may correspond to fluids, which originated from marine water of Carpathian Foredeep. These saline (and possibly methane-bearing) fluids leached the Paleozoic host rocks. The presence of collomorph calcite, bothryoid structures, framboids of Fe-sulfides, as well as still "very light" carbon isotope compositions of carbonates (in spite of leaching of host rocks) suggest, that late generations in these veinlets could be bacterial precipitates, particularly, if related temperatures were < 50°C. The conditions of this type are realizable for Miocene ages.

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Syngenetic Deformation Structures in Carboniferous Turbidites in the Basement of the Fore-Sudetic Homocline – an Example from Well Marcinki IG-1

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Well Marcinki IG-1, drilled in the 1960's, is located in the southern part of the Fore-Sudetic homocline, near to Ostrzeszów. Its aim was prospecting for hydrocarbons in Carboniferous clastic succession underlying the homocline. The Carboniferous was drilled between 1715 m and 4237 m (terminal depth). The drilled interval of more than 2500 m in length is, however, not a depositional thickness, since in places the sequence was found to be tectonically duplicated by folding and thrusting. The cored intervals did not exceed 30 percent of the length of the Carboniferous section in this well. The coring was not uniform along the section, with the fully cored (100 percent) interval below the depth of 3536 m.

The Carboniferous of the Fore-Sudetic homocline is a relatively homogeneous clastic sedimentary complex. Based on textural diversity, this complex comprises rocks of three facies groups: (1) coarse-grained facies, (2) medium-grained facies and (3) fine-grained facies rocks. The structural diversity is the basis for a more elaborated division of these rocks, shown in Table 1. The distinguished lithofacies can be grouped into three facies associations, referred to as the turbidites (1), gravity flow deposits (2) and pelagites and hemipelagites (3).

The turbidite association comprises sediments of lithofacies F, G and E, partly also D (see Table 1), thus represented mostly by fine-grained (F and G) and, subordinately, sandy (E and D) turbidites. The gravity flow sediment association corresponds mostly to facies B1, B2, C and, probably partly also D (Tab. 1), interpreted here as products of variable gravity flows, ranging from collisional flows (B1; possibly partly represented by fluxoturbidites), to cohesive flows (B2, C) and to fluidized sediment flows (D?). The latter case is, however, of low probablity, since it requires high inclination of a palaeoslope (ca 30°). The pelagic/hemipelagic association includes only claystones of lithofacies H (Table 1), interpreted as resulting from quiet sedimentation of finest-fraction material from suspension. The distinguished associations point to deposition in an environment of submarine fans. In this environment, in normal conditions, turbidity currents were common, leading to deposition of turbidites. Stable conditions of turbiditic sedimentation changed periodically. The increase in environmental activity reflected by increased material supply, including coarse-grained material, was associated with the occurrence of gravity flow phenomena. The activity increase was also associated with intense erosion and sedimentation of eroded material. The result of a temporary quiescence of the environment was, in turn, a deposition of clayey material from suspension.

In clastic deposits drilled in well Marcinki IG-1 encountered were geometrically and genetically variable syngenetic deformational structures. The syngenetic deformational structures are understood here as distortions of internal geometry, structures, bed boundaries etc., that formed during the sedimentation or at an early phase of diagenesis (Gradziński et al., 1986, Allen, 1984). The most important classification criteria for distinguishing these structures are their geometric features, deformation kinematics as well as the origin of parental stresses. Based on the latter criterion, Allen (1984) distinguished several groups of deformation structures related to:

- gravitationally unstable density bedding
- non-uniform sediment load
- slope-related gravity effects.

A direct reason for the deformation is often also an abrupt expulsion of pore waters (e.g. due to a seismic shock) or an effect of living organisms on fresh sediment.

Deformational structures in well Marcinki IG-1 are concentrated mostly in fine-grained facies rocks (facies F, G, H) and are less frequent in medium- (D,E) and coarse-grained facies (B1, B2, C) rocks. The most common are deformation structures due to gravitationally unstable density bedding. The deformations of load-cast type were consolidated at various stages of development and, hence, they are geometrically variable, ranging from small distortions of sole surfaces, to drop structures deeply penetrating the substratum. The load casts are related not only to sandy-mudstone heteroliths (lithofacies F), but occur, as well in sandstone facies rocks (lithofacies D and E). Similarly, single pebbles sunken in underlying mud, can also be classed into this category of structures. The load cast are often additionally deformed due to horizontal shearing into flame structures. Such a shearing may have resulted from tangential component of the gravity forces acting on a slope or from current impact on the sea floor. The structures associated with non-uniform sediment load include sunken ripples and probably also many more complex load structures present in the profile of well Marcinki IG-1. Relatively frequent in the analysed material are also small-scale synsedimentary fold structures, which probably originated through plastic down-slope creep of entire packages of sediments. A significant part of them show features of coherent distorted bedding (Dżułyński, 1963). A successive significant group of deformational structures in the well are those of organic origin. They comprise various small-scale channels and burrows, being traces of living activity of fauna and deforming the primary "architecture" of the sediment. Very conspicuous, though the most infrequent, are water-escape channels, genetically related to abrupt dewatering of the sediment and defining diapir-like forms, several cm high and with a diameter of several mm at their bases. The cores from well Marcinki IG-1 contain also discontinuous deformational structures, such as horizons with intraclasts and horizons of intraformational conglomerates. The clasts in these horizons are very often plastically deformed. Various stages of sediment brecciation were also observed.

The development of so numerous and variable deformational structures in the Carboniferous deposits of the substratum of the Fore-Sudetic homocline was possible only due to some specific environmental conditions. Most of these structures could have originated only under conditions of significant saturation of the sediments with water. The deformations were also facilitated by textural properties of the sediments, mostly silts and sands. The common small-scale lateral displacements of sediments point to a deposition on a stable, low-angle slope. On the other hand, the occurrence of discontinuous deformational structures, such as breccias, intraclast-bearing horizons and intraformational conglomerates must have been associated with a periodic slope instability due to e.g. active tectonics.

The conclusions from analysis of the syngenetic deformational structures are compatible with the results of lithofacies analysis. They confirm, thus, the association of the turbidites and gravity flow deposits in the substratum of the Fore-Sudetic homocline with an environment of submarine fans in the Variscan basin in Poland.

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		Fac. assoc	Facies	Interpretation
I	1	Coarse-grained facies	B_1 – clast-supported conglomerates and sandstones	Sediment transported in conditions of high energy; collisional (?) flow; material deposited due to abrupt drop of energy
	2		B_2 – matrix-supported conglomerates and sandstones	Result of gravity transport; cohesive(?) gravity flow; deposition due to energy decrease and "freezing" of the flow
	3		C – intraclast-bearing horizons, intraformational conglomerates, sedimentary breccias	Result of transport and deposition of material eroded in conditions of elevated environmental activity
II	4	Medium-grained facies	D – thick-bedded massive sandstones	Transport and sedimentation in conditions of high energy; result of fluidized sediment flow
	5		E – horizontally-bedded sandstones	Transport and sedimentation in conditions of planar bed flow (upper flow regime); sandy turbidite
III	6	Fine-grained facies	F – sandy-mudstone heteroliths	Conditions of transport and sedimentation related to lower regime of rhythmic transport phase (=lower regime of flow); fine-grained turbidite
	7		G – laminated mudstones	Transport and sedimentation in conditions of low energy; plastically deformed mudstone laminae can be due to redeposition of sediment on a slope(?)
	8		H – laminated claystones	Episodes of quiet sedimentation from suspension

Tab. 1. Lithofacies of the Carboniferous in the basement of the Fore-Sudetic homocline.