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Deformation and Kinematics of Mafic Dikes in the c. 500 Ma Izera Granites, Northern Izera–Karkonosze Block

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The northern part of the Izera–Karkonosze Block consists mostly of the Izera granites (515–480 Ma, U–Pb zircon; Korytowski et al. 1993, Philippe et al. 1995, Kröner et al. 1997). These granites became heterogeneously transformed to orthogneisses, or to mainly WNW/ NW-trending mylonites. Before the deformational history of the Izera granites and gneisses was completed, they had been intruded by a swarm of mafic dikes of commonly fine-grained gabbroic composition, with predominantly alkaline, within-plate chemistry (Nowak 1998).

Although spread all over the region, the dikes concentrate in a WNW-oriented, at least 60 km long belt. Most dikes belong to a WNW/NW-trending set of subvertical, few centimetres to several tens of metres thick veins, with characteristic representatives exposed near Wrzeszczyn. Mafic dikes in the vicinity of Leśna are less than 5 m thick, strike NE–SW to E–W and dip NW or N at moderate angles. The dikes occurring immediately west of Jelenia Góra are less than 50 cm thick, subvertical, striking NE–SW to N–S. Accordingly, with respect to their attitude all the dikes may be generally classified into three differently oriented groups, which – to some extent – have also been proved to develop different dike/host-rock relationships.

At least 6 types of dike/host-rock contacts, shared by the three groups, can be distinguished. These are: (1) vein and granite host undeformed, (2) vein foliated and metamorphosed to greenschist or amphibolite, granite host undeformed, (3) vein as in type 2, granite sheared along one side of the vein, (4) vein of type 2, granite mylonitized on its either side, (5) orthogneiss boudins inside amphibolitized vein in foliated and mylonitized granite, (6) amphibolitized mafic dike crosscutting the foliated orthogneiss. Mafic veins, even of the same group, have been differently strained and metamorphosed. Strongly heterogeneous deformation of the mafic veins set in granite was localized at the rheologically contrasting vein/host-rock contacts and controlled by vein geometry (length, width, spacing), overall and local temperature, and circulating fluids.

The Wrzeszczyn group of NW-striking dikes developed from mafic magma that intruded mostly into the originally subvertical fractures in the largely unfoliated Izera granite subjected to roughly NE–SW horizontal extension possibly related to Ordovician? rifting (Żelaźniewicz 1994). Less frequently the magma penetrated early mylonitic zones dipping steeply NE or SW, produced in a dip-slip to sinistral oblique slip regime. The first deformation recorded by mafic veins of the Wrzeszczyn group was at least locally accomplished in a dip-slip to oblique-slip regime with the SW walls downthrown. In most cases it was also the very first deformation of the country granite becoming orthogneiss. This event was followed by extensive strike-slip dextral shearing widely experienced by both the vein and the host rocks. The dextral strike-slip shearing occurred at 335–330 Ma and terminated at 325 Ma as shown by mylonites from the Intra-Sudetic Fault Zone (Ar–Ar, white mica; Marheine et al. 2000). Therefore, the widespread deformation and lower amphibolite- to greenschist-facies metamorphism of the Wrzeszczyn dikes coinciding with the strike of this fault zone and occurring close to it, is ascribed to the same event which produced the dextral ductile transpression on the Intra-Sudetic Fault (Aleksandrowski et al. 1997, Achramowicz 1998) in Viséan times.

The Leśna group of dikes crosscuts the pre-existing, N-dipping foliation of the host granitic gneisses. First common deformation of the vein and host rocks occurred in a normal dip-slip to oblique-slip regime. It was mainly localized within the N and NW-dipping schistose and amphibolitized dikes, but it slightly affected the country gneisses. Further deformation under greenschist-facies conditions consisted of ductile dextral strike-slip followed by sinistral strike-slip brittle/ductile overprint.

