Not the sea and not a lake: meromictic water bodies separated from the White Sea

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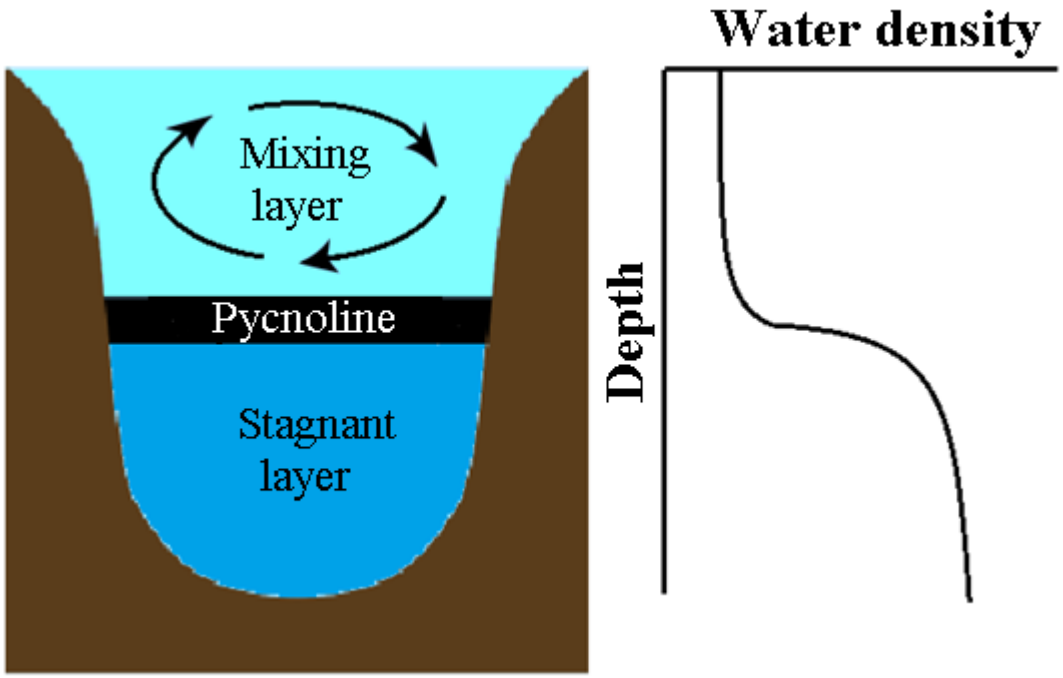
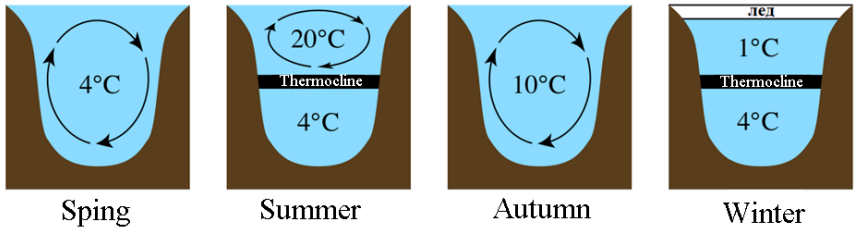
Vertical structure of meromictic lake



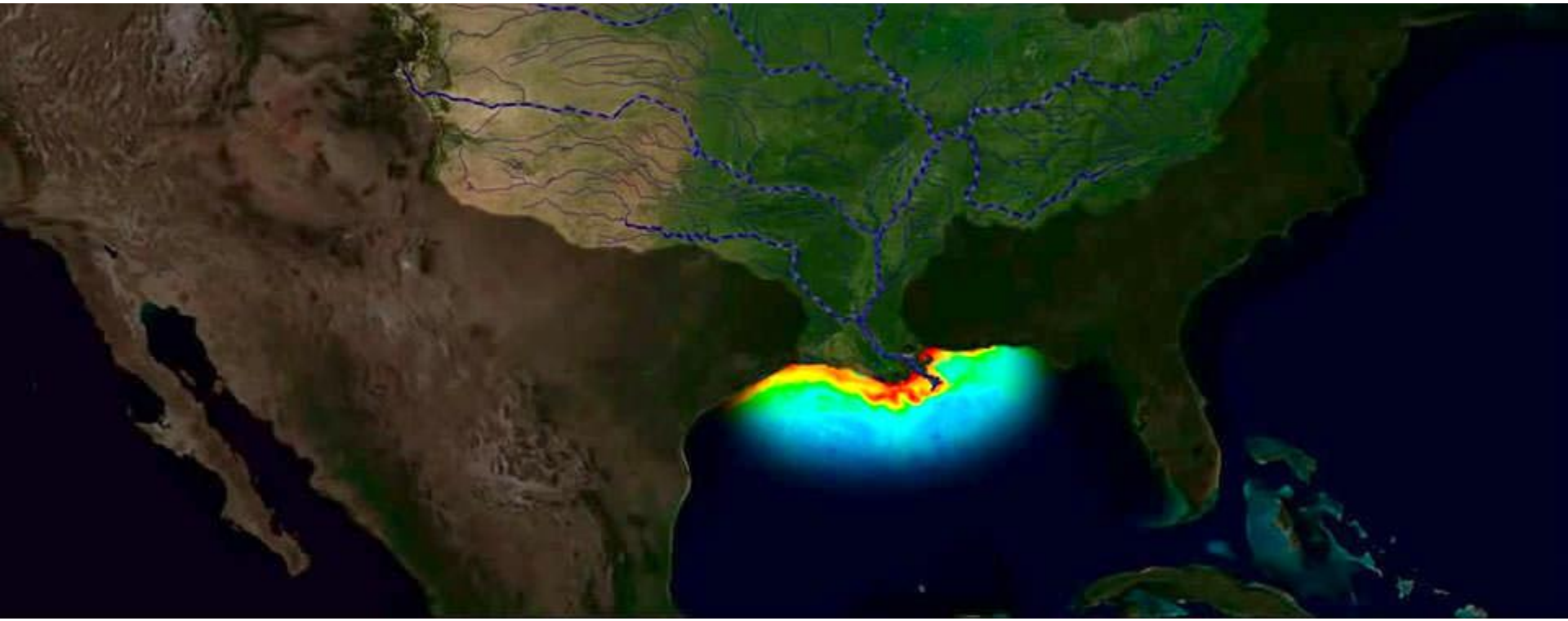
Bacterial sulfate-reduction:

