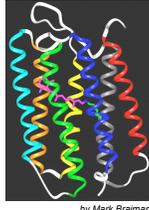


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Proteorhodopsin phototrophy in the ocean

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Introduction

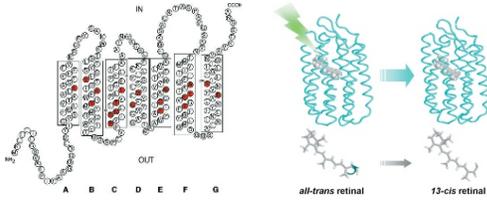
Bacteriorhodopsin versus Proteorhodopsin

Bacteriorhodopsin

- first found in Archaea
- *Halobacterium salinarum*
- functions as a light-driven proton pump

Proteorhodopsin

- first found in bacteria
- Member of the "SAR86" group
- assumed to function as a light-driven proton pump as well



Objectives of the paper

1. Objective: Identification of proteorhodopsin in environmental samples

- Beja et al. 2000 (Science) found proteorhodopsin based on recombinant DNA
- So far not observed in the sea

2. Objective: Search for proteorhodopsin in samples from different areas

- using samples from different environments for analysis
- Excluding unique appearance
- finding proteorhodopsin genetic variants

3. Objective: Characterization of different proteorhodopsin

1. Objective: Identification of proteorhodopsin in environmental samples
Conclusions

- observed transient flash-induced absorption changes
 - Photochemical reaction cycle of 15ms
 - Characteristic of retinylidene ion pumps
- hydroxylamine blocks photoactivity
 - Recovery of photoactivity by adding retinal
 - photosignal derive from retinylidene pigmentation

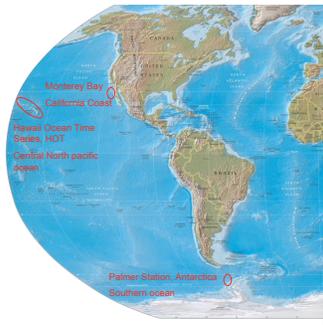
⇒ proteorhodopsin present in membranes of native marine bacterioplankton

2. Objective : Search for proteorhodopsin in samples from different areas
Goal, layout and methods

Goal: explore existence of other proteorhodopsins

Layout: 3 different sampling stations

Method: Polymerase Chain Reaction (PCR) using DNA extracts



2. Objective : Search for proteorhodopsin in samples from different areas
Multiple alignment of proteorhodopsin amino acid sequences

Monterey: 97% identity over 248 aa, 93% identity on DNA level

⇒ Proteorhodopsin similar, but not identical

Antarctica: 78% identity over 248 aa in regards to Monterey samples,

- changes of aa sequence regarding hydrophilic loops (changes near retinal binding site)
- insertion of 1 aa



- = conserved sequence
 Boxes = transmembrane helices
 Red residues = retinal - binding pocket

Take Home Message

1. Proteorhodopsin is present in marine bacteria
2. Shows diversity in bacteria from different areas and depth
3. Is adapted to it's environment and light conditions

What next?

Are the proteorhodopsin-containing organisms autotroph?
⇒ If organisms gain their energy from light, do they fix CO₂ as well (which is also available in "high" concentrations in the ocean)?

Is proteorhodopsin present in terrestrial bacteria?
