

# Understanding the Akchagyl and Apsheron in the Greater Caspian Sea Region: New Biostratigraphic Insights\*

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Search and Discovery Article #51665 (2020)\*\*

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## Abstract

The Akchagyl (Akchagyl) and Apsheronian (Apsheron) Regional Stages are well known stratigraphic intervals that were widely deposited in and around the Greater Caspian Sea Region during the latest Pliocene and early Pleistocene. Both these stratigraphic units were deposited as a result of water levels in the Caspian Sea that were significantly higher than at the present time. The Akchagyl is important as it provides the regional seal overlying the oil and gas bearing Productive Series, whereas the Apsheron forms a major portion of the 'overburden' sediments in this over-pressured petroleum system. Detailed biostratigraphic investigations reveal that both the Akchagyl and Apsheron units were deposited primarily under brackish rather than fully marine conditions. However, marine influences are widely evident in the lower part of the Akchagyl, marked by the presence of dinoflagellate cysts and small cassidulinid foraminifera which typically occur in deep and/or cold marine waters. The marine microfossils are likely to have originated from the Arctic Ocean, and not the Black Sea or Mediterranean Sea as is widely believed. Microfossils with affinity to Central Paratethys (Pannonian and Dacian basins) occur sporadically in the Akchagyl and frequently in the Apsheron intervals. Accurate dating and subdivision of the Akchagyl and Apsheron units is possible using a combination of Ar/Ar dating of ash layers, magnetostratigraphy, and biostratigraphy. This is demonstrated in outcrop, core and well studies from Azerbaijan and Russia.

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# Understanding the Akchagyl and Apsheron in the Greater Caspian Sea Region: new biostratigraphic insights

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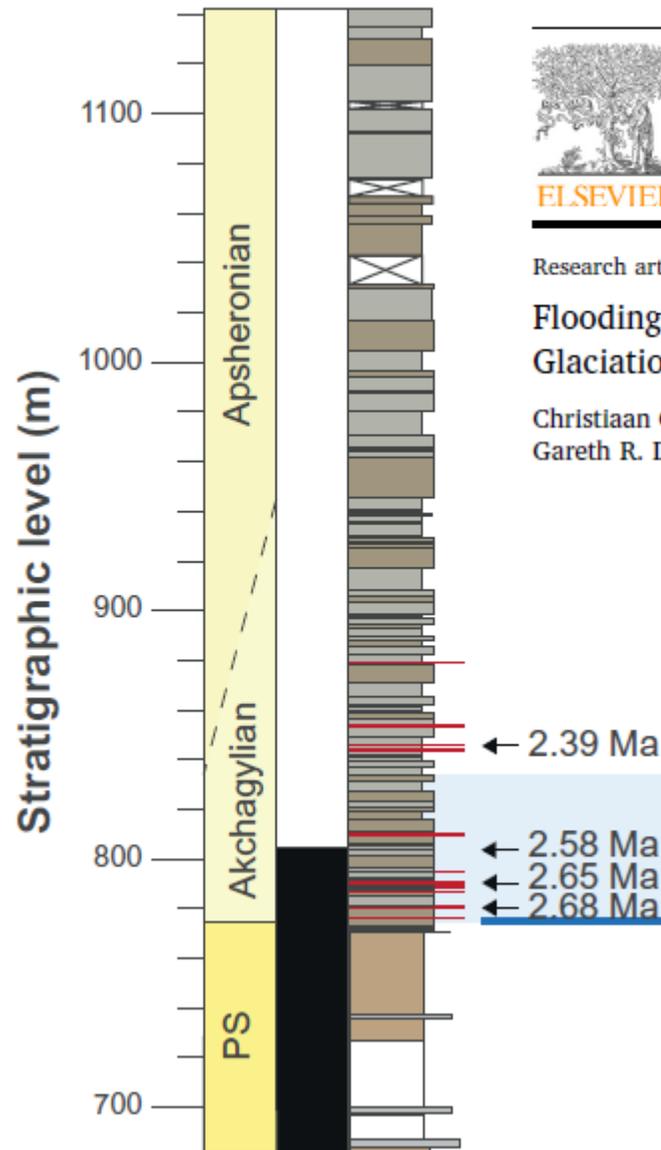


Research article

### Flooding of the Caspian Sea at the intensification of Northern Hemisphere Glaciations



Christiaan G.C. Van Baak<sup>a,b,\*</sup>, Arjen Grothe<sup>a,c</sup>, Keith Richards<sup>d,e</sup>, Marius Stoica<sup>f</sup>, Elmira Aliyeva<sup>g</sup>, Gareth R. Davies<sup>h</sup>, Klaudia F. Kuiper<sup>h</sup>, Wout Krijgsman<sup>a</sup>





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Palaeogeography, Palaeoclimatology, Palaeoecology

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Palynology and micropalaeontology of the Pliocene - Pleistocene transition in outcrop from the western Caspian Sea, Azerbaijan: Potential links with the Mediterranean, Black Sea and the Arctic Ocean?



Keith Richards<sup>a,b,\*</sup>, Christiaan G.C. van Baak<sup>c,1</sup>, John Athersuch<sup>d</sup>, Thomas M. Hoyle<sup>c,e</sup>, Marius Stoica<sup>f,c</sup>, William E.N. Austin<sup>g</sup>, Alix G. Cage<sup>h</sup>, Antoine A.H. Wonders<sup>d</sup>, Fabienne Marret<sup>i</sup>, Carmel A. Pinnington<sup>i</sup>



University of Amsterdam



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Quaternary International xxx (xxxx) xxx–xxx



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## The Akchaglyian stage (late Pliocene-early Pleistocene) in the North Caspian region: Pollen evidence for vegetation and climate change in the Urals-Emba region

Olga D. Naidina<sup>a,\*</sup>, Keith Richards<sup>b,c</sup>

<sup>a</sup> Geological Institute, Russian Academy of Sciences, Biostratigraphy and Paleogeography, Pyzhevsky, 7, 119017, Moscow, Russia

<sup>b</sup> KRA Stratigraphic Ltd., 116 Albert Drive, Deeganey, Conwy, LL31 9YY, United Kingdom

<sup>c</sup> Institute for Biodiversity and Ecosystem Dynamics (IBED), University of Amsterdam, 1090 GE, Amsterdam, the Netherlands



# **INVITATION**

**to attend the public  
defence of my PhD thesis**

## **Biotic Change and Landlocked Seas**

**Ecosystem responses  
to climate and sea level  
variability in the  
Plio-Pleistocene of the  
Pontocaspian basins**

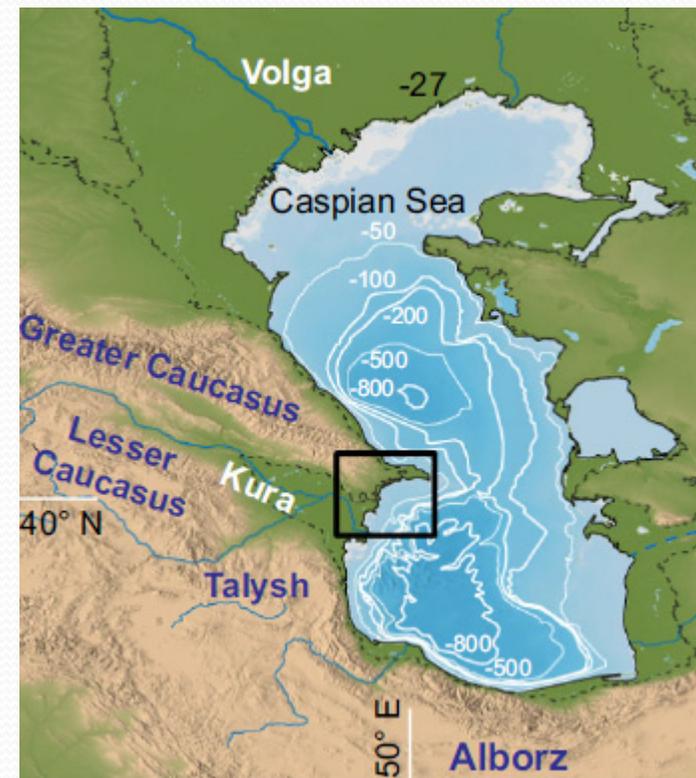
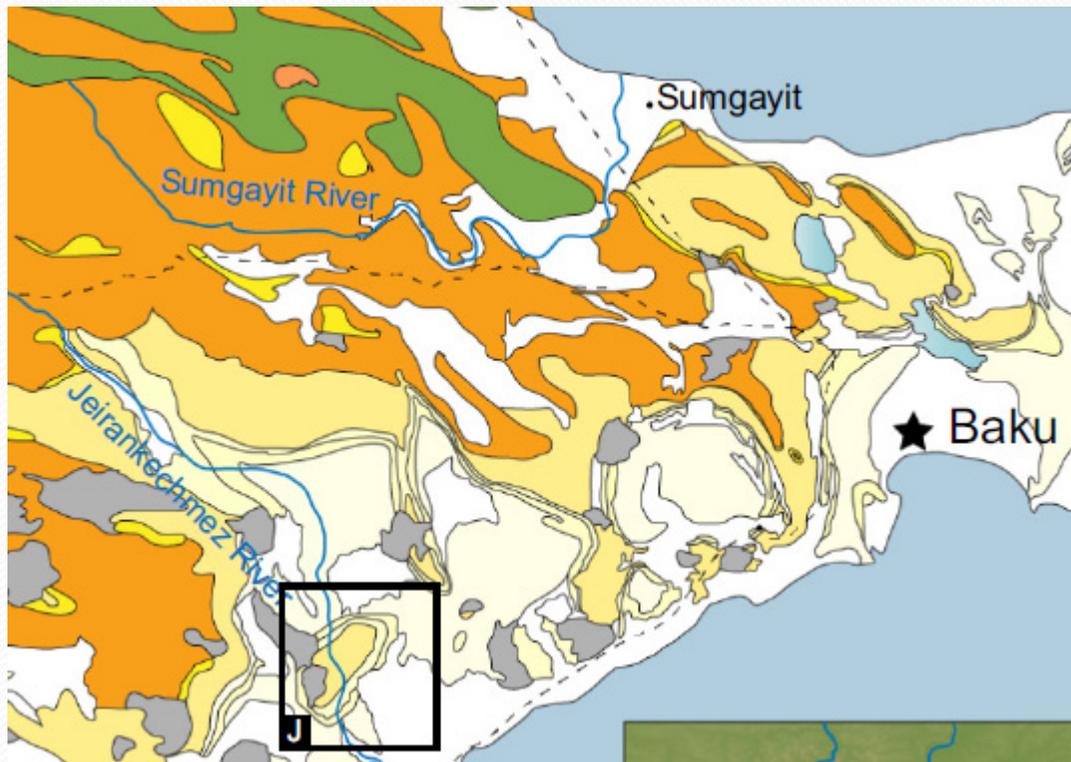
**On Friday 29th March,  
2019 at 10.30 am in the  
Senate Hall of the  
Academiegebouw  
Utrecht University**



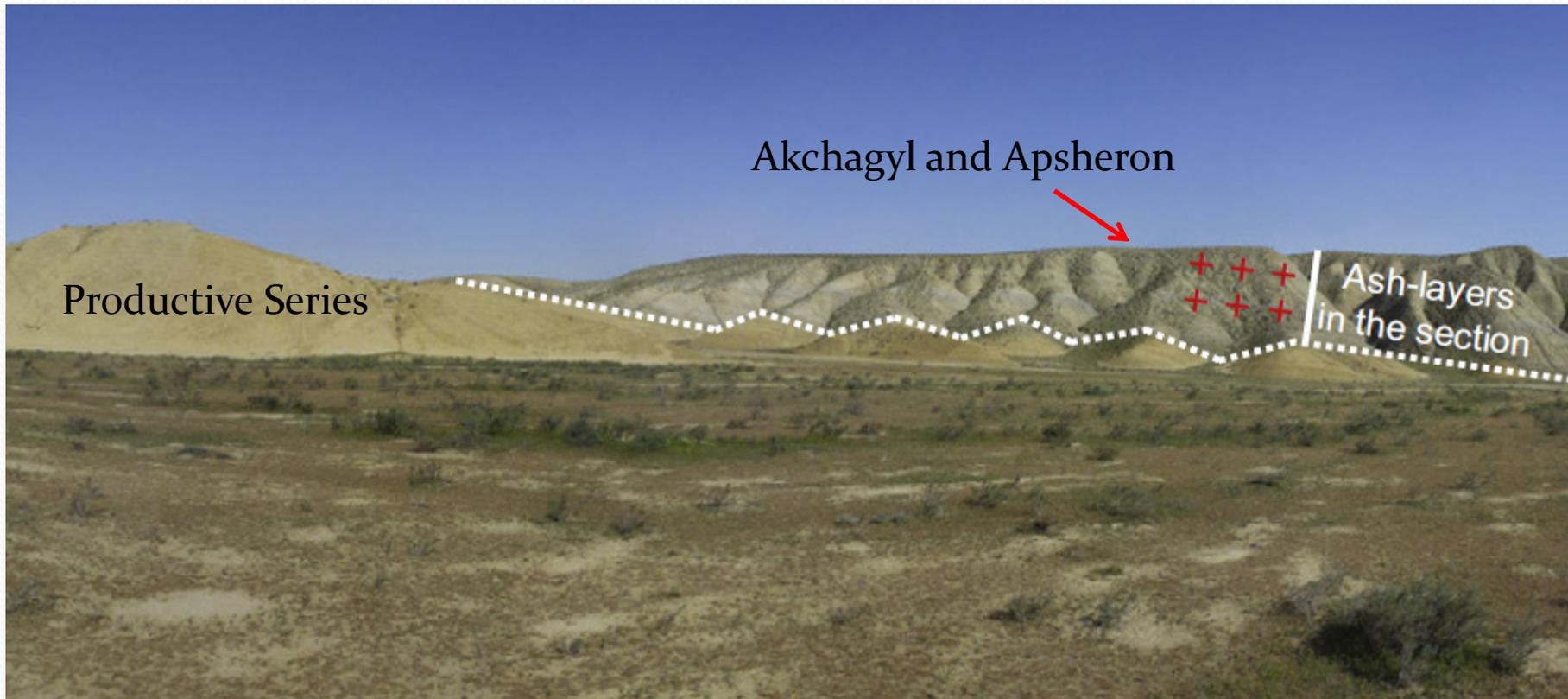
The background is a solid blue gradient, transitioning from a darker blue at the bottom to a lighter, cyan-like blue at the top. Several thin, wavy lines in shades of blue and cyan curve across the upper portion of the image, creating a sense of motion and depth.

