Lower Saxonian Alluvial Deposits: Trutnov Fm., Intra-Sudetic Basin, NE Bohemia

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The aim of my study is to specify the sedimentary environment of the Trutnov Formation, to recognize in changes of the source areas and to decipher the cause of these changes. The Trutnov Fm. (upper Lower Permian) is mostly composed of conglomerates (at the base), sandstones, carbonate-cemented sandstones, mudstones, rare calcrete horizons, and represents fining upward sequence of redish-brown alluvial sediments. Its thickness varies from 40 m to 250 m. The base of the overlying Bohuslavice Fm. (Upper Permian) is defined by the first occurence of the dolomite-cemented sandstones.

According to the provenance of clastic components of the basal conglomerates, the basin is divided into three areas: 1) south-western part is dominated by pebbles of basic volcanites; 2) north-western part is dominated by pebbles of acid volcanites (rhyolite lavas, ignimbrites); 3) eastern part is dominated by pebbles of polymictic crystalline material (gneisses, phyllites). According to Tásler et al. (1979), these three types of clastic components indicate three separate alluvial fan settings with distinct source areas.

Outcrop sections were measured in northern part of the basin and six sedimentary lithofacies (sensu Miall, 1996) were distinguished in six sections. Lithofacies Gt: Clast supported well-sorted cobbly conglomerate; subangular grains; coarse-grained sandy matrix; trough-cross bedding is developed. Foresets dip from 20° to 30°; deposited by high-energy traction flow. Lithofacies Gmm: Matrix-supported unsorted pebbly conglomerate; subrounded grains; massive with muddy-sandy matrix; deposited by suspended load turbulent flow. Lithofacies Gp: Clast-supported unsorted pebbly conglomerate; subrounded grains; matrix vary from clayey to sandy; developed low angle cross bedding; deposited in upper flow regime. Lithofacies Sh: Coarse-grained sandstone; poorly sorted with linear elongate lenses of coarse-grained gravel; horizontal bedding, low angle trough cross bedding is also rarely present; deposited in upper flow regime. Lithofacies Fl: Fine-grained well-sorted sandstone; horizontally laminated with alternating clay and fine sand laminae; sedimentation from suspension. Lithofacies Fm: Massive mudstone; subrounded sandy and fine gravelly clasts float in muddy matrix. Clast content increases upwad; sedimentation from suspension.

The Gt, Sh and Fl lithofacies are associated with channel shaped bodies. The channels are in average 16.4 m wide and about 1.2 m thick bodies with erosional relief at the base reaching one meter. The basal part of the channels is made up by Gt lithofacies which continuously pass upward to Sh and Fl lithofacies. These channels were filled in upper flow regime, where the energy of flow gradually decreased upward as the channels were abandoned. The Gmm lithofacies form 1.5 m thick elongate lens shaped bodies. Erosional base with relief about 0.5 m is common. Within these bodies flat surfaces, which may indicate repeated deposition are observable. This lithofacies is interpreted here as an overbank sediment deposited close to channel during violent floods, when dense suspended load turbulent flow rapidly expands away from channel and spreads over an alluvial plain. The Gp lithofacies form elongated flat bodies with common erosional scours (2.4 m wide, 0.6 m thick). These flat bodies are formed by multi-storey filling of Gp lithofacies, which mutually erode. Erosional bases of all bodies and thinly developed beds are probably caused by rapid changing of hydraulic conditions and gravel-clast overpassing.

Stěnava River Section (Meziměstí, see add. 2 above): Lower part of the Stěnava River section is dominated by coarse overbank flood deposits (Gmm lithofacies) and rarely fine alluvial plain deposits (Fm lithofacies). Channels with association of Gt, Sh and rare Fl lithofacies occupy the upper part of this section. Lateral shifting of the channels toward SE can be observed (Fig. 1).

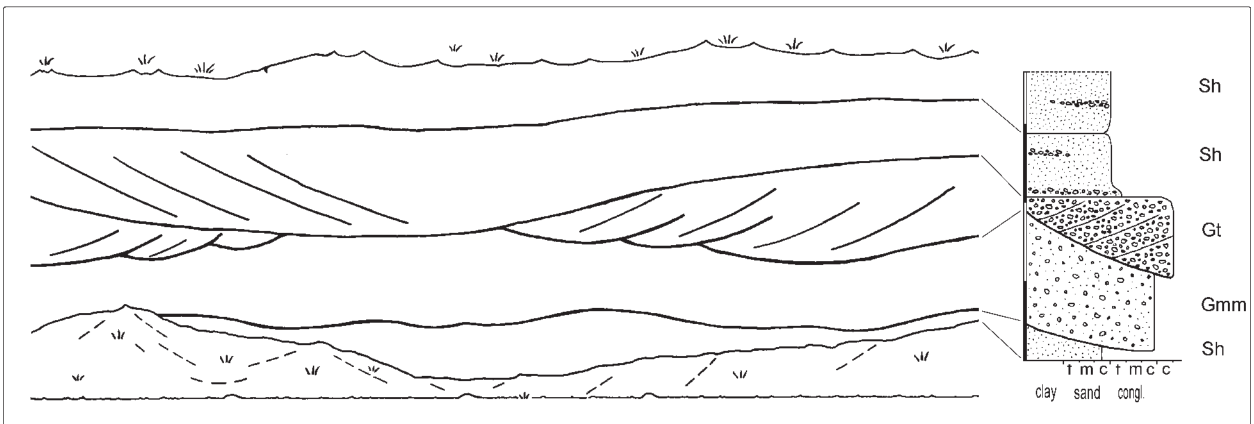

Fig. 1. Lateral migration of the channels and typical facial succession. Stěnava river section (scale-bar on the measured section is in the meters, sketch of the outcrop is not vertically exaggerated).

