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Projects ALP 2002 and SUDETES 2003 – Continuation of 3D Refraction Seismic Experiments in Central Europe

ALP 2002 and SUDETES 2003 Organizing Committee (Ewald BRUECKL[1], Marek GRAD[2], Aleksander GUTERCH[3], Pavla HRUBCOVÁ[4] and Aleš ŠPIČÁK[4])

[1] *Vienna University of Technology, Gusshausstrasse 27-29, A-1040 Wien, Austria*
[2] *Institute of Geophysics, University of Warsaw, Pasteura 7, 02-093 Warsaw, Poland*
[3] *Institute of Geophysics, Polish Academy of Science, Ks.Janusza 64, 01-452 Warsaw, Poland*
[4] *Geophysical Institute, Academy of Sciences of the Czech Republic, Bocni II/1401, 142 00 Prague, Czech Republic*

Two large-scale seismic refraction experiments performed recently were aimed at the investigation of lithospheric structure in Central Europe. Experiment POLONAISE'97 targeted the structure and evolution of the prominent European suture zone – TESZ and adjacent units. CELEBRATION 2000 experiment covered namely East European Craton and Paleozoic Platform, Western Carpathians, Panonian basin and partly also the neighbouring units including the Bohemian Massif. Both projetcs benefited from the new generation of small, portable, programmable seismic instruments TEXAN developed in the USA. This fact enabled their massive deployment in the field (1,200 stations during the CELEBRATION 2000 experiment) resulting in a dense coverage of the investigated area. Such methodology offers a possibility of 3-D modelling of seismic wave velocity distribution in the lithosphere in the advanced stage of interpretation. Both experiments were iniciated and realised as an international co-operation of ca. 30 institutes from Europe and North America (Guterch et al., 1999, 2000).

To cover sufficiently the remaining areas of Central Europe, two new seismic refraction projects have been proposed – project ALP2002 and project SUDETES 2003.

Project ALP 2002, scheduled for summer 2002, will cover the Eastern Alps, the Europe's most prominent and complex mountain belt, and adjacent parts of Austria, Hungary, Italy, Czech Republic, Slovenia, and Croatia. The longest Trans-Alpian line of this experiment extending from Adriatic Sea will continue up to the northern part of the Bohemian Massif (Bílina in the Eger Graben region). University of Vienna (group of prof. Ewald Brueckl) is responsible for the project.

The experiment SUDETES 2003 is scheduled for summer 2003 and will cover the northern part of the Czech Republic, southwestern Poland and southeastern Germany. The overall scientific objective of the project is to investigate the deep crustal structure and geodynamics of the northern part of the Bohemian Massif, the largest outcrop of the Late Paleozoic Variscan orogen in Central Europe. In addition to targeting this massif, its relationships with the adjacent Caledonides and TESZ will also be investigated. The project will also focus on Elbe Zone and Eger Graben regions and an unsolved question of the Late-Paleozoic through Recent history of their reactivation. The NW-SE oriented Elbe Zone has for most of its history been active as an important strike-slip zone, parallel to the TESZ. The Elbe Zone produced a juxtaposition of terranes with different geodynamic histories, compositions, and geophysical properties. The WSW-ENE trending Eger Graben has been interpreted as a Neogene rift, characterized by significant Oligo-Miocene volcanism (Kopecký, 1986). At a deep crustal level, the rift axis is generally associated with the southeast-dipping boundary between the Saxothuringian and Moldanubian terranes. This boundary might be (?) associated with a major subduction zone within the Variscan belt that formed during the Middle-Late Paleozoic. The actual spatial characteristics of this boundary, its relationship with the intersecting Elbe Zone structures, as well as the history of its numerous reactivations at shallow crustal levels, remain a challenge to unraveling the geodynamic history of Central Europe.

The layout of the SUDETES 2003 project is suggested to consist of two orthogonal systems of recording profiles oriented perpendicular to and parallel with two main tectonic features of the region, the Elbe Zone and Eger Graben. To obtain dense ray coverage, not only in-line shots but also off-line ones are planned. The network of profile measurements together with the fan records of off-line shots should provide a sufficient 3-D coverage for 3-D modeling in the interpretation stages of the project.

The SUDETES 2003 and the ALP 2002 projects are designed to merge not only with CELEBRATION 2000 and

POLONAISE'97 experiments, but also with the seismic tomography experiment BOHEMA 2001/02, and numerous Czech-German projects on the geodynamics of the West Bohemia/Vogtland area that is repeatedly experiencing earthquake swarms. The projects should contribute to delineation of basement structure in regions covered by sedimentary basins, to better knowledge of crustal rheology, and deep-seated crustal inhomogeneities and will be complemented by concurrent geological/geophysical research projects focused on the shallower crustal levels. Warsaw and Prague groups with the support of NSF through University of Texas at El Paso will be responsible for the performance of the SUDETES 2003 experiment.