$CH_4 + SO_4^{2-} \rightarrow HCO_3^- + HS^- + H_2O$

Holomictic dimictic lake

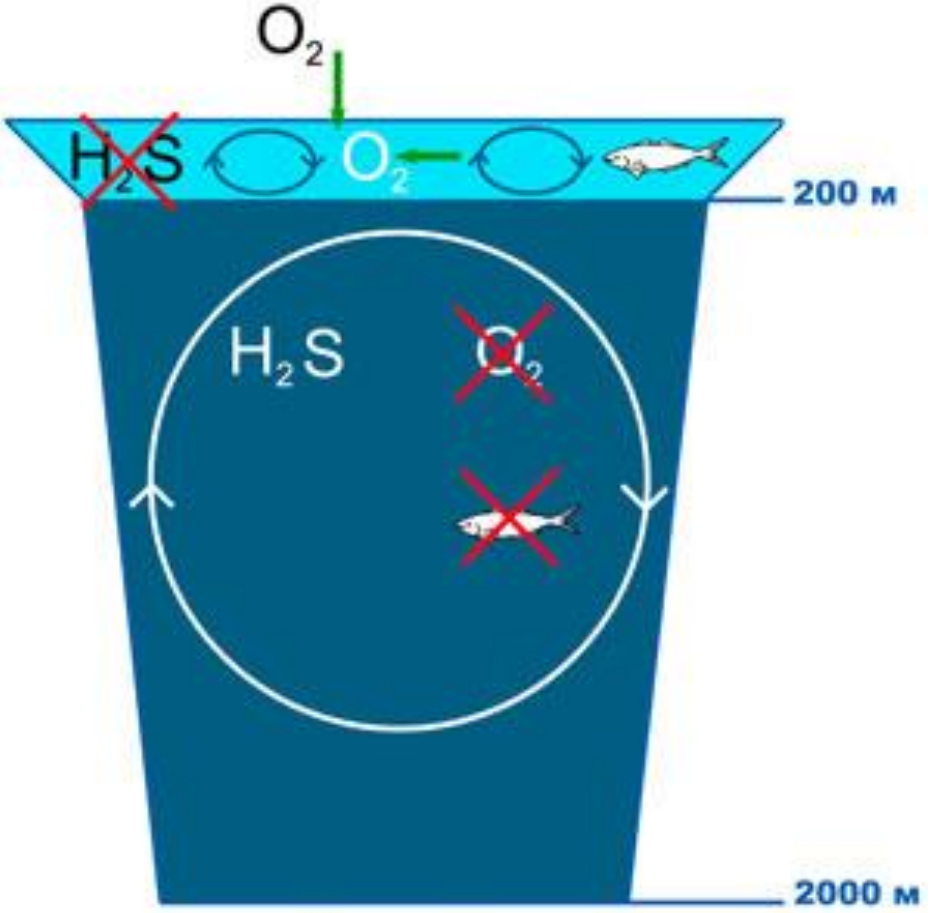


Dead zone in the Gulf of Mexico

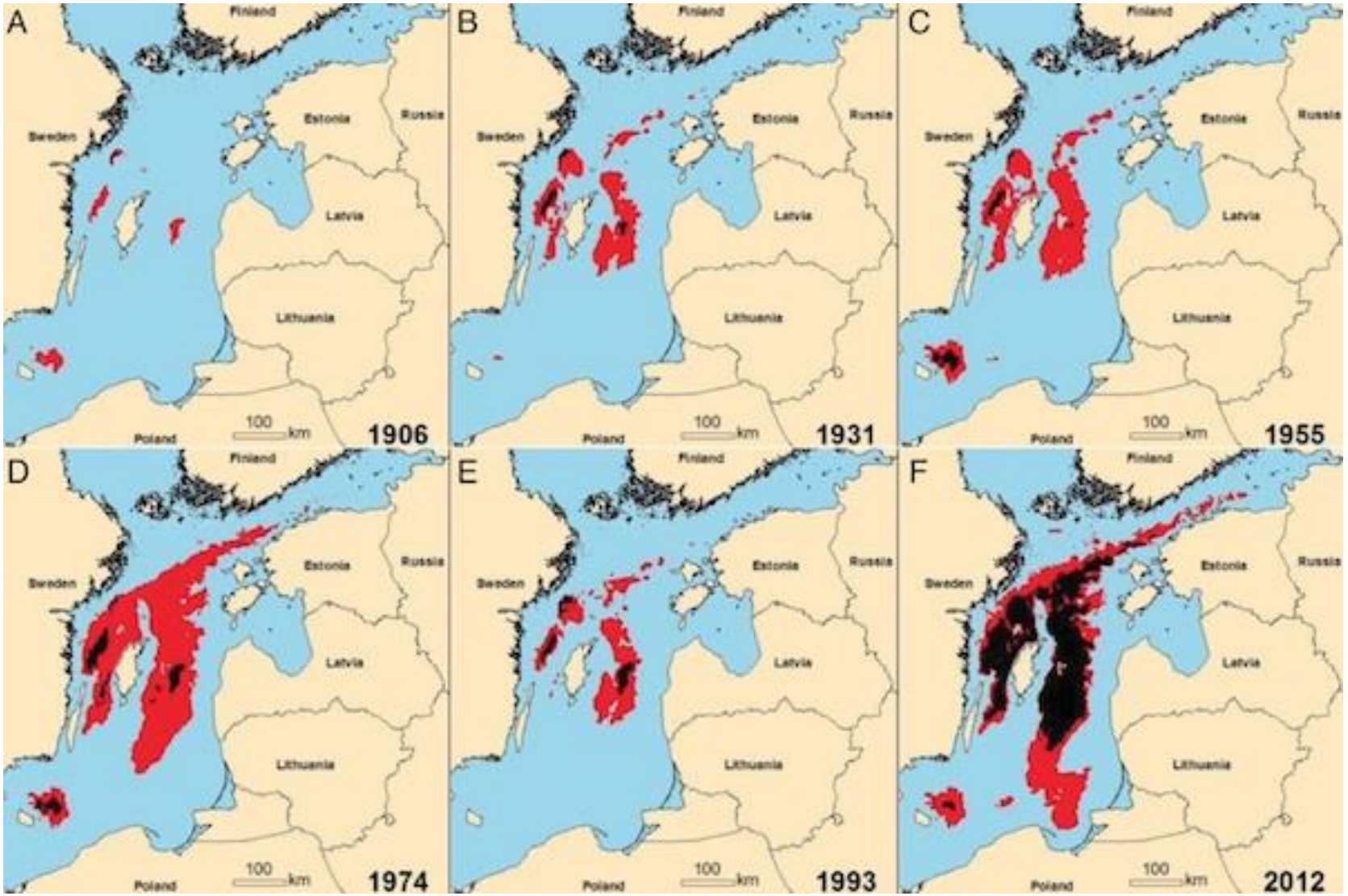


In 2016 – 16 000 km^2

Black Sea is the largest meromictic water body with the dead zone of natural origin



