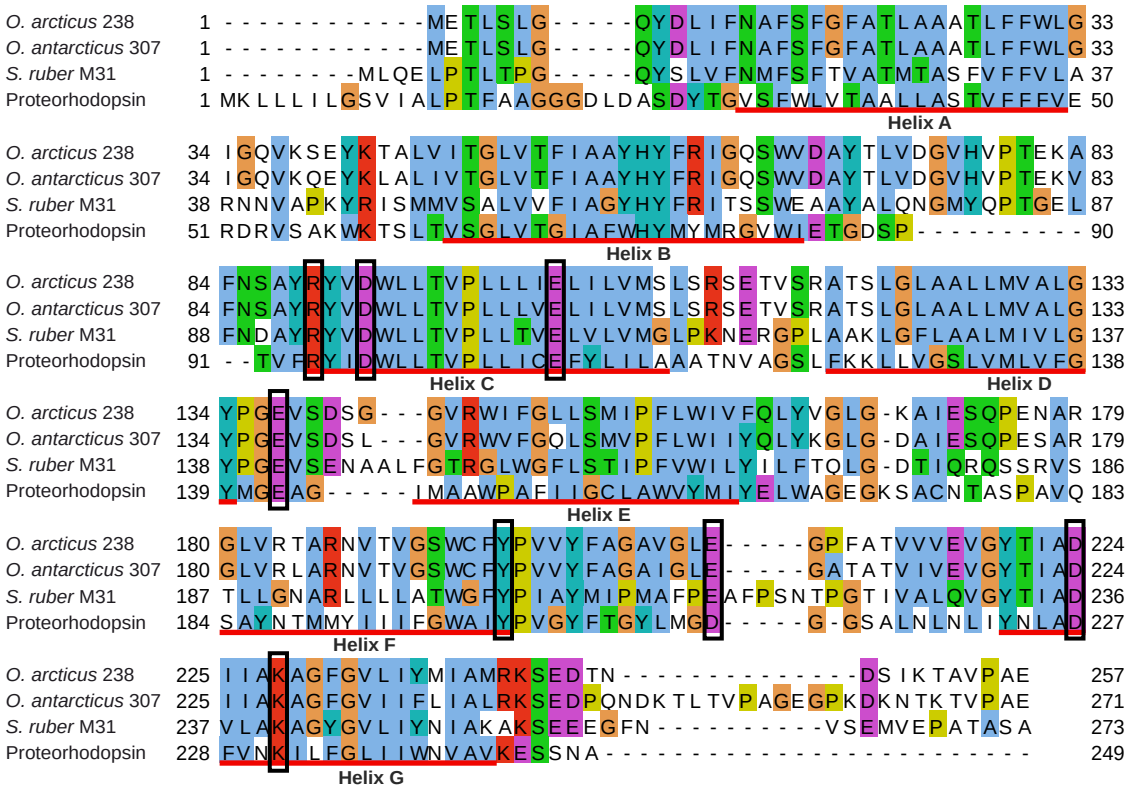
A




B

| Rhodopsin source | Amino acid residue/sequence position | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *O. arcticus* 238 subgroup II xanthorhodopsin | Arg89 | Asp92 | Glu103 | Glu137 | Tyr196 | Glu208 | Asp224 | Lys228 |
| *S. ruber* M31 subgroup I xanthorhodopsin | Arg93 | Asp96 | Glu107 | Glu141 | Tyr203 | Glu215 | Asp236 | Lys240 |
| EBAC31A08 proteorhodopsin | Arg94 | Asp97 | Glu108 | Glu142 | Tyr200 | Asp212 | Asp227 | Lys231 |
| Function [Reference] | Proton release complex [1] | Proton acceptor [1] | Proton donor [2] | Proton release complex (suggested) [3] | Proton pathway [1] | Proton-Release-Complex [1] | Counter-ion for Schiff-base [1] | Schiff base [1] |
| Corresponding residue in bacteriorhodopsin | Arg82 | Asp85 | Asp96 | - | Tyr185 | Glu194 | Asp212 | Lys216 |

**Figure S8. Functional residues important for proton translocation in different rhodopsins.**

(A) Alignment of subgroup I xanthorhodopsin from *S. ruber* M31, subgroup II xanthorhodopsins from the *Octadecabacter* strains and proteorhodopsin from the environmental clone EBAC31A08. The transmembrane helices of proteorhodopsin are marked as red lines beneath the alignment. Conserved residues with predicted functions for proton translocation are marked by black boxes. (B) Residues with predicted functions for proton translocation found in xanthorhodopsins and proteorhodopsins. The individual function is stated for each residue together with the corresponding reference. Sequence positions of equivalent residues in bacteriorhodopsin are given below.

**References**


1. Balashov SP (2000) Protonation reactions and their coupling in bacteriorhodopsin. Biochim Biophys Acta Bioenerg 1460: 75-94.
2. Balashov SP, Imasheva ES, Boichenko VA, Anton J, Wang JM, et al. (2005) Xanthorhodopsin: a proton pump with a light-harvesting carotenoid antenna. Science 309: 2061-2064.
3. Beja O, Aravind L, Koonin EV, Suzuki MT, Hadd A, et al. (2000) Bacterial rhodopsin: Evidence for a new type of phototrophy in the sea. Science 289: 1902-1906.