

# **Well Known (and Still Unknown) Crimea Highlands\***

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## **Abstract**

Crimea Highlands should be considered as an extremely important natural lab for understanding of the Ukrainian Black Sea and its petroleum potential. Geological mapping and research activities during Soviet times resulted in the classical “geosynclinal model” of Crimea by M. Muratov and followers. Based on the extensive biostratigraphic studies the classical model stratigraphy survived “structural revolutions” and still dominates over research and mapping in Crimea. Recent field study of numerous locations in Crimea Highlands reveals significant controversies in the stratigraphic interpretation of several sedimentary successions and their structural relationships. The list of stratigraphic controversies is as follows:

- 1) Tauric group: Aptian-Albian vs. Triassic-Liassic age;
- 2) “Flysch and conglomerates succession” (FCS): Pliocene vs. Late Jurassic age;
- 3) Bitak conglomerates: Pliocene vs. Middle Jurassic age;
- 4) Krymskaya Rosa succession: Pliocene vs. Hauterivian ;
- 5) Prokhladnoye succession: Cenomanian vs. Berriassian-Hauterivian age.

The list of controversial structural relationships is as follows:

- 1) Salgir valley: tectonic semi-window vs. erosional depression;
- 2) Kara Su valley: tectonic klippen vs. erosional remnant;
- 3) Echki-Dag area: disconformity vs. thrust.

Both of lists could be extended demonstrating uncertainties surrounding well-studied areas of key importance for successful exploration in the Black Sea.

### **Selected References**

Androussov, A.B., and C. Vogdt, 1910, Geologic map of the Crimea: Leningrad, Russia.

Muratov, M.V., V.G. Bondarenko, L.G. Plakhotnyy, and N.I. Chernyak, 1969, Structure of the folded basement in the Crimean plainland: *Geotectonics*, v. 4, p. 230-237.

Zhabina, N.M., and L.G. Mintuzova, 2000, Structural model of southeastern Crimea: *Geologiya i Geokhimiya Goryuchikh Kopalin*, v. 2000/1, p. 25-36.

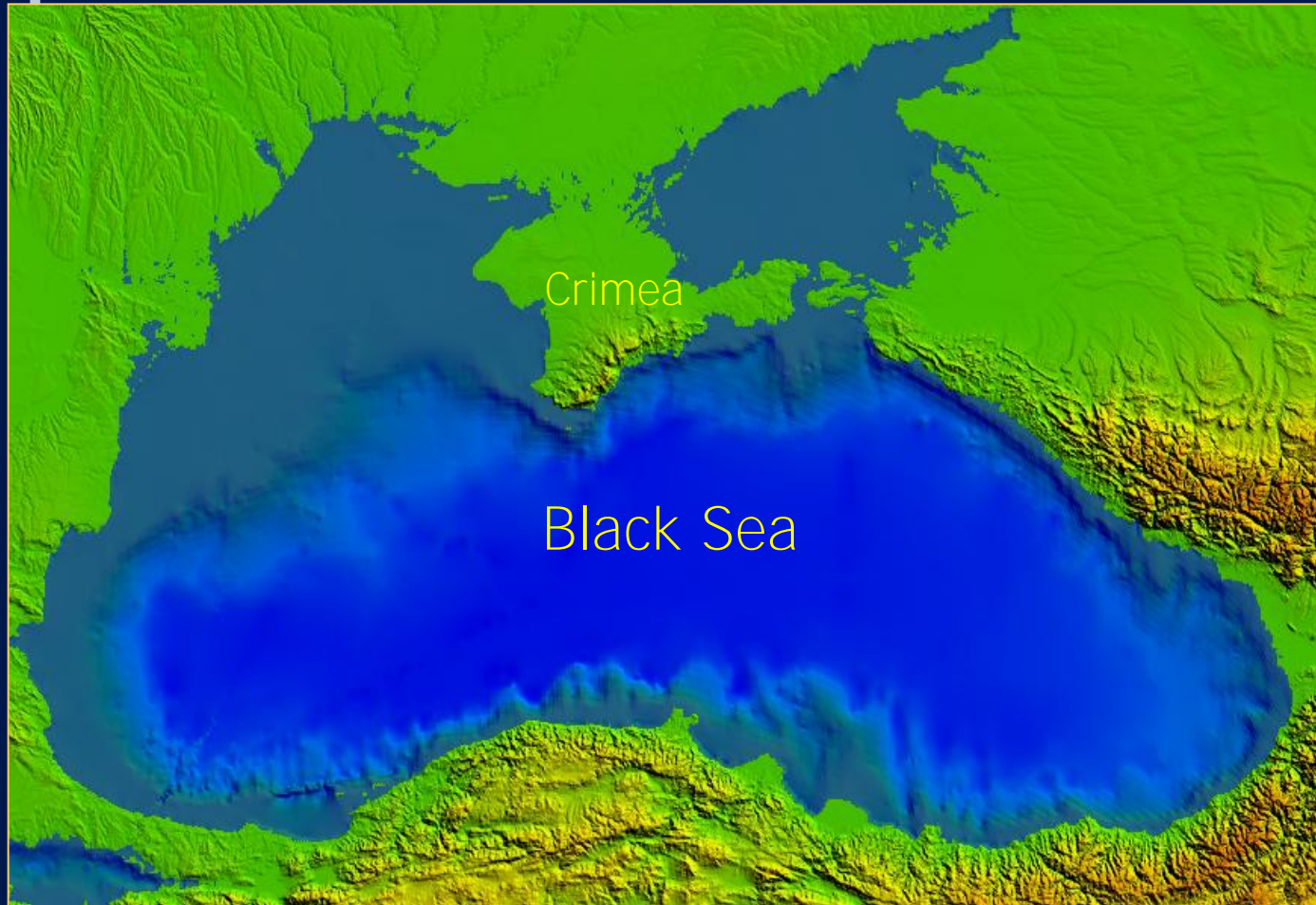
# **Well known, and still unknown, Crimea Highlands**



**Igor Popadyuk**

AAPG European Region Annual Conference  
Exploration in the Black Sea and Caspian Region  
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# Crimea location map



The Crimea geology is very important for the understanding of the entire Black Sea because the Jurassic and Cretaceous rocks are well exposed here, whereas in the Black Sea these rocks are hidden beneath the thick Tertiary sediments.