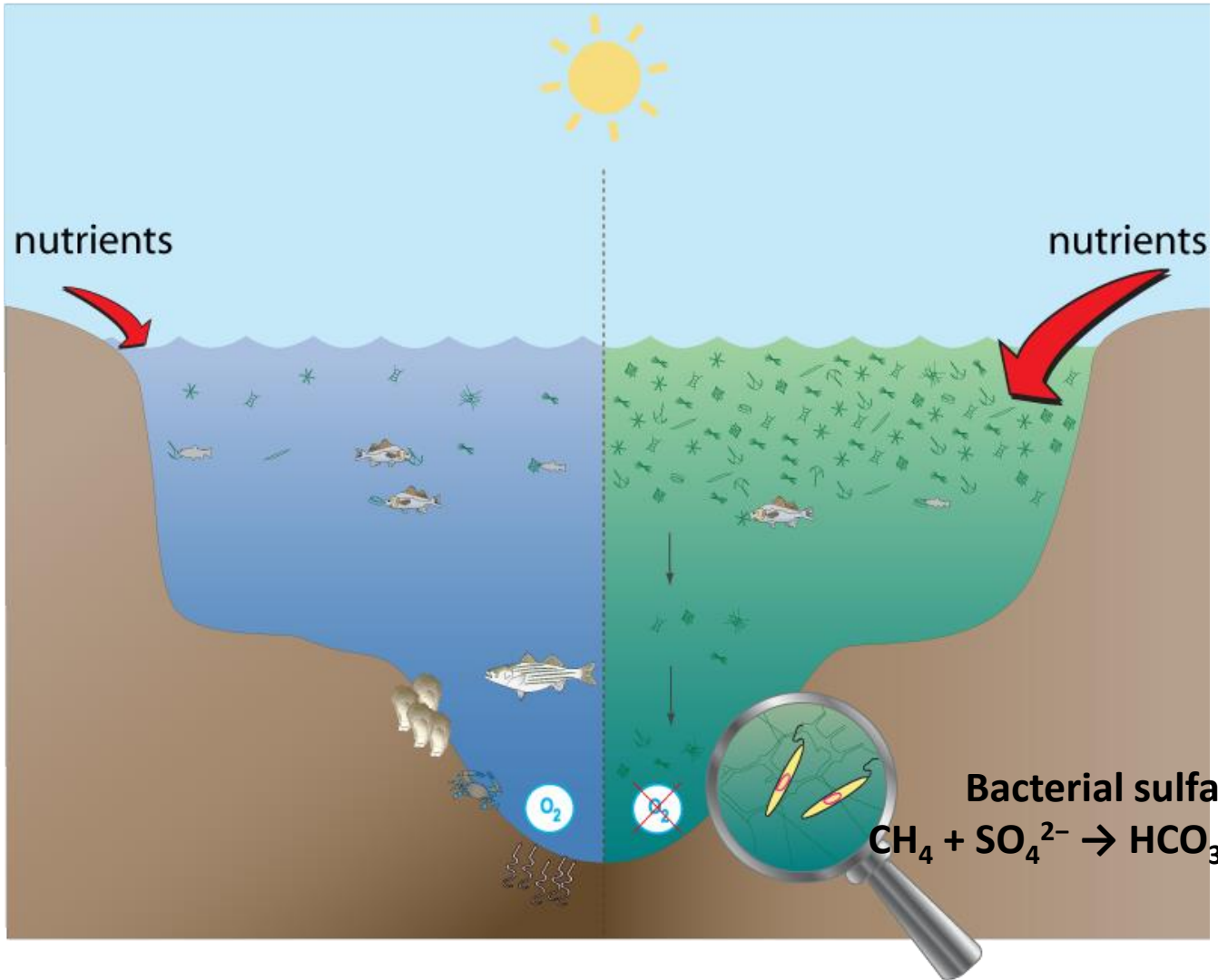
Dead zone in the Baltic Sea



In 2012 – 70 000 km^2

How does dead zone forms

Cause 1. Eutrofication.

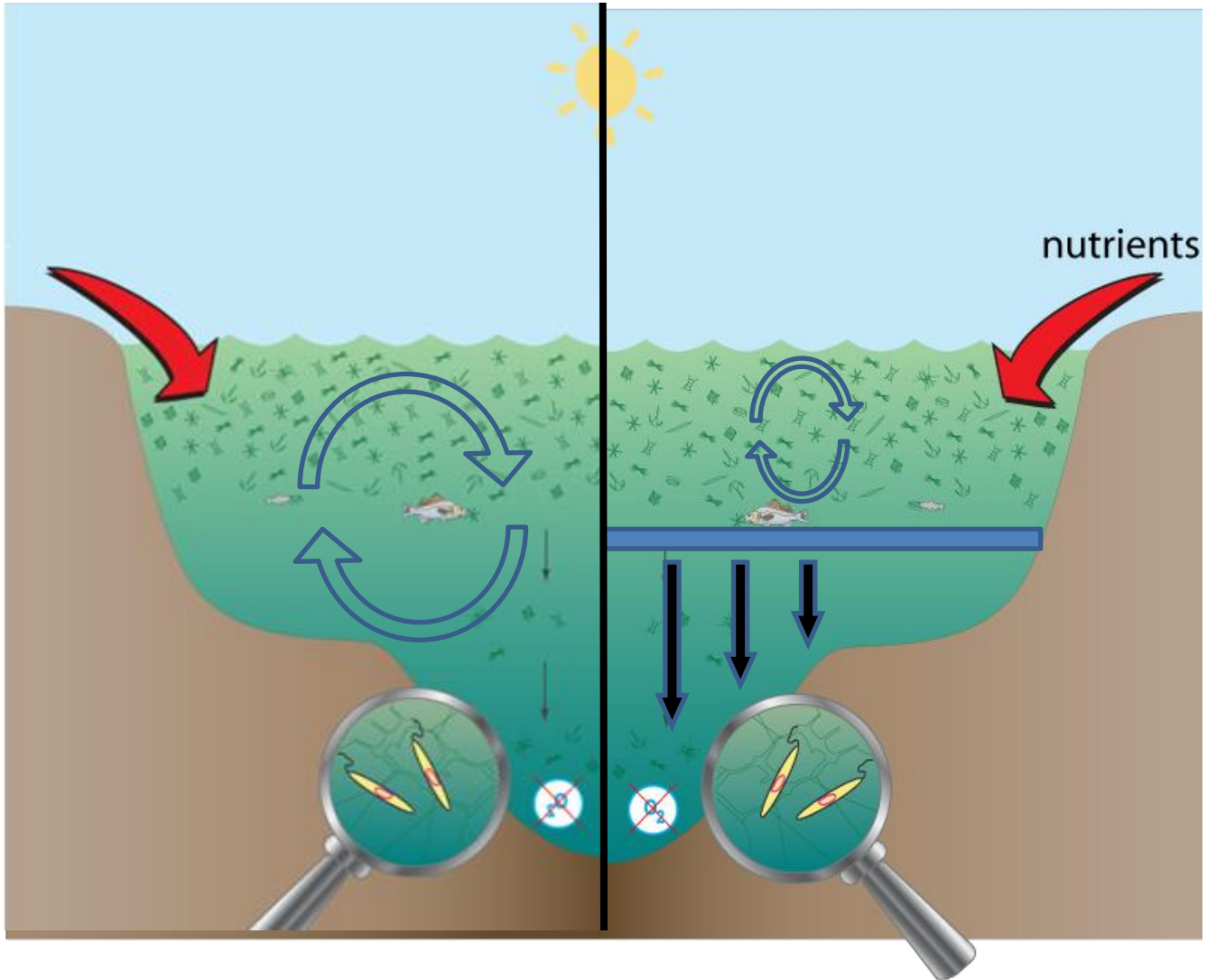


Bacterial sulfate-reduction:

