stratovolcano;
- mineral assemblages of gabbroic rocks of the ML complex, including study of opaque and heavy minerals;

Isotope studies and Geochronology
- geochronological dating of several rock types;
- study of stable isotopes in several rock units and characterization of processes by stable isotopes;

Paleofluids and fluid inclusions
- study of paleofluids in granulites of S Bohemia and in granitoid rocks of the Krušné hory Mts.;

Hydrogeology
- compilation of regional database on 5,000 hydrogeological boreholes and wells in region I (SE of Klatovy) and region II (20 km wide belt between Nepomuk and Kraslice, along the profile 9HR), including filtration parameters and a map of transmissivity. The data will be interpreted, in combination with geophysical data and regional fault network, in prognostic maps of groundwater reserves.

Synthesis of geological, tectonic, geophysical and geochemical data from W and SW Bohemia, in combination with data produced by the KTB program, resulted in completely new information on age, tectonic positions (and their changes in time), age of tectonothermal events of several major units in the region.

Complete review of results is presented in annual Abstract volumes distributed by the Czech Geological Survey, and extended results will be presented in the Final Report (1994).

DIAGENESIS OF UPPER CARBONIFEROUS ROCKS IN THE OUACHITA FORELAND SHELF IN THE MID-CONTINENT OF USA: WIDESPREAD EFFECTS OF THE VARISCAN-EQUIVALENT OROGENY

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Middle and Upper Pennsylvanian (Upper Carboniferous) sandstones and limestones of southeastern Kansas have experienced regional diagenesis at temperatures higher than expected from reconstructed depths of burial at normal geothermal gradients. These effects appear to be related to widespread invasions of heated brines that were also important in developing MVT base-metal deposits in Lower Carboniferous and lower Paleozoic rocks elsewhere in the US Mid-continent (Fig.1).

Uplift of the Ouachita Mountains to the south in Oklahoma and Arkansas may have caused artesian flow of heated brines northward across the Arkoma foreland basin. Flow was most likely through regional aquifers in the Ordovician and Mississippian (Lower Carboniferous) rocks of the region. Our work concentrates on the effects of this brine invasion on Pennsylvanian rocks in the Cherokee and Forest City basins in the shelf region of southeastern Kansas and western Missouri covering an area approximately 250 by 100 km.

Upper Carboniferous rocks of the US Mid-continent characteristically consist of cyclothems. Upper Middle Pennsylvanian rocks (lower Desmoinesian Series) in the Cherokee Group are predominantly shale with about 20% sandstone. Most sandstones are fluvial or estuarine valley-filling sequences, some are shoreline sandstones that form the uppermost component of progradational or regressional intervals. Overlying rocks of the Marmaton, Kansas City, and Lansing groups (upper Desmoinesian and Upper Pennsylvanian Missourian series) show alternations of limestone and shale, again with sandstone valley fills. Transgressive limestones are characteristically about 1 m thick and consist of wackestones and carbonate mudstones. Regressive, or progradational, limestones are commonly 3–5 m thick, consisting of lime mudstones and wackestones overlain by packstones and grainstones. In places, regressive limestones include phylloid algal mounds that are up to 10's of meters thick. The Desmoinesian and Missourian series total 400 m thick.

Sandstone diagenesis included formation of siderite cement, development of quartz overgrowths, a widespread episode of dissolution of feldspar and carbonates, followed by minor precipitation of Fe-calcite, and precipitation of pore-filling kaolinite and sub-poikilotopic Ca-ankerite. Actual duration of precipitation episodes of minerals overlapped (Fig. 2). Clay coatings are not visible in most

rocks or are very thin. Limestone diagenesis included formation of drusy or fibrous isopachous calcite cements that pass into blocky calcite spar and Fe-calcite spar, growth of quartz crystals and chalcedony, an episode of dissolution and formation of Ca-Fe-dolomite plus development of kaolinite in some samples. Other phases are present in minor amounts in either sandstone or limestone.

Key diagenetic events took place in limestones and closely interbedded sandstones in the same order: quartz growth as overgrowths, chalcedony, and euhedral crystals; dissolution; and overlapping growth of kaolinite and highly ferroan Ca-Mg carbonates (Fig. 2). Presumably, these events took place in the two rock types simultaneously and arose from the same causes. The causes operated over the entire study area. Fluid inclusions in the late ferroan Ca-Mg carbonates record temperatures ranging from 90° to 160 °C (Fig. 3). Vitrinite reflectance in oil shows a regional background of 0.6% to 0.7% with warm areas, which may be a few 10's of km across, with values as high as 1.6%. Analyses of organic constituents by Rock-Eval pyrolsis confirms the vitrinite results. These maturation values correspond to the range of ternperatures indicated by fluid inclusions. Diagenetic mineral assemblages in sandstones are similar to those developed at temperatures of 100–120 °C elsewhere.

