

## The fish fauna from the ŠVM - 1 borehole (Tajná village, Slovakia)

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**Abstract:** Following taxa were identified in structural borehole ŠVM – 1, Tajná village (Mochovce, Danube Basin): *Alosa* sp., Clupeidae, Engraulidae, Gobiidae and Triglidae. Fragments of bones were found in Middle Sarmatian clay sediments. The spectrum of fish species corresponds to a typical marine shallow water association of to subtropical up to temperate zone.

**Key words:** paleoecology, Middle Sarmatian, marine shallow-water, fish fauna, Danube Basin

### Introduction

Neogene sediments from the Danube Basin yield rich assemblages of fossil fish, which records evolution of Tertiary fish fauna in a broad area. Neogene fish assemblages of Danube Basin were described from several localities – Smolenice, Skalka near Štúrovo and from Rišňovce depression (Holec, 1973, 1974; Fordinál & Nagy, 1997; Fordinál, 2000). Fish remains of *Alosa* sp., Clupeidae, Engraulidae, Gobiidae and Triglidae were determined from structural borehole ŠVM-1 (Fig. 1), which was drilled SW from Tajná village in the Danube Basin. Neogene sediments of Sarmatian to Dacian age were drilled in (211 m depth) this borehole. Fish fauna was contained in grey-green laminated claystones (121.45 up to 142.30 m) of Vráble Fm. This relative thin section, can be lithologically and faunistically correlated with other Sarmatian localities in the Danube and in the Vienna Basin as well as.

### Geological setting

Broad area around the Mochovce village is build by Neogene deposits of the Danube Basin (Fig. 2). Neogene sequence in this area consists of Pliocene Volkovce Fm, Pontian Beladice Fm, Pannonian Ivánka Fm, Sarmatian Vráble Fm, Badenian Ruskov Fm, Svinná Fm, Pozba Fm and Madunice Fm (Harčár et al., 1988).

The borehole proper consists of the Volkovce Fm in the interval 1.00 up to 24.00 m, which also crops out on the surface. The formation is composed of complex of sands, pebble sands and gravels. Silty clays with layer of siltstones occur in the interval 12.15 – 16.18 m (Andrejeva-Grigorovič et al., 2001).

Sediments of the Ivánka Fm (l.c.) are developed in the interval 24.00 up to 111.70 m. According to biostratigraphy and lithological structure this formation is divided into the Pannonian E (interval 24.00 - 61.00 m), Pannonian C/D (interval 61.00 - 75.00 m) and Pannonian B (75.00 - 111.7 m). The Pannonian E informal member interval is composed of dark-grey silty clays and coarse till fine-grained

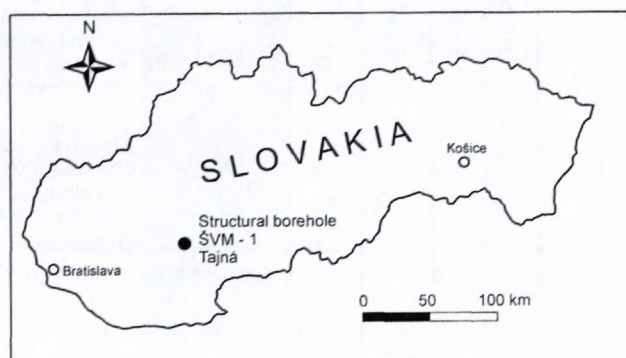


Fig. 1: Localization of the borehole ŠVM – 1 Tajná.

sandstones, sometimes also pebble sandstones. The underlying deposits of the Pannonian C/D are mainly in the clays trend. These clays are richer on the residual of shell fauna. Deposits of the Pannonian B were deposited in freshwater low dynamic environment. This member is composed from relatively hard and crackly claystones, the silts laminas are very seldom (109.00 – 109.50 m). Claystones with a lot of ostracods (Andrejeva – Grigorovič et al., 2001) in overlying part of the Pannonian B.