$$CH_4 + SO_4^{2-} \rightarrow HCO_3^- + HS^- + H_2O$$

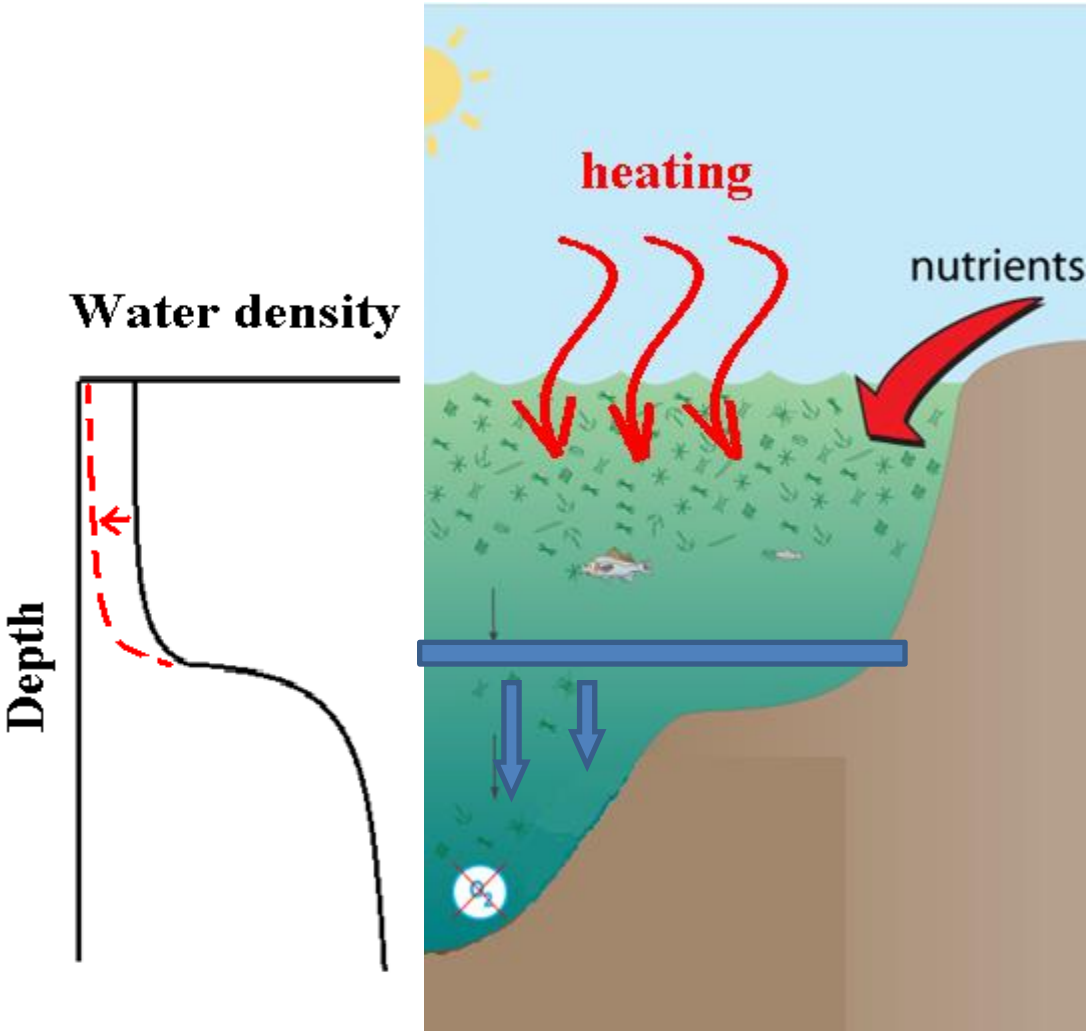
How does dead zone forms

Cause 2. Stratification.



How does dead zone forms

Cause 3. Global warming.



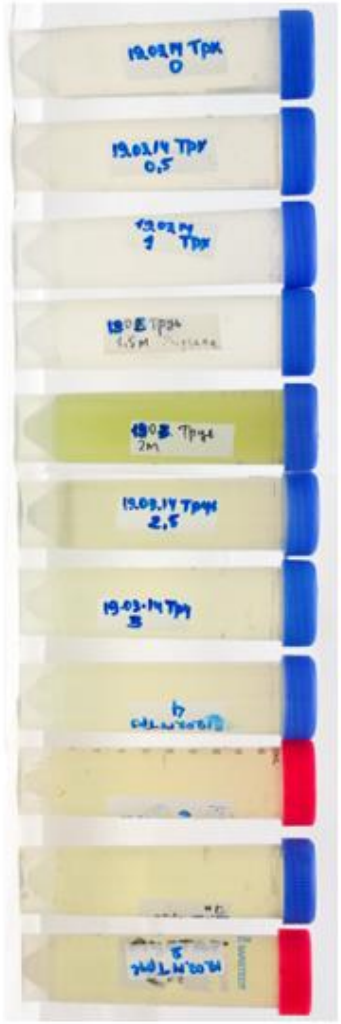
H_2S accumulation

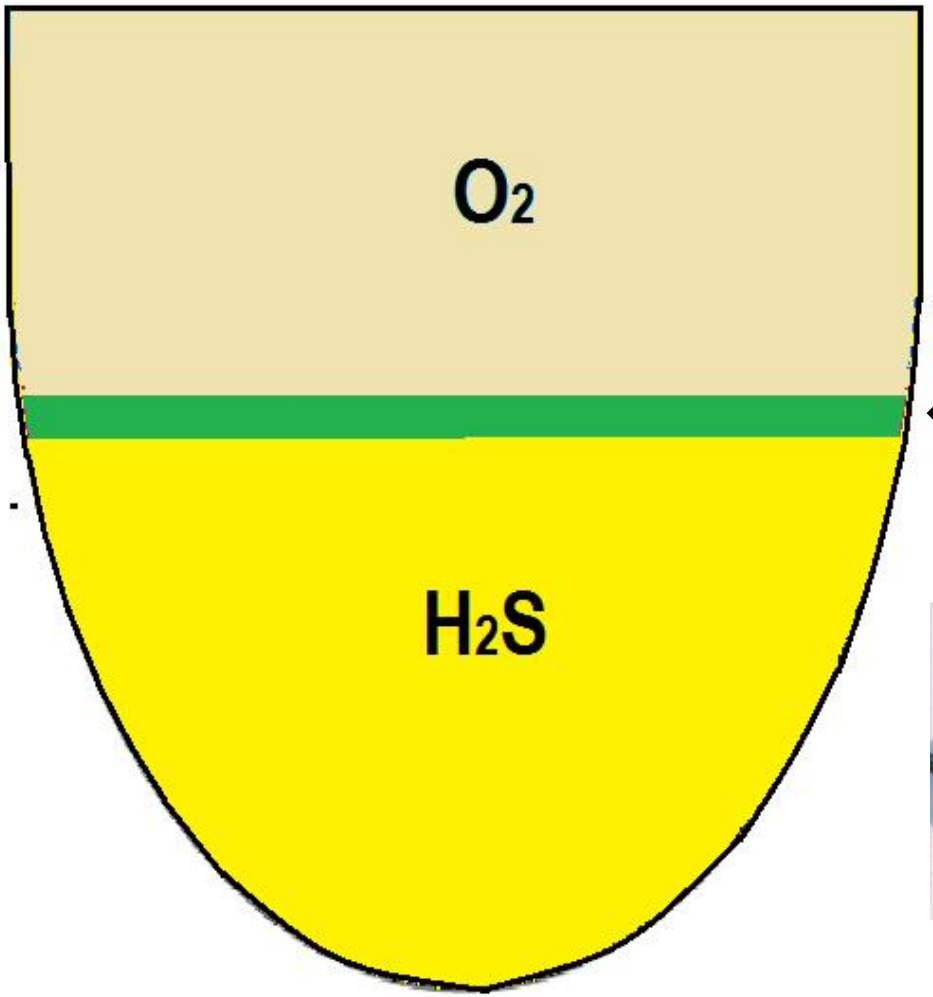
Black Sea –
up to **9 mg/l**.

