gesteine darstellen. Lagerstätten natürlicher Kohlenwasserstoffe wurden am SO-Hang des Nesvačilka-Grabens im Raum Uhřice-West gefunden. Einzelne gasführende Horizonte wurden auch in den Bohrungen Uhřice-20 und Dambořice-1 ermittelt.

ZONES OF POSSIBLE OCCURRENCE OF NON-ANTICLINAL DEPOSITS IN THE VIENNA BASIN

Štěpán Buchta, Eduard Ralbovský, Moravské naftové doly, Hodonín, Czechoslovakia
Margarita Kolářová, Ústřední ústav geologický, Praha, Czechoslovakia

Prognostication of and research for non-anticlinal types of deposits are the fundamental problems of present-day petroleum geology in the Vienna basin. This interest is the result of the high grade of exploration on all elevations known. The character of non-anticlinal traps suggests that can be expected to occur anywhere in an oil-bearing basin. However, biofacies, lithofacies and palaeotectonic analyses of a basin permit zones of the possible occurrence of certain non-anticlinal trap types be determined. Such a prognosis was made for the Vienna basin in the framework of COMECON theme No 7.1.2. „Methods for determining non-anticlinal oil and gas traps and their improvement regarding the experience gained in highly industrialized contries" (Kolářová M., Buchta Š. Ralbovský E., 1987). As this study has yielded results relevant to the potencial occurrence of non-anticlinal traps, the paper presented it in abbridged and modified form.

The research work started by revising the entire fund of deposits from the viewpoint of non-anticlinal traps. This revision has shown that all principal types of traps are present in the Vienna basin, including traps formed by domal uplift of the cover, traps with lateral sealing and lithologic traps sealed on all sides. The classification by V. J. Ratner (Ratner et al., 1982) was used in order to class them. In our opinion, this classification based on trap morphology fully complies with the requirements of oil and gas exploration. I addition to traps bounded tectonically, lithologic, stratigraphic and biogenic traps, traps in erosional elevations and traps closed on all sides occur in the Vienna basin. Combined traps, mostly lithologic-tectonic ones, are relatively abundant (Fig. 1).

The non-anticlinal deposits ascertained were subdivided into groups on accordance with the trap type stratigraphic age of the reservoir rock. This analysis has shown that certain stratigraphic levels comprise several oil and gas deposits in traps of the same or similiar types (Table 1). This accumulation of deposits can be regarded as the primary indication of a zone with a certain type of non-anticlinal traps (Lab horizon, 8. Pannonian horizon, etc.). The subsequent investigations consisted in determining the courses of the zones indicated with aid of lithofacies analyses using electric logs and seismic profiles. The results obtained are depicted in a map delinesting the zones of the potential occurrence of non-anticlinal deposits (Fig. 2).

The zones with the occurrence of a certain type of non-anticlinal deposits can be subdivided from two points of view. The first group includes linear and areal zones. The linear ones are zones regionally wedging out, reducing their marl content, uncoformities and organogenic barrier reefs. They can follow any course, but are characterized by traps positioned like pearls on a string. An areal zone implies the irregular spatial arrangement of non-anticlinal traps, e. g.

Zones of the potential occurrence of non-anticlinal deposits in the Vienna basin

Zone	Age	Trap type (see Fig. 1)	Deposit	Description on the map
A	Triassic	I. a	Borský Jur	A1
			Závod	A2
B	Ottnangian	II. c	Mikulčice — H 1	B1
			Lužice — H 1	B2
C	Karpatian	II, b, d	Hrušky — Karpatian	C1
D	Lower Badenian	II. a, c	Hrušky — L. Badenian	D1
			Lanžhot — horizon 26	D2
E	M. Badenian	II. a	Gajary — horizon 1	E1
			Gajary — horizon 3	E2
			Jakubov — horizon 2	E3
			Dúbrava — horizon 2	E4
			Dúbrava — horizon 5	E5
			Vysoká — horizon E	E6
F	M. Badenian (Láb — horizon)	II. a, c	Poddvorov	F1
			Josefov	F2
			Hrušky	F3
			Brodské — lifted block	F4
			Závod	F5
			Studienka	F6
G	M. Badenian	I. b	Láb — reefs	G1
		III. c	Kostice	G2
		I. b	Lednice	G3
H	U. Badenian	II. a, c	Poddvorov	H1
			Hrušky	H2
			Závod — south	H3
I	Pannonian	III. a, b	Suchohrad — Gajary	I1
			Jakubov — Pannonian 8	I2
			Láb — Pannonian 8	I3
			Vysoká — Pannonian 8	I4