The whole sedimentary succession in Crimea gives the excellent possibility to study petroleum system elements important for the shallow and deep water plays.



# Well known Crimea



Geological study of Crimea Mountains continues for more than century and half.

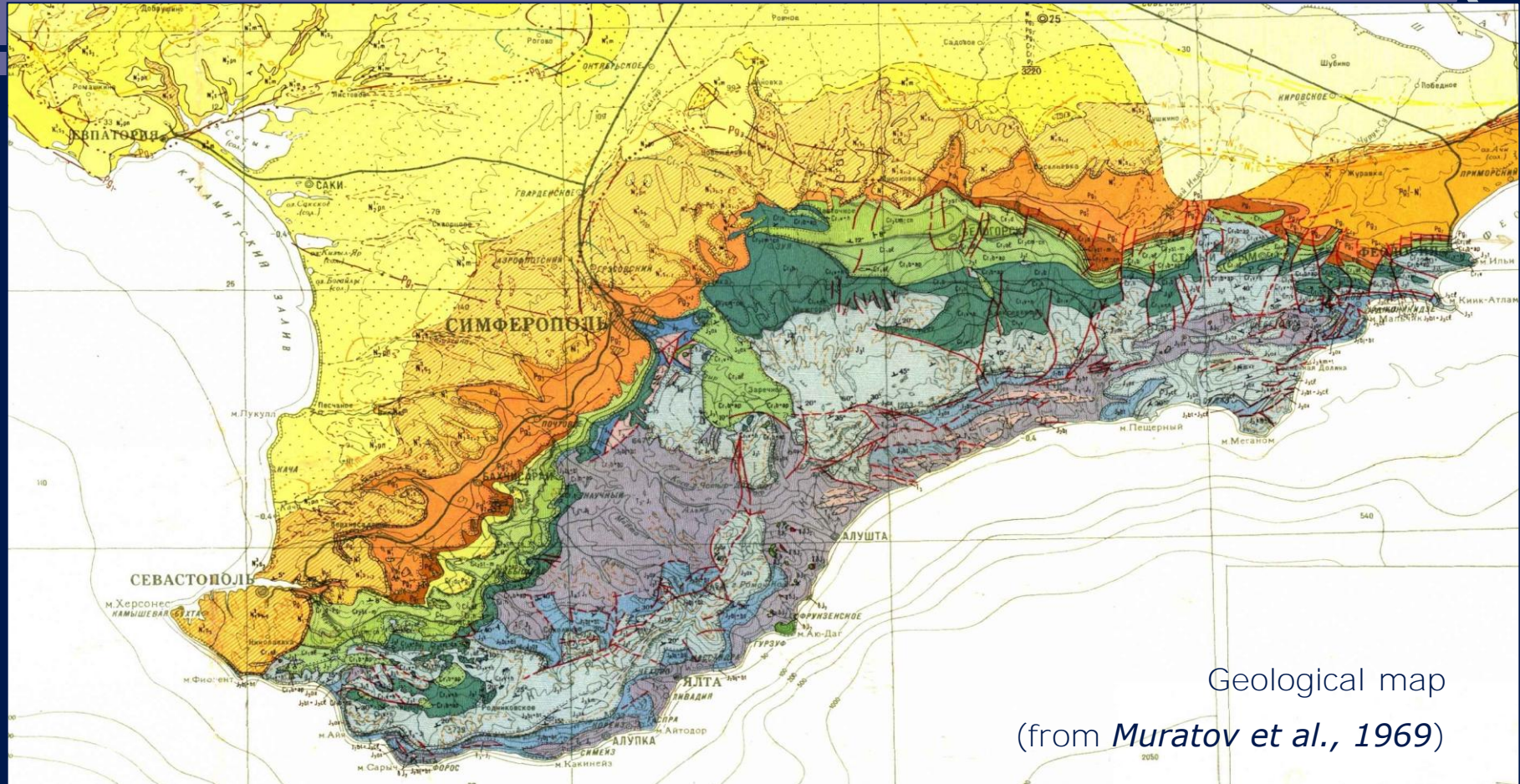
The main progress was attained in XX century with efforts of

- Geological Committee of Russia (1882—1922) and of Soviet Union (till 1929)
- Geological Organizations of Soviet Union (1929 -1991)

**The main achievements were gained between the Second World War and 70's of XX century.**

This period could have qualified as the Golden Age of Crimea geology when Geological map of Crimea of 1 : 200 000 scale and the fundamental geological description were completed.

# Well known Crimea



Geological map  
(from *Muratov et al., 1969*)