Norwegian fjord **Framavaren**, a leader among the open marine areas –
up to **200 mg/l**.

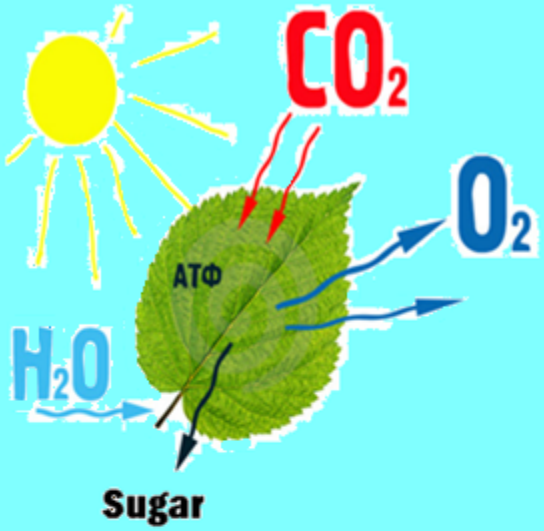
Lake **Trekhtzvetnoe** –
up to **600-900 mg/l** H2S in its bottom water!

Main source of organic compounds in the separated lakes



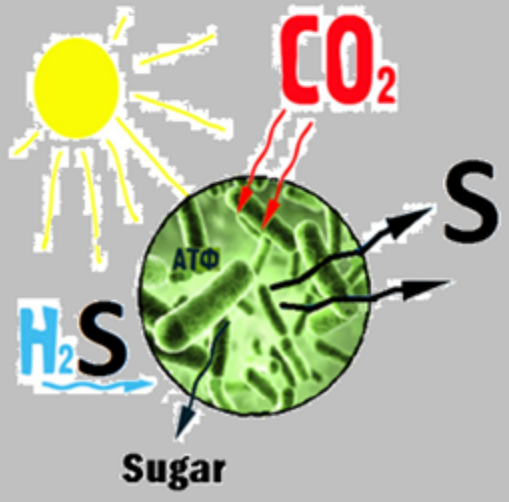


Layer of autotrophic bacteria



«Regular»
plant photosynthesis.
Realize
of O2 → oxygenic

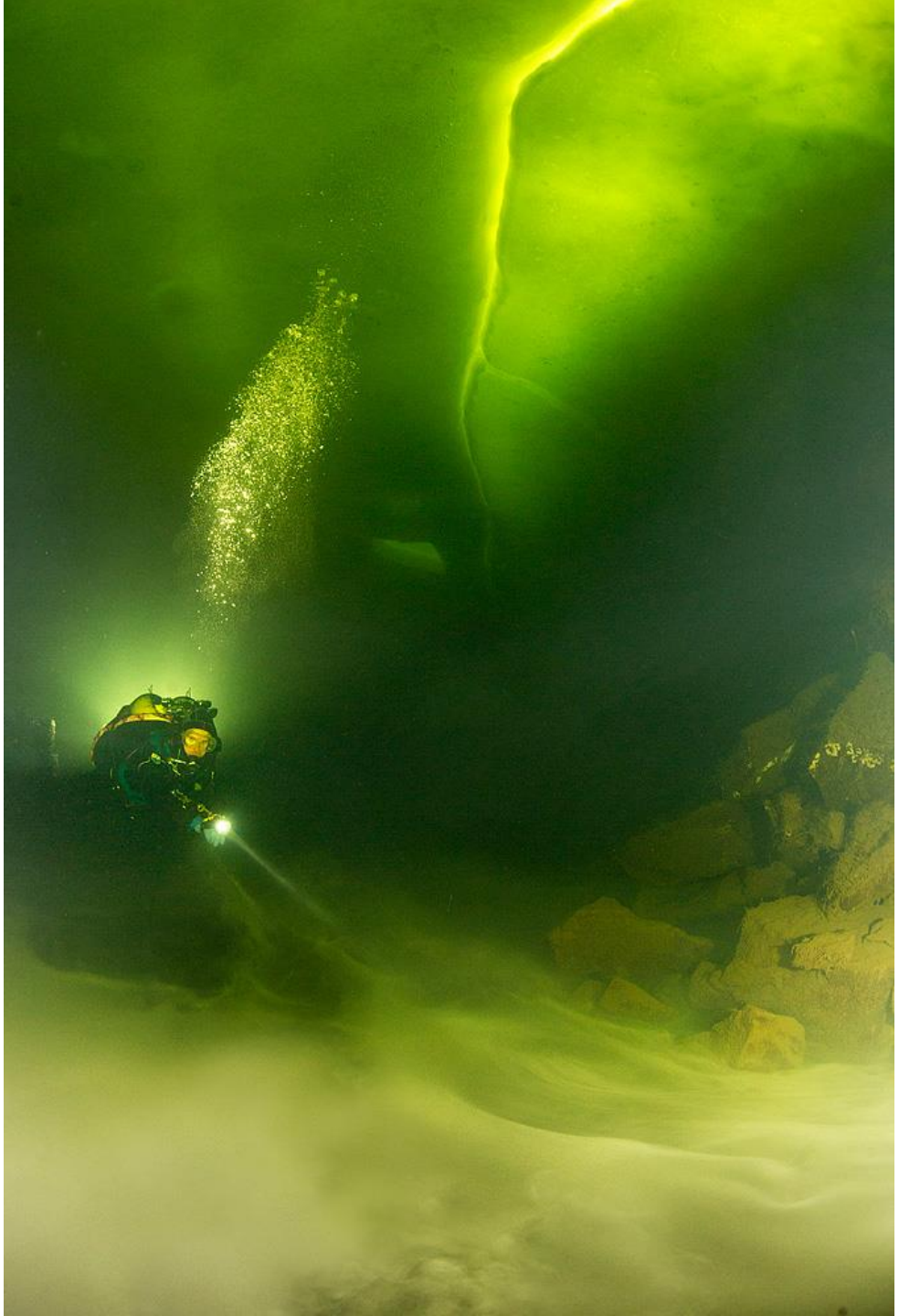
O_2



ANoxygenic
photosynthesis

~~O_2~~

S!



White underwater “smoke” is a colloid sulfur produced by sulfur bacteria

in anoxygenic photosynthesis:

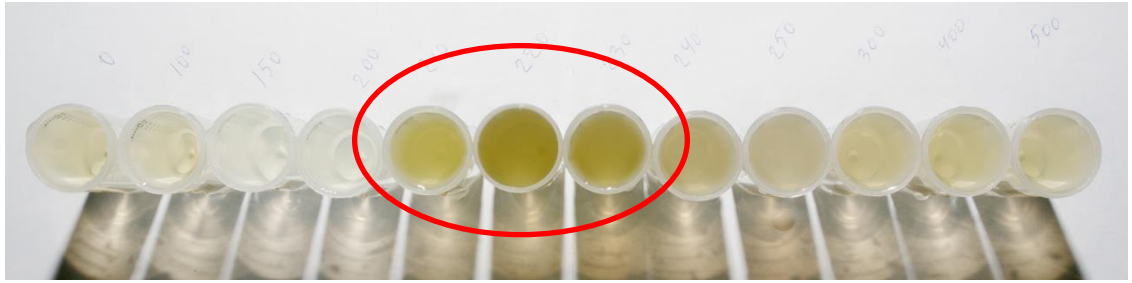
$CO_2 + 2H_2S$ light = $(CH_2O) + H_2O + 2S$

