Slovak Geol. Mag., 6, 2-3(2000), 188–190

Suprafan deposits of the Biely Potok Fm. in the Orava region: sedimentary facies and nannoplankton distribution

DUŠAN STAREK[1], A.S. ANDREYEVA-GRIGOROVICH[2] & JÁN SOTÁK[3]

[1]Geological Institute, Slovak Academy of Sciences, Dúbravská cesta 9, 842 28 Bratislava, Slovak Republic
[2]Department of Geol. and Paleont., Faculty of Sci., Comenius University, Mlynská dolina G, 842 15 Bratislava, Slovak Republic
[3]Geological Institute, Slovak Academy of Sciences, Severná 5, 974 01 Banská Bystrica, Slovak Republic

Abstract. Biely Potok Fm. represents a terminal sediments of the Paleogene depositional cycle in the Central Western Carpathians. This formation can be interpreted as a depositional system of suprafan, exhibiting lateral and vertical variability of facies tracts. Sedimentological study of the Biely Potok Fm. in the Orava region allows to distinguish several facies: typical massive sandstones (suprafan-toe deposits), medium rhythmical bedded sandstones (progradational lobes) and thin rhythmical bedded formations with prevalence of mudstones (levee, fan-fringe and open fan facies). These facies are considered to be a falling stage and lowstand system tracts, which were deposited during the Late Oligocene and Early Miocene. Different facies tracts of the Biely Potok Fm. provide an uniform nannoplankton associations, corresponding to NP 24 – 25/NN1 biozones.

Key words: Central Carpathian Paleogene Basin, Orava, submarine fans, facies tracts, nanoplankton

The name of Biely Potok Sandstone was introduced by Andrusov (1931) for the sandstone formation of the Skorušinské vrchy Mts. This name has been accepted in lithostratigraphic classification of the „Central Carpathian Paleogene" after Gross et al. (1984), where the Biely Potok Formation is characterized as a thick-bedded sandstones with occasional conglomerates and sporadic claystones. The Biely Potok Formation is situated above the Zuberec Formation, taking a position of terminal sediments of the Paleogene depositional cycle in the Western Carpathians. Based on the palynoflora and calcareous nannoplankton, the stratigraphic age of the Biely Potok Fm. has been established to Uppermost Eocene and Lower Oligocene (Gross et al. 1993). From the sedimentological point of view, the Biely Potok Fm. comprises heteropic lithologies, which are related to various submarine fan environments.

Sedimentological study of the Biely Potok Fm. allows to distinguish several facies in the Orava region. (Fig. 1) Sediments of this formation are typically developed as massive sandstones, corresponding to stratotype locality near Oravský Biely Potok. (Fig. 1b) Their structureless and massive character (S_1 type *sensu* Lowe 1982) points to sand-laden flows lacking internal separation. Such sediments are indicative of high-density turbidites or sandy debris flows with a high concentration, cohesive matrix and dispersive pressure. The deposition from high-density currents is inferred from sharp contacts of thick sandstone beds (concentration of shear on the bases of sandstone beds), frequent appearance of floating mudstone clasts in upper parts of the beds (erosion, dispersive pressure and freezing of overloaded flows), absence of water escape structures (high solidification of flows with l ow content of pore fluids), etc. On the lower bed surfaces, there are frequently scour marks and flute moulds, produced due to basal shear of overloaded flows. Massive and graded sandstone beds sometimes show an upper lamination, which results from overflow of frozen deposits by diluted suspensions with laminar flow (traction currents). Massive sandstone sediments of the Biely Potok Fm. are poor in nannoplankton, consisting of reticulofenestrids and cyclicargoliths with bad preservation (mostly redeposits).

Sediments of the Biely Potok Fm., which correspond to progradational lobes (Fig. 1b), show a partly different character, indicating a higher flow dynamics. Lobe successions consist of medium rhythmical bedded sandstones, structures of which indicate an internal fractionation and gradational sorting of flows, sometimes with basal traction of finer grained sediments and buoyancy of coarser grains and rafted clasts, or with tractional lamination in top of beds (S_3 type *sensu* Lowe 1982). There are also a multiply laminated beds (e. g. Habovka), deposited from traction carpets of high-concentration turbidites. Laminations frequently exhibit a convolute deformation due to fluid expulsion. These sandstones do not correspond to sandstone lithosomes of the Biely Potok Fm. neither in absence or only sporadic occurrence of flute marks (Gross et al., 1984). They, on the contrary, are characterized by more intensive current erosions producing flute casts, bulbous moulds, corkscrew casts with spiral welts, frondescent marks, deltoid marks, etc. (e.g. Podbiel, Zabiedovo, Habovka, Tvrdošín). Erosional and mould structures in these sandstones indicate a high flow regime and depositional capacity. The nannoplankton of lobe sediments provides a more relevant biostratigraphi-