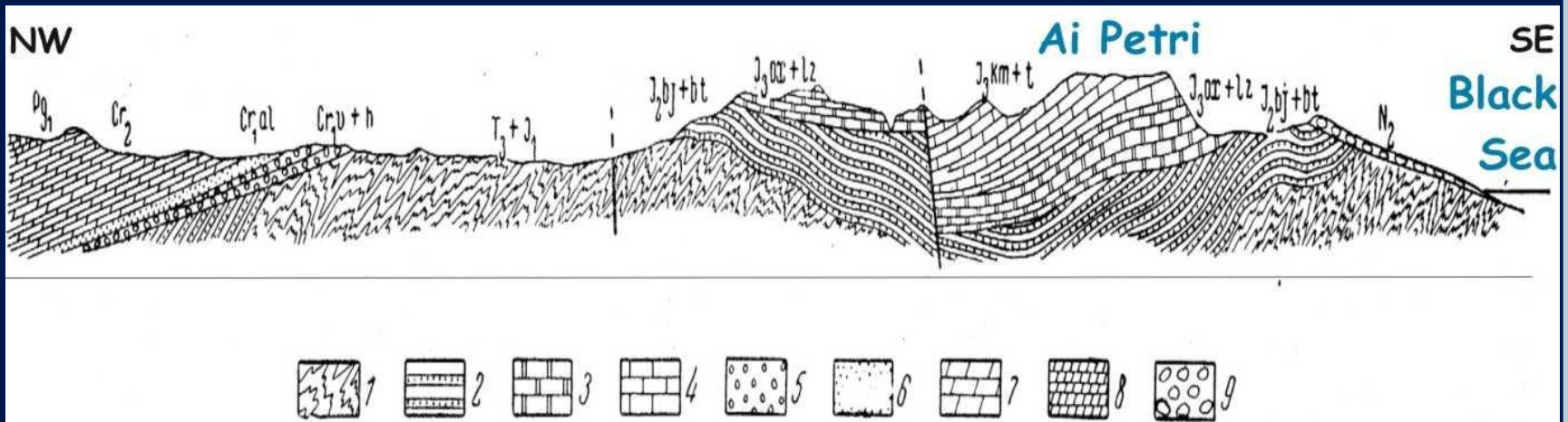
The map of 1:200 000 scale has generalized the knowledge of Crimea geology at classical, pre-plate period.

Despite further more detail mapping, this map is still very valuable for study and sometimes it is more comprehensive than later maps.

# Well known Crimea



## Geological section across Crimea Mountains (from Muratov et al., 1969)



1 - Tavrisc group, 2 - Middle Jurassic, 3 - Oxfordian limestones, 4 - Tithonian limestones, 5 - Valanginian-Hauterivian, 6 - Upper Albian, 7 - Upper Cretaceous, 8 - Paleogene, 9 - Pliocene

Geological description of the Crimea of classical period edited by M. Muratov was published in 1969. To date it is the most complete and systematic description of the Crimea geology.

# Well known Crimea



Extensive study during 70's-90's of XX century resulted in:

- a set of geological maps of 1:50 000 scale
- new regional stratigraphic charts

**After 1991 when Ukraine became an independent country** Ukrainian Geological Survey started the edition of new generation of Geological maps of Crimea of 1:200 000 scale.

**Looking at voluminous literature and lists of works done and available in public domain there is every reason to say that Crimea is well studied terrain.**



# Is Crimea well known?

After 1969 the continuous geological study and mapping resulted in a set of maps of 1: 50 000 scale and the new stratigraphic charts. Yet after a lot of work and several attempts to modernize the model of Crimea in thrust-tectonic style, these efforts left the core of stratigraphy unchanged. In fact, the **stratigraphy of key successions remains the same as it was in 60's of XX century. Not too much** changed in structural interpretation as is evident comparing maps of old and new generations.

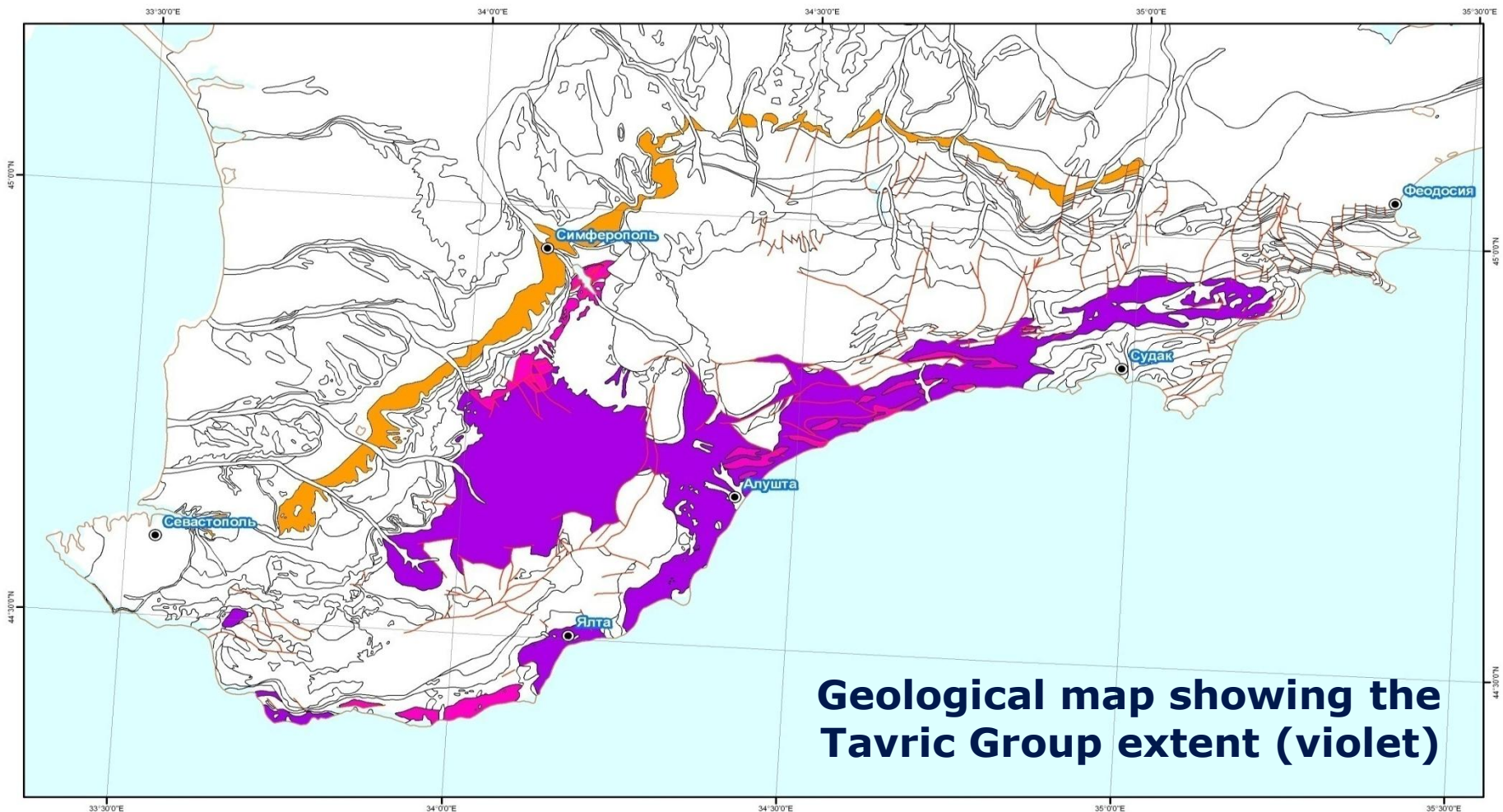


The main goal is to demonstrate that the basement of Crimea geology is not as firm as it looks.