The Desmoinesian and Missourian succession in SE Kansas has been uplifted after burial and partially exposed. Maximum depth of burial of can only be inferred from the thickness of younger rocks, which are preserved to the west. Summing of those thicknesses implies a maximum depth of burial of about 1.4 km for the top of the succession and 1. 8 km for the bottom. Using recent, and rather elevated (30° to 50 °C/km), geothermal gradients suggests that temperatures at such depths should have reached levels 30° to 50° below those recorded by fluid inclusion temperatures (Fig. 3).

Hot brines derived from late Paleozoic (Variscan equivalent) mountain building caused fluid flow that raised temperatures in rocks hundreds of km away, causing extensive diagenesis in shelf rocks not otherwise affected by orogenic activity.

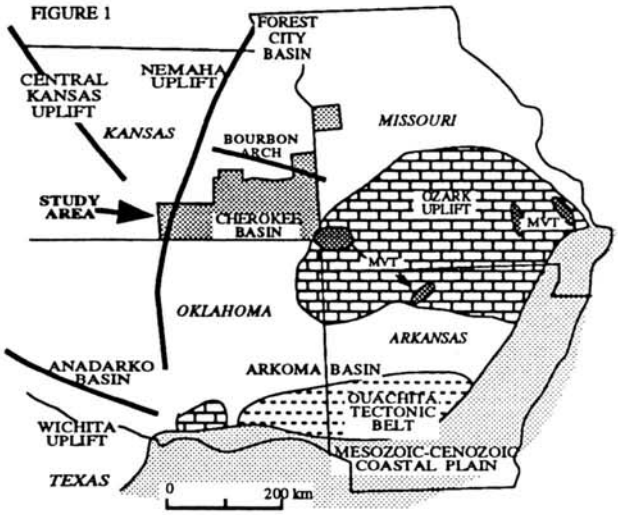

Fig 1. Mid-continent of USA showing study area and tectonic elements. MVT=Missouri Valley-type base-metal deposits.

Reference
Wojcik, C.J. (1991): unpub. Ph.D. dissertation, The University of Kansas, Lawrence, Kansas, USA, 66045.

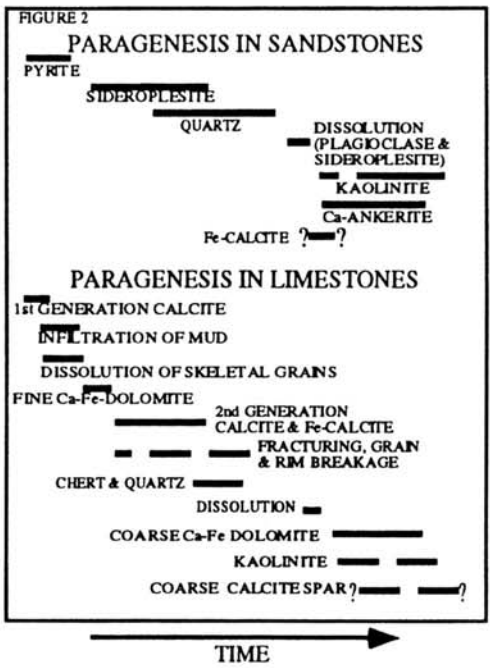

Fig 2. Paragenesis of diagenetic minerals in sandstones and limestones of study area.

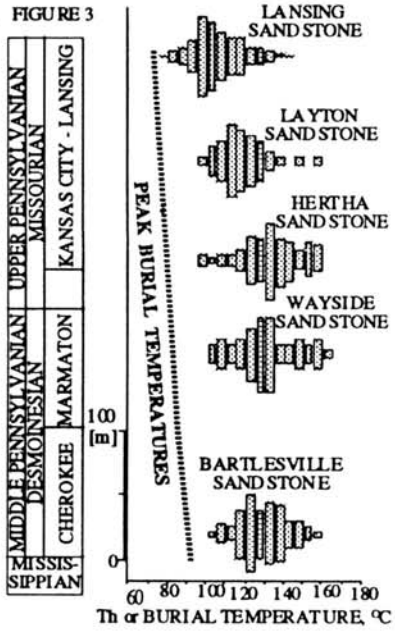

Fig 3. Homogenization temperatune of fluid inclusions in late ferroan Ca-Mg carbonates, SE Kansas. Length of bar on histograms is proportional to number of inclusions. Peak burial temperature calculated from modern gradients and projected thickness of overlying rocks. Fluid inclusions, vitrinite reflectance, and Rock-Eval pyrolysis show temperatune or degree of maturity beyond that expected for burial alone, even at modern, rather high, geothermal gradients. Modifiied from Wojcik (1991).