**Akchagylian**

# Jeirankechmez section



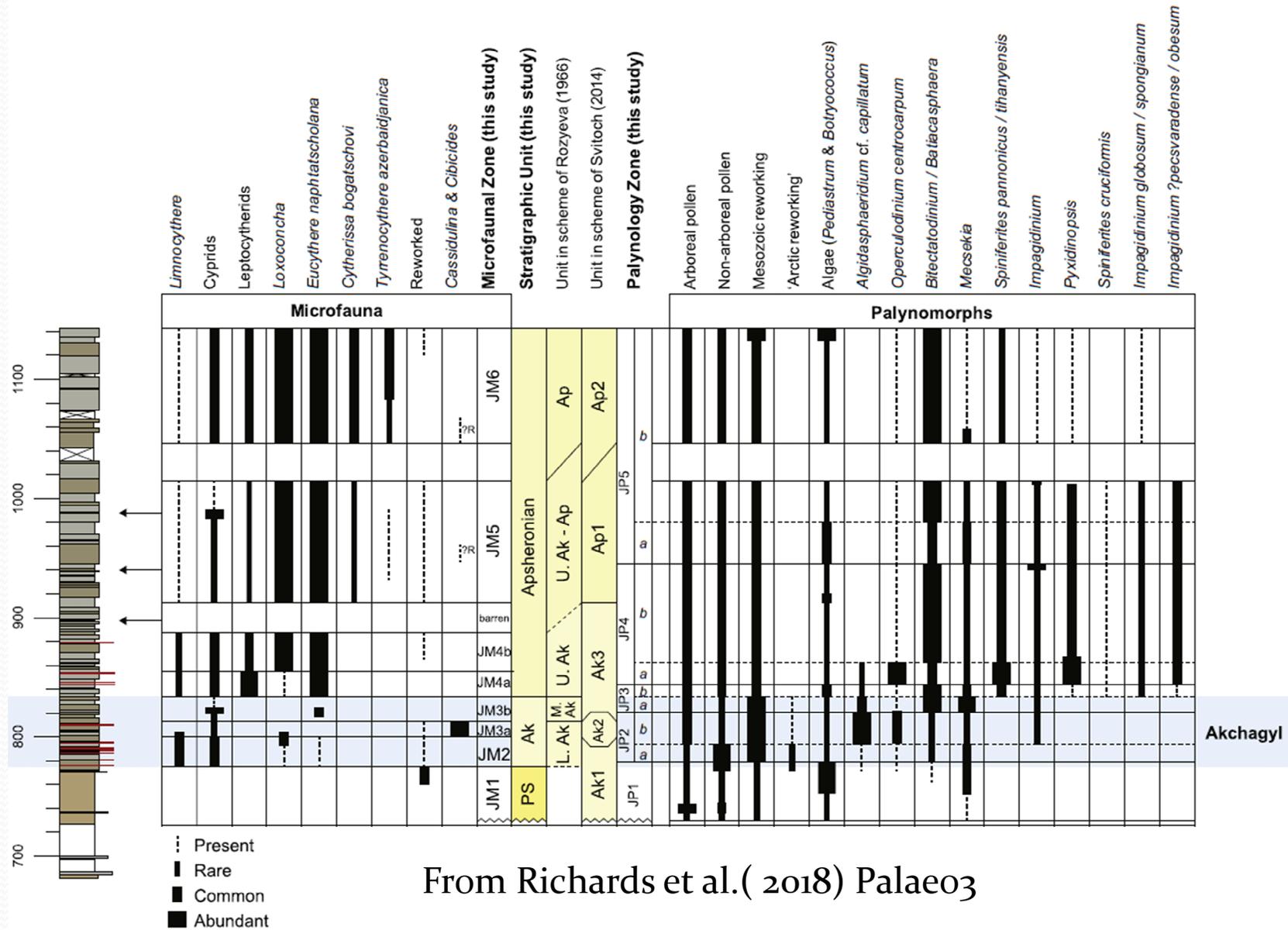
# Jeirankechmez section



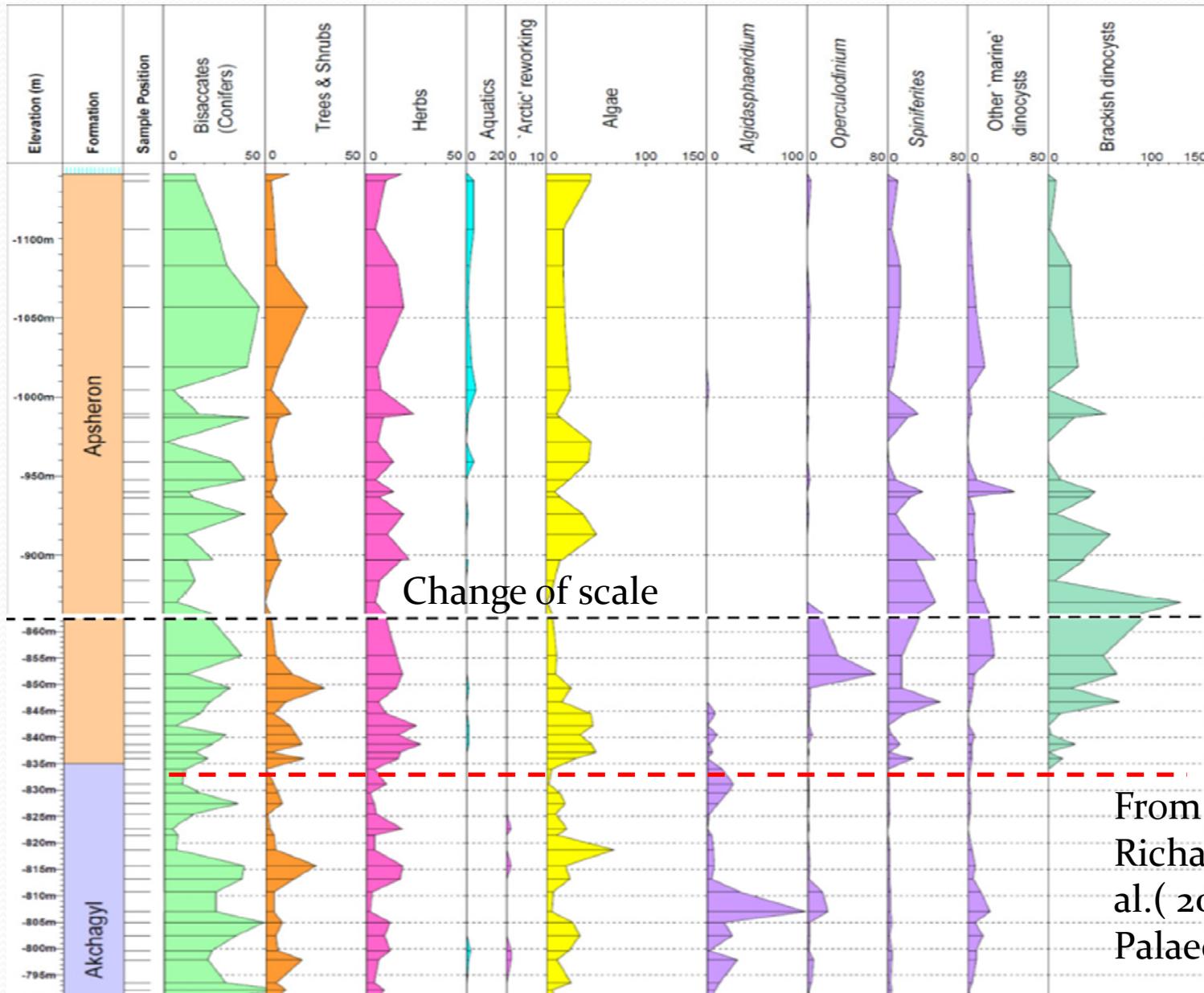
1600 metres of continuous exposure: Productive Series fluvio-deltaic; Akchagyl marine to brackish; Apsheron mostly brackish.

(Photo by C. Van Baak)

# Jeirankechmez: Biostratigraphic summary

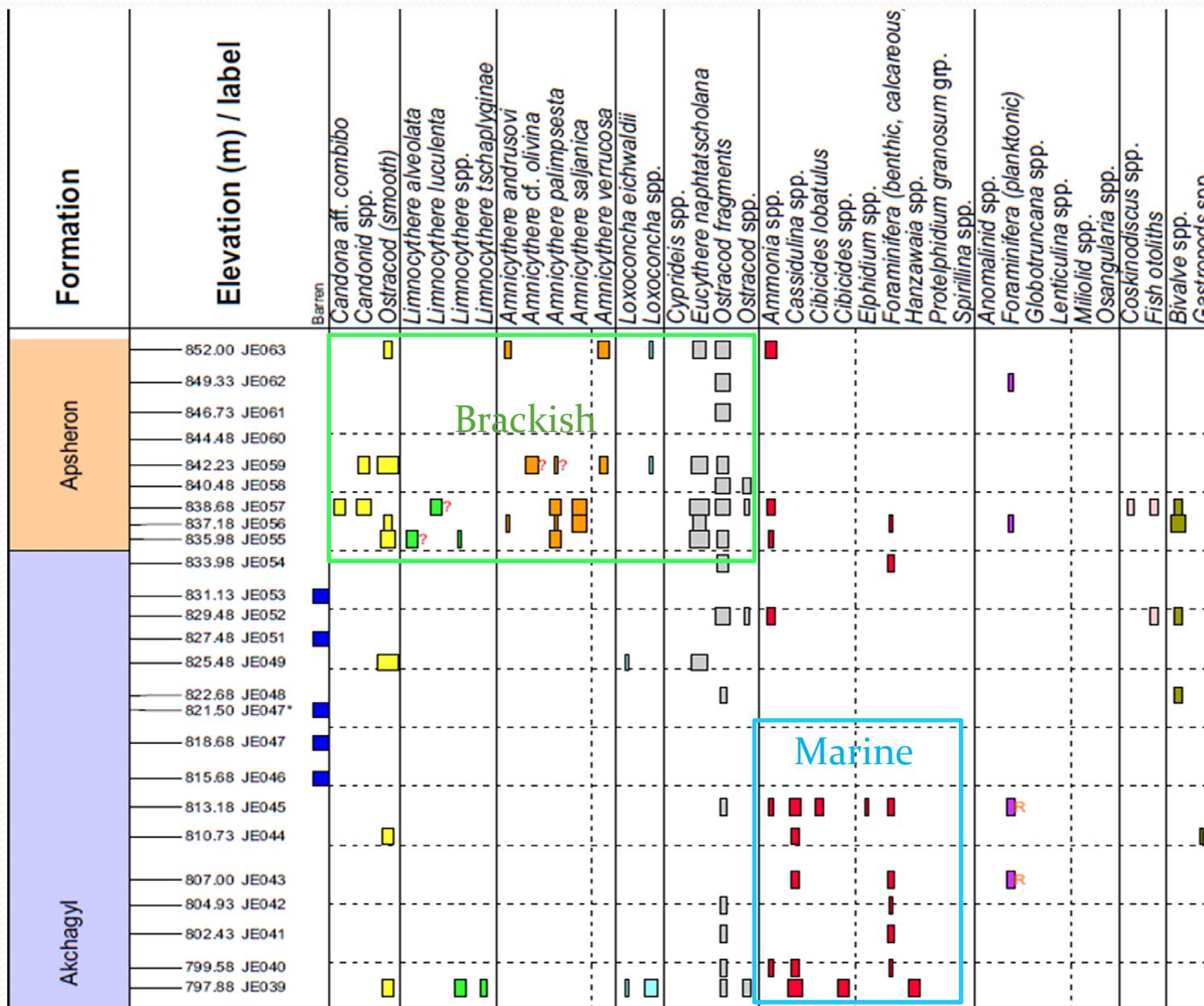


# Jeirankechmez: Palynology



From  
Richards et  
al. (2018)  
Palaeo3

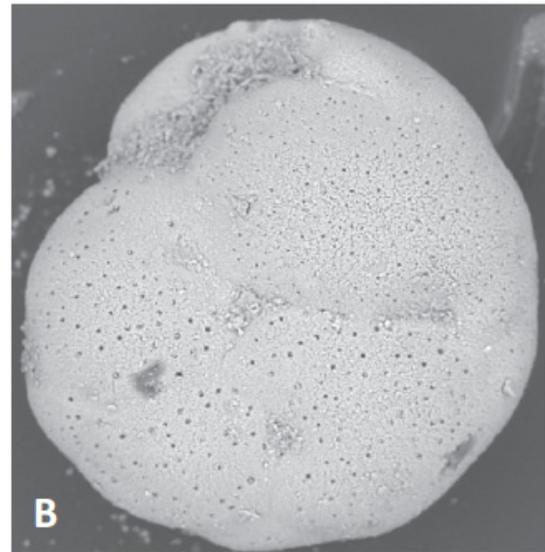
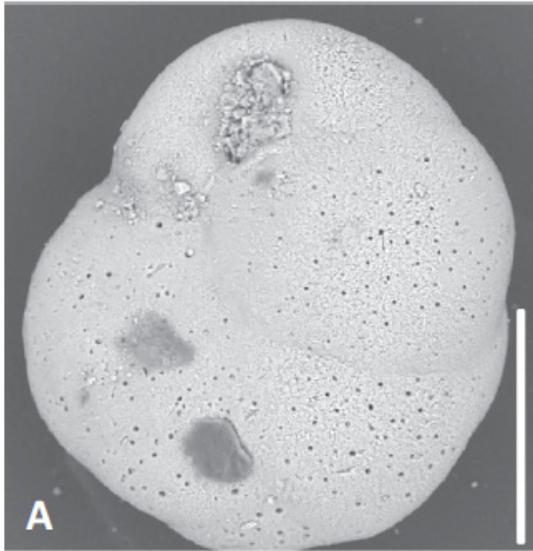
# Jeirankechmez: Micropalaeontology