In other words I shall try to show that indeed Crimea displays a lot of puzzles and thus it remains **unknown** to a critical extent.

## **Just stratigraphy, and just two examples:**

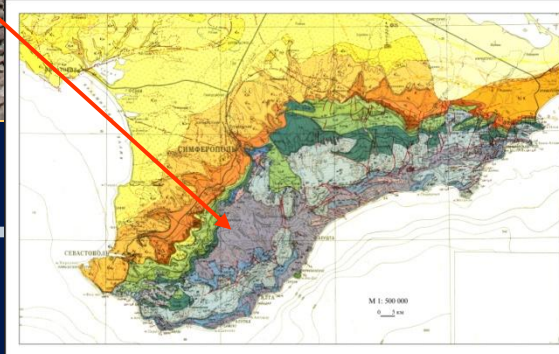
- **Tavric Group**
- **Upper Jurassic Flysch**
- **These two sedimentary successions were chosen to demonstrate that the stratigraphy of Crimea Mountains is surprisingly disputable.**



The Tavrisc Group crops out in many places in Crimea Mountains. This strongly folded and faulted succession is classically dated as Late Triassic – Early Jurassic in age and thus it is interpreted as the oldest formation cropping out in the Crimea.



# Tavric Group



The group is widely exposed along the southern seashore of Crimea and throughout the Kacha area.

Usually it comprises the rhythmically bedded (flysch) succession of sandstones, silts and shales with exotic blocks which crops out in a few localities.

Because of monotonous lithology and strong deformations the group is easily recognized at a single glance.

The fauna remnants are generally rare and often found in exotic blocks or siderite nodules.

# Tavric Group stratigraphy



Система	Отдел	Ярус	М. В. Муратов, 1959 г.
Юрская	Средний	Батский	Среднеюрские отложения
		Байосский	
		Ааленский	
	Нижний (лейас)	Тоарский	Перерыв
		Домерский	<div style="display: flex; justify-content: space-between;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);"> Эскиординская свита — песчанки, сланцы, глы- бы известняков </div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);"> Верхнетаврическая свита — флиш </div> </div>
		Плинсбахский	
		Лотарингский	
		Синемюрский	
		Геттангский	
Триасовая	Верхний	(Рэтский)*	Нижнетаврическая свита (верхний триас) — флиш
		Норийский	
		Карнийский	
	Средний	Ладинский Анизийский	

Upper Tauric Fm.

Eski Orda Fm.

Lower Tauric Fm.

The group is usually divided into three formations, Lower Tauric Fm, Upper Tauric Fm, and commonly placed in between, the Eski Orda Fm.

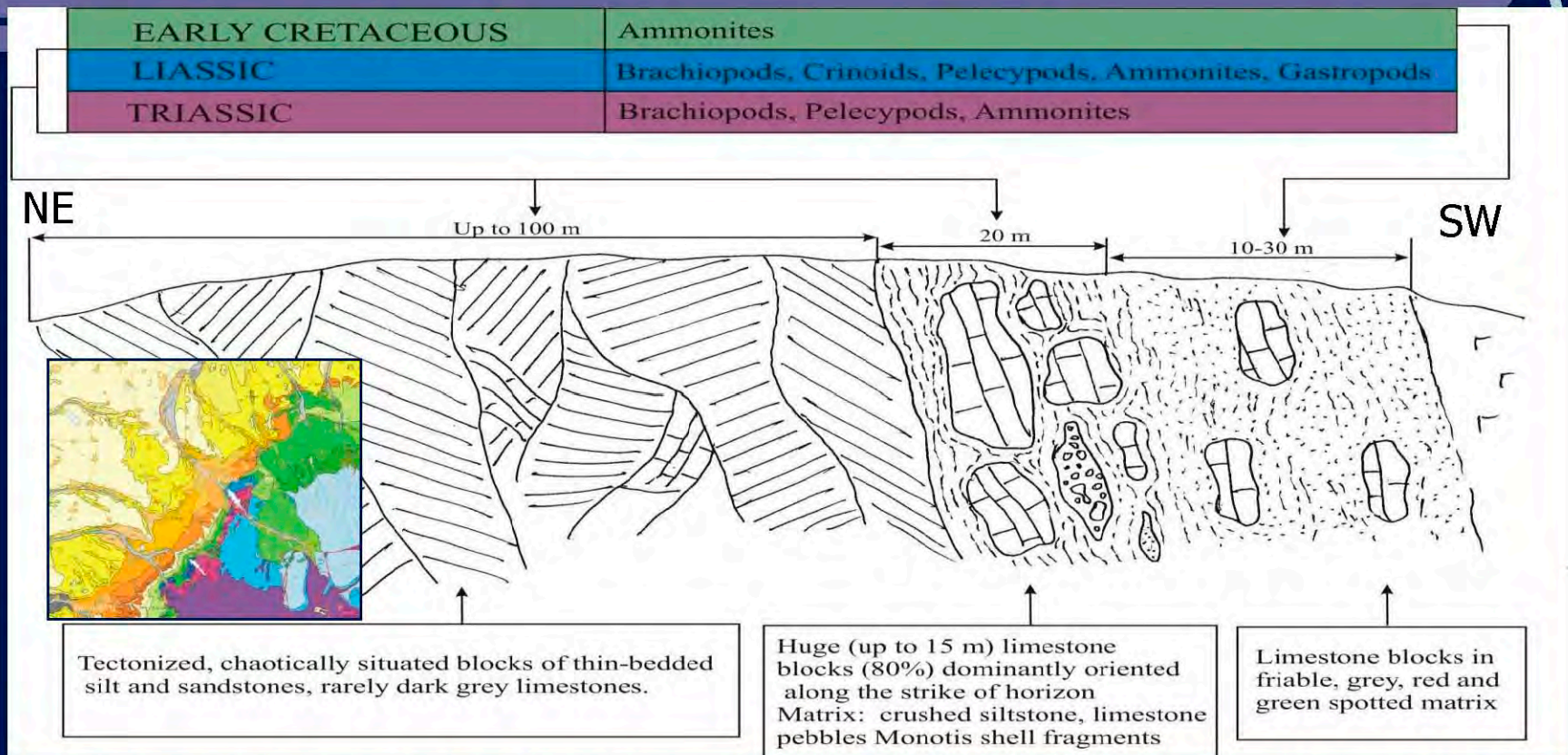
The Eski Orda Fm consists of the rhythmically bedded sandstones and shales containing exotic blocks, mostly of limestones.

