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ABSTRACT OF PhD THESIS

Sedimentation of olistostrome complex together with underlying and overlying detrital sediments in Skrzydlna area (Polish Outer Carpathians)

Large-scale submarine landslides crucially important for modifications of topography of marginal parts of the modern sedimentary basins. They result in characteristic accumulations of sediments called olistostromes, sedimentary mélanges, chaotic deposits or mass transport deposits (MTDs). Fossil occurrences of such type of sediments are the subject of scientific interest because of their applications in research on evolution of the ancient sedimentary basins and role as depositional systems connected with hydrocarbon resources or ore deposits. Despite the development of interdisciplinary methods used in submarine research, field observations of ancient landslides provide important data which document interplay between many types of transport mechanisms are a key method for detailed recognition of internal structure and stratigraphical relations of chaotic deposits.

The research area is located about 50 km to the south east of Kraków, in the southern part of the Skrzydlna village. The main object of investigation was near 200 m thick succession of Menilite Formation, exposed in actively mined quarry, where central part of the exposure constitutes a conglomeratic olistostrome complex.

Detailed field observations were conducted on five operational levels of the mine. Special attention was paid to grain size, bed thickness, depositional and post-depositional structures and lateral variations of sedimentary features within beds. The field data collected were used to prepare bed-by-bed sedimentological profiles, sketches and descriptions illustrated with photographic documentation. Quantitative microscopic analysis of sandstones and paleo-current analysis were carried out as well. A considerable facies contrasts in the succession is reflected by three main complexes that have been distinguished: (I) fine-grained deposits underlying the olistostrome (II) coarse-grained conglomeratic complex in the central past of exposure (the olistostrome body) and (III) sandstone-mudstone complex overlying the olistostrome.

Observations in the fine-grained complex allowed to identify sediment deformations related to the forthcoming olistostrome deposition. Also the diversification of the deep marine environment and a broad range of sedimentary processes were determined. In the conglomeratic sediments (II) seven lithofacies of sediments gravity flow sediments were distinguished; to each of them transportation and deposition mechanisms were assigned. Vertical and horizontal variability of lithofacies, hydrodynamic transformations of gravity

flows and transport mechanisms were characterized. For the youngest sandstone-mudstone complex (III) qualitative and quantitative analysis of eight turbidite facies was presented. Vertical and lateral variations in this part of the succession were illustrated with histograms that document frequency distributions of each particular facies for all investigated profiles.

The observations and analysis described above enabled to conclude, that the sequence exposed at Skrzydlna Quarry was deposited by a wide spectrum of submarine gravity flows: from debris flow, through hybrid flows and high density turbidity currents to low density turbidity currents and hemipelagic deposition. The highly diversified Menilite Beds sequence is a reflection of rapid changes in sediment supply, and erosion and transportation mechanisms, which were controlled by tectonic activity of the source zone and uplift that transformed a part of the basin plain into slope adjacent to the newly uplifted emergent source area.

Sedimentation of the fine grained complex underlying the olistostrome, took place in wide and calm basin, where bottom sediments could have been reworked by contour currents and deep marine tidal currents. Facies variations of the conglomerate complex (olistostrome) indicate, that its origin was related to a series of episodes of mass wasting at the basin margin and transfer of detrital materials into deeper parts of the basin by mass gravity flows diversified in terms of density, velocity and rheology. The main role at this stage of deposition was played by non-cohesive debris flows, which were transformed without changes of rheology or evolved into high density turbidity currents. During breaks in sedimentation of coarse grained sediment, deposition of dark mudstones took place. The olistostrome complex together with the overlying sandstone-mudstone complex are interpreted as a sequence of retrograding submarine fan. From this point of view the conglomerate complex (II) represents submarine canyon infill, which erosionally incised into the underlying fine-grained deposits (I) while, the sandstone-mudstone complex (III) reflects successive sandy-muddy elements of the submarine fan: from inner- to mid-fan with distributary channels to distal parts with depositional lobes.

A distinctive feature documented in the examined succession is the presence of structures very rarely found in deep-marine flysch sequences, usually interpreted as associated with shallow marine environment, and therefore sometimes causing confusion. The first detailed documentation of such structures in Polish Outer Carpathians and their interpretation in categories of deep marine environment has been performed in this study. Infrequent occurrences of sedimentary structures traditionally linked with shallow tidal environment has been interpreted as deep-marine on the basis of the most recent research conducted in modern deep marine basins and applying outcomes of laboratory experiments. In addition, this thesis contains the first in the literature 3D characterization of sedimentary

structures bearing evidence of hydraulic jump, which here involved rapid changes in flow characteristics in the zone transitional between the canyon and the depositional lobes.

In the absence of any tectonic structures that could account for systematic variations in dip angle of beds forming the sedimentary sequence in Skrzydlna, a consistent change of that parameter has been interpreted as result of progressive, synsedimentary rotation of depositional surface. Three unconformity surfaces were recognized. They indicate two phases of tectonic activity occurring during deposition of the investigated succession which were: (1) rotative offlap developed during accelerated local uplift and (2) rotative onlap recording a decrease in the rate of local uplift and resulting in backstepping/retrogradation of the turbidite fan lobe facies.