erosional elevations or deltaic deposits. The second group is related to the number of reservoir beds countoured by the boundary of the zone. A single horizon (Lab horizon, bioherms) or a whole sequence of sandy layers (Middle Badenian delta), i. e. a set of reservoir rocks, can be concerned. The two types are shown in the occurrence of individual traps. Their correspondence to a certain zone is indicated by code numbera in accordance with Table 1. A lithological trap is denoted by the hatched zone boundary.

The spatial arrangement of non-anticlinal trap zones in the Neogene sediments of the Vienna basin reflects their complex lithofacies structure and locally the questionable nature of our present-day views on the lithostratigraphical classification of reservoir rocks and the spatial interrelations between zones of lithologic changes. Nine zone (A—I) for the potencial occurrence of non-anticlinal traps have been distinguished and are listed in Table 1. Five of these zone are areal ones with areal trap distribution and four zones are linear ones.

The zones of the potential occurrence of non-anticlinal traps (hereinafter referred to as NAT) can be characterized as follows:

A) Areal NAT zones in erosional elevations of the Mesozoic basement

The occurrence of traps in erosional elevations in the Mesozoic frontal nappes in the basement of the Vienna basin was established in analogy to the Austrian portion of the Vienna basin was based on the interpretation of seismic profiles and the geological results from deep boreholes. Structural maps depicting the relief of the basement of the Vienna basin were constructed and elevation zones determined. As to the discovery of commercial occurrences, exploratory drilling was successful in the tops of these elevations. However, merely elevations with a sealing cover are significant for exploration. The Karpatian pelites can be regarded as a suitable cover. Erosional elevations lacking such a cover were found to be dry (Láb, Malacky, etc.). Reservoir rocks are represented by Upper Triassic dolom-

