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The Fe-Ti-V ore deposits - new insight from the geophysical-geological modelling of the Suwałki Anorthosite Massif (NE Poland)

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The Suwałki Anorthosite Massif (SAM) is located in NE part of Poland within Mezoproterozoic beltiform, magmatic AMCG (Anorthosite-Mangerite-Charnockite-Granite rapakivi) suite known as the Mazury Complex. These crystalline basement rocks of 1.5 Ga are covered by 750-1200 m thick sedimentary rock complexes. The SAM has an oval shape and occupies an area of 250 km2. Its central part is built up of anorthosites surrounded by the rings of norites, gabbronorites, diorites and granites. The Fe-Ti-V large ore deposits (∼1.5 billion of tonnes) in Krzemianka and Udryn areas and two other smaller bodies were established as mining prospective fields within the SAM. Titanomagnetite, ilmenite and sulphides: pyrite, pyrrhotite, chalcopyrite are main ore minerals. The Fe-Cu-Co-Ni sulphides represent 1 to 4% of the rock volume. Moreover a nano-concentrations of REE (La, Ce, Nd), PGE, Au and Zr elements were currently recognized within sulphide dispersed mineralization. Their size ranges from 10 to 150 μm or in some cases up to 450 μm. Numerous, small inclusions of Te-bearing minerals (0.4-0.7 mass %) were also found in secondary type sulphides, especially in millerite. The goal of present study have been to achieve a three-dimensional geophysical-geological model, based on borehole, geophysical, stratigraphic, lithological and tectonic data, supported by new geochronological survey done on SHRIMP ion microprobe. A geological cross-sections developed as a result of combining geological interpretation with 2D gravity and magnetic modelling using the OasisMontaj (Geosoft) software package were prepared. 3D geological model has been constructed by the GeoModeller 3D (Intrepid Geophysics) application based on data about the floor surfaces of individual stratigraphic units (in case of sedimentary cover) and lithological contacts (in the crystalline basement). A network of discontinuities and fault zones crossing the SAM rock sequences were filled by low-temperature S-type granite and pegmatite veins emplaced between 1495 ± 15Ma (Krzemianka), 1492-1493±5Ma (Udryn, Jeleniewo) and 1488 ± 5 Ma (Udryn) respectively. These younger cross cutting veins widespread within the SAM intrussion have been used as a correlative strata, defining the last tectonic episode, locking a formation of the SAM. The new insight has allowed also to describe the occurrence of a very rare dike rocks as jotunites and nelsonites within the massif, which can be used as a correlative level as well. They constitute a significant element on the way of researching the evolution of the massif and developing a detailed geological model. In order to accurate construction of the model, a chronological succession of the geological units has been prepared.

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