Photo: V. Lyagushkin

Colored layers with green sulfur bacteria

In the lake Trekhtzvetnoe

In the lake Nizhnee Ershovskoe

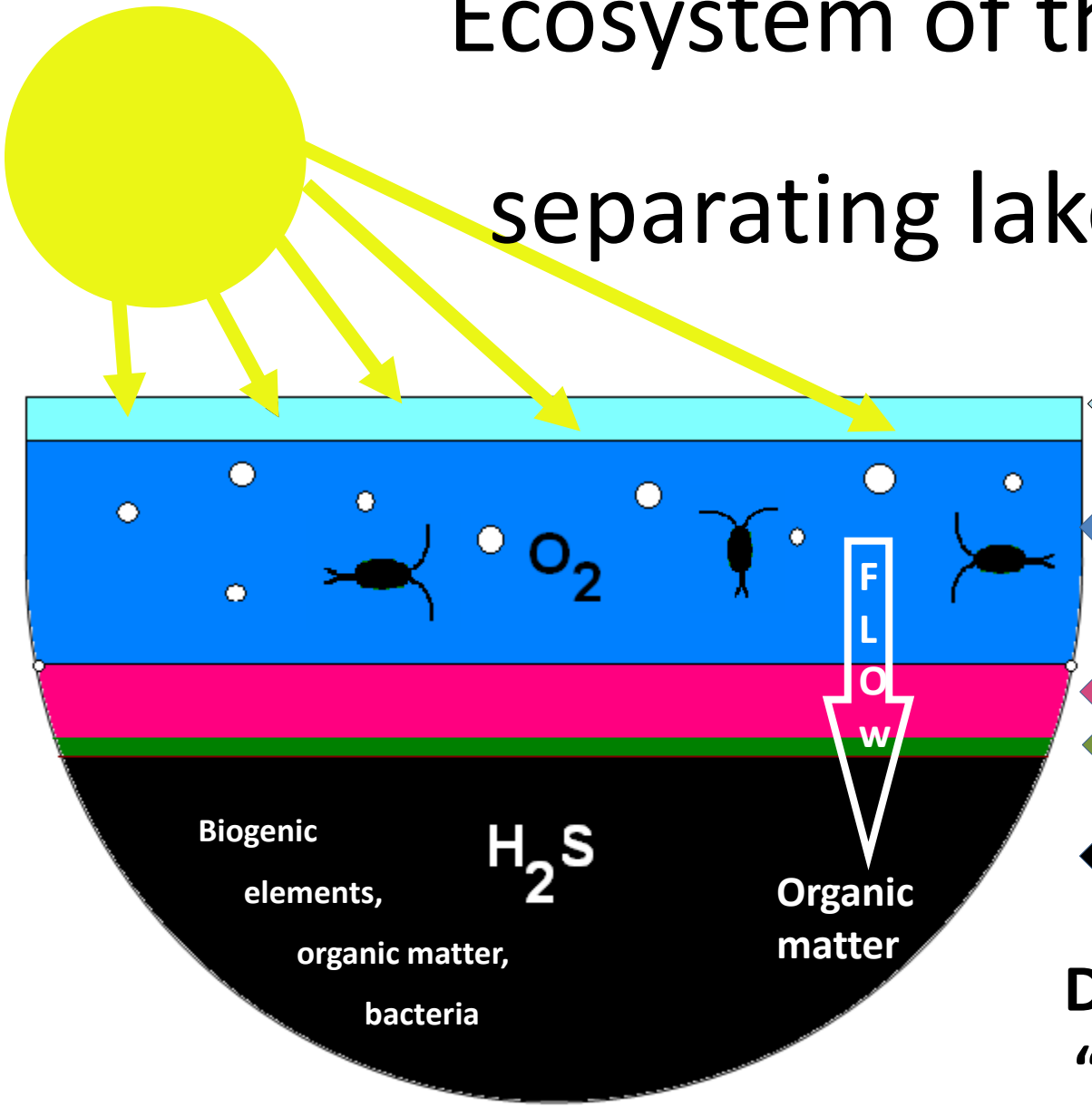


In the lake Elovoe

In the lake Nizhnee Ershovskoe

In the lake Bolshye Khruslomeny

Ecosystem of the separating lake



Brackish «greenhouse roof»

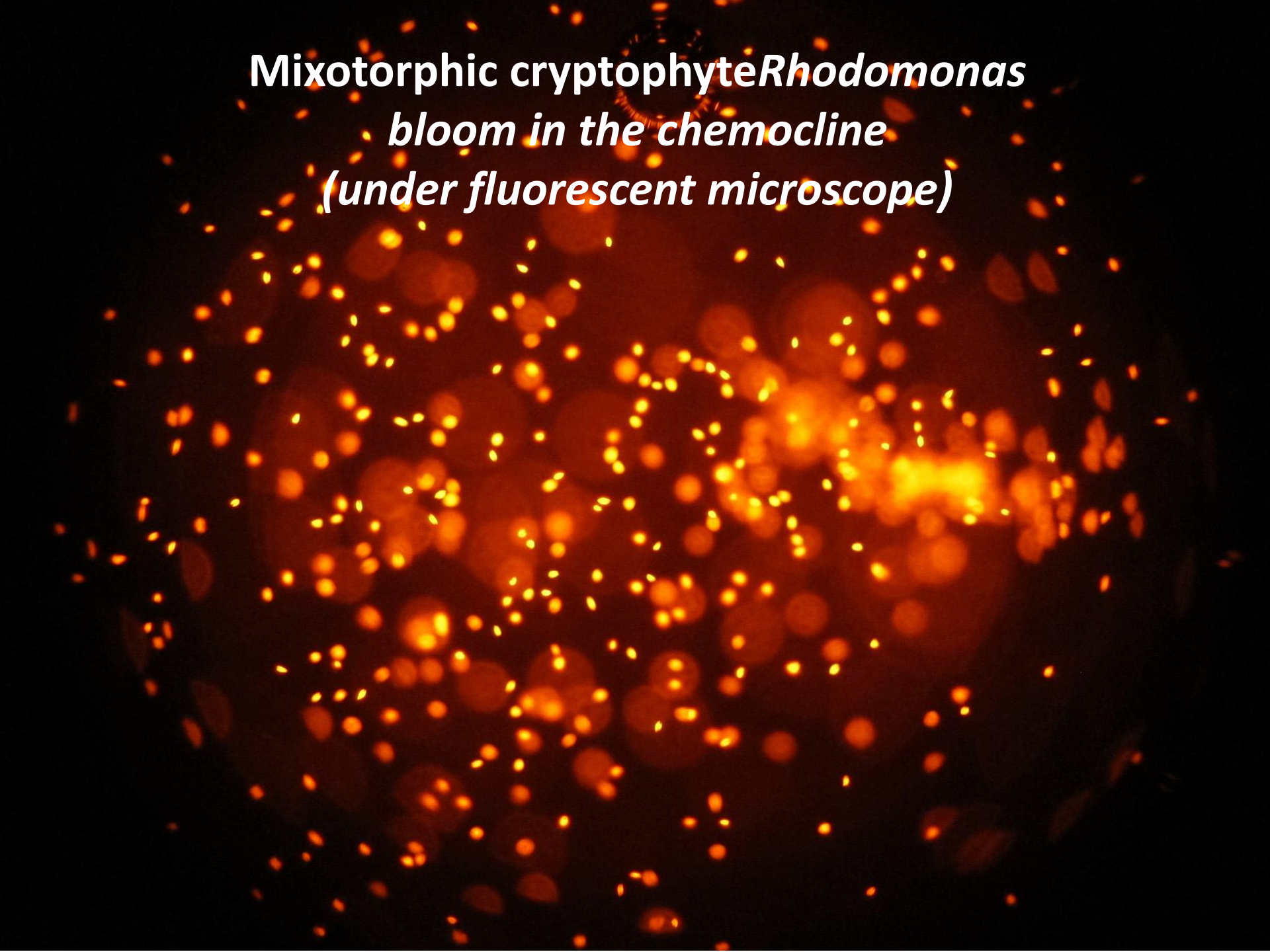
Photic zone: oxygenic photosynthesis, heat. Aerobic life.

