with vanadium and other metals (Bernard and Pouba 1986).

Conclusions

Numerous borehole data, documentation of underground coal mines and detailed geological exploration of the Upper Paleozoic continental basins have revealed the complicated relationship between red bed units and grey sequences.

The set of predominantly grey units contour maps clearly demonstrates that red and decolored sediments are preserved at the original basin margins and at the edges of intrabasinal highs whereas major parts of a sedimentary basin are filled with grey-coal bearing strata. The depicted varicolored facies distribution is typical for intervals when depocenters were occupied by sedimentary environments with high ground water level enabling the growth of a permanent vegetation cover and the large preservation of organic matter. Another configuration is characteristic for intervals when the deposition of red beds prevailed. In this case the marginal and basinal sediments are mostly red and grey deposits are restricted to areally limited permanently wet environments (e. g. peats and bogs fed mainly by ground water, profundal parts of lakes with a fluctuating water table). This clearly shows that the pigmentation itself is not unequivocally a climatic indicator. The quality of supplied clastic material from the source area was principally similar for the whole period of Upper Paleozoic sedimentation and the difference in coloration was subject to a quantitatively varying scale of oxic and anoxic diagenetic processes in individual intervals. Such intervals are defined by the presence or absence of specific features which might be considered climate indicators.

The evaluation of commonly used climate indicators suggests that they may be classified as follows:

i) a paucity and low diversity of faunal and floral remains, occurrence of limestone, calcretes, evaporites, cherts, bimodal sandstones, relatively low mineralogical maturity of sandstones and conglomerates, specific sedimentary textures and diagenetic features evidence dominating hot arid to semiarid climate.

ii) Silicified wood, fossil weathering products, paleosoils, calcium sulphate or carbonate cements in sandstones mostly indicate hot and at least semiarid climate but they occur in beds formed at the time of important climatic change.

iii) Indicators such as: arkoses, clay minerals and kaolinized interbeds were found unreliable, i. e. not reflecting primary climatic circumstances.

The alteration products of pyroclastic or volcanogenic beds distinctly differ between red and grey sequences. Montmorillonite, mixed-layer minerals, zeolites, authigenic feldspar and quartz are characteristic of the former and well ordered kaolinite for the latter.

The color parameters evaluated in 184 samples have revealed that their differences depend on several factors such as: grain size and the amount of clay fraction, sedimentary environment, age and regional peculiarities. The imprint of diagenetic processes upon the pigmentation is often obvious and microscopically recognizible. Hematite, the principal coloring pigment of red beds originated probably in the source area as well as diagenetically from hydrated iron oxides. Hematite which incorporates in its lattice up to 6 % of Al is considered a product of goethite conversion whereas an elevated amount of Ti points to a magmatic magnetite source. The evaluation of chemical remanent magnetization of red bed samples shows its origin in the early diagenetic stage. Magnetite yielding clastic remanent magnetization of grey colored sediments was mostly hematitized in red beds or was absent in the supplied detritus.

Decolored sediments originated during various stages of lithification. The early diagenetic reduction spheroids evidence a mobilization of Fe, V, U, Cu, Ni, Pb caused by temperature and moisture changes. As nuclei of the decoloration process primary (organic matter, microbial colonies, mafic minerals) or secondary inhomogenities (calcite, sulfate, sulfide) may have been engaged. Large scale decoloration was caused by ascending or descending reducing ground waters derived from layers or sequences rich in organic matter. The metal accumulations in red beds are related to grey intercalations, calcite concretions and the contacts with grey units.

The considerably different Fe_2O_3/FeO ratio identifies red, green and grey mudstones and claystones. The presence of coalified matter in some red strata suggests the secondary reddening of initially grey sediments long after their lithification. The variability of the Al_2O_3/Na_2O ratio in red mudstones reflects short transport and hence heterogeneity. The low value of this ratio is noted in mudstones containing authigenic analcime. The direct dependence between TiO_2, total Fe and Al_2O_3 reflects the presence of these elements in the fine fraction of red mudstones. The wider dispersal of total Fe versus TiO_2 values in grey mudstones compared with red equivalents is explained by a partial leaching of iron in the presence of organic matter. The slightly lower content of TiO_2 in grey mudstones is difficult to explain. A different quality of weathered clastics might be the answer. Both red and grey mudstones are rich in illite, therefore K_2O dominates over Na_2O in the majority of samples.

Trace elements in red and grey mudstones are present in minor amounts with the exception of some elements (particularly Cu, V, U) enriched in grey intercalations or coal flasers within red bed units. Red mudstones differ from grey ones in higher boron content (more than 70 ppm) evidencing an increased salinity of basinal waters.

Acknowledgements

The authors wish to express their thanks to V. Daněk for the elaboration of figures 1–6 and for data and results used in chapter Color – pigmentation relationship. In addition we are deeply indebted to Don Ptacek for improvement of the English language.