DEPTH DISTRIBUTION OF BACTERIOCHLOROPHYLL FLUORESCENCE IN THE CHEMOCLINE OF ELOVOE LAKE (WHITE SEA REGION)

Anastasia Kharcheva[1], Anna Zhiltsova[1], Elena Krasnova[2], Dmitriy Voronov[3,4], and Svetlana Patsaeva[1]

1. Lomonosov Moscow State University, Faculty of Physics, Moscow, Russia; harcheva.anastasiya(at)physics.msu.ru
2. Lomonosov Moscow State University, Faculty of Biology, Nikolai Pertsov White Sea Biological Station, Republic Karelia, Russia
3. Institute for Information Transmission Problems of the Russian Academy of Sciences (Kharkevich Institute), Moscow, Russia
4. Lomonosov Moscow State University, A.N. Belozersky Institute of Physico-Chemical Biology, Moscow, Russia

Water bodies separated from the White Sea typically consist of three layers: mixolimnion – upper layer with almost fresh or brackish water, monimolimnion – bottom layer with water salinity close to marine water, and chemocline – middle layer with a sharp gradient of physico-chemical characteristics and usually with high concentration of anoxygenic phototrophic bacteria (1). In the chemocline of six studied stratified lakes two strains of green sulphur bacteria can be found varying in spectral-fluorescent characteristics due to presence of different types of bacteriochlorophyll (BChl): green-coloured strain contains BChl *d*, brown-colored – BChl *e*. Fluorescence spectra of green sulfur bacteria have two bands in infrared region: at wavelength 740-770 nm (BChls *d+e* fluorescence) and at 815 nm (BChl *a* fluorescence) (2).

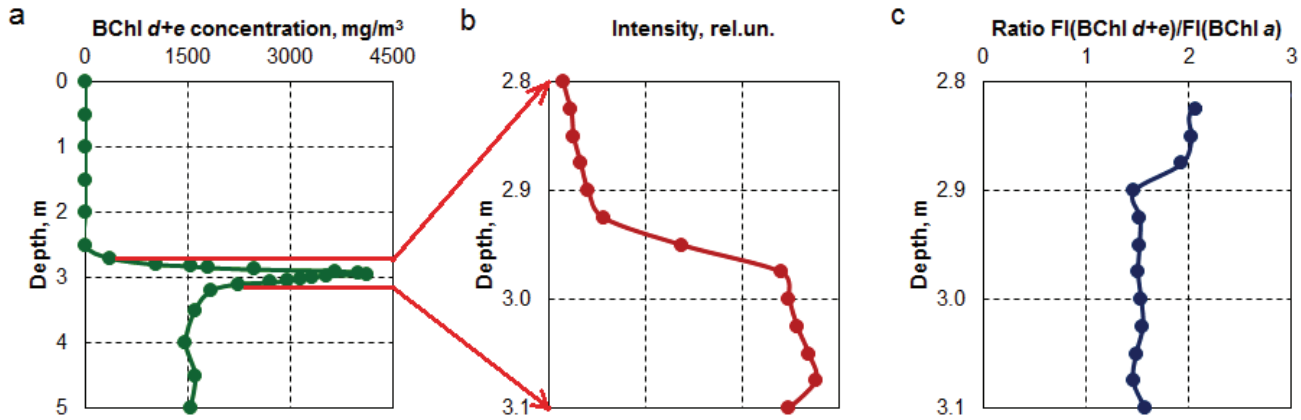

Figure 1: a) Depth distribution of BChl d+e concentration in the lake Elovoe; b) depth distribution of green sulfur bacteria fluorescence in the chemochine of the lake Elovoe; c) depth distribution of the ratio BChl d+e fluorescence intensity to BChl a fluorescence intensity in the chemocline of the lake Elovoe.

Objects of the study were water samples from the lake Elovoe, meromictic lake separated from the White Sea. In this lake brown-colored green suslfur bacteria dominate. Samples were collected in July 2016 by a submersible pump with depth interval of 0.5-1.0 m and a multisyringe water sampler from layers with dense population of green sulfur with depth interval of 2.5 cm. Fluorescence spectra of water samples were measured in a laboratory using luminescence spectrometer Solar CM2203. Acetone-methanol (7:2) extracts were prepared to calculate concentration of BChls *d+e* (3) from absorption spectra of extracts registered using spectrophotometer Unico.

Green sulfur bacteria in the lake Elovoe were located at the depth of 2.7m and deeper (Fig. 1a). The highest abundance of BChls *d+e* was detected at the depth of 2.8-3.1 m. Depth distribution of

BChls *d+e* fluorescence intensity within the chemocline is shown on the Fig. 1b. Fluorescence intensity sharply increased by the depth of 2.975 m and remained constant below it. Ratios of BChls *d+e* (740-770 nm) to BChl *a* (815 nm) fluorescence intensities were calculated from fluorescence spectra. This value was 1.5 in the upper layer with green sulfur bacteria and 2 at the bottom of the lake (fig. 1c). The chemocline zone can be divided into three sub-layers according to fluorescence properties of green sulfur bacteria: a) upper chemocline (2.800-2.875 m) characterized by low concentration of BChl, low BChl fluorescence intensity, ratio Fl(BChls *d+e)*/Fl(BChl *a*) equals 2; b) middle chemocline (2.900-2.950 m) with the highest concentration of BChl, low BChl fluorescence intensity, ratio Fl(BChls *d+e)*/Fl(BChl *a*) is 1.5; c) lower chemocline (2.900-2.950 m) where BChl concentration decreases, the highest BChl fluorescence intensity is registered, and ratio Fl(BChls *d+e)*/Fl(BChl *a*) equals 1.5. Presence of three sub-layers in the chemocline can be explained by different photosynthetic activity of green sulfur bacteria, redox-dependent fluorescence quenching or photoinhibition in upper layers.

ACKNOWLEDGEMENT

This work was supported by the Russian Foundation for Basic Research, project no. 16-05-00548a.

REFERENCES

1 Krasnova E., Voronov D., Frolova N., Pantyulin A., Samsonov T. Salt lakes separated from the White Sea as an object of research using remote sensing methods. EARSeL eProceedings, 2015, 14(S.1), 1st Student Workshop on Ecology and Optics of the White Sea, 2014, 8-22

2 Kharcheva A., Zhiltsova A., Lunina O., Savvichev A., Patsaeva S. Quantification of two forms of green sulfur bacteria in their natural habitat using bacteriochlorophyll fluorescence spectra. Proceedings of SPIE, 2016, Vol. 9917: 99170P-1-99170P-8

3 Lunina O, A Savvichev, B Kuznetsov, N Pimenov & V Gorlenko, 2013. Anoxygenic phototrophic bacteria of the Kislo-Sladkoe stratified lake (White Sea, Kandalaksha Bay). Microbiology, 82 (6): 815-832