ON THE POSSIBLE ORIGINS OF NATURAL LOW-FREQUENCY EM NOISE IN SHALLOW BRACKISH WATER BASINS

Nikolay Palshin[1], Denis Yakovlev[2], Andrey Yakovlev[2] and Aleksey Geraskin[2]

1 Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow, Russia
2. Nord West Ltd., Moscow, Russia

Vast territory of the Earth is taken up by shallow brackish water basins, i.e. estuaries of the Volga river and great Siberian rivers Ob, Yenisey rivers, the Botnic and Finish Bays, as well the northern part of the Caspian Sea. Many of the above areas are potentially oil and gas productive. In 2008 Russian geophysical company "Nord West Ltd" carried out experimental study along two, i.e. in estuary of the Volga River and the north-eastern part of the Caspian Sea, using MT sounding method with shallow water modification of the industrial MT instrument produced by "Phoenix Geophysics Ltd.". Data analysis shows that some of time series are contaminated by natural electric field noise at frequencies less then 1 Hz, and the character of noise is different for the estuary creeks characterized by strong water currents and the shallow region of the Caspian Sea with depths about 1-2 meters characterized by intensive wind waves and swells. The spectral analysis of time series made it possible to suggest that the nature of electric field noise in these two cases is also different.

Due to the strong current in the estuary creeks streamlining of electrodes placed inside brick-shaped concrete anchors take place producing turbulence with characteristic frequency between 0.1 and 1 Hz. This phenomenon (Strukhal eddies) could be responsible for vibration of the electrodes. An experiment carried out later in a small river with a heavy current confirmed the above hypothesis. The records of the electric field, obtained by means of electrodes placed on the river bed, are characterized by natural noise having maximum in the range of the period about 0.5 Hz, which was absent in the records obtained on the river bank. Mechanical isolation of an electrode from the river flow by means of a glass semi-sphere causes significant noise reduction. Obviously that this type of EM field noises may be observed as well in the time series obtained by seafloor instruments in the seas and oceans at the presence of strong bottom currents, which occur rather often under the conditions of the continental shelf and slope.

Other factors account for electric field noise observed at the presence of wind waves and swells. At the depth of first meters wind waves wavelength is much greater than depth. Whereas the seafloor is continuously affected by two factors: periodic fluctuations of hydrostatic pressure and periodic bottom horizontal currents. The presence of "wave" maxima in the spectra of electric field noise unambiguously points at the source of these noise interferences. This phenomenon could be explained by electrokinetic effects of the second order: streaming and sedimentation potentials. The first one is proportional to pressure, while the second is proportional to water velocity and both are proportional to the resistivity of the water. The last fact explains that these effects are significant only in brackish and fresh water. Both effects depend upon the presence of an electrical double layer at a solid-liquid interface. The movement of liquid over the surface of the solid produces an electric current, because the flow of liquid causes a displacement of the mobile counter ions with respect to the fixed charges on the solid surface.

natural noise, electrokinetic effect, shallow brackish water basins

Shirshov Institute of Oceanology, 36 Nakhimov Av., Moscow 117997, Russia