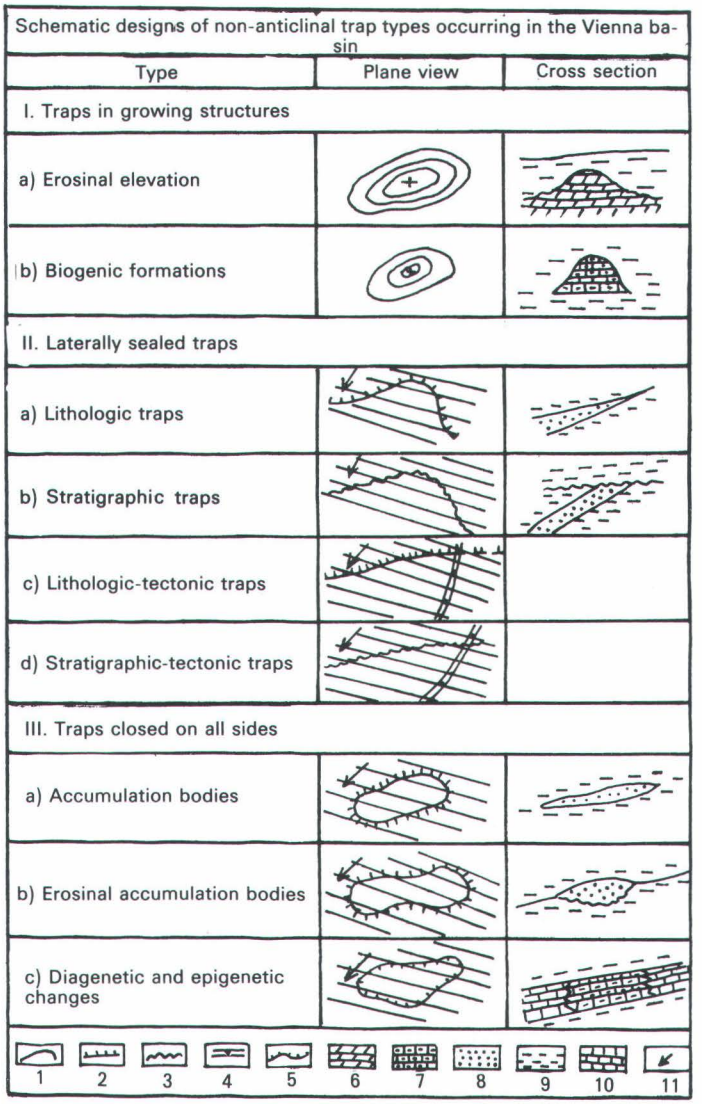


Fig. 1: Explanatory notes
1 — structural line; 2 — thinning, reduction of marl content; 3 — unconformity; 4 — faults; 5 — delineation of a region of secondary changes; 6 — dolomite; 7 — permeable limestone; 8 — sand, sandstone; 9 — clay, claystone; 10 — impervious limestone; 11 — direction of dip.

ites of low and medium secondary porosity. The types of the traps present are schematically illustrated in Fig. 1, Ia. The Borský Jur and Závod deposits only were found in this zone, but the discovery of analogous deposits is expected for the future.

B) Areal NAT zone at the Ottnangian base

This region includes porous rocks comprising Ottnangian basal clastics. The irregular areal development is due to sedimentary conditions — the partial depression sof the pre-Ottnangian relief apper to have been filled first, after which sedimentation continued in the broader region. In terms of sedimentology, the basal clastics consist of a broad group of psamitic sediments ranging from coarse-grained conglomerates to medium — and fine — graines sandstones. Generally the rock bodies are lenticular in shape; the boundaries of the individual traps are influenced both by thinning beds and tectonics (types IIa, c). With regard to the unconformable bedding of the overlying sediments, the occurrence of stratigraphic or stratigraphic — tectonic deposits (types II b, d) is also possible. In view of the results obtained in the Lužice and Hodonín areas, relatively small deposits with low hydrocarbon reserves can be present. Traps of this zone are exemplified by the Mikulčice and Lužice deposits accumulated in the Ottnangian basal sand locally designated as H 1.

C) Areal NAT zone in Karpatian basal clastics

This zone of trap occurrence associated with an unconformable boundary of sand hodies in the Lower Karpatian could be proved merely on the western sloope of the Týnec hign in the Hrušky area. In addition to the unconformity, the trap is also bounded by slip faults. The reservoir consists mainly of coarse — to fine — grained sand of low porosity and permeability. As the Karpatian sediments are poorly explored, a short section of this zone only could be identified so far. The deposits in the Karpatian of the Hrušky field are examples of a morphogenic trap type with combined stratigraphic-tectonic sealing (II d). They have accumulated in several horizons (sands) of the basal Karpatian Týnec sand complex; their main sealing element is a partial surface of unconformity between the Upper and Lower Karpatian.