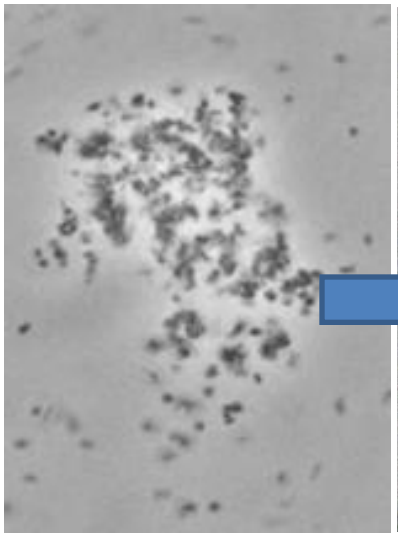
Rhodomonas layer provides upflow of organic matter

Anoxygenic photosynthesis

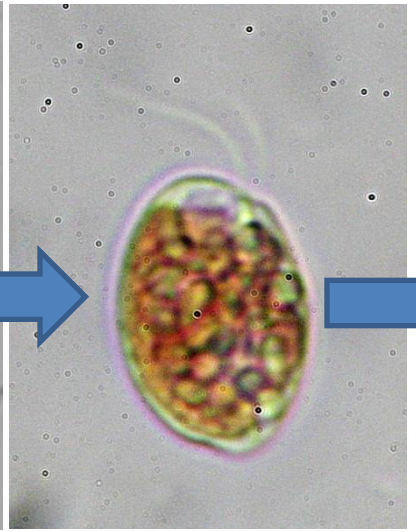
Aerobic zone, decomposition of organic matter

Decomposition – “digestive zone”


Mixotorphic cryptophyte*Rhodomonas*
bloom in the chemocline
(under fluorescent microscope)



Green sulfur bacteria (photo: A.S. Savvichev)



Cryptophytes
Rhodomonas

Dinoflagellates
Oxyrrhis marina

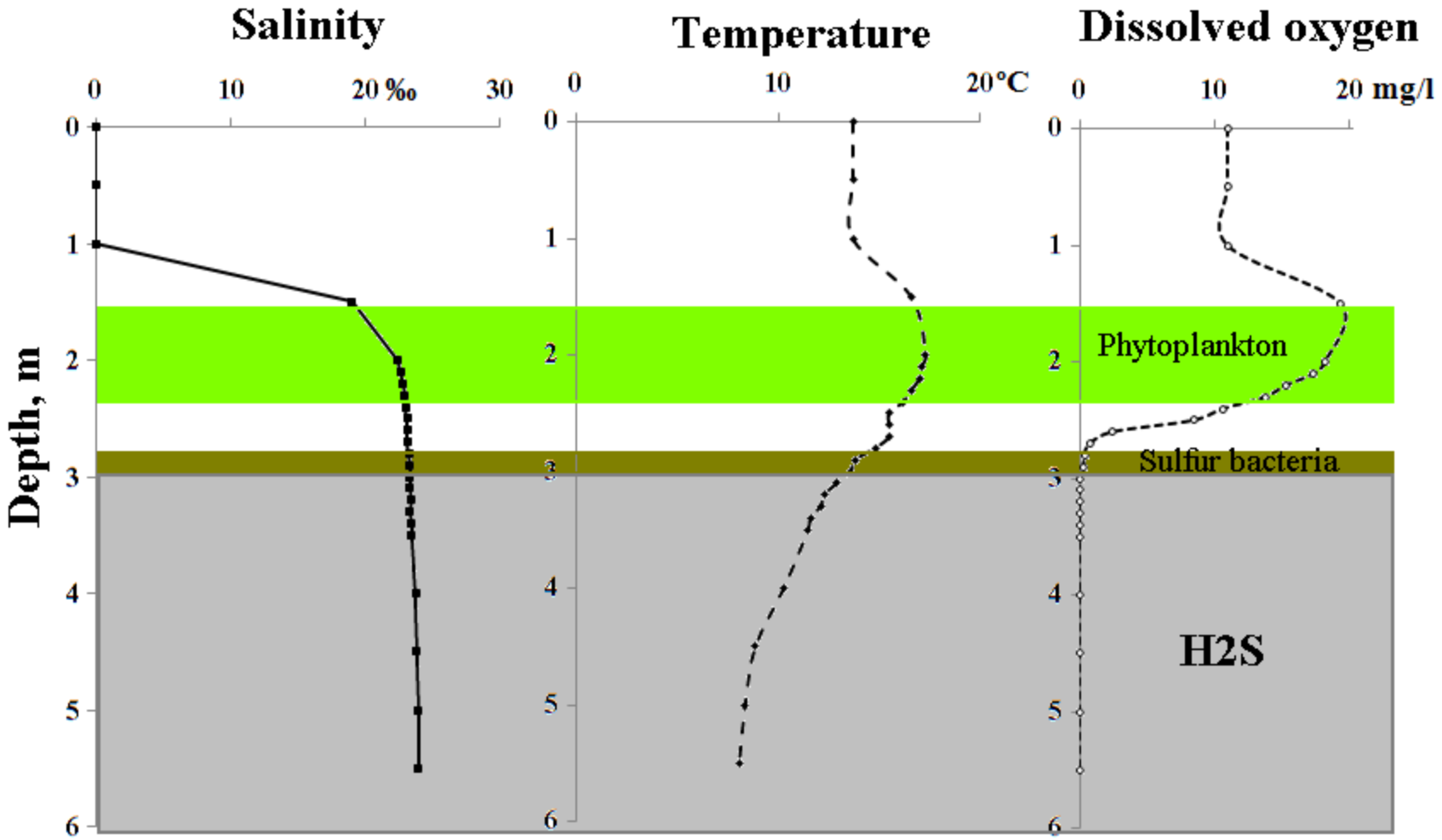
Rotifers
Synchaeta sp.

