OLIVER ,G.J.H., CORFU, F., KROUGH, T.E., 1993:. U-Pb ages from SW Poland: evidence for a Caledonian suture zone between Baltica and Gondwana. Journ. Geol. Soc. London, 150: 355-369.
PUPIN J.P., 1980: Zircon and granite petrology. Contrib. Mineral. Petrol., 73: 207-220.