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Architectural Analysis of the Hlavačov Gravel and Sand – a Fluvial Relict of Neogene River System: Preliminary Report

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Fluvial deposits of Hlavačov gravel and sand represent the largest relict of Neogen river system, which drained the western and central Bohemia to the Most Basin (Pešek and Spudil 1986). The Most Basin is filled by late Eocene to early Miocene clastics and volcanic products and forms a part of NE-trending Eger Graben, a system of Cenozoic sedimentary basins and intense intraplate alkaline volcanism (Kopecký 1978, Malkovský et al. 1985, Adamovič and Coubal 1999, Cajz et al. 1999, Rajchl and Uličný 2000), recognized as a part of Central European Rift System (Ziegler 1990). The Hlavačov gravel and sand form NW-trending narrow belt, nearly 20 km long with maximum thickness varying around 40 metres (Bretšnaidr 1950, Váně 1985). The thickness and width of the belt generally decrease basin wards. At NW border, the Most Basin deposits overlay the Hlavačov gravel and sand. The age of deposits is not accurately proved and remains uncertain. However, the flora assemblages correspond to a temperate riparian forest probably of the uppermost Oligocene age (Teodoridis 2002). Hlavačov gravel and sand deposits were studied at three open gravel-pits situated at NW and SE borders of the belt (Hlavačov, Velká Černoc and Želeč).

Mostly coarse-grained deposits reflect high-energy, bed-load dominated depositional environment with significant portion of suspended-load material as shown by frequent clayey-sandy matrix. Sedimentary facies are arranged to a several depositional elements, such as gravel bars, sand flats, channels and chute channels. Gravel bars consist mostly of poorly sorted, planar-cross to horizontally bedded, pebbly to coarse-grained or sandy conglomerates with some sandstone interbeds and mudstone intraclasts. The base is usually planar or irregular, locally slightly erosional. Thickness can reach 5 m and lateral extend exceed 50 m. Widely spaced reactivation surfaces record slight changes in mainly downstream to oblique, preferably eastern or western ward accretion. The gravel bars are usually succeeded by sand flats or gravely/sandy channel fills. Sand flats are composed of number of small-scale trough-cross-bedded cosets of well-sorted mostly medium- to fine-grained sandstones. Occasionally some large-scale low-angle stratified sets may occur. Some erosional surfaces record small discharge fluctuations. Dispersed paleoflow directions usually differ from underlaying or overlaying depositional element. Their thickness reach up to 2 m and lateral extend can reach 50 m. Sand flats deposits result from mostly small-scale sandy dune trails running in rather shallow flows on bar tops and are usually truncated by channels. Package of medium- to well-sorted, trough-cross-bedded, coarse-grained sandstones to conglomerates fill the channels with pronounced concave erosional bases reaching several meters in relief (~ 3 m). The channel-fills consist of large- to small-scale cross-bedded sets and usually show a multi-storey framework; thickness of single channel-fill can exceed 4 m and lateral extend reach from 15 m to more than 40 m. The thickness of multi-storey channel-fill reach up to 8 m and lateral extend exceed 60 m (the limit of outcrop). Common alteration of open-framework and bimodal gravel laminas together with trough-cross-bedded sandstones suggests the filling of the channels by migrating high- to low-relief gravel and sand dunes. Frequent, usually erosional reactivation surfaces record discharge fluctuations and consequently minor changes in accretionnal directions. Significant lateral accretion surfaces show mostly northeast to east direction of accretion. Western or northwestern directions are subsidiary. Frequent channel shifting also display mostly northeastern to eastern trends. However, the channels are largely oriented to the north or northwest. Lenses of massive or laminated sandy clay representing the final stage of channel filling and subsequent abandoning can form the top of the channel-fills. Similar fine-grained deposits with gravel lag along the erosional, concave base locally truncate the gravel bars or sand flats. These channel shaped elements are interpreted as abandoned chute channels.