Brackish

Marine

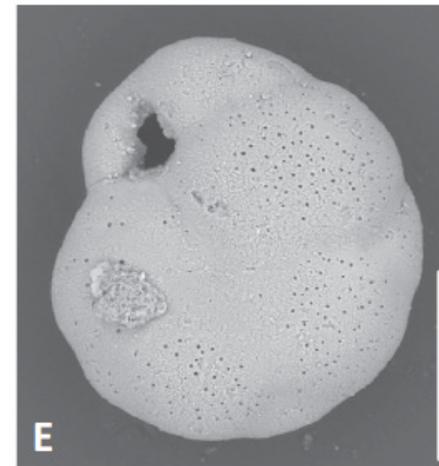
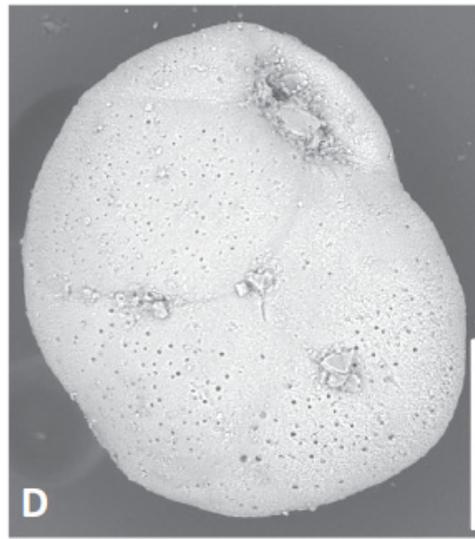
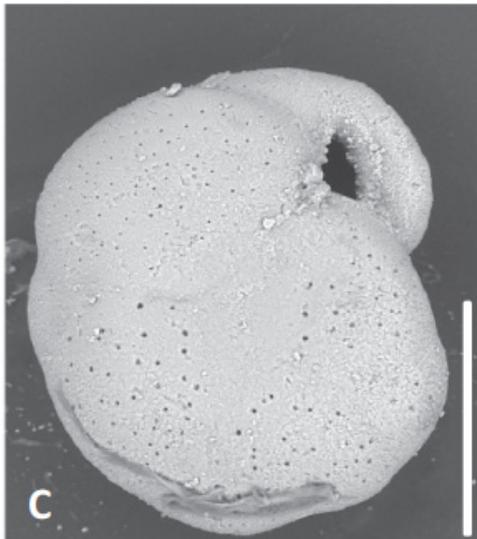
# Jeirankechmez: Micropalaeontology



Cassidulinid  
foraminifera in  
lower part of  
Akchagyl after c.  
2.6 Ma....

*Cassidulina* /  
*Globocassidulina*

DEEP / COLD



From Richards et al. (2018) Palaeo3

Таблица CVII

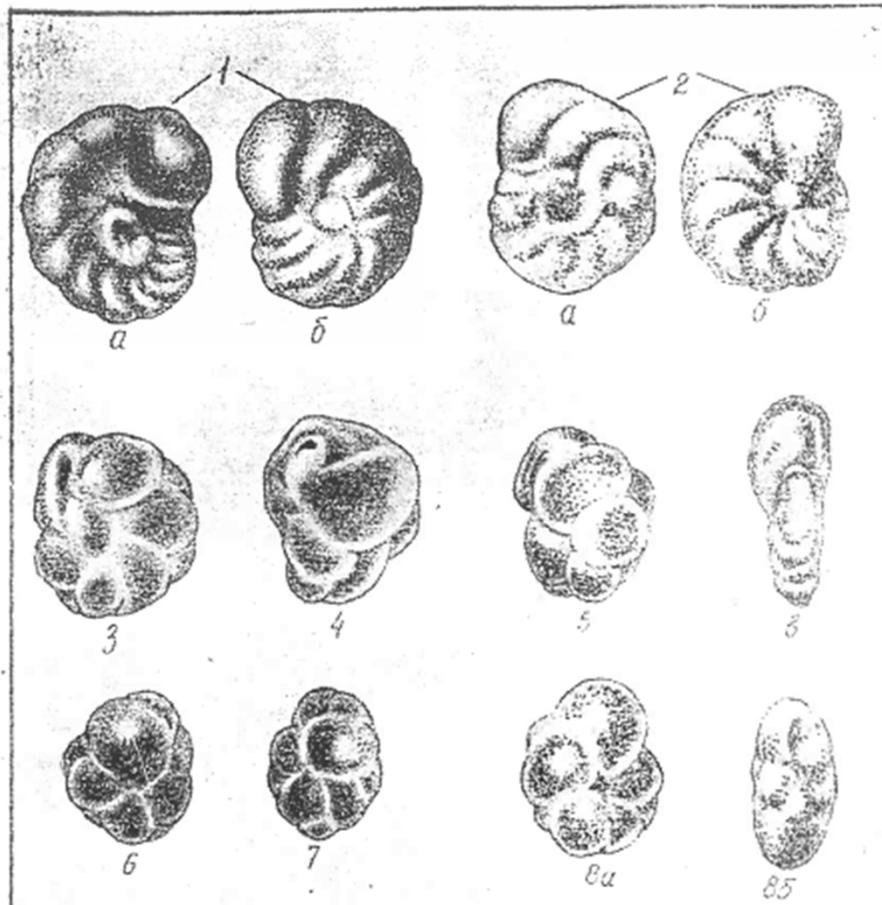


Рис. 1 и 2. *Cibicides lobatulus* (Walk. et Jak.) ×

Оригинал: а—раковина со спинной стороны; б—раковина с брюшной стороны; в—раковина с периферического края.

Азербайджан, Бакинский архипелаг (о. Дуванный). Плиоцен (акчагыский ярус).

Рис. 3—8. *Cassidulina* ex gr. *crassa* Orbigny × 94

Оригинал: раковина с внешней стороны; 8б—раковина сбоку.

Азербайджан, Бакинский архипелаг (о. Дуванный). Плиоцен (акчагыский ярус).

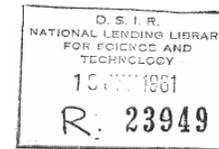
PLATES 567 (119) (419.24)

Д. А. АГАЛАРОВА, З. К. КАДЫРОВА,  
С. А. КУЛИЕВА

57814

Ostracodes in the Pliocene and  
Post-Pliocene deposits of Azerbaijan.

ОСТРАКОДЫ ПЛИОЦЕНОВЫХ  
И ПОСТПЛИОЦЕНОВЫХ  
ОТЛОЖЕНИЙ АЗЕРБАЙДЖАНА

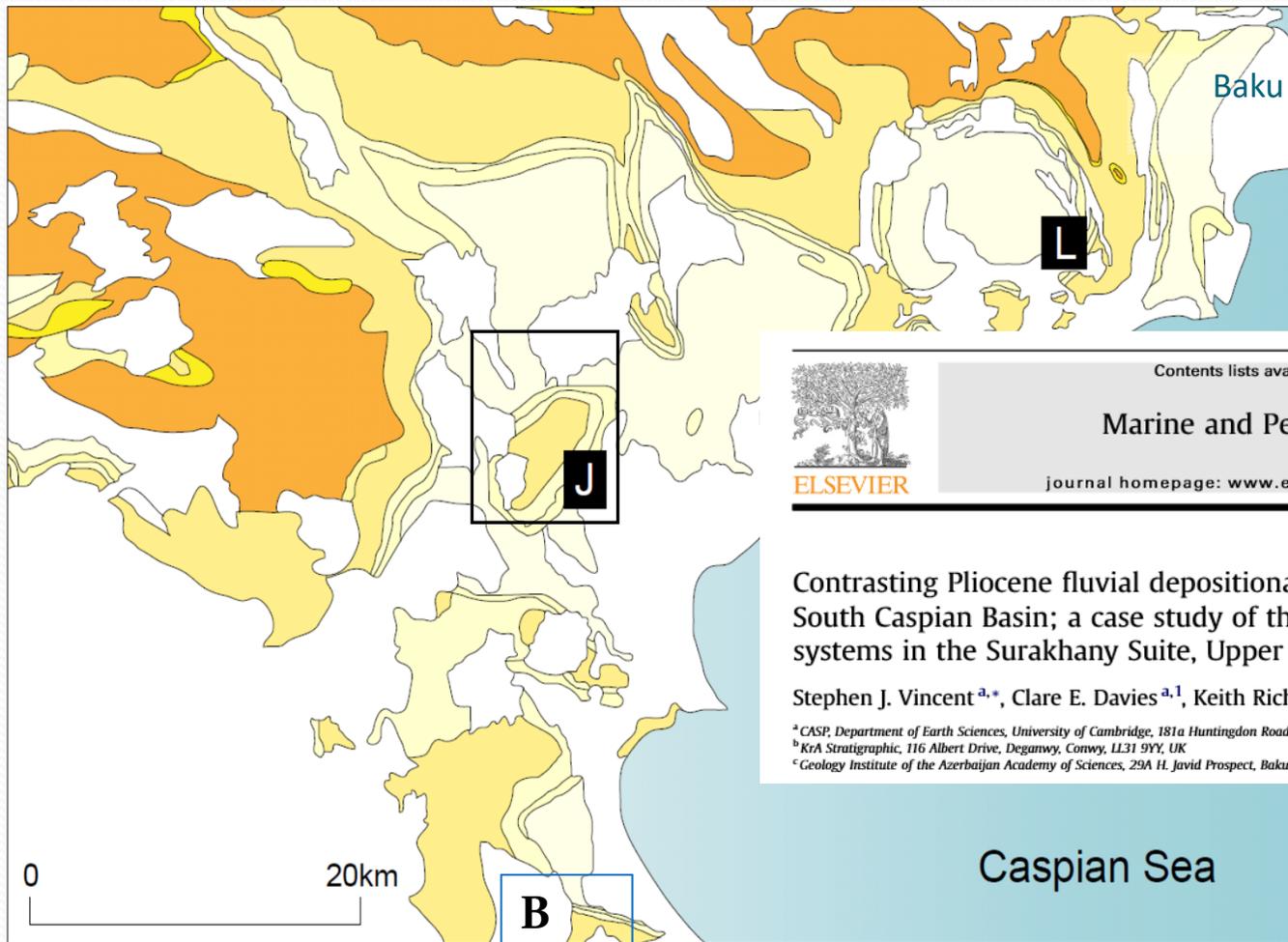


33

АЗЕРБАЙДЖАНСКОЕ ГОСУДАРСТВЕННОЕ ИЗДАТЕЛЬСТВО  
Баку • 1961

БЛИЦА CVII

# Lokbatan & Babazanan sections



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Marine and Petroleum Geology

journal homepage: [www.elsevier.com/locate/marpetgeo](http://www.elsevier.com/locate/marpetgeo)



Contrasting Pliocene fluvial depositional systems within the rapidly subsiding South Caspian Basin; a case study of the palaeo-Volga and palaeo-Kura river systems in the Surakhany Suite, Upper Productive Series, onshore Azerbaijan

Stephen J. Vincent<sup>a,\*</sup>, Clare E. Davies<sup>a,1</sup>, Keith Richards<sup>b</sup>, Elmira Aliyeva<sup>c</sup>

<sup>a</sup> CASP, Department of Earth Sciences, University of Cambridge, 181a Huntingdon Road, Cambridge, CB3 0DH, UK