NEKTON + **BENTHOS**

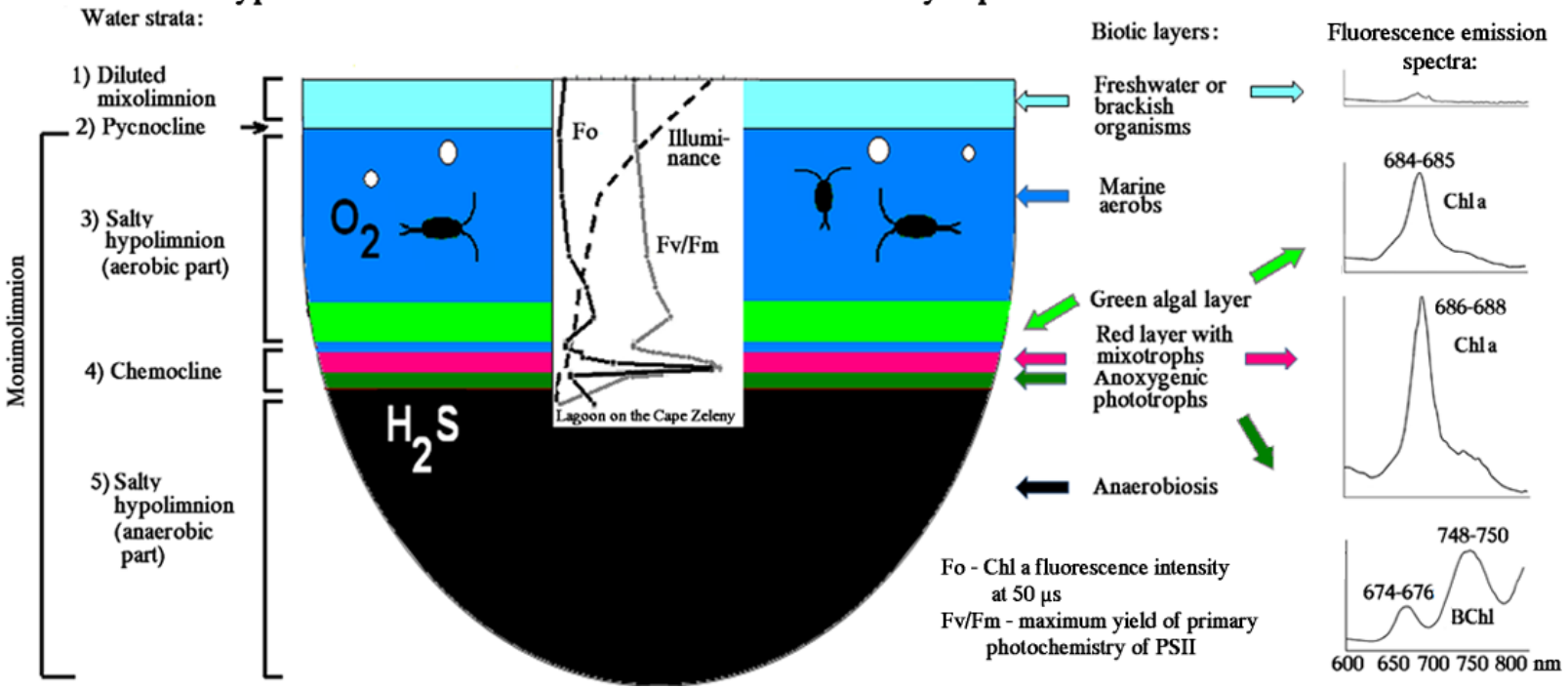
Stickleback, bivalve *Macoma* balthica

Trophic chain in the lake Kislo-Sladkoe based on the primary production od green sulfur bacteria

Some physico-chemical parameters

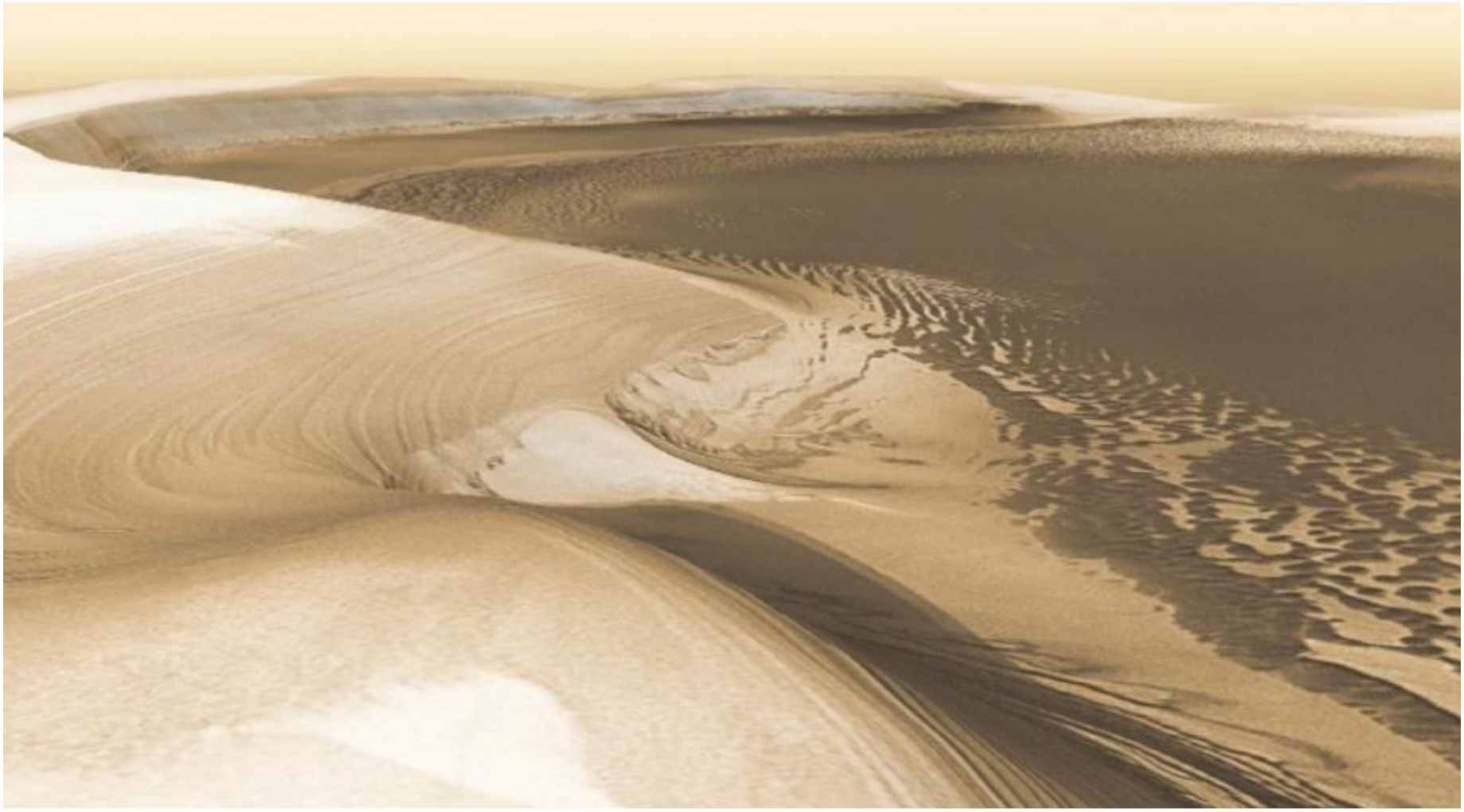


Typical structure of the coastal stratified lake naturally separated from the White Sea



Tidal power plant in Kislaya bay

Green sulfur bacteria were main photosynthetic organisms before the Great Oxygenation Event



Crater Gale in the Mars was once meromictic lake?
What about green sulfur bacteria?