POLSKIE TOWARZYSTWO MINERALOGICZNE – PRACE SPECJALNE
MINERALOGICAL SOCIETY OF POLAND – SPECIAL PAPERS
Zeszyt 20, 2002; Volume 20, 2002

Ulrich LANGE[1], Michael BRÖCKER[1], Klaus MEZGER[1], Andrzej ŻELAŹNIEWICZ[2]

Sr-Nd ISOTOPE COMPOSITIONS OF THE ŚNIEŻNIK AND GIERAŁTÓW GNEISSES FROM THE ORLICA-ŚNIEŻNIK DOME (WEST SUDETES, POLAND)

Interpretation of the complex P-T-t-deformation path of the Orlica-Śnieżnik dome (OSD), representing the easternmost structural unit of the West Sudetes at the NE margin of the Bohemian Massif, is severely hampered by (1) the difficulty to unravel the pre-Variscan evolution and (2) a conspicuous consistency of Variscan metamorphic ages for rocks that represent different P-T stages.

In order to decipher some of the unsolved questions we have started with a research project that focuses on the following aspects:

- genetic relationship (bulk compositions, REE, Sr-Nd isotope characteristics) between several types of orthogneisses traditionally subdivided into two categories: the Śnieżnik and Gierałtów gneisses,
- additional constraints on the protolith ages of the orthogneisses (are there any regional differences?),
- geochemical and model age correlation with other crustal segments of the Variscides,
- dating of distinct deformational events,
- timing of migmatisation processes (is it possible to date pre-Variscan metamorphic stages?).

With this multimethod geochronogical study an attempt is made to provide key information that, together with results of previous work, will help to develop a reasonable geodynamic model for the study area. Here we present first results related to whole rock compositions and Sr-Nd isotope characteristics.

The orthogneisses of the Orlica-Śnieżnik dome are traditionally subdivided into two types: the Śnieżnik and Gierałtów gneisses. The genetic relationships between both varieties are controversially discussed and the importance of repeatedly reported textural, bulk and mineral chemical differences is unclear (Borkowska et al. 1990, Don et al. 1990, Grześkowiak and Żelaźniewicz 2002). There seems to be a general consensus that some orthogneisses have Cadomian protolith ages and that

[1] *Institut für Mineralogie, Universität Münster, Corrensstr. 24, 48149 Münster, Germany. E-mail address: langeul@nwz.uni-muenster.de (Ulrich Lange)*
[2] *Institute of Geological Sciences, Polish Academy of Sciences, ul. Podwale 75, PL 50-449, Wrocław, Poland*

all types underwent at least one episode of high-T metamorphism during Variscan times (e.g., Turniak et al. 2000). However, the available data sets are not sufficient to reconcile contrasting views about the origin of both gneiss varieties. In order to ensure a representative regional characterization, we have studied 39 samples collected across the Orlica-Śnieżnik dome. Based on bulk compositions and REE patterns systematic differences between both gneiss types cannot be documented. For Śnieżnik and Gierałtów gneisses, Rb-Sr whole rock isochrons yield indistinguishable dates of 474 ± 17 Ma and 456 ± 8 Ma, respectively, including the data from Borkowska et al. (1990). The Rb-Sr isochron age of 474 ± 17 Ma (Fig. 1) for the Śnieżnik orthogneisses is interpreted as currently best estimate for the time of emplacement (initial $^{87}Sr/^{86}Sr = 0.7065 \pm 0.0023$).