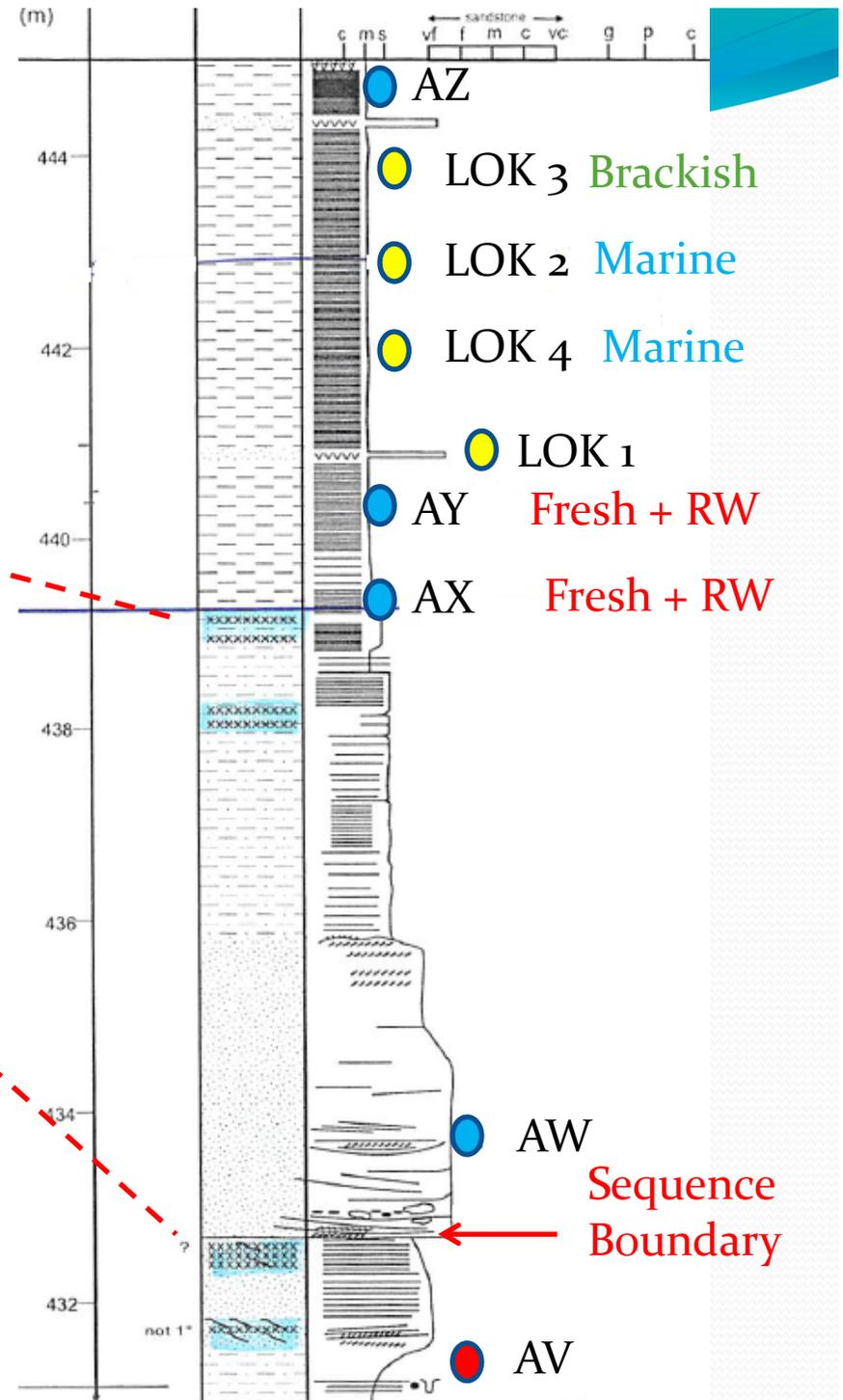
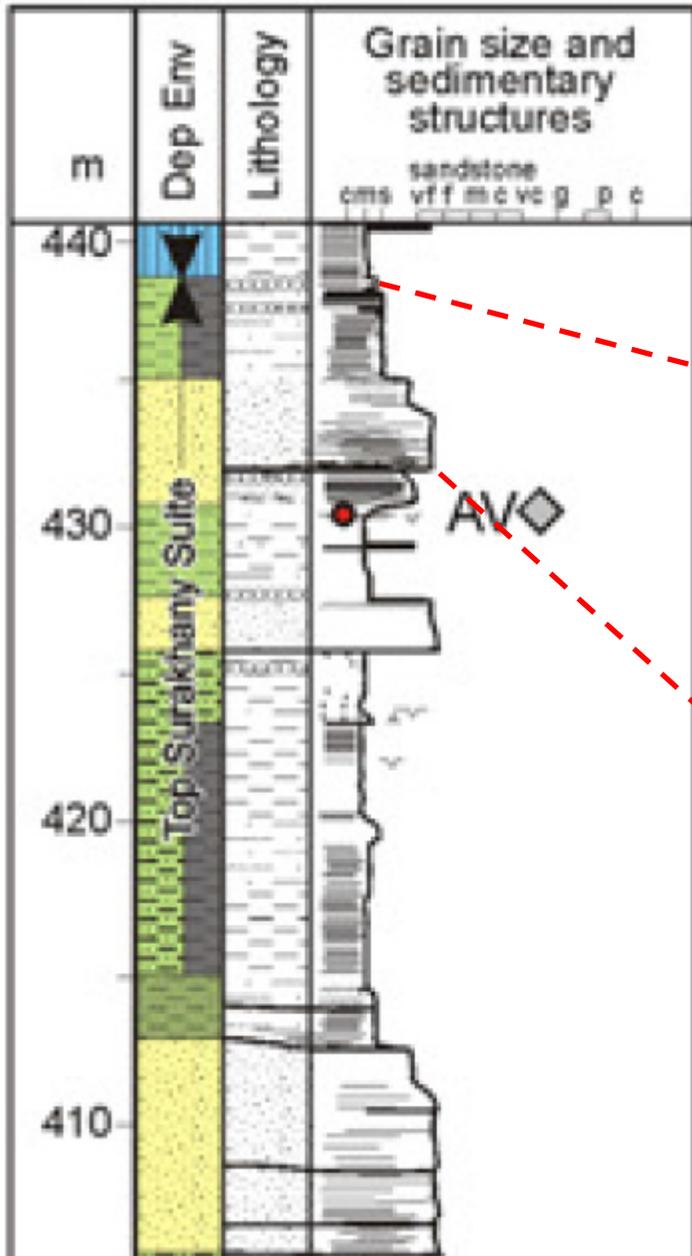
<sup>b</sup> KfA Stratigraphic, 116 Albert Drive, Deganwy, Conwy, LL31 9YY, UK

<sup>c</sup> Geology Institute of the Azerbaijan Academy of Sciences, 29A H. Javid Prospect, Baku, Azerbaijan

(Slide courtesy of C. Van Baak)

Simplified from Nalivkin, 1976

# LOKBATAN



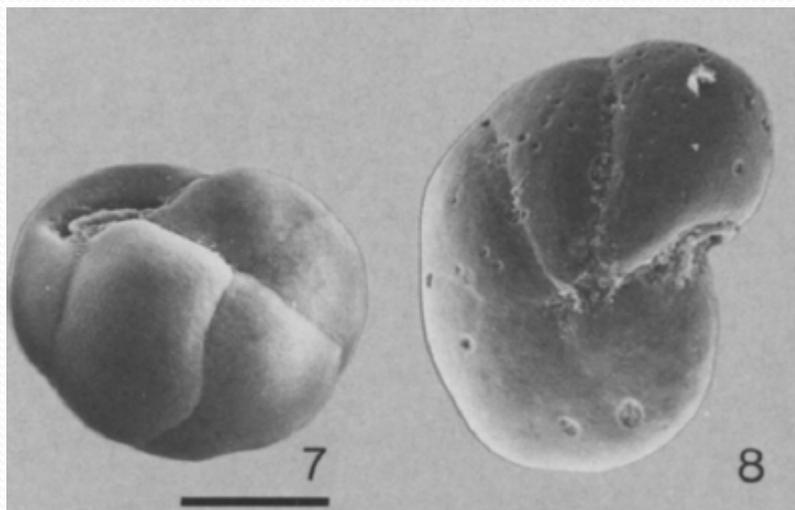


## FORAMINIFERAL STRATIGRAPHY AND ENVIRONMENT OF LATE WEICHSELIAN DEPOSITS ON THE CONTINENTAL SHELF OFF TROMS, NORTHERN NORWAY

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*University of Tromsø, Institute of Biology and Geology, P.O. Box 3085, Guleng, N-9001 Tromsø (Norway)*

(Received November 5, 1985; revised and accepted November 12, 1986)



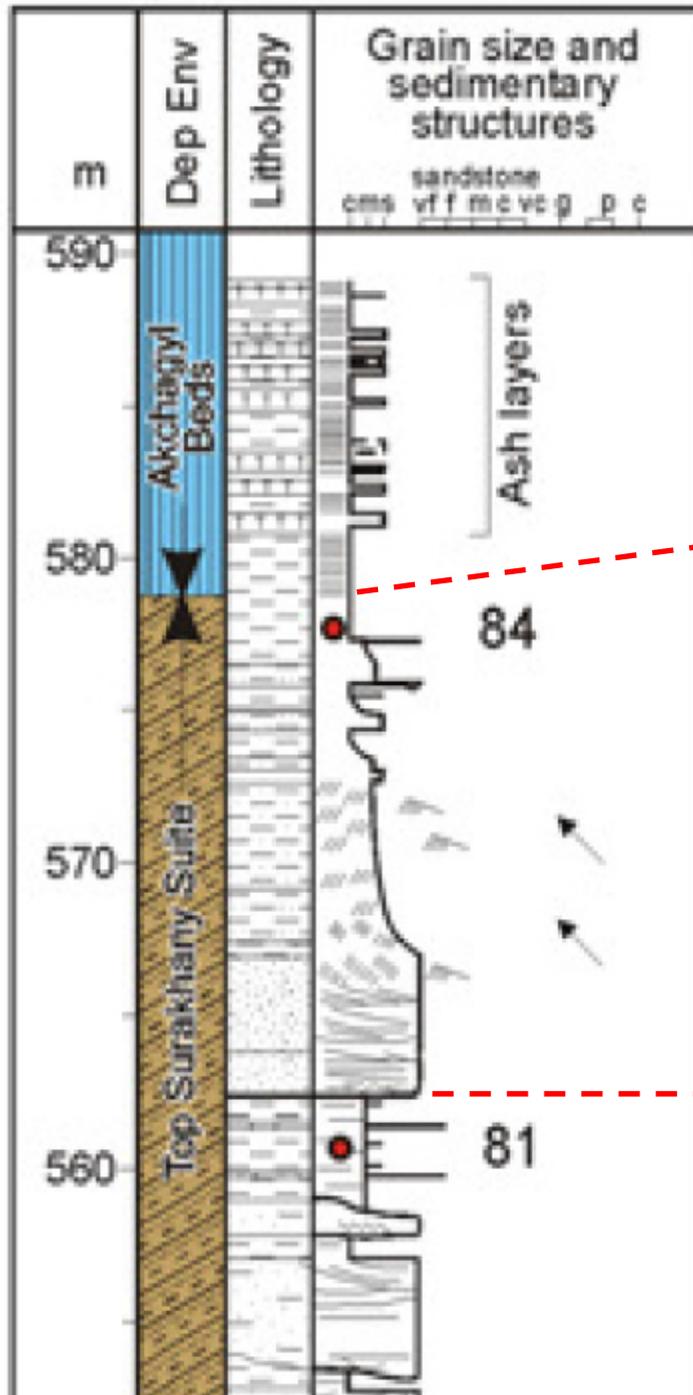
SEM-pictures of selected foraminifera. Scale bar is 100  $\mu\text{m}$ .

1. *Astrononion gallowayi*.
2. *Bolivina spissa*.
3. *Bolivina spissa*.
4. *Buccella frigida*.
5. *Cassidulina laevigata*.
6. *Cassidulina laevigata*.
7. *Cassidulina reniforme*.
8. *Cibicides lobatulus*.
9. *Elphidium excavatum*.