The Sarmatian sequence is represented by the Vráble Fm (l.c.) in the interval 111.70 up to 211.00 m. Biostratigraphically the Vráble Fm was divided into Upper (111.70 – 120.60 m), Middle (120.70 – 173.15 m) and Lower Sarmatian (173.15 – 211.00 m) parts. Upper and Middle Sarmatian deposits are practical identical, their boundaries are very gradual and they are distinguishable biostratigraphically only. At this boundary, laminated to massive claystones alternate with more expressively claystones and claystones with frequent chalk laminas. Distinctively laminated claystones are dominating. The fish fauna was found in the last mentioned lithologies. The results of biostratigraphical research indicated on sedimentation in brackish environment up to 20 m depth. The change of markedly and indistinctively laminated claystones signified occasional stratification of water column with anoxic layer near the bottom. Synse-



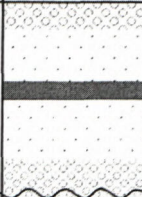
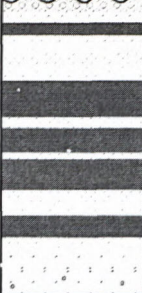
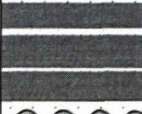
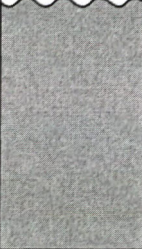
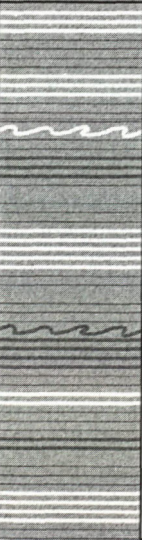
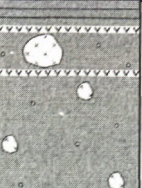
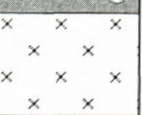
AGE		FORMA- TION	DEEP (m)	LITOLOGY		INTERPRETATION	
PLIOCENE	Dacian						
PANNONIAN		Ivánska Fm.	0 - 24		Fine to coarse grained sands, pebble sands and fine to medium grained gravels, occasionally are occur clays with admixture and thin beds of silt, without fosill remnant.	Deposits of the coarse-grained fan delta. Sedimentary facies of delta front and alluvial part of delta topset.	
			— hiatus —				
E			24 - 61		Dark gray, calcareous clays, with high amount of silt and thick beds of coarse to fine grained sand, silt, occasionally too with fine grained gravel. They are arranged to thickening upward trends. Remnants of the fossil flora and fauna are preserved.	Basinal sediments of the shallow brackish environment (mainly clays). Occasionally are developed local deltas deposits (delta front sands and prodelta silts).	
C/D			61 - 75		Gray, gray-green to green clays with admixture and thin intercalations of fine grained sands and silts. Shell and plant remnants are preserved.	Shelf deposits of the shallow marine brackish environment. (gray clays). Occasionally are developed lagunar clays or local deltas deposits (prodelta silts)	
B		75 - 106		Massive, calcareous brown-green claystones with very fine silt admixture and abundant ostracoda fauna. Strong tectonic deformation, abundant slicken-sides. Upper boundary is discordant, lower one is conforms.	Basinal facies of the extremely brakish environment. Neritic deposits without deltaic sand and silt.		
		— hiatus —					
SARMATIAN		Vráble Fm.	106 - 120.6		Mainly green- brown and brown-green calcareous very fine silty claystones. Alternating of diffuse and sharp laminated claystones. White tuff and tuffite lamina are common. Occasionally are developed small synsedimentary deformations. Clays are tectonic deformed, bed dip is 10 - 30°. Shell, fish and plant remnants are quite common.	Deep shelf deposits of the brackish environment. Rare, thin, laminated tuffites suggests to minimal influx of the silty and sandy material. Clays are both, aeolian (vulcanosedimentary) and sedimentary origin. Synsedimentary deformations suggest to seizmic activity of the region, dipping lamina suggest to postdiagenetic deformation of rocks.	
Middle			120.6 - 173.1		Massive, occasionally laminated brown-green to gray-green claystones. Redeposited shell fragment and volcanic lappilas are common. Thin andesite layer are interpreted as clast in claystones. Lowermost part of borehole is form by porphyritic andesite (Čifáre type).	Shoreface, transgressive deposits of brackish environment with volcanic clasts in claystones. Tuff and tuffite beds suggest to volcanic activity of area. In upper part of section is documented abrupt deepening and increase of salinity connected with marine ingression. Andesites in lowermost part are interpreted as part of subaquaceous lava flow.	
Lower			173.1 - 211				

Fig. 2: General lithological and sedimentological description of borehole ŠVM – 1 Tajná.



dimentary deformations were observed locally suggesting seismic activity in broad area.