The type section of Eski Orda Fm is located near Simferopol.

There are some other places where Tavric succession with exotic blocks is also exposed.



# Geological cross-section of Eski Orda Fm. (Maryino-Ukrainka villages near Simferopol)

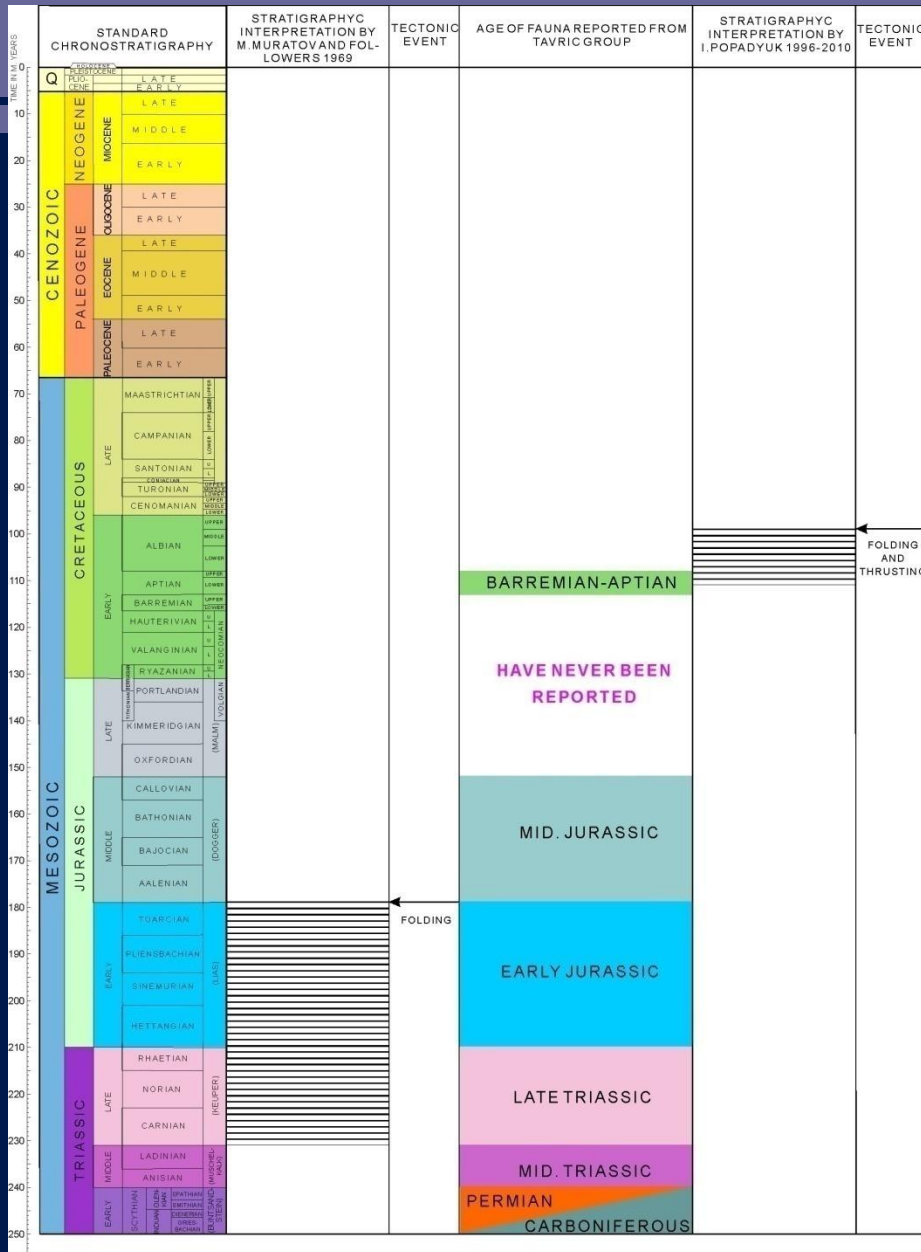


Geological section of Eski Orda Fm composed by I.Popadyuk on the basis of description given by L.Dekhtiariova, V.Nerodenko, O.Komarova, I.Mikhaylova, 1978

The type section of Eski Orda Fm is located near Simferopol. Because of proximity to the city the section was studied and described many times by several authors. The oldest Triassic and the youngest Toarcian remnants found in this section have determined that stratigraphic range of the whole Tauric Group was defined as Late Triassic - Early Jurassic. It was, and it remains to be almost axiomatic....