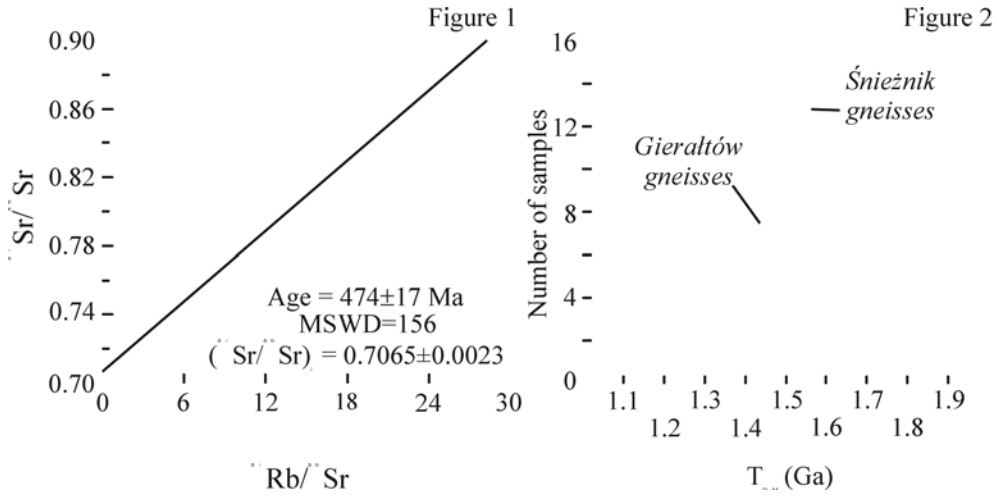

Figure 1. Rb-Sr isochron diagram based on the isotopic data of Śnieżnik orthogneisses (black triangles, n = 15), including the data from Borkowska et al. (1990) (black circles, n = 8). Heterogeneous source rocks or later disturbances of the Rb/Sr isotope system during a thermal overprint might be the reasons for the high MSWD value.
Figure 2. Histogram showing the distribution of T_{DM} model ages of Śnieżnik (n = 15) and Gierałtów (n = 24) orthogneisses from the Orlica-Śnieżnik dome. The model age calculations are based on the two stage model of Liew and Hofmann (1988) considering Sm/Nd modifications due to high-T metamorphism and melt fractionation in igneous rocks.

In a Sm-Nd isochron diagram the data show a large scatter ($\varepsilon Nd_{(474)}$=-0.39 to -5.98, MSWD = 51), probably related to modification of Sm/Nd during migmatisation. Most T_{DM} model ages (Fig. 2) fall in the range of 1.4 to 1.6 Ga. Gierałtów gneisses show a larger range (1.1 to 1.8 Ga) that indicates modification of the Sm-Nd systematics by metamorphic overprinting.

The new isotope data is compatible with the interpretation that the Śnieżnik and Gierałtów gneisses, at least partly representing a large batholith, are derived from

identical source rocks. The petrographic variability was mainly caused by superimposed modifications during deformation and migmatisation.

REFERENCES

BORKOWSKA M., CHOUKROUNE P., HAMEURT J., MARTINEAU F., 1990: A geochemical investigation of the age, significance and structural evolution of the Caledonian-Variscan granite-gneisses of the Śnieżnik metamorphic area (Central Sudetes, Poland). Geologia Sudetica, 15, 1–27.

DON J., DUMICZ M., WOJCIECHOWSKA I., ŻELAŹNIEWICZ A., 1990: Lithology and tectonics of the Orlica-Śnieżnik Dome, Sudetes – recent state of knowledge. Neues Jahrbuch für Geologie und Paläontologie Abhandlungen, 179, 159–188.

GRZEŚKOWIAK A., ŻELAŹNIEWICZ A., 2002: On the significance of gneissic enclaves in the 500 Ma metagranite, the Lądek-Śnieżnik Metamorphic Unit, the West Sudetes. GeoLines, 14, 28–29.

LIEW T.C., HOFMANN A.W., 1988: Precambrian crustal components, plutonic associations, plate environments of Hercynian Fold Belt of Central Europe: Indications from a Nd and Sr isotopic study. Contributions to Mineralogy and Petrology, 98, 129–138.

TURNIAK K., MAZUR S., WYSOCZAŃSKI R., 2000: SHRIMP zircon geochronology and geochemistry of the Orlica-Śnieżnik gneisses (Variscan belt of Central Europe) and their tectonic implications. Geodinamica Acta, 13, 293–312.