On the interface of Middle and Lower Sarmatian, in biostratigraphy proved sea ingression into very isolated sedimentary environment. In the sedimentary record this event could be indicated by presence of claystones rich in destroyed shells (transgressive shell bed lag), which rapidly pass into deep-water laminated clays. These transgressive sediments are frequent mainly at the base of deposits.

Lower Sarmatian part of sequence consists of laminated claystones. Massive claystones which often contain admixture of pyroclastic rocks prevail. Lower Sarmatian sequence is typical by occurrence of andesite blocks as well as by tuffites and rare also by biotite tuffs. In the lowermost part of core more than 22 m thick andesitic lava flow (Andrejeva – Grigorovič et al., 2001) occurs.

### Methods and terminology

Morfometric measurement was made in binocular microscope with precision of 0.5 mm, length data was measured on the vertical line with the axis of body.

Abbreviations used: SL – standard length, LCa – head length, LM – length of the jaw, DO – eye length, PO – preorbital length, PD – predorsal length, PP – prepectoral length, PV – prepelvic length, PA – preanal length, LD – length of the base of the dorsal fin, LA – length of the base of the anal fin, AC – body depth, AP – least depth of the caudal peduncle

D – dorsal fin, V – pelvic fin, P – pectoral fin, A – anal fin, C – tail fin, Vert. – number of vertebra

### Systematics

Superorder Clupeomorpha

Order Clupeiformes

Suborder Clupeoidei CUVIER, 1817

Family Clupeidae BONAPARTE, 1831

**Clupeidae gen. indet.**

Plate 2a

**Materials:** One incomplete skeleton (without the head), tail part is destroyed too; body with cycloid scales (number of sample 3 TA).

**Description:** The fish body is prolate and on the transverse section is oval with abdomen keel. The lower jaw-bone is shorter as upper jaw-bone. This specimen has big eyes. The dorsal fin is short; it consists of 17-20 relatively high rays. The tail fin is cut out deeply, having the shape of the "V" letter. The pelvic fins begin in the middle of the fish body. Clupeidae have expressive separate big cycloid scales. The size of the body reaches up to 36 cm.

**Paleoecology:** The modern counterparts of this fish are social, herd living in epicontinental sea water, in little depth subtropical to arctic areas.

**Stratigraphic range:** Eocene – Pleistocene of the Europe (Romer, 1967).

**Occurrence:** Structural borehole ŠVM – 1, depth 123.00 m (number of sample 3 TA), Rohožník locality (Holec, 1973, 1974).

Genus *Alosa* Linck, 1790

***Alosa* sp.**

Plate 1a, Plate 2b, c

**Materials:** One incomplete skeleton with spinal column and tail (number of sample 4 TA) and one complete fish (number of sample 7 TA).

**Dimensions:**

Vert. 40, SL 36.0 mm, LCa 10.5 mm, PD 13.0 mm, AP 2.0 mm.

Tab. 1: Principal metrical parameters (mm) of the specimens n. 7 TA *Alosa* sp. (% SL in paranthesis).

Number	SL	LCa	PD	AP
7 TA	36.0	10.5 (29.1)	13.0 (36.1)	2.0 (5.56)

**Description:** The body is prolate with big head part. The abdomen keel is apparent in generally oval transverse section. There are big eyes and broad mouth on the head. The lower jaw-bone is shorter than the upper jaw-bone. The dorsal fin is high and short, it begins before the pelvic fins. It consists of 15-17 rays. The pelvic fins are short (6-7 rays). The tail fin is deeply cut out in "V" shape. Cycloid scales could have been easily lost. The size of the body is different, it reaches 75 cm in length.

**Paleoecology:** This has social, herd fish living in brackish and normal salinite both shallow littoral water as well as in mesopelagial.

**Stratigraphic range:** Oligocene – Pliocene of the Europe (Romer, 1967).

**Occurrence:** Structural borehole ŠVM – 1, depth 138.00 m (number of sample 4 TA) and depth 137.50 m (number of sample 7 TA).

Family Engraulidae

**Engraulidae gen. indet.**

Plate 1b, Plate 2d

**Materials:** One incomplete skeleton with spinal column with vertebra and tail (number of sample 2 TA) and one no complete tail (number of sample 5b TA).