Meanwhile in 1978 L. Dekhtiariova, V. Nerodenko, O. Komarova, and I. Mikhaylova reported besides Triassic-Liassic fauna the Early Cretaceous chronostratigraphically indicative Barremian- Aptian Ammonites: *Barremites* sp. ind., *Salfedinella* ex.gr.guettardi (Rasp), *Diadochoceras* sp.

# What it should mean....



Surprisingly the data published in 1978 take no notice till now.

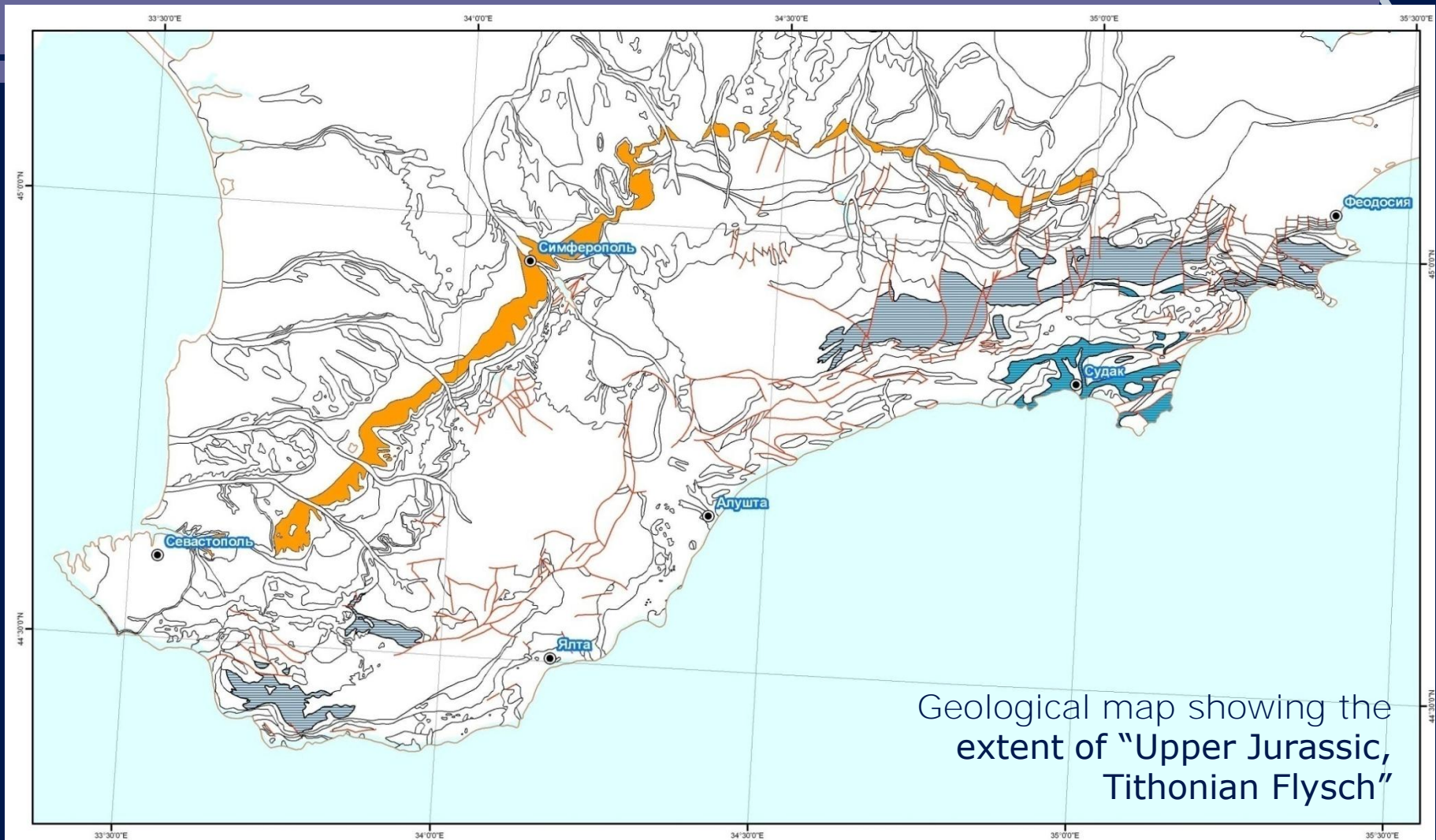
In analyzing paleontological data on Tavric succession it is necessary to note that besides L.Triassic-Liassic the Carboniferous, Permian, M.Triassic, M.Jurassic and at last Early Cretaceous fauna fragments are identified from exotic blocks encased in the Tavric succession.

The youngest fragments give the base to consider the Tavric Group as most likely Aptian-Albian in age.

In turn it means that some additional issues arise, first of all the age of tectonic events determined the deformations of Tavric rocks and consequently the age of post-tectonic cover, which should not be older than.... Cenomanian.

In other words the data left with no notion for more than 30 years indeed trigger the domino effect.