D) NAT zone at the Lower Badenian base

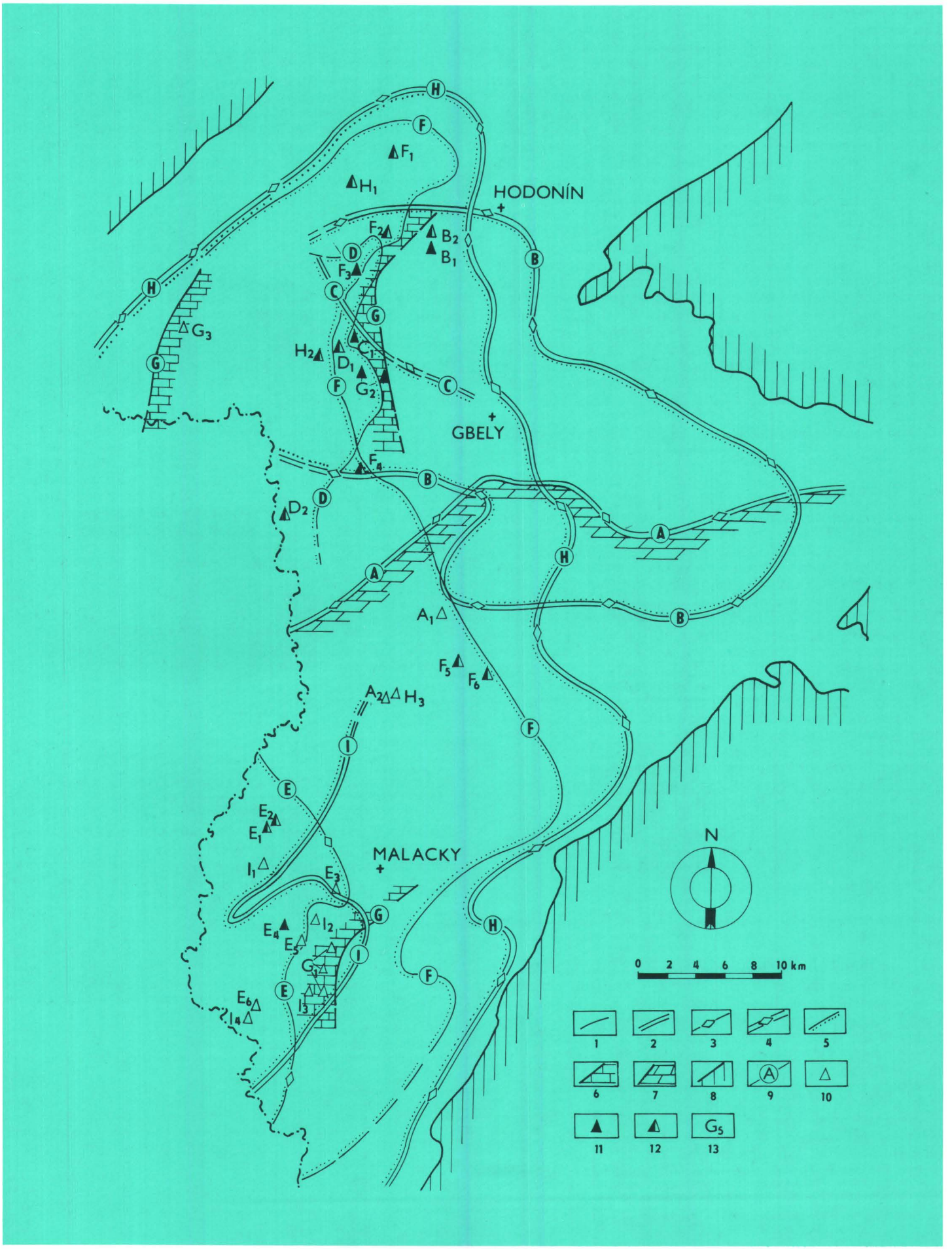
Within the Hodonín-Gbely horst, Lower Badenian basal clastics have developed in the Lanžhot, Brodské and Hrušky areas, where they gradually wedge out on the slopes of the Týnec high. Commonly they consist of medium — grained sandstones, but coarse — grained sandstone conglomerates are present too. The traps are seales lithologically, to a lesser degree also tectonically (type II a, c). The potencial extension of this zone into other parts of the Vienna basin will be the subject of further study. The traps of this zone are exemplified by the deposit in horizon No 26 of the Badenian in the Lanžhot field. It can be characterized as a trap formed at the place where the sand body is wedging out up-hill. Other deposits placed into this zone were found on the lifted block of the Lanžhot—Hrušky faultin the Hrušky field.