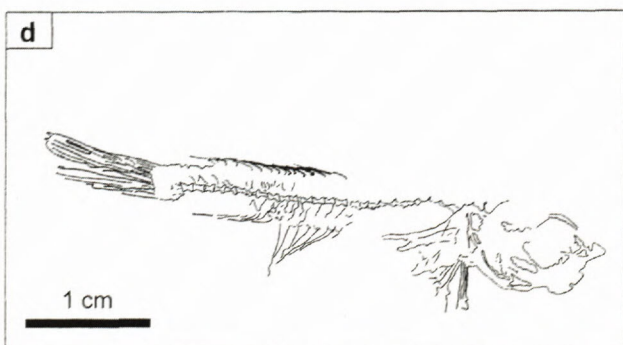
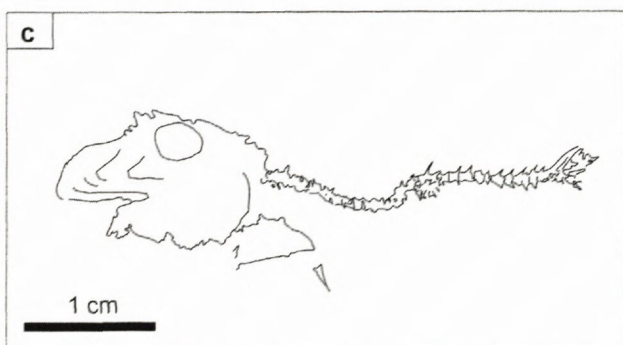
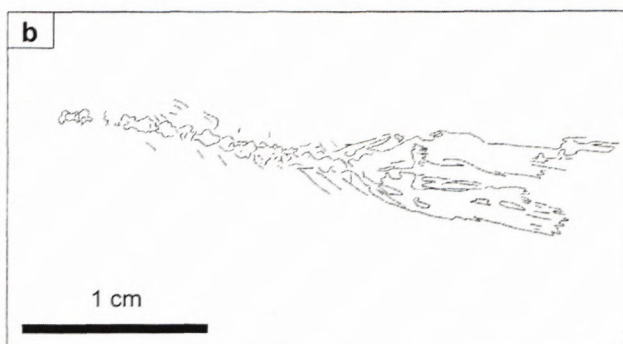
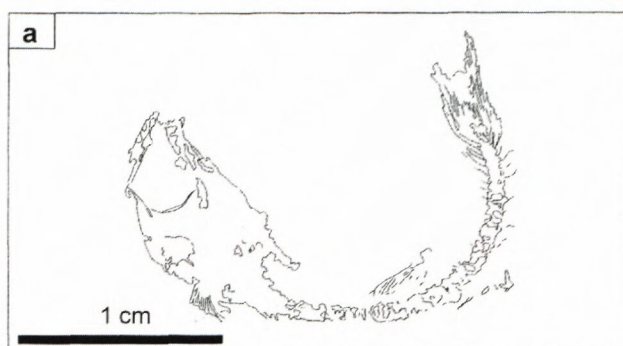
**Description:** The fish body is very slim, laterally flattened. The lower jaw-bone is very broad (extending well behind eyes). The upper jaw-bone is long. The dorsal fin begins in the middle of the fish body and it has 15-18 soft rays. The anal fin begin in 2/3 length of the fish body and it has to 26 soft rays. The pelvic fins begin before the middle of the fish body, before the base of dorsal fin. There are two scales on the base of tail fin. The total size of the body attains 25 cm, but it is usually smaller than 18 cm.

**Paleoecology:** This is bevy fish, herd fish living in mostly of shallow coastal waters and estuaries in tropical and temperate areas.

**Stratigraphic range:** Eocene – Miocene of the Europe (Romer, 1967).

**Occurrence:** Structural borehole ŠVM – 1, depth 142.30 m (number of sample 2 TA) and in the depth 139.40 m (number of sample 5b TA).