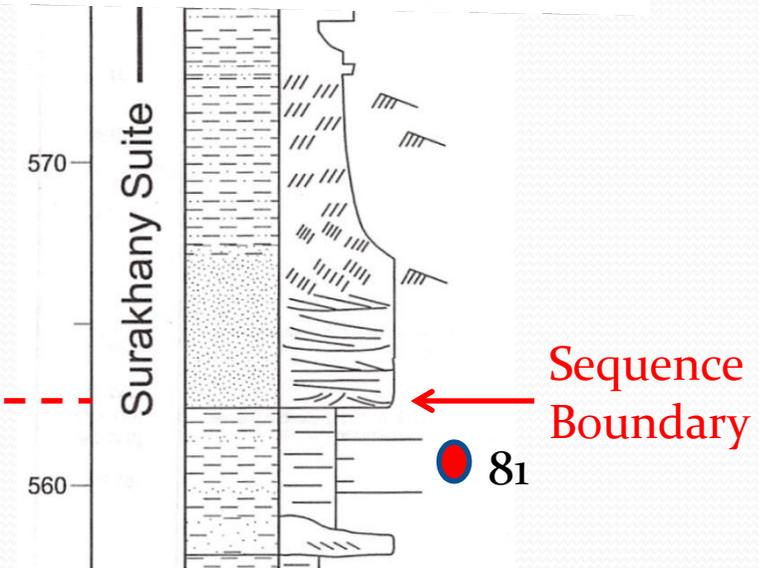
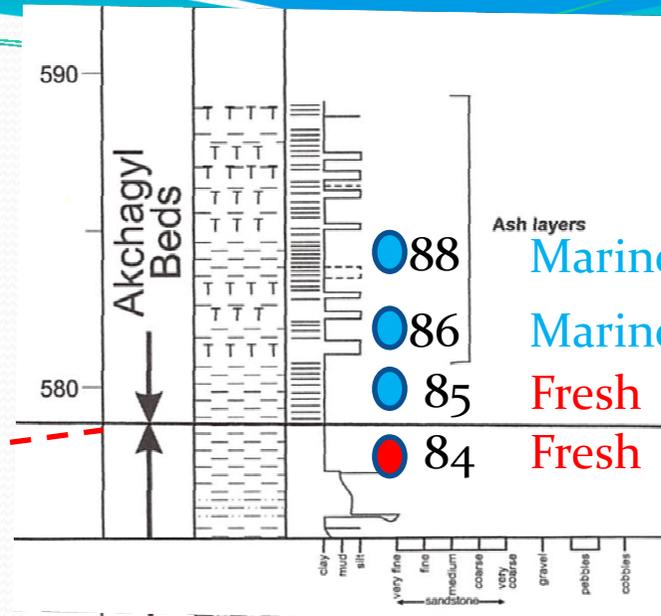
*Cassidulina reniforme* Nørvang (Plate I, 7)

1971 *Cassidulina crassa* d'Orbigny; Knudsen, p. 245, pl. 7, figs. 18-19.

1980 *Cassidulina reniforme* Nørvang; Sejrup and Guilbault, p. 79, fig. 2F-K.

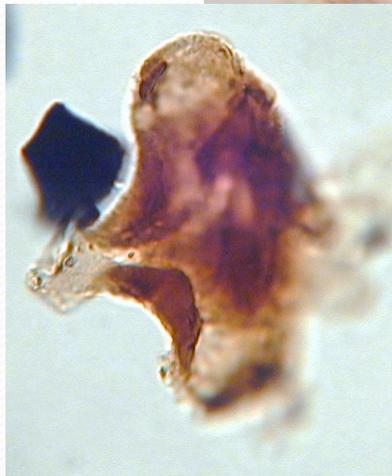


# BABAZANAN





# BABAZANAN



*Aquilapollenites / Triprojectus*



*Wodehousia*

Sample KB85: basal Akchagyl in Babazanan  
*Botryococcus* (freshwater algae)

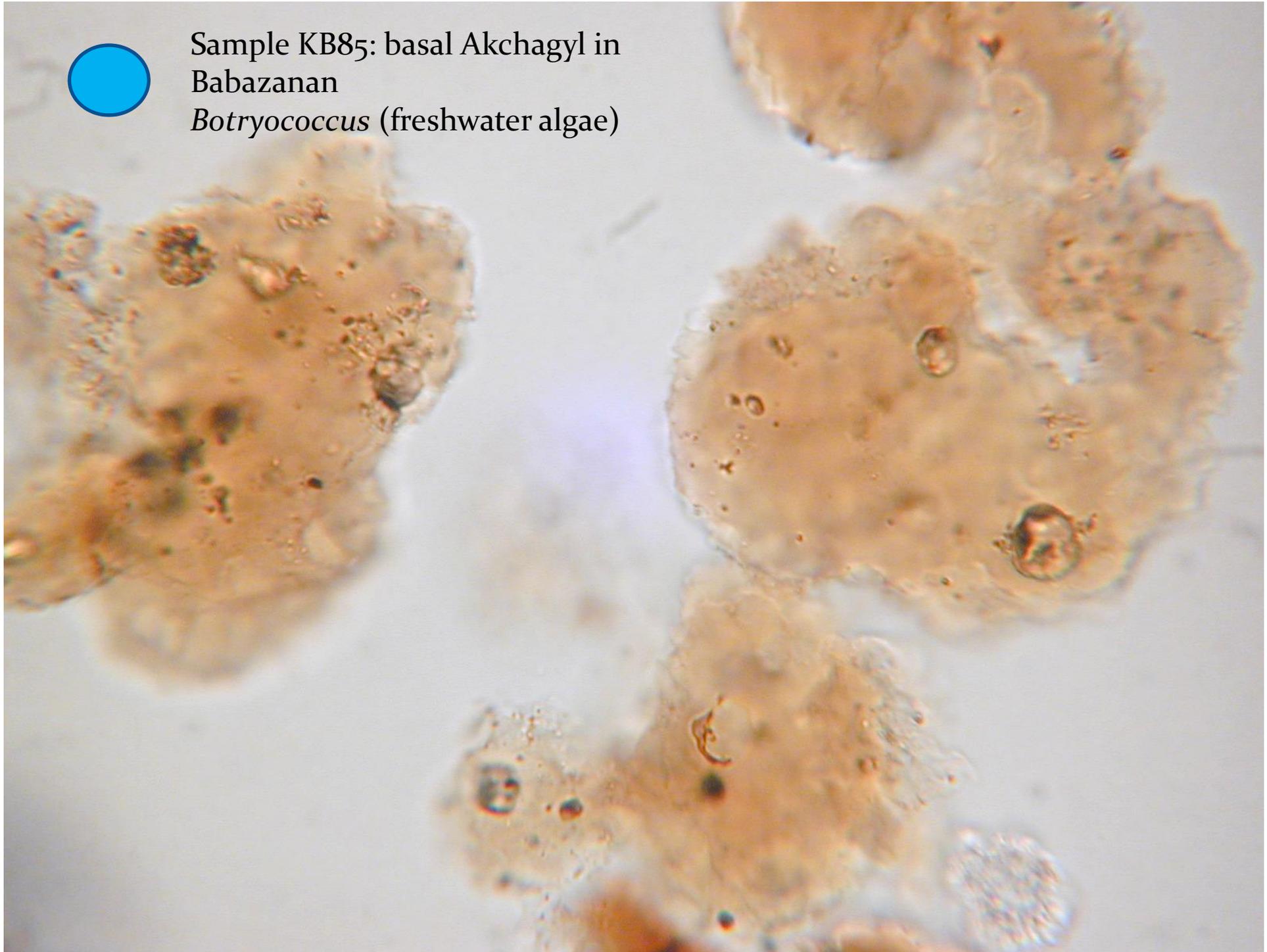


*Artemisia*

High latitude (~above 60°N) reworking (Paleogene / Late Cretaceous)

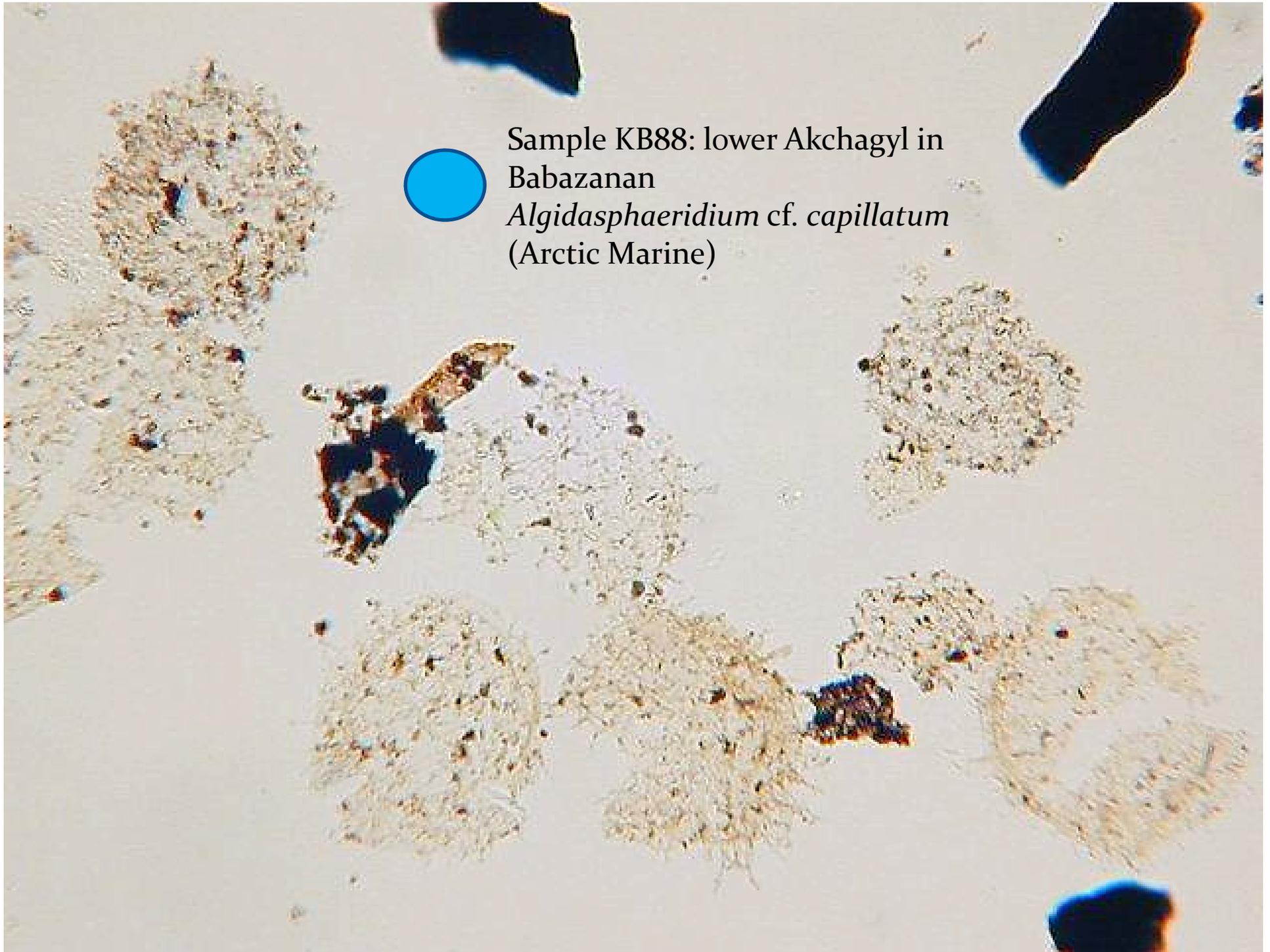


Sample KB85: basal Akchagyl in  
Babazanan  
*Botryococcus* (freshwater algae)





Sample KB88: lower Akchagyl in  
Babazanan  
*Algidasphaeridium* cf. *capillatum*  
(Arctic Marine)





CENOZOIC DINOFLAGELLATE CYSTS FROM THE NAVARIN BASIN,  
NORTON SOUND AND ST. GEORGE BASIN, BERING SEA

Kazumi MATSUOKA<sup>1)</sup> and Jonathan P. BUJAK<sup>2)</sup>

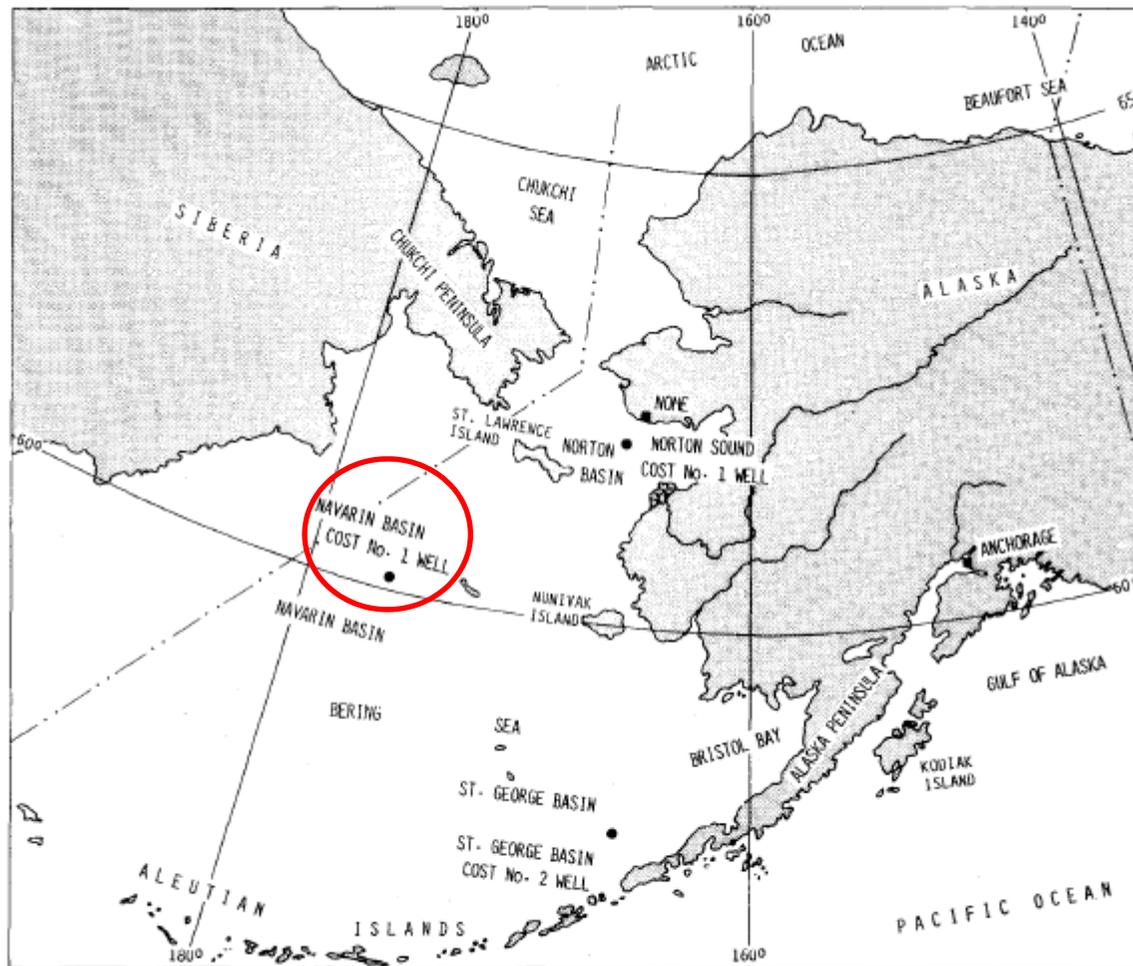
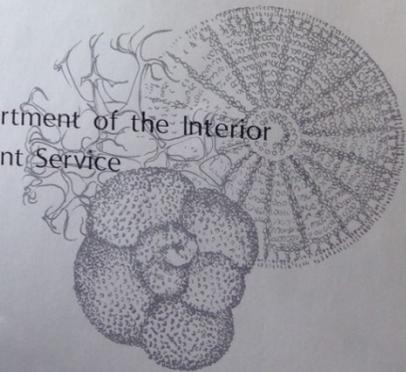
Biostratigraphic studies in the Navarin Basin COST No. 1 well, Norton Sound COST No. 1 well and St. George Basin COST No. 2 well in the Bering Sea were carried out based on dinoflagellate cyst and acritarch assemblages. Several local dinoflagellate cyst zones