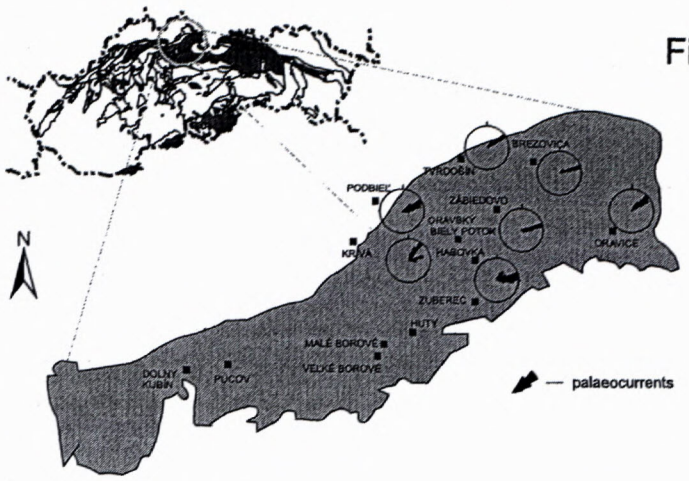
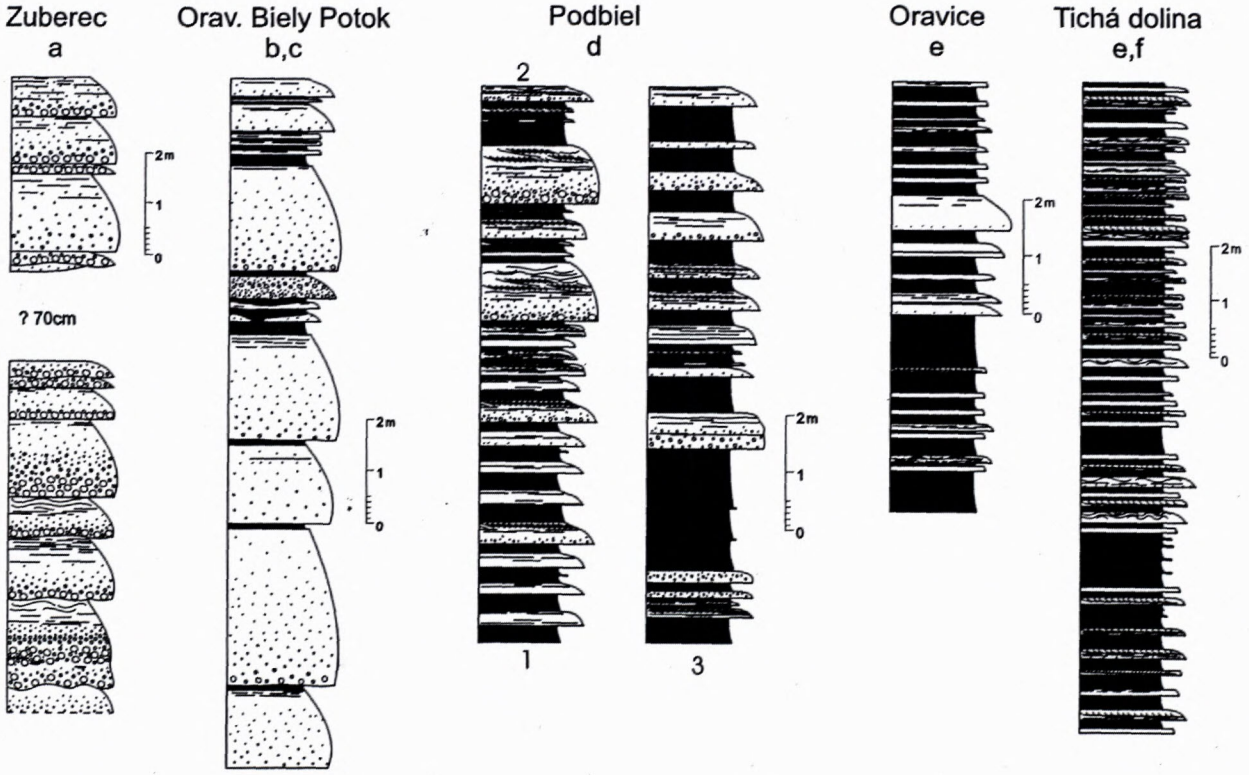


