



Thermal maturity of the Palaeozoic Moravo-Silesian Basin: a digital image analysis approach to conodont colour alteration index (CAI)

O. Bábek (1,2), E. Francu (3)

(1) Masaryk University, Brno, Czech Republic, (2) Palacky University, Olomouc, Czech Republic, (3) Czech Geological Survey, Brno, Czech Republic (babek@prfnw.upol.cz / Fax: ++420-585225737 / Phone: ++420-585634532)

Sediments of the Moravo-Silesian Basin (MSB) recorded a complex evolution from Devonian passive margin to Carboniferous peripheral foreland basin at the eastern periphery of the Variscan orogene in Europe. Vitrinite reflectance (R_r) and illite crystallinity (IC) database indicate the MSB underwent a complex pre-, syn- and post-Variscan thermal history. Study of conodont colour alteration index (CAI) was recently introduced in the thermal maturation studies of the MSB in an attempt to quantify the conodont colour using image analysis tools, calibrate it with other thermal maturation indicators, expand the existing thermal alteration database and explore the significance of the individual thermal alteration phases.

Colour composition of the representative CAI samples ranging from CAI_{3.5} to CAI₆ was quantified by measurement of the intensities of the red, green and blue colour components of reflected light from unpolished conodont elements. Results from statistical processing of the red, green and blue components (histogram shapes, mean, median and mode values) showed results that were largely comparable with previously published results from image analysis of polished conodont sections. Conodonts were photographed along with polished white pottery background using digital camera attached to a stereomicroscope, under standard conditions of illumination and magnification. The images were imported into PC and analysed by Corel PhotoPaint graphic software. After white point adjustment, three 841 pixel square areas on each conodont were carefully selected for calculation of the light component intensities in the RGB mode.

The MSB thermal maturity field as revealed from the combined R_r , IC a CAI database shows the following features: (i) thermal maturity varies from anchimetamorphic conditions ($R_r = 3.5-5.5\%$, CAI5, IC = $0.2-0.3^{\circ}2\theta$) to late diagenetic conditions ($R_r < 1.8\%$, CAI3.5, IC = $0.8 - 1.6^{\circ}2\theta$); (ii) vertical saw-tooth pattern in the R_{min} a R_{max} values in several boreholes in the eastern MSZ indicates that Variscan thrust tectonics did not affect the area before it attained its final thermal maturity; (iii) in the western part, however, paleoisotherms crosscut the major Variscan tectonic structures; (iv) heat flow during the maximum heating was much higher than the present-day values; (v) Alpine tectonomagmatic cycle did not produce sufficient heat to overprint this principal pattern.

As the data show, the rocks in the western part of the MSB attained their maximum thermal maturation during the final stages of the Variscan deformation and just after it, within the Upper Carboniferous to Lower Permian period. This coincides with the timing of some principal tectonomagmatic processes at the eastern margin of the Bohemian Massif: late Carboniferous – early Permian major remagnetisation event in the Moravian part of the MSB, late Carboniferous – early Permian ages of intrusion of the Zulová intrusive body in northern Moravia and 300-310 Ma cooling ages of white micas in the Keprník and Desná domes. Stretching lineations in the mica-bearing blastomylonites of the Keprník and Desná dome as well as in the sediments of the MSZ document a Late Variscan orogen-parallel extension, which was associated with a huge thermal pulse overprinting the rocks of the MSB.

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