Totally thirty-four genera and seventy species of dinoflagellates including one new genus (*Algidasphaeridium*) and twenty new species, and three genera and three species of acritarchs containing one new genus and species (*Joviela magnifica*) are recorded from the three wells.

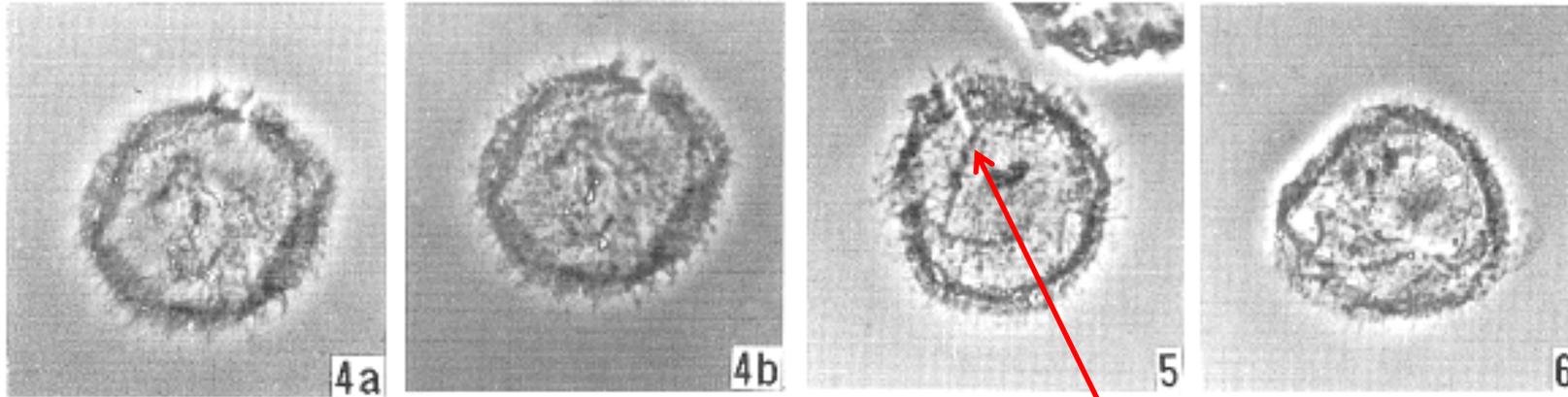
## Geological and Operational Summary NAVARIN BASIN COST NO. 1 WELL

### Bering Sea, Alaska

United States Department of the Interior  
Minerals Management Service



Text-figure 1 Location map of the Navarin Basin COST No. 1 well, Norton Sound COST No. 1 well and St. George Basin COST No. 2 well.



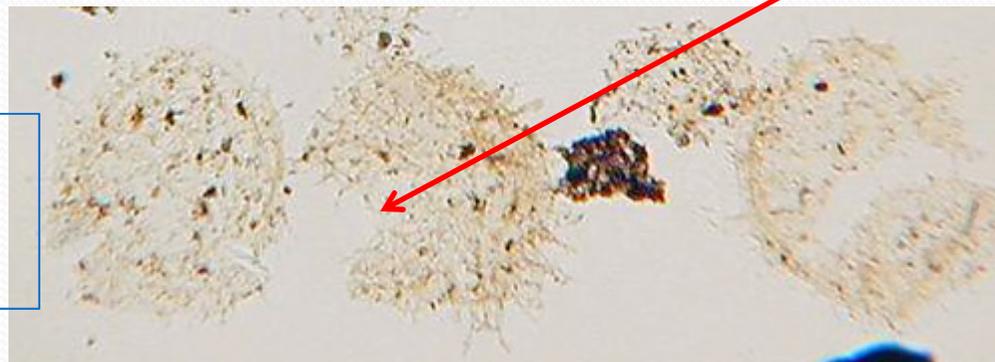
Figs. 4-6 *Algidasphaeridium capillatum* gen. et sp. nov.

4 : Paratype, slide no. Navarin 4530-4620ft R5, showing a chasmic archeopyle (a) and showing hair-like spines (b).

5 : Holotype, slide no. Navarin 4530-4620ft R4, showing a chasmic archeopyle.

6 : Paratype, slide no. Navarin 4530-4620ft R8.

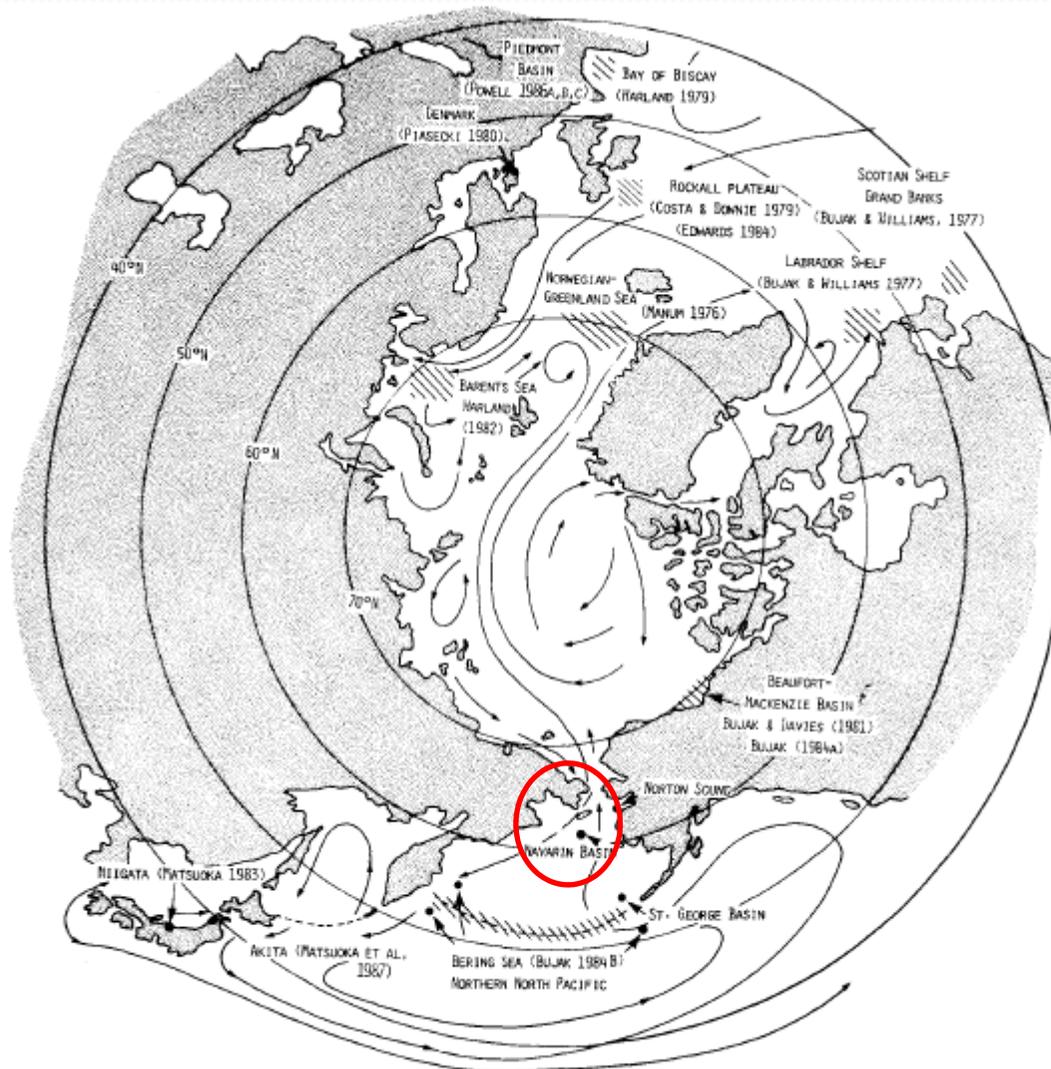
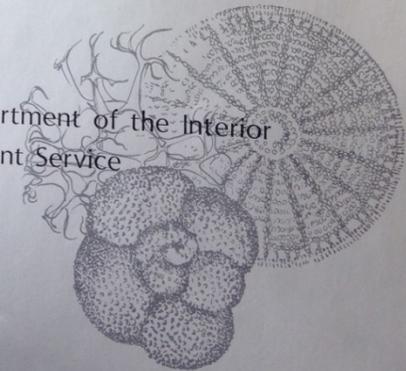
Caspian Sea  
Akchagyl  
specimens



Geological and Operational Summary  
NAVARIN BASIN COST NO. 1 WELL

Bering Sea, Alaska

United States Department of the Interior  
Minerals Management Service



Text-figure 3 Published Neogene dinoflagellate cyst studies in the northern hemisphere and generalized modern current systems.

Turner (1984) .... Late Miocene interval with *Algidasphaeridium* deposited in water ~20 to 100m deep. Co-occurs with Cassidulinid forams.....



## Research article

## Flooding of the Caspian Sea at the intensification of Northern Hemisphere Glaciations

Christiaan G.C. Van Baak<sup>a,b,\*</sup>, Arjen Grothe<sup>a,c</sup>, Keith Richards<sup>d,e</sup>, Marius Stoica<sup>f</sup>, Elmira Aliyeva<sup>g</sup>, Gareth R. Davies<sup>h</sup>, Klaudia F. Kulper<sup>h</sup>, Wout Krijgsman<sup>a</sup>