E) NAT zone in deltaic sand bodies in the Middle Badenian

The traps are tongue-shaped with simple lithologic lateral sealing (type II a). They form a well-outlined zone passing to the southeastern corner of the Vienna basin in Austria. Five deposits have been discovered so far, the largest of them being the Gajary oil and gas deposit in horizon No 1. The Jakubov gas deposit and the Dúbrava oil deposit in horizon No 2 and the Gajary oil deposit with a small gas cap accumulated in horizon No 3 are of minor size. The fifth deposit forming a gas accumulation discovered by Dúbrava-16 borehole in horizon No 5 is of an extent so far unknown. The individual productive horizons exhibit monoclinal bedding and wedge out roughly southeasterly. Greygreen calcareous sandstones of excellent permeability in the central parts of the deposits are the reservoir rocks. They are overlain by Middle Badenian sealing pelites. Analogous conditions can be expected to exist also in the area north of Gajary, into which the northern branch of the Danube palaeodelta is thought to have extended. The Gajary deposit is a typical example of traps occurring in this zone.

▶

Fig. 2: Vienna basin
Map depicting the zones of the possible occurrence of non-anticlinal deposits.
Explanatory notes: 1 — linear zone for one natural reservoir; 2 — areal zone for one natural reservoir; 3 — linear zone for a complex of natural reservoirs; 4 — areal zone for a complex of natural reservoirs; 5 — sand and sandstone reservoir rocks; 6 — limestone reservoir rocks; 7 — dolomite reservoir rocks; 8 — boundaries of the Vienna Basin; 9 — indication of a zone (see text and table); 10 — gas deposit; 11 — oil deposit; 12 — oil deposit with gas cap; 13 — description of the deposit (see table).


HODONÍN
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F) NAT occurrence in the zone of regional thinning of the Láb horizon

The Láb horizon, an extensive sand complex developed at the base of the Agglutination zone in the Middle Badenian, has been considered the principal reservoir rock of the Vienna basin in Czechoslovak territory. It extends almost over the entire basin. Besides a number of fields with anticlinal and tectonic traps, non-anticlinal trap deposits, commonly of the lithologic and lithologic-tectonic types (II a, c) have been found. The horizon is composed of several gradually thinning sand bodies. This fact has been proved for the Závod and Borský Jur fields and also for the Poddvorov field. For this reason, the zone outlined on the map should be regarded as a relatively broad belt bordering the boundary of the thinning Láb horizon. The lithology ranges from medium — to very fine — grained consolidated sands to sandstones, generally well graded. The major part of the oil and gas reserves of the Neogene sediments in the Vienna basin have accumulated in the sands of this horizon. Therefore, primary attention should focus on the exploration of natural hydrocarbon accumulation in this reservoir rock. The deposit at Brodské (lifted block) is a typical example of the traps in this zone.

G) NAT zones in biogenic formations of the Middle Badenian

Biogenic accumulations of the shallow-water shelf have formed in Middle Badenian sediments and are present at three locations in the Vienna basin — on the southwestern slope of the Láb high, on the western slope of the Týnec high and in the Mistelbach block. The three occurrences (fragments) may be related to a single zone charakterized by the presence of Lithothamnion limestones that form two kinds of traps in the Vienna basin: (1) conic bioherms and (2) biostromes — beds of common thickness lithologically grading into clays of low permeability. The bioherms (biogenic highs) form three separate accumulation traps (type I b) developed in the Láb horizon and covered by the marls of the Agglutination zone in the Láb region. An extensive biostrome was found on the Týnec high, borgering its western slope. Two minor oil deposits in the Kostice area have been discovered there. The reservoir rocks are probably the result of secondary changes in carbonates. The traps are irregularly shaped and sealed on all sides (type IIIc). The third occurence of biogenic carbonates in the Lednice area resembles that on the Hodonín-Gbely horst where it forms a relatively extensive biostrome. A minor gas deposit was found in the uplifted position of the biostrome near Lednice — 6 borehole. The trap is the result of a semibrachyanticlinal closure at the Schrattenberg fault. Its sealing appears to be a purely tectonic one.

