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p-T-t Conditions of the Calc-Silicate Skarn Formation from Garby Izerskie, Karkonosze–Izera Block, Poland

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Exocontact skarns of the Garby Izerskie mountain group in the Izera Mts. (Sudetes, Southern Poland) occur as intercalations (ca. 20 cm up to 1 m thick) in hornfels schists at the Stanisław Mine at Garby Izerskie, which is about 5 km north of the contact. The skarns developed from calcium-rich rocks. The following parageneses were identified: pyroxene – plagioclase (andesine); pyroxene – wollastonite – garnet – plagioclase (albite); pyroxene – wollastonite – garnet with vesuvianite; amphibole – calcite; epidote – calcite – quartz; calcite – quartz (calcite forms pseudomorphs after wollastonite); calcite – fluorite – quartz. The minerals in skarns formed during four stages characterized by different physico-chemical conditions.

Stage I was connected with prograde metamorphism. During this process hedenbergite (T = 330–324 °C, salinities of ca. 12 wt.% eq.NaCl) and wollastonite (liquid CO_2 – ca. 17–15 vol. %) probably crystallized at ca. 545–556 °C and grossular at ca. 500–525 °C (core – T = 330–310 °C, salinities of 14–10 wt.% eq.NaCl) and ca. 460–470 °C (rim – inclusions with CO_2, solution of 10 % NaCl) at $p_{static} = p_{total} = p_{fluids}$ = 1.5–1.8 kbar in a quasi-isochemical system. This crystallization represented peak metamorphic temperatures. Progressive metamorphism of protolith of these skarns resulted in a variety of stage-I mineral assemblages occurring within small domains probably defined by the initial bulk composition of individual sedimentary layers. Comparison of many samples shows that the following reactions were important for stage I:

$Tr + 3Cc + 2Qtz \Leftrightarrow 5Di + 3CO_2 + H_2O$

$Cc + Qtz \Leftrightarrow Wo + CO_2$

$Cc + An + Wo \Leftrightarrow Gr + CO_2$

Stage II is characterized by retrograde metamorphism which resulted in the formation of vesuvianite, actinolite, prehnite, epidote and pseudomorphs of calcite after wollastonite, also in a quasi-isochemical system. The first retrograde mineral was vesuvianite (T = 290–270 °C, salinities of 7–3 wt.% eq.NaCl) which formed at ca. 440–400 °C at p = 1.5–1.6 kbar. Stage II is linked with the following reactions:

$5Gr + 3Di + Wo + H_2O \Leftrightarrow Ves + 4Qtz$

$5Di + 3CO_2 + H_2O \Leftrightarrow Tr + 3Cc + 2Qtz$

$3Gr + 5CO_2 + H_2O \Leftrightarrow 2Zo + 5Cc + 3Qtz$

$Wo + CO_2 \Leftrightarrow Cc + Qtz$

$2Zo + 2Gr + 3Qtz + 4H_2O \Leftrightarrow 5Prh.$

Stage III was associated with extensive silicification (T = 430–310 °C after Kozłowski 1978, salinities of 8–5 wt.% eq.NaCl) of all existing rocks, especially along dislocations, at temperatures of 410–300 °C under allochemical conditions. It may have partly overlapped with stages I and II in time.

Stage IV was characterized by fluorite metasomatosis, yielding fluorite and apophyllite, associated with quartz, calcite and zeolites at 360 to 110 °C (after Kozłowski 1978) also in an allochemical system. The presented p-T conditions were estimated on the basis of fluid inclusion investigations.

Thus, the skarns from Garby Izerskie were high-temperature calc-silicate varieties, with late silica and fluorine metasomatosis. High-grade metamorphism was characterized by the appearance of wollastonite, grossular and a change in plagioclase to more albitic compositions. According to fluid inclusion data and mineral compositions, the metasomatic fluid was mainly CO_2 at peak metamorphic conditions, while during retrograde metamorphism the liquid phase contained very low CO_2 concentrations, which meant high water activity with Xco_2 less than ≅ 0.02 (prehnite formation). The presence of prehnite replacing grossular in some of the samples particulary indicates

that a possible influx of H_2O-rich fluids occurred after peak metamorphism. This study suggests that during contact metamorphism of the protolith of skarns from Garby Izerskie, CO_2 and H_2O behaved as "initial value components" whose activities were controlled by reactions within local systems.

Rb–Sr whole-rock dating of calc-silicate rocks from Garby Izerskie shows that this metamorphism was connected with Karkonosze granitoids of Variscan age, yielding an age of 302(?)–333 ± 4 Ma. The Karkonosze intrusion generated thermal fronts in its cover. These thermal fronts outstripped of the Karkonosze intrusion in time and were the source of heat causing contact metamorphism in the Izera area.

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Two-dimensional Computer Model of Subsidence, Erosion and Thermal History of the Nesvačilka Trough, Eastern Bohemian Massif

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The evolution of sedimentary basins situated on the eatstern margin of the Bohemian Massif underwent a complex evolution consisting of several subsidence and uplift phases. Computer program for two-dimensional simulation of sedimentary and diagenetic processes was applied to show the changing geometry of the basins situated on the Bruno-Vistulian crystalline basement and to estimate the original thickness of the partly eroded units.

The model starts with import of the digital seismic section where the horizons and unconformities are marked. In the next step, the age, lithology and physical properties are attributed to the individual sedimentary bodies. The most complex step is the restoration of the eroded units. Several features give evidence that the Upper Carboniferous strata were thicker than those preserved. An abrupt change in the trend of the diagenetic parameters, such as porosity, vitrinite reflectance, and pyrolytic data, is observed at the Jurassic/ Paleozoic boundary. The absolute values of these parameters are used to calibrate the modelled pre-erosional thickness of Namurian to Westphalian, Upper Jurassic, and Eocene strata.

The modelling results are shown as a series of the restored 2-D section at time of the most important events from the Paleozoic subsidence and thrusting through Jurassic rifting, Late Cretaceous erosion of a submarine canyon, Paleogene deposition and Early Miocene emplacement of the nappes of the Carpathian Flysch Belt.

Detailed Geological Documentation of the Jakubčovice Quarry; Moravian-Silesian Culm

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The active quarry at Jakubčovice nad Odrou (basal part of the Hradec–Kyjovice Fm., Upper Viséan) has been many times an object of excursions and research. The quarry was recently chosen as the largest and best exposed outcrop for complex research during the geological survey on the map sheet 1:25,000 Odry (25–121). Altogether nine benches were studied, with the lengths of sections on individual levels ranging between 50 and 600 m. The walls were documented from the viewpoint of lithostratigraphy, sedimentology, sedimentary petrology and structural geology. The principal results of the survey are presented below.

Lithostratigraphy and sedimentology:

Thick-bedded to massive-bedded greywackes (sandstones) represent deposits of the overbank facies association. They are interbedded with more sandstone-dominated lithologies of the amalgamated channel and sheet facies association. We suppose, in accordance with Hartley and Otava (in print), an axial turbidite system fed from the southern part of the basin. The paleocurrent reconstruction was derived from relatively rare bedding planes with flute casts and tool marks. Such bedding planes represent also horizons correlative across all benches. Paleocurrent indicators show a predominant S/SW to N/NE transport direction, approx. 25 % of marks are swung to NNW. The results agree with regional distribution of paleoflow indicators presented in the synthesis of Kumpera and Martinec (1994).

All levels locally display fine-grained laminated facies, the thickness of which does not exceed first tens of metres. This facies comprises parallel-laminated fine- to very fine-grained sandstones, siltstones and mudstones. Fine-grained sandstones