Global and Planetary Change 174 (2019) 153–163

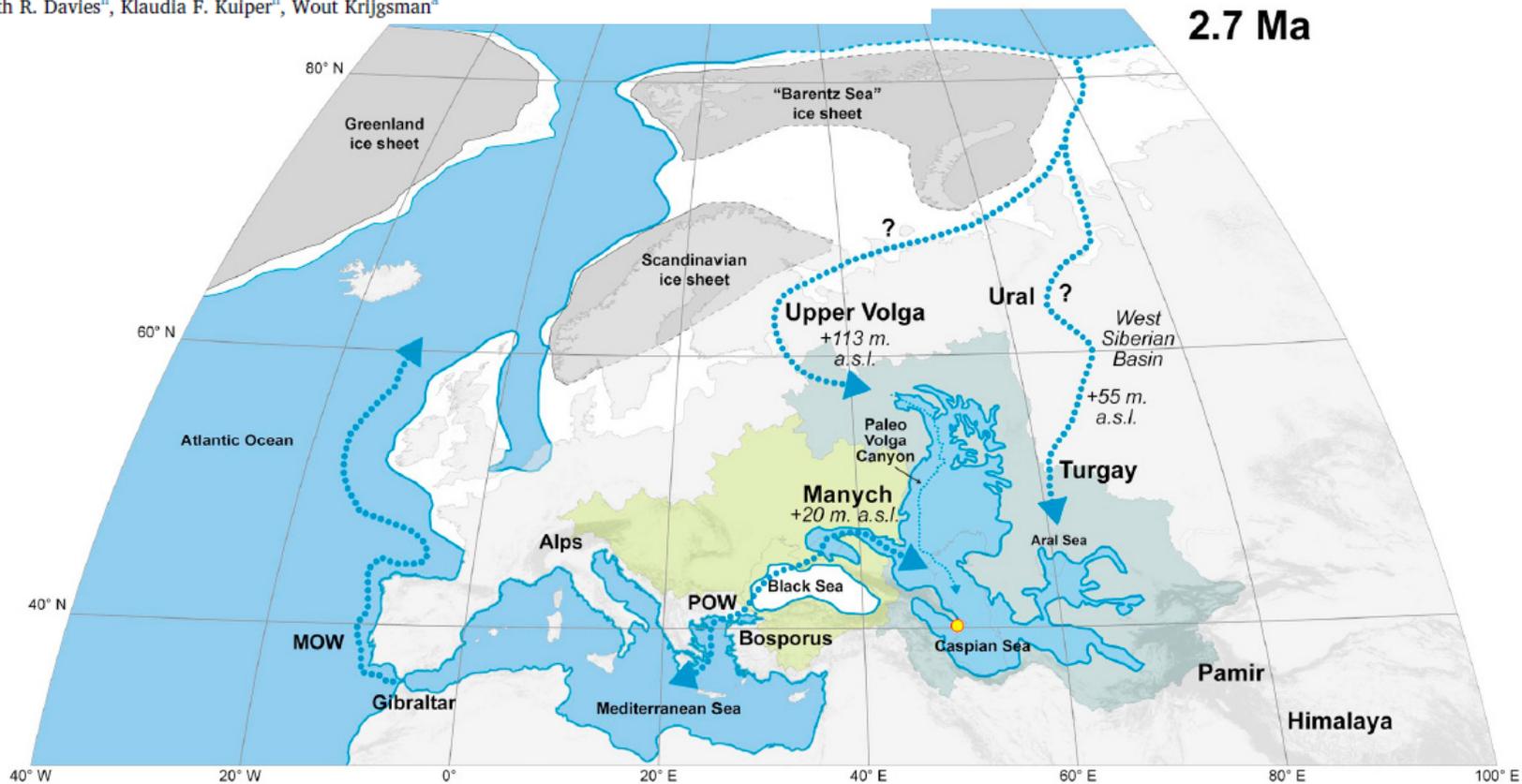
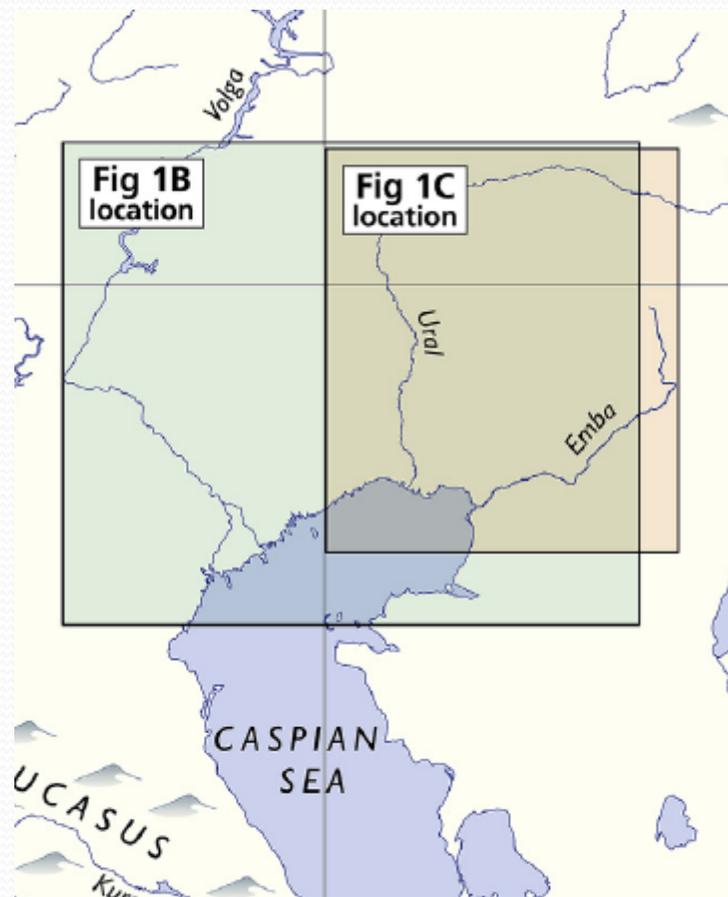


Fig. 8. Paleogeographic map of Eurasia at ~2.7 Ma during the intensification of Northern Hemisphere Glaciations. Indicated are potential marine gateways with the minimum present-day elevation which needs to be crossed to enter the Caspian drainage. In yellow and grey the present-day Black Sea and Caspian Sea drainages. The yellow dot indicates the location of the Jeirankechmez section. In light grey the likely extend of the Scandinavian and Barentz ice sheets, dashed lines indicating uncertain positions. Caspian reconstruction after [Vinogradov \(1969\)](#). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

# EMBA – URAL REGION: Location



УДК 551.782(574.1)

В. И. БЕНЬЯМОВСКИЙ, О. Д. ПАИДИА

ФАУНИСТИЧЕСКИЕ И ПАЛИНОЛОГИЧЕСКИЕ КОМПЛЕКСЫ  
АКЧАГЫЛА В МЕЖДУРЕЧЬЕ УРАЛА И УИЛА  
(ВОСТОЧНЫЙ ПРИКАСПИЙ)

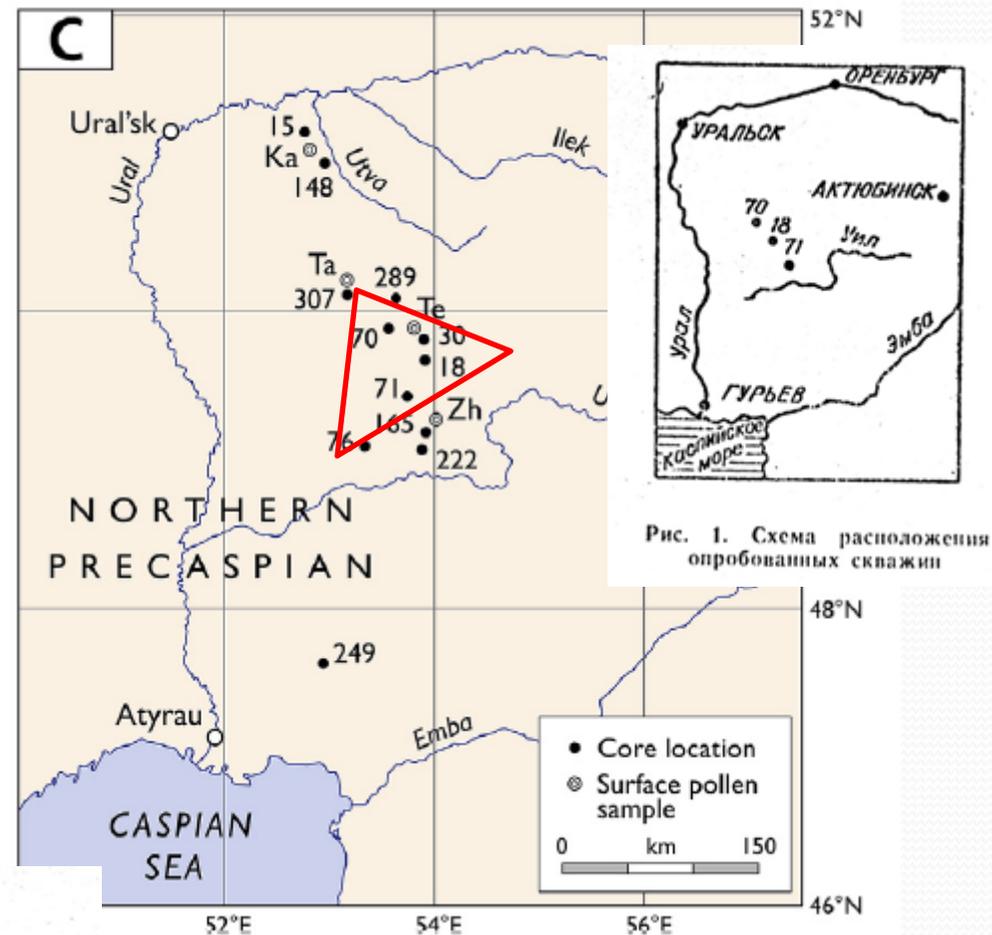
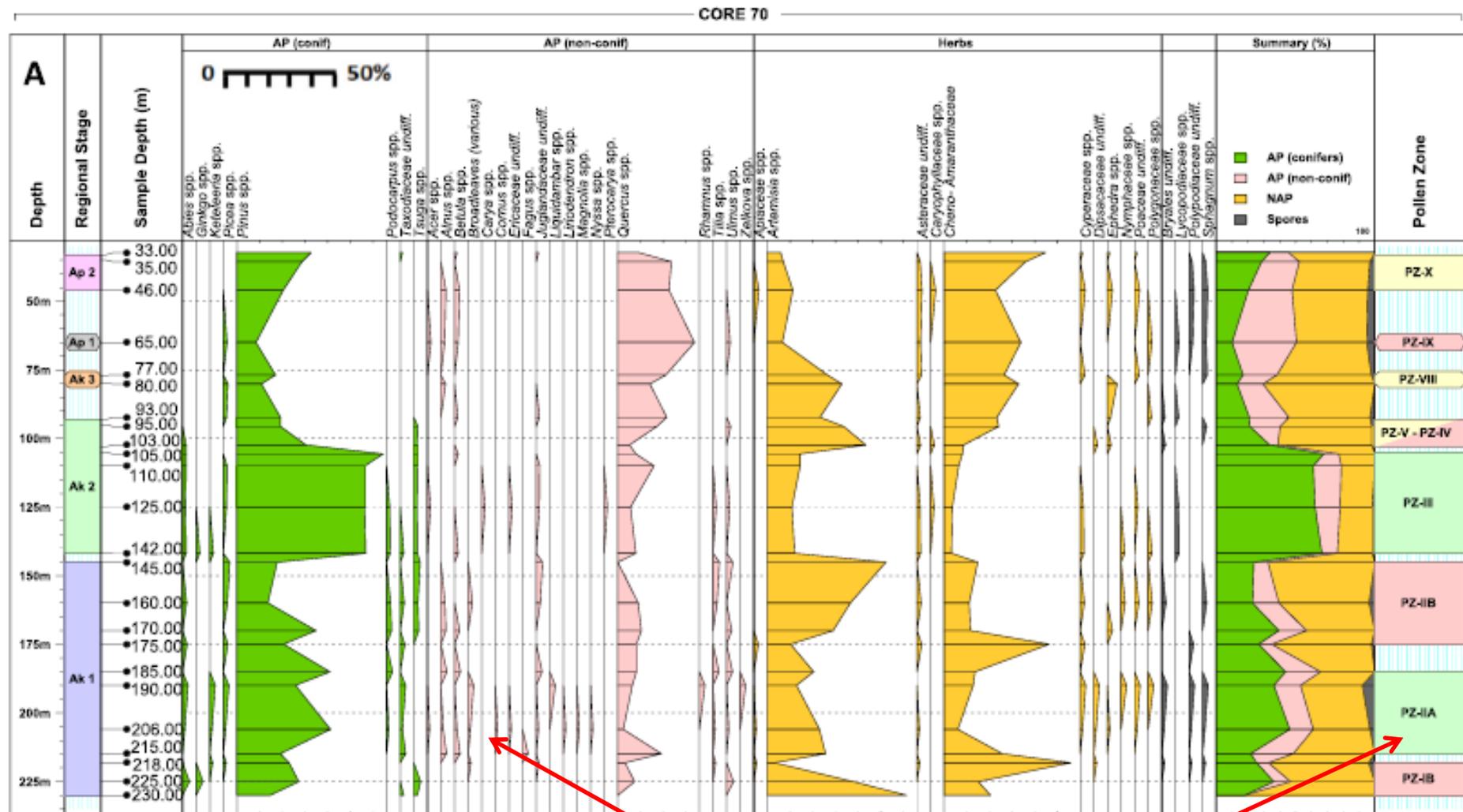