#### Plate 1

a - *Alosa* sp. (number of sample 7 TA)

b - *Engraulidae* gen. indet. (number of sample 2 TA)

c - *Triglidae* gen. indet. (number of sample 1 TA)

d - *Gobiidae* gen. indet. (number of sample 6 TA)

Superorder Acanthopterygii

Order Scorpaeniformes NELSON, 1994

Suborder Scorpaenoidei

Family Triglidae

**Triglidae gen. indet.**

Plate 1c, Plate 2e

**Materials:** One incomplete skeleton with the head and vertebra, but with fragment of tail (number of sample 1 TA).

#### Dimensions:

Vert. 29, SL 32.0 mm, Lca 12.0 mm, LM 5.0 mm, DO 3.0 mm, PO 5.0 mm, AP 1.0 mm.

Tab. 2: Principal metrical parameters (mm) of the specimens n. 1 TA *Triglidae* gen. indet. (% SL in paranthesis).

number	SL	Lca	LM	DO	PO	AP
1 TA	32.0	12.0 (37.5)	5.0 (15.6)	3.0 (9.4)	5.0 (15.6)	1.0 (3.1)

**Description:** The fish body is prolate with big head part. Compact bony cover is on the head. Triglidae have a big eyes and large jaws. The body has two dorsal fins, there are 8-10 hard rays on the first and 15-18 soft rays on the second one. The pectoral fins are big and ranging on 3-4 ray of the anal fin. The anal fin has 14-17 of soft rays. The size of the body is changeable, it reaches 25-50 cm in length.

**Paleoecology:** Triglidae are living over muddy, sandy and gravelly background, usually in 5-300 m. The young fish is living near the beach, especially in or near by the deltas (also in the fresh water) in tropical to temperate areas.

**Stratigraphic range:** Eocene – Miocene of the Europe (Romer, 1967)

**Occurrence:** Structural borehole ŠVM – 1, depth 128.20 m (number of sample 1 TA).

Order Perciformes

Suborder Gobioidi

Family Gobiidae

**Gobiidae gen. indet.**

Plate 1d, Plate 2f

**Materials:** One complete skeleton (number of sample 6 TA).

#### Dimensions:

Vert. 29, V 9, A 13, C 14, SL 23.0 mm, Lca 7.0 mm, DO 2.8 mm, PO 1.0 mm, PP 8.0 mm, PV 7.0 mm, PA 14.0 mm, LD 6.0 mm, LA 5.0 mm, AC 2.5 mm, AP 2.0 mm.

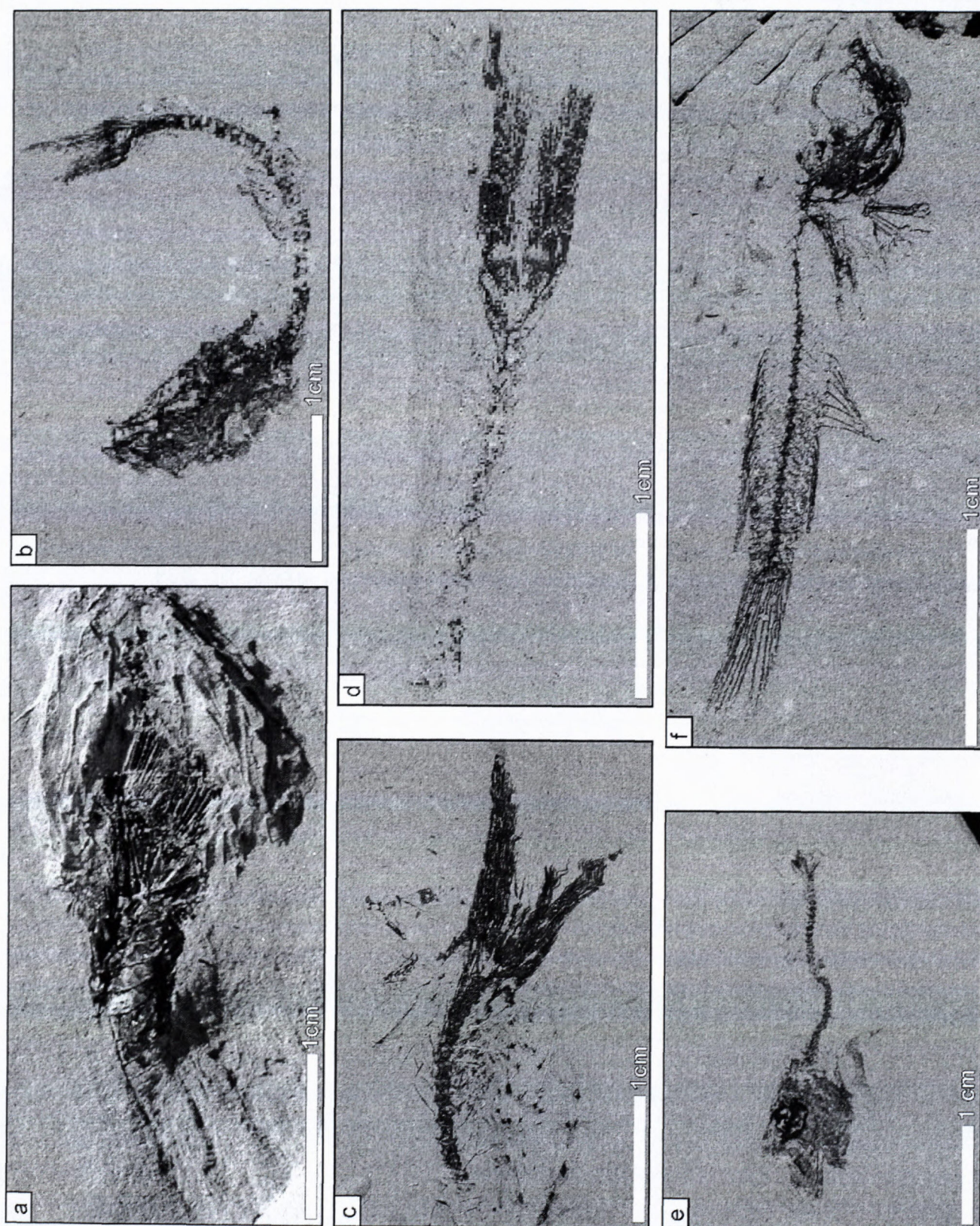
Tab. 3: Principal metrical parameters (mm) of the specimens n. 6 TA *Gobiidae* gen. indet. (% SL in paranthesis)

