Origin and Exhumation of UHPM Rocks their Tectonic Significance

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Within the continental collisional orogens of different age more and more occurrences of ultrahigh pressure metamorphic rocks of crustal origin are being recognized recently all over the world. Ultrahigh pressure metamorphism (UHPM) refers to metamorphic processes that occur in coesite stability field, i.e. under pressures over 28 kbar at about 7000 °C (Coleman and Wang, 1995). The UHPM rocks could be recognized by the presence of index minerals (coesite, diamond, ellenbergerite) or their pseudomorphs, by diagnostic chemical composition of the other minerals (supersilicic or high-K clinopyroxenes, high-Mg ilmenites, high-Al. titanites etc.) as well as by equilibration conditions of HP mineral assemblages, e.g. high-Si phengite with Grt-Omp±Qtz/Cs±Ky or grossular-rich garnet with Qtz/Cs-Rt-Ttn-Zo. The first coesite occurrence in crustal metamorphic rock (pyrope quartzite) was reported from the Dora-Maira Massif in the Western Alps by Chopin (1984). Soon after this discovery coesite was recognized in Caledonian eclogites of the Western Gneiss Region in Norway by Smith (1984). Five years later, coesite was discovered in eclogites of Dabie Mountains in eastern China (Wang et al. 1989), then Sobolev and Shatsky (1990) discovered the diamond-bearing gneisses in the Kokchetav block of Kazakhstan. In the Central European Variscides the UHPM rocks were recognized at first within the Bohemian Massif – in central Erzgebirge (Schmädicke, 1991) and in the Orlica-Śnieżnik Dome (OSD) of the West Sudetes (Bakun-Czubarow, 1991, 1992). The UHPM event in Erzgebirge has been confirmed by first findings of microdiamonds and coesite (Massonne, 2001a, b). The second UHPM province within European Variscides has been reported recently in French Massif Central by Lardeaux et al. (2001). In majority of occurrences the UHPM operated during Phanerozoic, but there were recognized two UHPM provinces with coesite-bearing rocks of Neoproterozoic age. First of them was discovered in Pan-African belt of northern Mali, by Caby (1994) and dated by Jahn et al. (2001), whereas the second one was reported recently in Pan-African orogenic belt at the margin of Sao Francisco craton of SW Brazil (Parkinson et al., 2001). The results of recent studies on UHPM provinces support the idea that the UHPM events were on a regional scale and the continental slices that underwent the ultradeep submergence could represent complete sections of continental crust. Most likely, the UHPM took place in blocks of cold and dry supracrustal rocks that underwent deep (over 100 km) submergence due to the subduction and terminal continent - continent collision accompanied by rapid crustal thickening. The UHPM bouyant rocks were exhumed with rates equal to those of subduction (up to 10–25 mm×a^{-1}, cf. Carswell, 2001) in order to preserve the climax metamorphism minerals. The OSD eclogites of the West Sudetes, that underwent UHPM, display two contrasting types of the uplift trajectories (Bakun-Czubarow, 1998, 2001). After peak metamorphism, eclogites from the western occurrences were rapidly and almost isothermally exhumed to the upper crust, where they were isobarically cooled, so their uplift may be related to coaxial shearing, operating, for example in the regime of extrusion tectonics. The eclogite-granulite rocks of northeastern occurrences underwent two-stage uplift: initial, very rapid one, to the depth of about 60 km, where the HP granulite assemblages were developed and next, mainly Visean uplift with simultaneous cooling and decompression, with the vertical rate of 2.2 mm×a^{-1}. The last uplift may be related to non-coaxial shearing operating, for instance, in an accretionary prism with continuous subduction.

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Deformation of Createaceous Complex in the Eastern Part of the Intra-Sudetic Basin and Nysa Graben (SW Poland) – a Geological Map Analysis

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Cretaceous complex in eastern part of the Intra-Sudetic Basin and Nysa Graben (SW Poland) is dominantly composed of sandstones and calcareous mudstones and claystones, interpreted as a littoral-to-shelf succession which formed between the Upper Cenomanian and Santonian (Wojewoda, 1997). Its present thickness varies from about 350 m in the Góry Stołowe Mts. area up to 1200 m in the Nysa Trough. The thickness variation of the complex is due to differences in paleotopography of the Cretaceous basin and its variable capability of sediment accommodation in different parts, as well as to subsequent tectonic deformation and erosion. As a result of the latter, the complex is locally discontinuous, cut by faults and locally rotated up to vertical position or even overturned (Don B. and Don J., 1960, Don J., 1996). In the area studied, Cretaceous deposits overlie both crystalline and older sedimentary rocks.

Based on information on the strike and dip of Cretaceous beds displayed on the detailed geological maps of the Sudetes at the scale of 1:25,000, the orientation of beds was analysed and its dependence on basement type and depicted tectonic structures was studied. The interpolation of dip values allowed to plotting isolines of equal inclination of beds. The accuracy of this interpolation depended upon the amount and correctness of the bed orientation measurements, therefore it varies between the map sheets.

The Cretaceous complex is dominantly flat-lying, dipping at the angle of 0–15 . Only in a few localities anticlinal or synclinal structures of a broad width and small height are remarkable. Beds steepen significantly, up to vertical or overturned position, at most of mapped contacts with exposed crystalline basement, suggesting fault boundaries with the latter and the steepening being due to fault drag. This is also supported by a remarkable congruence of high angle isolines with strikes of major faults plotted on the maps and a higher inclination of beds in the vicinity of those faults. The trends of high angle isolines may, thus, indicate the position of fault zones within and around the Cretaceous complex. In places where the complex borders (on the ground surface) on older sedimentary complexes, no bed steepening is observed.

Most of the steeply inclined areas of the analysed structural unit corresponds to the occurrences of fine-grained sediments, i.e., calcareous mudstones and claystones. Sandstone bodies lie generally flat – in places even close to fault boundaries of the complex. This may imply that during tectonic deformation coarse-grained sediments responded in a more brittle way in comparison to fine-grained ones. Besides the fault zones, the deposits remain flat both on the crystalline and sedimentary rock basement. This suggests that the Cretaceous complex has been displaced vertically together with the individual fault-separated blocks of the basement at different heights and, as a result, it was eroded at different structural levels. The latter is confirmed by varying isoline values at the mapped boundaries between the complex and its basement.

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AMS and Deformation Patterns in The Jawornickie Granitoids, Rychlebske Hory – Preliminary Data

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During the last two decades, a number of studies has shown that the magnetic properties of rocks, especially anisotropy of magnetic susceptibility (AMS), can be used as a tool for grain fabric characteristic (Richter et al., 1993), as a strain indicator (Borra-