Described features are typical for gravel bed braided rivers with deep, perennial and relatively stable laterally slightly migrating channels. Huge gravel bars formed relatively stable banks or islands surrounded by channels; however, some bank collapse and frequent large mudstone intraclasts show to extensive erosion and redeposition during high-discharge events, when lateral channel shifting and avulsions took place. Frequent reactivation surfaces reflect high discharge fluctuations. Hence, the channel belt development was most probably controlled by climatic conditions, namely seasonal oscillations under overall rather colder climate. Within 3–5 km wide channel belt the individual channels migrated mostly NE ward while the SW part remained gradually abandoned with oxbow lakes formation as shown by frequent occurrence of thick clayey lenses (Váně 1985). Distinct vertical changes, such as thinning of depositional elements, decreasing of erosional relief, increasing of width/depth ratio and upward fining grains could be recognized. Depositional architecture at lower parts show to aggrading braided river system formed by deep, relatively stable and laterally slightly migrating channels. Depositional framework of upper parts of the relict suggests laterally more extended channel belt formed by far shallower mobile channels with reduced transport capacity, where the transport prevailed over deposition (degrading river system). During fractional deposition the vertical and downstream accretion of low-relief bedload sheets prevailed.

The reasons of change in fluvial style are still uncertain, but the autocyclic causes are the most probable. Similarly the nature of braiding remains questionable. The braided rivers occur in poorly vegetated preferably high-gradient areas and fluctuating discharge is a crucial for braiding pattern creation. Evidences of riparian forest and highly improbable high-gradient relief of western Bohemia in Neogene times suggest that the braided pattern evolved mainly due to high discharge fluctuations.

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Origin and Orientation of Microporosity in Eclogites of Different Microstructure

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Crystalline rocks of metamorphic and magmatic origin are usually of very low porosity (below 1%). Porosity corresponds to grain boundaries, cleavage planes of rock forming minerals and microfractures of different length that can be either sealed or open. Orientation and connectivity of microporosity in these rocks and its closure with respect to increasing confining pressure is of great interest as they are suitable for dangerous waste disposal. However, there is limited number of methods how to measure it. In this work, we examine origin and spatial orientation of microporosity in two eclogites of similar lattice preferred orientation (LPO) of omphacite, but different microstructure and grain size using:

1. subtraction of velocities of acoustic P-waves ($\Delta Vp(\Delta p)$) experimentally measured in 132 directions at different confining pressures on spherical sample (pulse transmission technique of Pros and Babuška (1968) and Pros et al. (1998)),
2. measurement of lattice preferred orientation using SEM-EBSD method and
3. quantitative microstructural analysis of grain boundaries orientation in three thin sections that are oriented parallel to xz, xy and yz planes of finite strain ellipsoid (polyLX of Lexa (2003).

We choose eclogites as a relatively simple bi-mineralic rock type composed of omphacite and garnet as cleavage-bearing anisotropic and cleavage-free isotropic minerals, respectively. The first sample (JK1b) is dynamically recrystallized crustal eclogite that consists of fine-grain clinopyroxene grains having mean Ferret diameters of 41 µm. Garnet grains have idiomorphic shapes and mean Ferret diameters of 87 µm. The second sample (SNW3) belongs to the population of coarse-grained mantle xenoliths. Sample consists of clinopyroxene and slightly elongated garnet grains that define well-developed macroscopic foliation. Mean Ferret diameter of clinopyroxene and garnet is 1.31 mm and 2.20 mm, respectively.In the sample JK1b, two main fields (A and B) of directions of high P-wave velocity difference values characterize spatial distribution of microporosity. Third less significant field of directions of high values of P-wave velocity differences (field C) occurs in the foliation plain at eastern pole of diagram.

Partial subtractions between increasing hydrostatic pressure steps show that most microcracks from the set corresponding to the field A were progressively closing down between confining pressures of 0.1 and 20 MPa. Most microcracks correspond-