Fig. 1b

a - channel-fill deposits
b,c - suprafan lithosomes, sandy debris flow deposits
d - progradational lobe unit
e,f - small-scale progradational units (open fan facies)



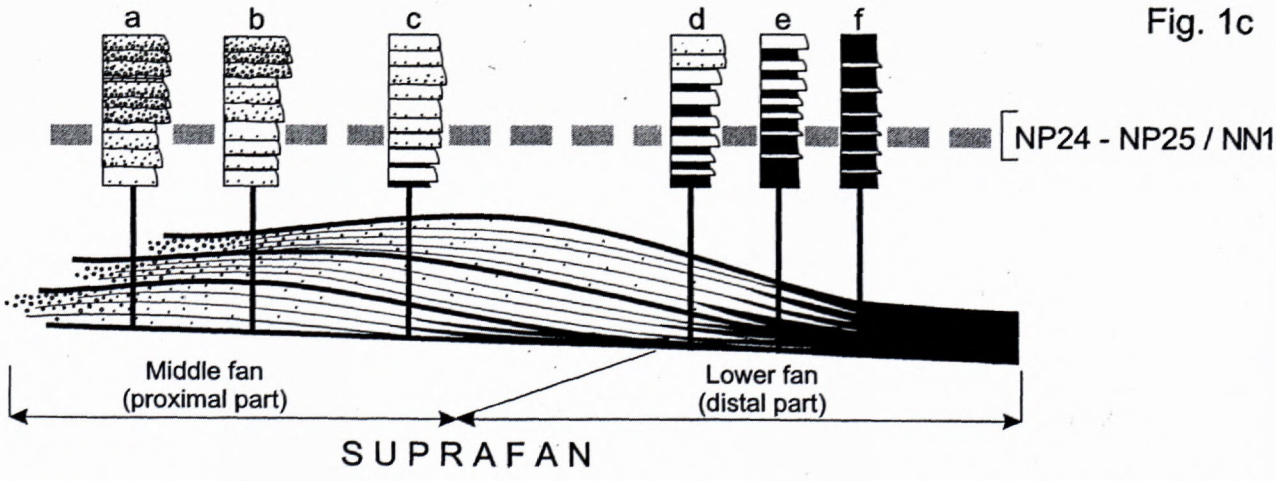


Fig. 1c

Fig. 1 Sedimentological logging of the Biely Potok Fm. in the Orava region (b), paleocurrent data (a) and interpretation of suprafan system of facial tracts in time of NP 24 – 25/NN1 Biozones (c).

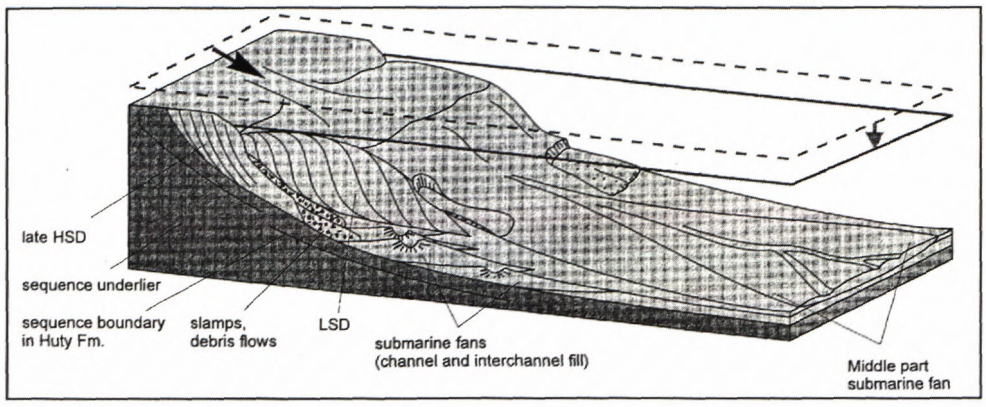


Fig. 2 Depositional model of submarine fans, interpreted for the Biely Potok and Zuberec Fms.

cal data. Nannoplankton species belong mostly to the NP 24 – NP 25 Biozone (*Cyclicargolithus abisectus*, *C. floridanus*, *Reticulofenestra bisecta*, *R. ornata*, *R. lockeri*, *R. cf. coenura*, *Pontosphaera multipora*, *P. rothii*, *Discoaster tani tani*, *Helicosphaera intermedia*, *H. recta*, etc.). Hovewer, some of nanoplankton species from the Biely Potok Fm. are indicative already for the Lower Miocene (e.g. *Sphenolithus cf. conicus*, *S. cf. dilphix*, *S. cf. calciculus*, *S. dissimilis*, *S. capricornutus*, *Triquetrorhabdulus carinatus*, *Calcidiscus abisectus*).