Number	SL	Lca	DO	PO	PP	PV
6 TA	23.0	7.0 (30.4)	2.8 (12.2)	1.0 (4.3)	8.0 (34.8)	7.0 (30.4)

Number	PA	LD	LA	AC	AP
6 TA	14.0 (60.9)	6.0 (26.1)	5.0 (21.7)	2.5 (10.9)	2.0 (8.7)

**Description:** The fish body is prolate, little flattened laterally with long tail. The eyes are usually large and it situated near top of the head. Gobiidae have two separately dorsal fins, the first one with 7 (few with 8 hard rays), the second one with 1 hard and 9-10 soft rays. The





**Plate 2:**

- a - Clupeidae gen. indet. (number of sample 3 TA)
- b - *Alosa* sp. (number of sample 7 TA)
- c - *Alosa* sp. (number of sample 4 TA)
- d - Engraulidae gen. indet. (number of sample 2 TA)
- e - Triglidae gen. indet. (number of sample 1 TA)
- f - Gobiidae gen. indet. (number of sample 6 TA)



pectoral fins are big, without loose rays. The pelvic fins are accreting. The back of the tail fin is even. Gobiidae have expressive cycloid or ctenoid scales. The maximum length attains 50 cm, most specimens are smaller than 10 cm.

**Paleoecology:** Herd fish living in brackish and normal saline shallow coastal waters in tropical to subtropical areas.

**Stratigraphic range:** Middle Miocene - Recent of the Europe (Romer, 1967)

**Occurrence:** Structural borehole ŠVM- 1, depth 121.45 m (number of sample 6 TA).

### Conclusions

This paper brings new data on occurrence of fish fauna from the borehole ŠVM – 1. From this borehole seven remnants were determined belonging to *Alosa* sp., Clupeidae, Engraulidae, Gobiidae and Triglidae. The study material comes from of Vráble Fm, from 121.45 up to 142.30 m interval.

The fish remains found document relatively shallow-water conditions – the sublittoral, open shelf zone or shallow, protected bays, with stratified water column. Tropical up to temperate climate could be confirmed by analysis of other fauna found (calcareous nannofossils,

foraminifera and ostracods). This fauna which is also of brackish character indicates sedimentation in 30 – 40 m depth. The lack of carbonate in the water could be interpreted by the volcanic activity and by strong terrigenous debris support. In this period (Middle Sarmatian), the restriction of the basin was interrupted, which can be evidenced by immigration of Clupeidae.

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