Рис. 1. Схема расположения опробованных скважин

МОСКОВСКИЙ ОРДЕНА ТРУДОВОГО КРАСНОГО ЗНАМЕНИ  
ГЕОЛОГОРАЗВЕДОЧНЫЙ ИНСТИТУТ ИМЕНИ СЕРГО ОРДЖОНИКИДЗЕ  
МОСКВА — 1990

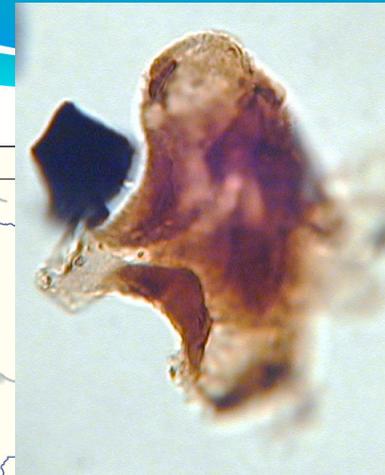
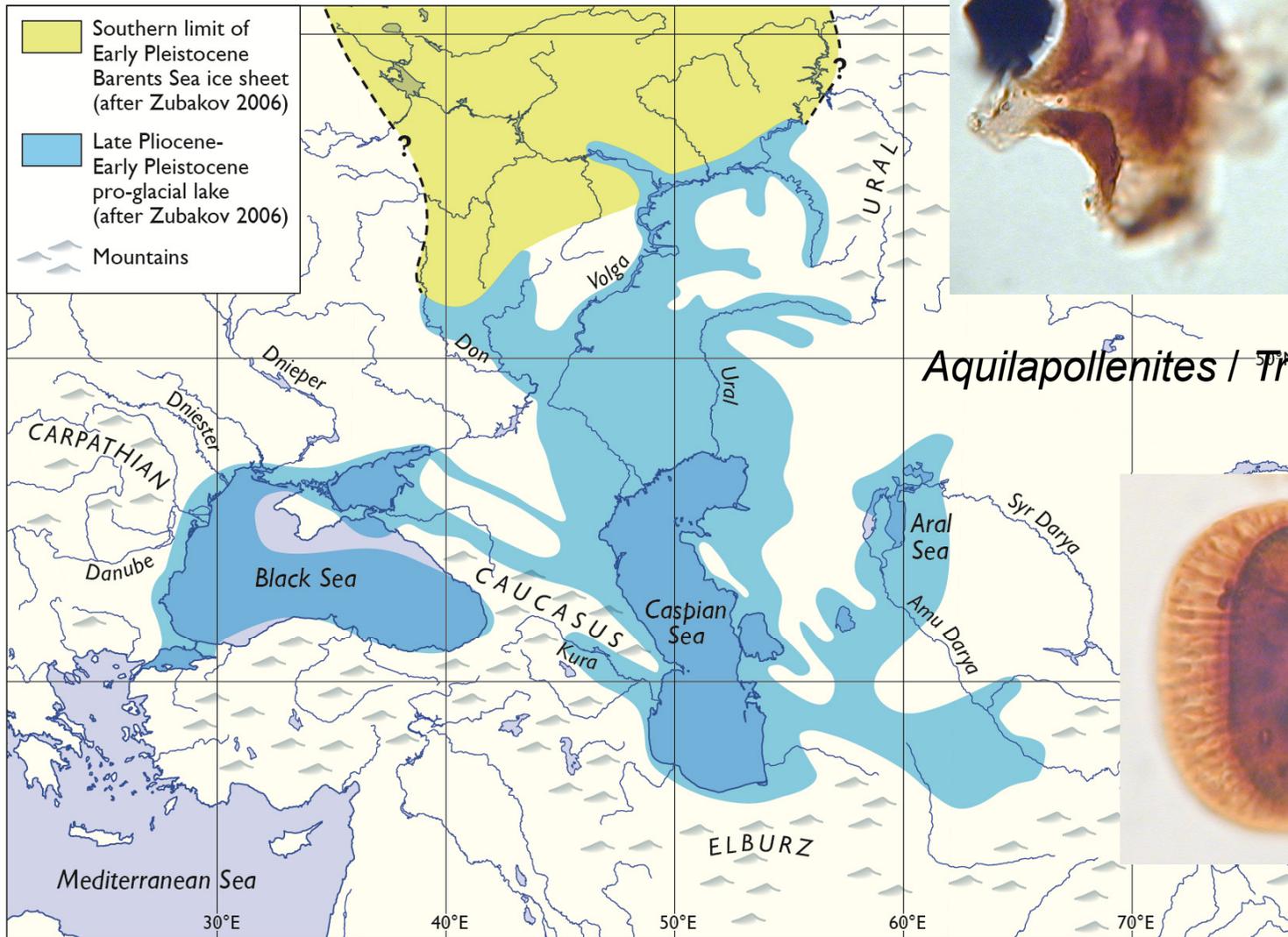
# EMBA – URAL REGION: Pollen analysis



(by Olga Naidina)

“Mid Pliocene Warm Period” c. 3.2 to 3.0 Ma



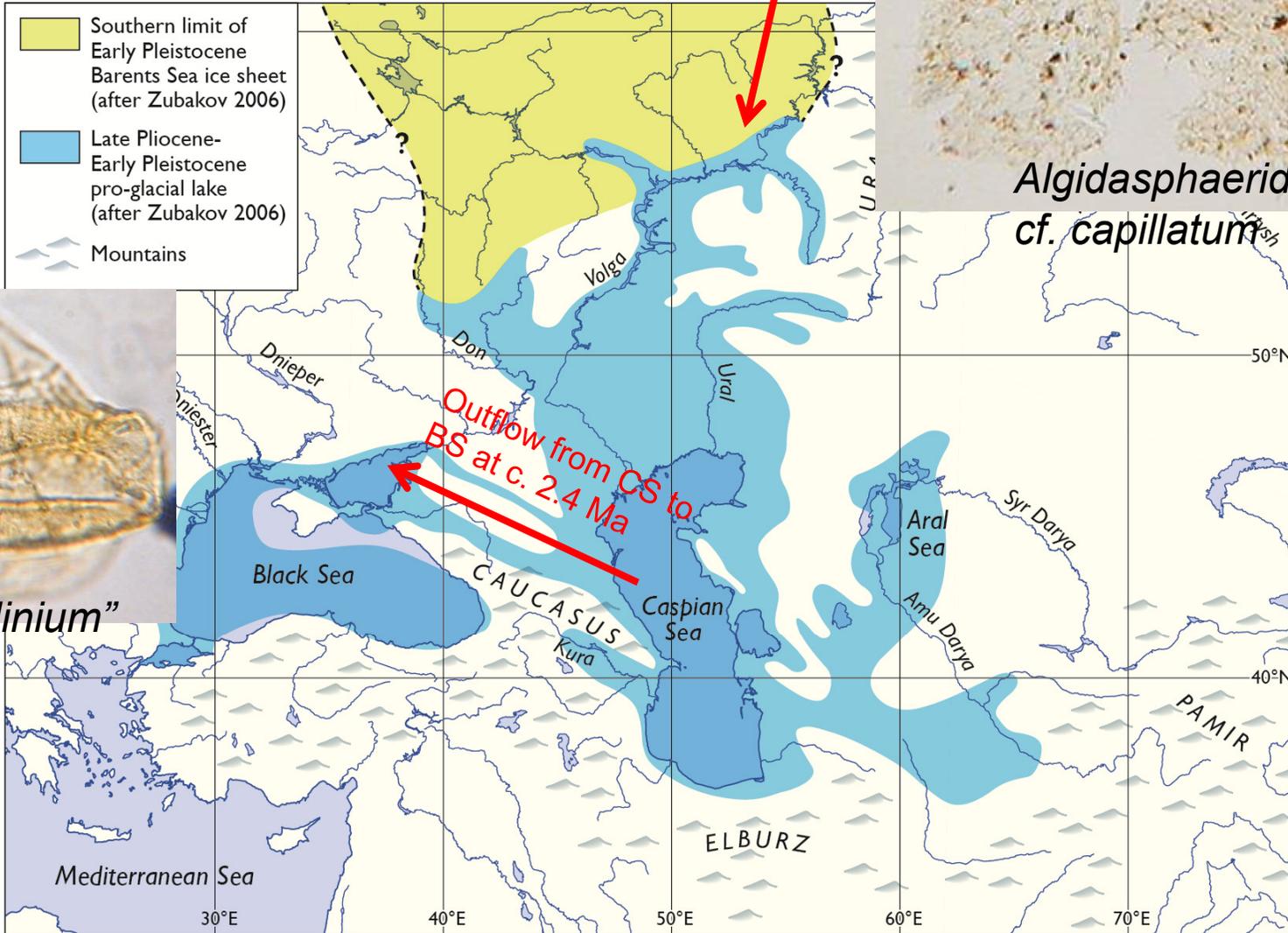


*Aquilapollenites / Triprojectus*



*Wodehousia*

Connection from CS to Arctic  
Ocean via Volga canyon (c.  
2.6 Ma based on new data)

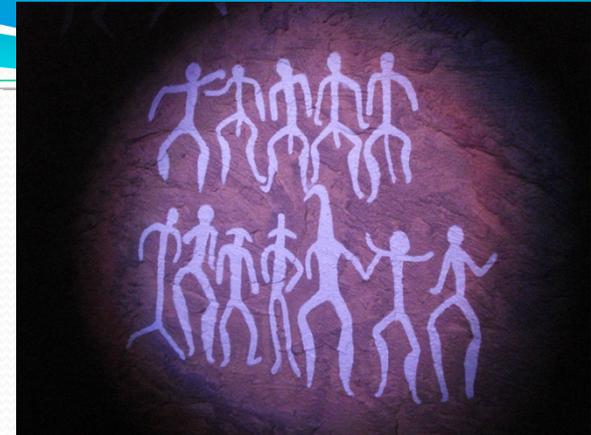


- Southern limit of Early Pleistocene Barents Sea ice sheet (after Zubakov 2006)
- Late Pliocene-early Pleistocene pro-glacial lake (after Zubakov 2006)
- Mountains





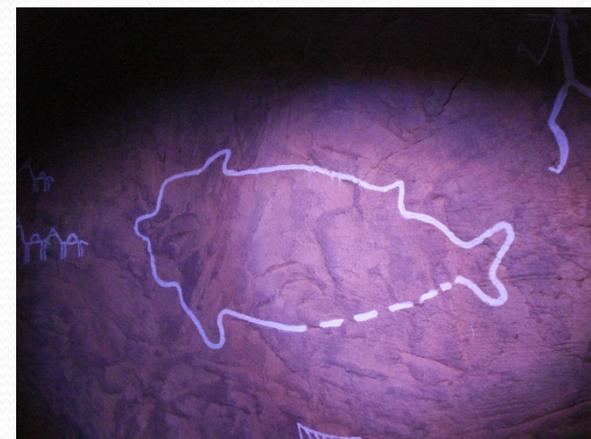
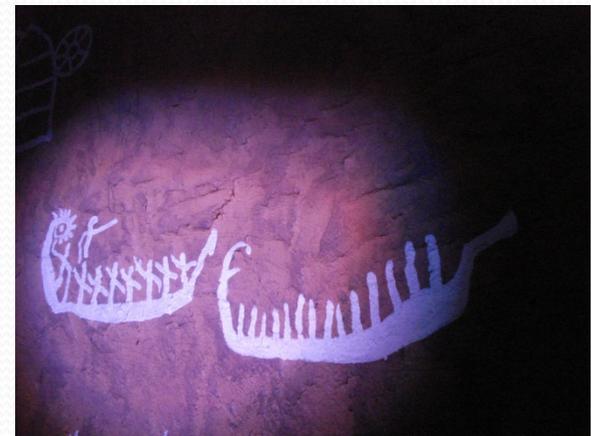
Apsheeronian



Apsheron limestone (caprock) and Late Pleistocene rock art at Gobustan..... embellished!



Apsheronian outcrop (Turianchay)

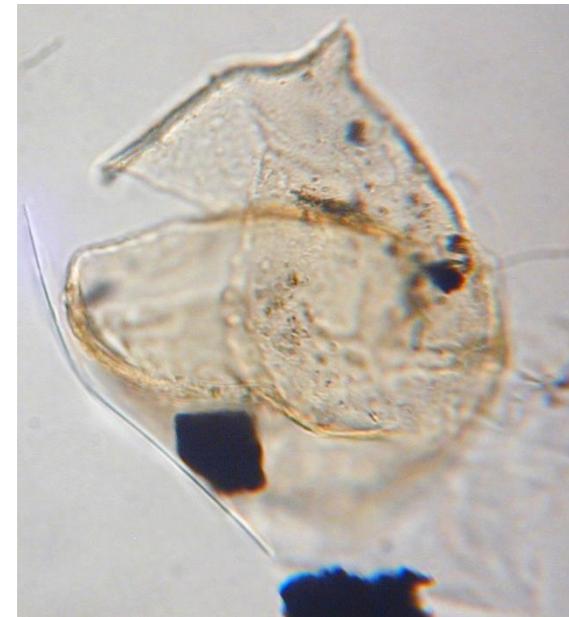


**Apsheronian dinocysts at the  
Garagush locality (Early Pleistocene)**

Frequent presence of 'noded cysts'  
of the '*Pontiadinium*' lineage

(now *Impagidinium*? and/or  
*Komewuia*?)

First described from the Middle / Late  
Miocene (Pannonian) of Hungary by  
Maria Suto-Szentai



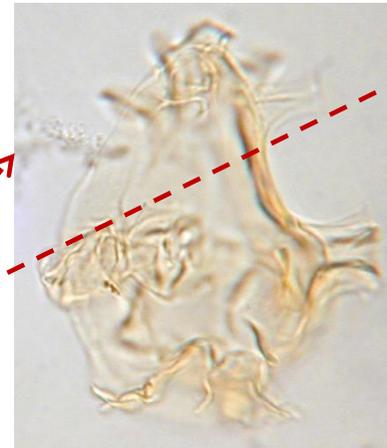
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Also present 'noded' *Spiniferites* of  
the '*bentorii* – *pannonicus* –  
*tihanyensis*' lineages



## CONCLUSIONS

- Potential to develop **Sequence Correlation** which is independent of lithology, e.g. Upper Productive Series to Akchagyl transition.
- Akchagylian..... only marine in part, '**Arctic affinity**'.
- Data from Emba-Urals suggests “failed transgression” linked to “Mid-Pliocene Warm Period” (rising global sea levels ~3.2 Ma).
- Apsheronian.... '**Pannonian affinity**' suggesting links with Black Sea region.
- Detailed sub-division and age/environmental interpretation using multi-proxy approach, e.g. magnetostratigraphy, Ar/Ar dating of ash layers and biostratigraphy.

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# Thank You !!