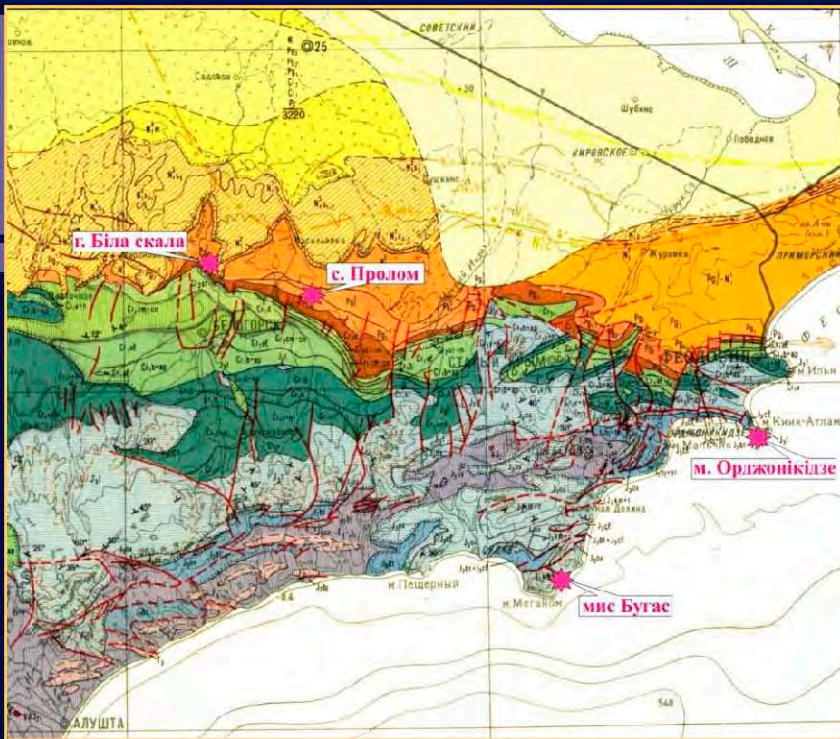




So called "Upper Jurassic flysch is widely exposed in the Eastern Crimea to the east of Tona Su River. Typically the succession begins with conglomerates grading upward into rhythmically bedded sandstone, silt and shale.

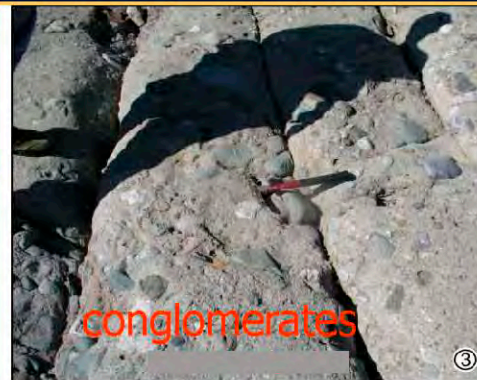


## Conglomerate-and-flysch succession in outcrops



The conglomerates thinning upward pass into flysch succession.

M. Muratov assigned these rocks to the Kimmeridgian-Tithonian based on the sparse ammonites findings, likely reworked from Upper Jurassic carbonates.



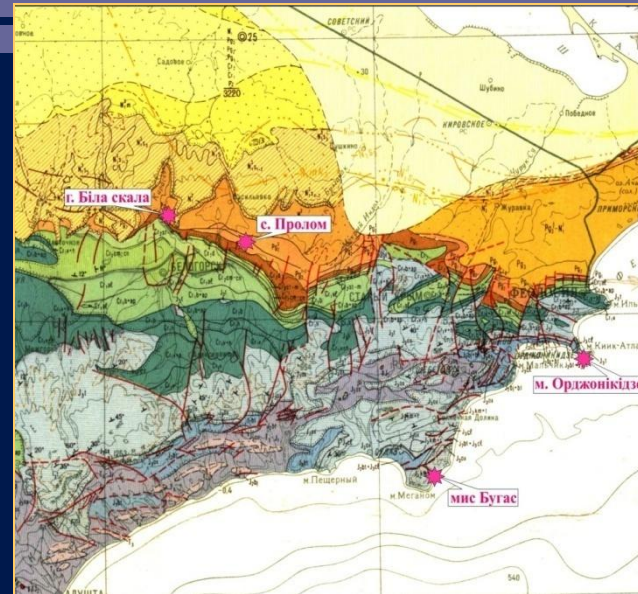
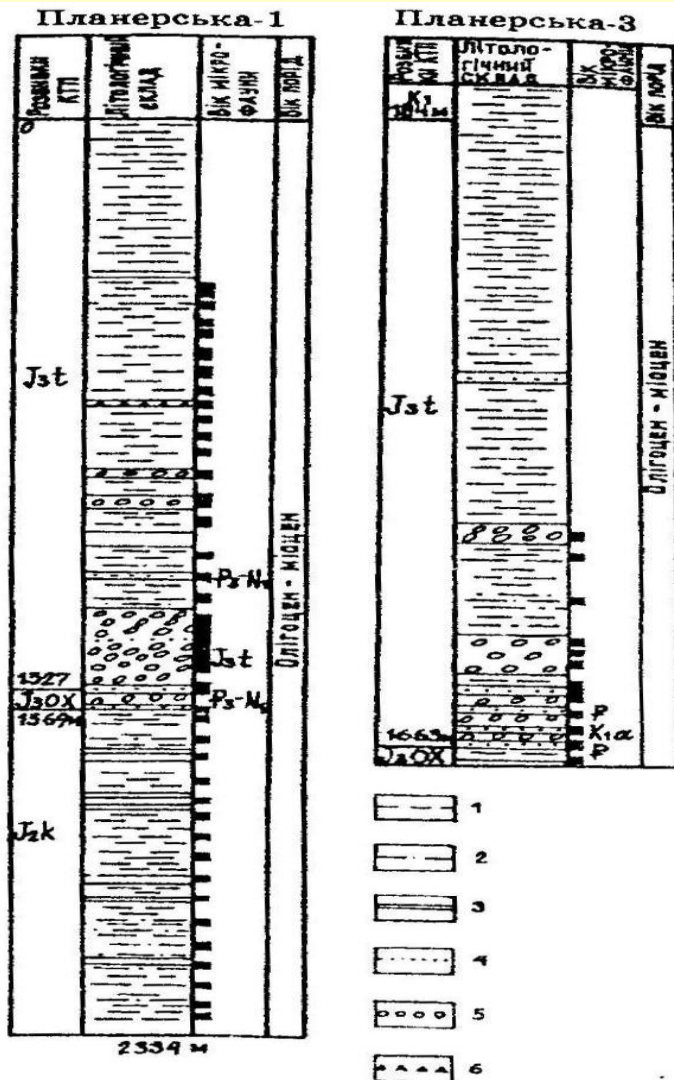


## Rhythmically bedded siliciclastics in impressive outcrops in the eastern Crimea





# Four wells drilled in 50's of XX century in the eastern Crimea have brought a very important data in... 1999



For more than 30 years since 1969 the age of the succession was undoubted.