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Tourmaline-Bearing Leucogranites from the Třebíč Pluton in the Moldanubicum

David BURIANEK and Milan NOVAK

Department of Mineralogy, Petrology and Geochemistry, Masaryk University, Kotlářská 2, 611 37 Brno, Czech Republic

Peraluminous leucogranites with accessory tourmaline derived from crustal sources are widespread in mountain belts formed by continental collision (London et al., 1996). In eastern part of the Moldanubicum they are spatially associated with the Třebíč pluton, and three distinct types of leucocratic, medium- to fine-grained, biotite and muscovite-biotite granites with accessory tourmaline were distinguished.

(i) Two mica granites with tourmaline concentrated in orbicules (OTG) compose small intrusive bodies and dykes, scarcely up to 200 m thick. Quartz + tourmaline ± feldspars orbicules, up to 10 cm in diameter, or rare veins, up to 2 cm thick, are randomly distributed or concentrated in several m thick zones within bodies of leucocratic granites. Subhedral tourmaline is intersticial between euhedral grains of feldspars and quartz, and it replaces dominantly plagioclase. The accessory minerals include apatite, andalusite, cordierite, ilmenite, zircon, allanite, xenotime and monazite in granite; apatite is fairly abundant in orbicules. The tourmaline-quartz orbicules and veins seem to be a product of crystallization of evolved, B-rich medium (melt and/or fluid) during late solidus to early subsolidus stage of the granite formation.

(ii) Two mica granites with disseminated tourmaline (DTG) form relatively large intrusive bodies and dykes, up to several km^2. They do not exhibit such apparent spatial relationship to durbachite plutons as OTG. Euhedral to subhedral tourmaline grains, up to several mm long, are rather regularly distributed in the rock. The accessory minerals include apatite and zircon. In contrast to the OTG, disseminated tourmaline crystallized from granitic melt.

(iii) Biotite granites with tourmaline (MTG) typically occur in marginal zone of the Třebíč pluton. They form relatively small bodies (up to several hundred m thick) and are associated with migmatites and aplites. Euhedral tourmaline grains occur in coarse-grained pegmatoid facies, subhedral intersticial grains in rare quartz + tourmaline ± feldspars orbicules, up to 5 cm in diameter. Poikilitic garnet forms grains from 5 to 25 mm in diameter, randomly distributed in the rock, further accessory minerals include apatite, zircon and sillimanite.

All types of tourmaline granites have very similar geochemical signature corresponding to leucocratic and peraluminous (ASI = 1,0–1,3), syn- to post-collisional S-type granites: K_2O = 2.77–6.14; Fe_2O_{3tot} = 0.42–2.08; Rb = 194–234 ppm; Mg/Fe = 0.08–0.33; Rb/Sr = 1.00–5.56 in OTG, 5.24–7.34 in DTG and 0.5 in MTG; CaO = 0.49–0.87, 0.36–0.66 and 1.67, respectively. The normalized REE patterns are very similar for OTG and DTG granites; low REE concentrations ∑REE = 20.08–99.81 ppm and slight LREE enrichment (La_N/Lu_N = 1.9–6.8). The MTG indicate HREE depletion (La_N/Lu_N = 10.14) with distinct positive europium anomaly (Eu/Eu* 2.5). Similar mineral assemblages, whole rock major, minor and trace chemistry suggest that positive and negative europium anomalies (Eu/Eu* 0.5–1.6) found in both OTG and DTG rather reflect different fO_2 during crystallization. Lower CaO/Na_2O ratios (0.10–0.22) in OTG and DTG are typical for melts derived from clay-rich, plagioclase-poor pelitic rocks (Sylvester, 1998). The high CaO/Na_2O ratios (0.53) in MTG are typical for melts generated from plagioclase-rich psammitic rocks.

The zircon saturation temperatures 784–725 °C obtained for durbachitic rocks in Třebíč pluton (Watson and Harrison 1983) are similar to those the MTG (778 °C); DTG and OTG provided 660–713 °C, and 660–746 °C respectively.

The geochemical signatures suggest relatively primitive character of all granite types. The OTG and DTG had similar protoliths (metapelites) and conditions of melting (probably muscovite dehydration melting). Geochemical and mineralogical signatures of MTG exhibit less primitive character and