Thin subvertical veins of the Jelenia Góra group were emplaced into unfoliated granite. No deformation occurred at the vein/host-rock contacts, whereas the veins were internally sheared in semi-brittle sinsitral strike-slip regime. The late sinistral strike-slip shearing on NE-striking structures is found as the youngest deformational overprint in dikes of both the Wrzeszczyn and Leśna groups.

Summing up, the swarm of alkaline, within-plate mafic dikes was subvertically emplaced into the undeformed or locally foliated Izera granite during Ordovician? to Devonian? rifting. The subsequent straining of the dikes was controlled by rheological contrasts in the vein/granite system and by dike geometries. Most of the strain was localized at, and expanded either way from, the dike/host-rock contacts. Their early deformation, although not very extensive, occurred under the tensional regime with the westerly walls being downthrown. This was followed and obscured by the late Viséan, NW–SE-directed shearing in the dextral strike-slip to transpressional regime, and finally overprinted by semi-brittle sinistral strike-slip shears, particularly on NE-striking structures.

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Preliminary Data on Amphibolites of Northem Part of the Vysoká hole Nappe (E Sudetes)

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Rocks belonging to the crystalline complex of the Jeseniki Mts. occur in the southeastern part of the Fore-Sudetic Block. Their northernmost parts are situated in Poland. These are: rocks of the Červenohorské sedlo Belt in the vicinity of villages Burgrabice and Sławniowice and rocks of the Vysoká hole nappe, forming the Góra Parkowa between Głuchołazy and Polish/Czech border (cf. tectonic sketch of Cháb et al. 1994).

Western and northwestern parts of the Góra Parkowa are dominated by quartzites with subordinate mica schists and biotite gneisses. Small, decimetre-sized veins of amphibolites and lenses of calc-silicate rocks occur also in that area. Southern part of Góra Parkowa consists of chlorite–muscovite or chlorite–muscovite–biotite schists with intercalations of amphibolites.

Three types of amphibolites occur in the discussed area. Amphibolites of the first one show preserved ophitic structure. They are medium-grained and contain subordinate quartz, plagioclase and small amounts of biotite plus accessory titanite, zircon and opaques. Amphibole grains form triangular spaces filled with quartz, plagioclase or quartz–plagioclase aggregates. This type of amphibolites was described by Muszyńska (1989).

The second type are banded amphibolites/ calc-silicate rocks. These were supposedly described by Majerowicz and Sawicki (1958) as "zoisite amphibolites". Banded amphibolites occur close to the Polish/Czech border in Gęstwina. The rock has very variable structure. Amphibolite layers are dominated by needle-like actinolite, locally including anhedral prismatic crystals of amphibole II or their aggregates. Fine-grained albite aggregates occur among amphiboles. They contain epidote–clinozoisite, titanite and opaques. Fine plates of biotite-like platy mineral occur sparsely among amphiboles. Calc-silicate bands consist of quartz, plagioclase, epidote–clinozoisite, pyroxene, carbonates and opaques. The bands are slightly cataclastic. They may contain various amounts of amphibole. Banded amphibolites are accompanied by homogeneous amphibolite, whose mineral composition and structure are similar to those of amphibolite layers described above.

The third amphibolite type is actinolitic quartzite, earlier described by Majerowicz and Sawicki (1958). It consists of quartz and subordinate amphibole, garnet and plagioclase. Amphiboles form elongated aggregates of needle-like crystals or layers. They locally contain prismatic crystals of amphibole II. Plagioclase occurs only within amphiboles. Garnet occurs in quartzitic parts of the rock.

Amphibolites of the Góra Parkowa are of low metamorphic grade. Those of types I and III occur, however, close to the staurolite-grade mica schists. Therefore, the position of amphibolites I and III relative to their surroundings should be assessed in detail. Amphibolites of type II contain mineral assemblage (albite+actinolite) typical of the greenschist facies. Muscovite-chlorite schists in their ambience also consist of the greenschist-facies mineral assemblage.

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