However, in 1999 N.Zhabina and L.Mintuzova published data demolishing the long held dating.

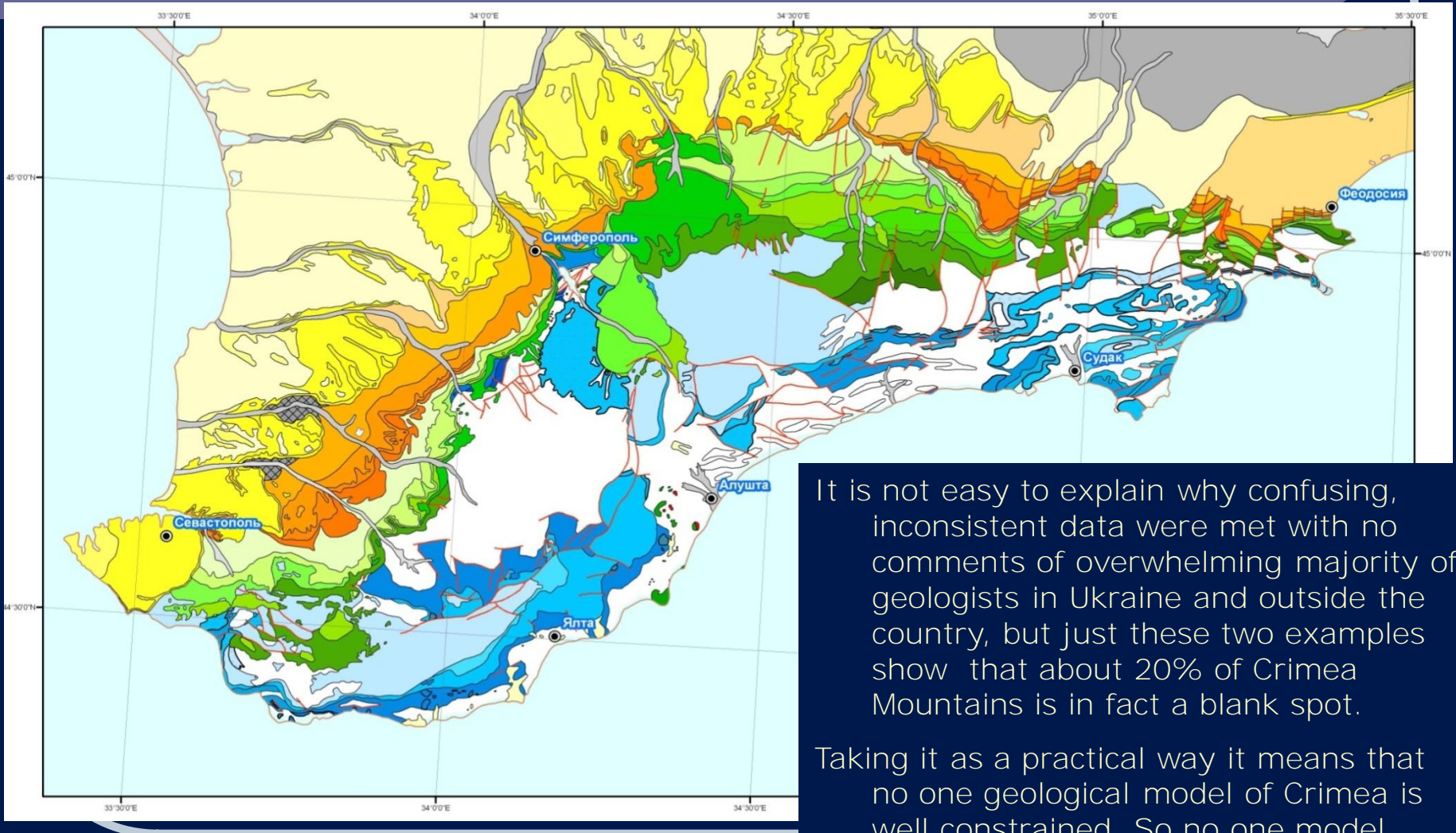
The foraminifera study of samples and thin sections revealed that taxa of Early Cretaceous, Late Cretaceous (up to Turonian) and Paleogene (up to Maykopian) are present in rocks previously defined as Upper Jurassic.

# What it should mean...



TIME IN YEARS	STANDARD CHRONOSTRATIGRAPHY	STRATIGRAPHIC INTERPRETATION BY M. MURATOV AND FOLLOWERS 1969	AGE OF FAUNA REPORTED	STRATIGRAPHIC INTERPRETATION BY I. POPADYUK 1996-2010
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# Geological map of Crimea Mountains: a blank spot of poorly dated rock assemblages



It is not easy to explain why confusing, inconsistent data were met with no comments of overwhelming majority of geologists in Ukraine and outside the country, but just these two examples show that about 20% of Crimea Mountains is in fact a blank spot.

Taking it as a practical way it means that no one geological model of Crimea is well constrained. So no one model could serve as a good guide for Black Sea exploration.



**Geological map of Crimea Mountains by N.Andrusov,  
A.Borissiak, and C.Voght completed 1910 and published  
1926 by Geological Committee of Soviet Union**



There were no blank spots in Crimea 100 years ago.

What might be done to improve **our knowledge**?

# What can be done to improve our knowledge of Crimea ?



- Crimea Mountains offers a excellent possibility to study the whole sedimentary succession of the Black Sea. Apparently well studied Crimea is poorly known as it was shown with two stratigraphic examples.
- The list of poorly dated sections could be extended; so the geological interpretation in time could be dramatically different from common wisdom.
- Probably the fastest way to update the knowledge of Crimea is to establish the Industrial Research Consortium involving European and Ukrainian Universities sponsored by petroleum companies exploring the Black Sea. **The Black Sea Industrial Research Consortium** could be established and would evolve the way similar to **the Gulf of Mexico Research Consortium at the University of Colorado** established in 1992.