The rapid lateral migration of the channels took place due to unstable, easily erodible banks. The coarse-grained fractions prevail in poorly sorted deposits. The channels are relatively wide and shallow with significant erosional bases, filled in steady upper flow regime. The deposition took place in braided river system. Bo•anov Section (SE from Broumov, see add. 3 above): The occurrence of the Gp lithofacies is restricted to the Bo•anov section. Overbank fine deposits are absent. Poorly sorted deposits with poorly developed bedding form tabular bodies showing cut-and-fill relief along their basal bounding surfaces. Unsteady traction flows were probably channelized by a network of unstable scours. A short time episodic sedimentation is likely to have taken place. The flows rapidly runoff toward the basin and partly infused into porous gravely background (clay is rarely presented as a matrix). This indicates that relatively steep gradient was developed. These deposits may represent a distal part of alluvial fan system or proximal braidplain, which corresponds to the interpretation of the nearby Radków conglomerates (Aleksandrowski et al., 1986).

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Geochemistry of the Orthogneisses from the Northern Part of the Lipowe Hills (Eastern Part of the Fore-Sudetic Block)

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The Lipowe Hills massif is located in the eastern part of the Fore-Sudetic Block (in the East/West Sudetes boundary zone), between the Strzelin crystalline massif in the east and the Niemcza-Kamieniec metamorphic complex in the west, about 40 km south of Wrocław. It consists of three main rock groups: gneisses, schist series (amphibolites, mica schists, calc-silicate rocks and marbles) of an unknown age and Variscan granitoids, dated at 329±11 Ma (Oberc-Dziedzic and Pin, 2000).

Four principal varieties of gneisses are exposed in the Lipowe Hills massif (Wójcik, 1968, 1973; Oberc-Dziedzic 1988, 1995): 1) light, laminated or augen gneiss (the light Stachów gneiss), 2) dark, fine-grained migmatitic, sillimanite gneiss (the dark Stachów gneiss), 3) light, migmatitic gneiss with sillimanite nodules (the Nowolesie gneiss) and 4) mylonitic, chlorite gneiss (the Henryków gneiss)

Geochemical investigations were carried out on samples collected from the boreholes Stachów-1 (ST-1) and Stachów-2 (ST-2), located in the middle and northern parts of the Lipowe Hills massif. For chemical analyses two samples of gneisses (ST-1 86, ST-2 233), corresponding to the so-called light Stachów gneisse, were selected.

The studied gneisses are light grey, medium to coarse-grained and show streaky texture. The rocks are composed of quartz, plagioclase and microcline. Biotite is less common. Muscovite, sillimanite (fibrolite) and chlorite (after biotite) occur as minor constituents. In places, sillimanite is replaced by large muscovite crystals. Plagioclase is often sericitized. Accessory phases comprise garnet, zircon, apatite and opaque minerals.

Discrimination plots TiO_2 vs. SiO_2 (Tarney, 1976) and P_2O_5/TiO_2 vs. MgO/CaO (Werner, 1987) show that the analysed gneisses are orthogneisses. They contain between 1.22–1.66 % of normative corundum. Chemical composition is dominated by normative quartz and feldspar (>90 %), whose proportion also suggests granitic protolith.

The orthogneisses have a composition of peraluminous, calc--alkaline granites. The value of normative corundum (> 1) as well as the molar proportion of $Al_2O_3/CaO+Na_2O+K_2O>1$ (1.07–1.12) indicate S-type granites (White and Chappell, 1974). The Nb/Th ratio ~2 (0.48–1.22) is characteristic of crustal material (Shaw et al., 1986). The analysed gneisses show a flat REE pattern with Eu anomaly as compared to the composition of lower crust. Chondrite-normalized values of the gneisses display slight enrichment in LREE, strong negative Eu anomaly and flat HREE pattern (10–20 times chondrite). Negative Eu anomaly and relative LREE enrichment indicate that fractional crystalization played an important role (Pearce et al., 1984). Trace element contrentrations normalized to ocean ridge granite display geochemical patterns (K_2O, Rb, Ba Th >1, positive Ce anomaly) similar to volcanic arc granites and collision granites (Pearce et al., 1984). On the discrimination diagrams Rb vs. (Nb+Y) and Rb vs. (Ta+Yb) the analysed samples fall in the volcanic arc and late or post-collision calc-alkaline granites fields. Harris et al. (1986) provided a possibility to distinguish volcanic arc intrusion from late or post-collision one. Based on the Ta vs. Nb plot, the examined gneisses fall in the volcanic arc field. Similar conclusions may be drawn from the Rb/30--Hf-Ta*3 triangular plot (Harris et al., 1986).

Described gneisses originated from granitic protolith. Pristine rocks consisted of peraluminous, calc-alkaline granite of S-type. They were probably the products of crustal material melting. Tectonic setting of the granites is very questionable, although the obtained data indicate their emplacement in a volca-