

*Janina WISZNIEWSKA*¹, *Zbigniew CYMERMAN*², *Aleksandra GAWĘDA*³

THE SEQUENCE AND ORIGIN OF MINERALIZATION IN THE TECTONIC ZONES IN THE SUWAŁKI ANORTHOSITE MASSIF, NE POLAND

INTRODUCTION

The Suwałki Anorthosite Massif (SAM) is emplaced within the Mesoproterozoic rapakivi-type Mazury Complex (ca. 1.56 Ga) of the Anorthosite-Mangerite-Charnockite-Granite (AMCG) affinity (Wiszniewska, 2002, Wiszniewska et al, 2002.). This massif has been subjected to several tectono-hydrothermal events resulting in extensive mineralization. The sequence and origin of polyphase vein mineralisation and its relation to the deformation development is a subject of this study.

METHODS OF INVESTIGATION

The microscopical observations, X-ray and microprobe analyses were carried out at the University of Silesia, on the FET Philips XL 30 with EDS (EDAX), the acceleration voltage 15 kV, using the natural and synthetic standards. The X-ray analyses of separated minerals were done on Philips PW 3710, with Cu-K α_1 40 Kv and 35 mA, 2 s. counting time. The stable oxygen and carbon isotopes were performed at the Institute of Geological Sciences, Wrocław University, Laboratory of Isotope Geology and Bioecology. Mass spectrometer used was the Finnigan Matt CH7 with a modified inlet detection system. Values are quoted relatively to PDB international standard.

A. STRUCTURAL DATA

A comprehensive structural study of the SAM requires investigation of numerous (99) boreholes because each well displays several structural components and the combination of these data can be used to summarize SAM evolution. The style of deformation in the SAM area ranges from localised ductile flow, producing shear zones (from a few cm to tens of metre wide) with a mylonitic foliation and a stretching lineation, to brittle fracturing and accompanying brecciation. The SAM features alternating zones of high- and low-strain, both in ductile and brittle conditions. Dip-parallel stretching lineations are inferred to be remnants of the Gothian shortening and ductile thrusting. Almost all shear sense indicators indicate reverse sense of movements. Younger planar fabrics in the fault zones include a well-developed pressure-solution cleavage and or fracture cleavage. Locally, the cleavage become parallel to the fault direction, suggesting rotation of a passive marker during shearing and shortening. The fault zones commonly exhibit

¹ Polish Geological Institute 00-975 Warszawa, ul. Rakowiecka 4, Poland, jwis@pgi.waw.pl

² Polish Geological Institute 53-122 Wrocław, ul. Jaworowa 19, Poland; Zbigniew.Cymerman@pigod.wroc.pl

³ University of Silesia 41-200 Sosnowiec, ul. Będzińska 60, Poland, gaweda@us.edu.pl

newly formed subhorizontal stretching lineations that overprint the former dip-parallel stretching lineations.

B. MINERALOGICAL DATA

The kaolinization was the first brittle process, restricted to the close vicinity of the mylonitic structures. The syntectonic C_1 carbonate (calcite or Fe-dolomite) precipitated on the C planes of the S-C composite fabric. If C_1 is the calcite the carbonate is accompanied by the Fe-Mg chlorite. In case dolomite is present – no chlorite occurs.

The further faulting process was accompanied by the crushing, brecciation and thin pseudotachylite vein formation. Pseudotachylite veins are often displaced to some mm by micro-scale faults.

The cracks and fissures are filled by fine grained quartz and C_2 calcite, forming the cement of the tectonic breccias. The following relaxation event caused the opening of the earlier formed cracks and the crystallization of the teeth-like idiomorphic C_3 carbonate accompanied by the trioctahedral saponite-like smectite, mixed with trioctahedral Fe-smectite (distinguishable 15.04 Å and 12.63 Å basic reflections) and locally interrupted by the precipitation of fine-grained quartz Q_1 , due to the changes of fluid composition.

The crystallization of C_3 calcite continued in the open fissures and was followed by idiomorphic to hipidiomorphic barite precipitation. Barite crystals show the increase of SrO content to the margins.

The last mineral in the crystallization sequence was anhydrite, sometimes following the Q_2 fine-grained quartz. Sulfate minerals (and Q_2) form the late-stage, post-deformational filling of the composite mineral veins as well as the irregular impregnations in the deformed and kaolinitized host rocks.

The vein calcites show $\delta^{13}C$ ranging from -2.95‰ to -5.26‰ and $\delta^{18}O$ ranging from -10.82‰ to -19.8‰, while the calcites forming impregnations in the kaolinitized “mantle” $\delta^{13}C$ values ranging from -4.2‰ to -5.89‰ and $\delta^{18}O$ ranging from -9.41‰ to -15.21‰.

CONCLUSIONS

The deformation regime changed from the ductile compressional to brittle extensional. Both ductile and brittle shear zones enabled the mineralisation precipitation in the sequence C_1 (dolomite) or C_1 (calcite) + chlorite \Rightarrow pseudotachylite \Rightarrow C_2 (calcite) \Rightarrow C_3 (calcite) + smectite \Rightarrow Q_1 \Rightarrow C_3 (continued) \Rightarrow Brt \Rightarrow Q_2 \Rightarrow Anh.

The composite mineralization is supposed to be originated from the mixed hydrothermal to hypergenic fluids with admixture of marine-type sulphate waters in the last stage of mineralization.

REFERENCES

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