H) Areal zone of NAT occurrence in Upper Badenian thinning sands

Upper Badenian sediments have been deposited almost on all of the surface of the Vienna basin; at some locations they lie unconformably on Eggenburgian, Ottnangian and Karpatian sediments. The main reservoir beds are the sands of the Rotalia and Bulimina zones. The formation of lithological and combined traps (II a, c) can be assumed for the entire distribution of the Upper Badenian sand facies. Generally the reservoir beds are fine-grained sands, mostly consolidated in the lower parts of the horizons. A number of deposits from various oil and gas fields both in the Moravian and Slovak parts of the Vienna basin can be associated with this zone. Typical examples are some Upper Badenian deposits in the Hrušky field (horizons No 5 C, 6 and 10).

I) Areal NAT zone in deltaic accumulations at the Pannonian base

The deltaic development of Pannonian horizon No 8 was proved by exploratory drilling in the southwestern part of the Vienna basin within the Vysoká, Láb, Jakubov, Suchohrad and Gajary oil and gas fields. The bird-ffoot delta extends into Austria. Within this zone, the sand of Pannonian horizon No 8 forms extensive lenses lithologically sealed on all sides. The basal parts of the sand bodies are downwarped and usually fill the erosive depressions in the underlying Upper Sarmatian pelites. The lithology of the reservoir rock comprises grey crumbling calcareous sand of several grain sizes. The oil — and gas bearing characteristics of the sand are very favourable. Gas accumulations occur at the top of Pannonian horizon No 8 where they form a series of irregularly distributed major or minor gas deposits. The largest of them are those at Suchohrad-Gajary and Jakubov. These trap types are schematically illustrated in Fig. 1, III a, b. The interpretation of the seismic profiles permits an analogous development of Pannonian horizon No 8 to be assumed for the whole frontier zone from Gajary to Kúty. The Suchohrad-Gajary deposit is a typical example of this kind of deposits.

The map depicting zones of the possible occurrence of non-anticlinal deposits is the first step in predicting of and searching for such deposits. Detailed facies analyses of the Neogene sequences in the Vienna basin and of its Mesozoic basement will follow. The results of the analyses will reflect in the delineation of new areal or linear zones and in the subdivision of the zones outlined into several subzones. We belive that the construktion of a similar map for the Austrian part of the Vienna basin could supply data on the existence of zones that cannot be found on Czechoslovak territory. On the other hand, the map of the Czechoslovak section can yield information on zones that could not be outlined in the Austrian portion of the basin. A combination of these maps could produce a basic document for the future search for non-anticlinal deposits.

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Abstrakt

Problematika prognózování výskytu a vyhledávání neantiklinálních typů ložisek se stává základním problémem průzkumu vídeňské pánve. Ve zkrácené verzi jsou v článku předloženy výsledky analýzy výskytu těchto ložisek. Bylo zjištěno, že podle typu pasti a stratigrafické příslušnosti kolektoru je zde možné tato ložiska rozdělit do několika zón. Vymezení plošného rozšíření těchto zón umožňuje prognózovat výskyt dalších neantiklinálních ložisek, a tím určit směry dalšího průzkumu ve vídeňské pánvi.

Zusammenfassung

Die Problematik der Prognostizierung des Vorkommens und Aufsuchens nichtantiklinaler Lagerstättentypen wird zum Hauptproblem der Forschungsarbeiten im Wiener Becken. Im vorliegenden Beitrag werden kurzgefaßte Ergebnisse einer Analyse des Vorkommens dieser Lagerstätten geboten. Es wurde festgestellt, daß hier möglich ist, diese Lagerstätten entsprechend dem Fallentyp und der stratigraphischen Zugehörigkeit des Speichergesteins in mehrere Zonen zu teilen. Durch die Abgrenzung der Flächenausdehnung dieser Zonen wird die Prognostizierung des Vorkommens weiterer nichtantiklinaler Lagerstätten und somit die Bestimmung der künftigen Forschungsorientation im Wiener Becken ermöglicht.