Sandstone lobes of the Biely Potok Fm. associate with levees formed by overspilled muds with pinching out ripples. Levee mudstones are relatively rich in braarudospherids, which appearance can indicate a shallowing and a decrease of salinity.

Sandy-rich tracts of suprafan are distally transformed to thin rhytmical bedded formations with prevalence of mudstones (e. g. Tichá dolina) (Fig. 1b). Sandstone components of this formation are developed as a base-missing turbidites with upper divisions of Bouma intervals. Such sandstones with lateral continuity indicate a flow stripping processes and deposition from dilute turbidites. Contemporaneous deposition of sand-rich and mud-rich sediments of the Biely Potok Fm. is documented by identical assemblages of nannoplankton biozones NP 24 – NP 25, extending up to NN1 Biozone.

Accumulation of sand-rich fans in the Biely Potok Fm. requires a specific conditions of flow hydrodynamics. High-density turbidites and sandy debris flows lost a velo city, overbanking a high volume of sands. They deposited a structureless or graded sandstones, corre sponding to A2. 7 facies *sensu* Pickering (1986) or F5 *sensu* Mutti (1992). Rapid accumulation of deep-water sands could resulted from a hydraulic jump, in which the flows changed a physical conditions. Due to hydraulic jump, the flows became overspread a slowed down, by which they lost a flow efficiency, resulting in sedimentary load accumulation. Sediments are deposited as massive and horizontally bedded sandstones and fine grained conglomerates (F3-F5 facies *sensu* Mutti 1992). When the flows lack a hydraulic jump, they operate as a traction carpets, depositing fine horizontally laminated sandstones and beds with normal gradation (S_1 facies *sensu* Lowe 1982, B 2.1 facies *sensu* Pickering 1986). Above the traction carpets or in their flow direction, a high volume of sands is accumulated rapidly. The medium- to fine-grained sandstones were deposited from these flows (F7-F8 facies *sensu* Mutti 1992). High-density turbidites were probably overspilled by dilute suspensions, which formed a less expressive Bouma intervals in uppermost parts of sandstone beds. These intervals are frequently eroded by successive currents, which led to the amalgamation of sandstone beds. Sediments of the Biely Potok Fm. are considered to be a falling stage and lowstand system tracts, which were deposited during the Late Oligocene and Early Miocene. (Fig. 2) Their deposition reveals a basinward progradation, when a shelf edge accumulated a high volume of clastic sediments, carried out into turbidites of slope and base-of-slope fans. The Biely Potok Fm. can be interpreted as a depositional system of suprafan (*sensu* Normark, 1978), exhibiting lateral and vertical variability of facies tracts (Fig. 1. c).

The paper is a contribution to the VEGA grant n_o 7068.

References

Gross, P., Köhler, E. & Samuel, O. 1984: Nové litostratigrafické členenie vnútrokarpatského paleogénu pri Pucove. Geol. Práce, Spr. (Bratislava), 113–117.

Gross, P., Köhler, E., Mello, J., Haško, J., Halouzka, R., Nagy, A. a kol. 1993: Geológia Južnej a Východnej Oravy, GÚDŠ, Bratislava.

Andrusov, D., 1931: Stratigrafie podhalského flyše v jeho jihozápadním zakončení, In: P.Gross, E. Köhler, J. Mello, J. Haško, R. Halouzka, A. Nagy a kol.: Geológia Južnej a Východnej Oravy, GÚDŠ, Bratislava 1993.

Lowe, D. R., 1982: Sediment gravity flows: II. Depositional models with special reference to the deposits of high-density turbidity currents, J. sedim. Petrol., 52, s. 279–297.

Pickering, K., Stow, D., Watson, M. & Hiscott, R., 1986: Deep-Water Facies, Processes and Models: A Review and Classification Scheme for Modern and Ancient Sediments, Earth-Science Reviews, 23, s.75–174.

Mutti, E., 1992: Turbidite Sandstones, Instituto di Geologia Universita di Parma.

Normark, W. R., 1978: Fan valleys, channels and depositional lobes on modern submarine fans. In: C. H. Nelson, T. H. Nilsen: Modern and Ancient deep-sea fan sedimentation, Sepm short course no.14, Society of Economic Paleontologists and Mineralogists, 1984.