

CHANGES OF MACRO COMPONENT STRUCTURE OF UNDERGROUND WATERS DURING THE PROGRESS OF PREPARATION OF EARTHQUAKES

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ABSTRACT

This article discusses the results of researches showing variations of pH and Eh depending on the chemical composition in underground waters of the KyzylKum and in front of Tashkent artesian basin wells.

Keywords: *Anomaly, Regime Supervision, Chemical Components, Deformation, Forecast, Earthquakes*

INTRODUCTION

The problem of earthquake prediction is one of the urgent problems of seismology. The target program of development of prediction methodology has been firstly set in 1966 when the Seismology Institute was started at the Academy of Sciences of the Republic of Uzbekistan. At the earlier research stages of earthquake predictions there were organized four experimental fields. Researches held on these fields revealed earlier unknown phenomenon of "Change of gas and component composition of underground water at earthquakes" in the nature (Sultankhodzhayev, 2006).

] which on a row with geophysical and deformation observations, became a basis of a technique of search for earthquake precursors. Monitoring of possible hydro geological harbingers provided observations on variations of component, gas and dynamic parameters of underground waters.

Now in a number of the countries, including those in the region of Central Asia, complex researches are aimed at search of harbingers and the forecast of earthquakes. In these researches hydro geological methods take the important place.

Changes in the parameters of the underground waters which are in direct contact with the deformed environment of the massifs can provide considerable information on seismogenic processes. In due time the academician V.I.Vernadsky repeatedly pointed towards a possibility of communication of chemical and gas composition of underground waters from the physical-chemical processes in the water containing rocks (Samarina, 1977).

Despite the obvious progress not strong reliable changes are found those could have some social or scientific importance. So far formation of predictive mechanisms of abnormal changes of underground waters before earthquakes are considered poorly studied, which demand further study and new methodical approaches for their practical use to assess the possibility of real manifestation of an earthquake (Ziyavuddinov, 2011).

It is well known that water solution has ability to carry electric current and it is called conductivity. Conductivity of underground water depends mainly on the level of the mineral salts dissolved in it. And it is measured by special devices (TDS meters). Electric conductivity of underground water depends generally on concentration of the dissolved mineral salts and it is generally high if it holds strong electrolytes, that mineral part of which is made up by Na^+ , K^+ , Ca^{2+} , Cl^- , SO_4^{2-} , HCO_3^- ions. Presence of other ions, for example Fe^{3+} , Fe^{2+} , Mn^{2+} , Al^{3+} , NO_3^- , HPO_4^- , H_2PO_4^- do not strongly influence the conductivity if these ions aren't present in significant amounts. By these values of conductivity of underground water and existence of ions in it, it is possible to judge approximately a water mineralization degree (Semenov, 1977).

MATERIALS AND METHODS

This work features variations of concentration of hydrogen ions, pH, oxidation-reduction potential – Eh and macro component composition of underground waters in front of Tashkent and Central Kyzyl-Kum artesian pools during preparation of a series of moderate earthquakes with magnitudes of M-4,5; M-3,6; M-3,0 on August 11, 2015 and on February 2, 2017 with magnitudes of M-4,4. For this, daily analysis of indicators such as concentration of hydrogen ions pH and oxidation-reduction potential - Eh, in different time and space was done. Monthly analysis of composition of macro component of underground waters in Tashkent and Central Kyzyl-Kum artesian basin was done. Sampling was made from the Gulistan and Tuyakochar wells. Measurements of indicators pH and Eh of water solution was held on I-160MI system devices, which are intended for measure an indicator of ion activity of hydrogen pH, Eh and other monovalent and bivalent anions and cations (pX). These observations are shown on fig. 1.

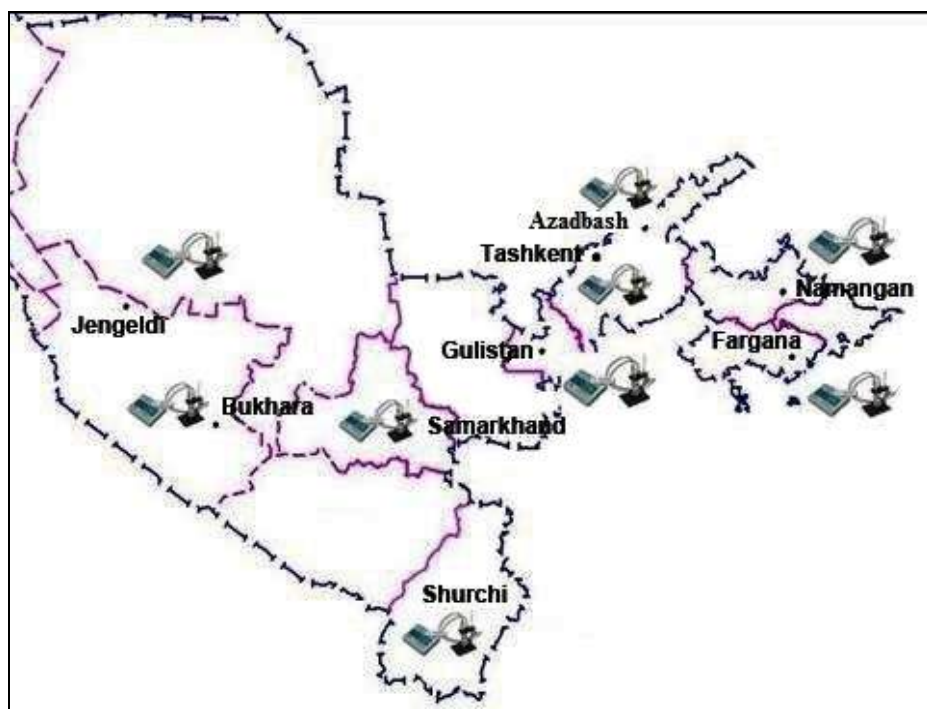


Figure 1: The observation's working map

The analysis of macro component composition of underground waters was made in laboratory of the NGMKA production center. In fig. 2 epicenters of earthquakes are shown on the schematic map of seismogenic zones of the KyzylKum and in front of Tashkent geodynamic ground.

RESULTS AND DISCUSION

Fig. 2 -- The schematic map of the Southern Tian-Shyan seismogenic zone are taken from the Maps of seismogenic zones of Uzbekistan, made by Ibrogimov (1978).

In fig. 3-4-5-6-7 curves of the analysis of Temp., S, pH and Eh data of these changes with hydro geochemical parameters of HCO_3^- , Cl^- , SO_4^- , Ca^{2+} , Na^+ , Mg^{2+} + in underground waters of the Tuyakochar and Gulistan wells are given.

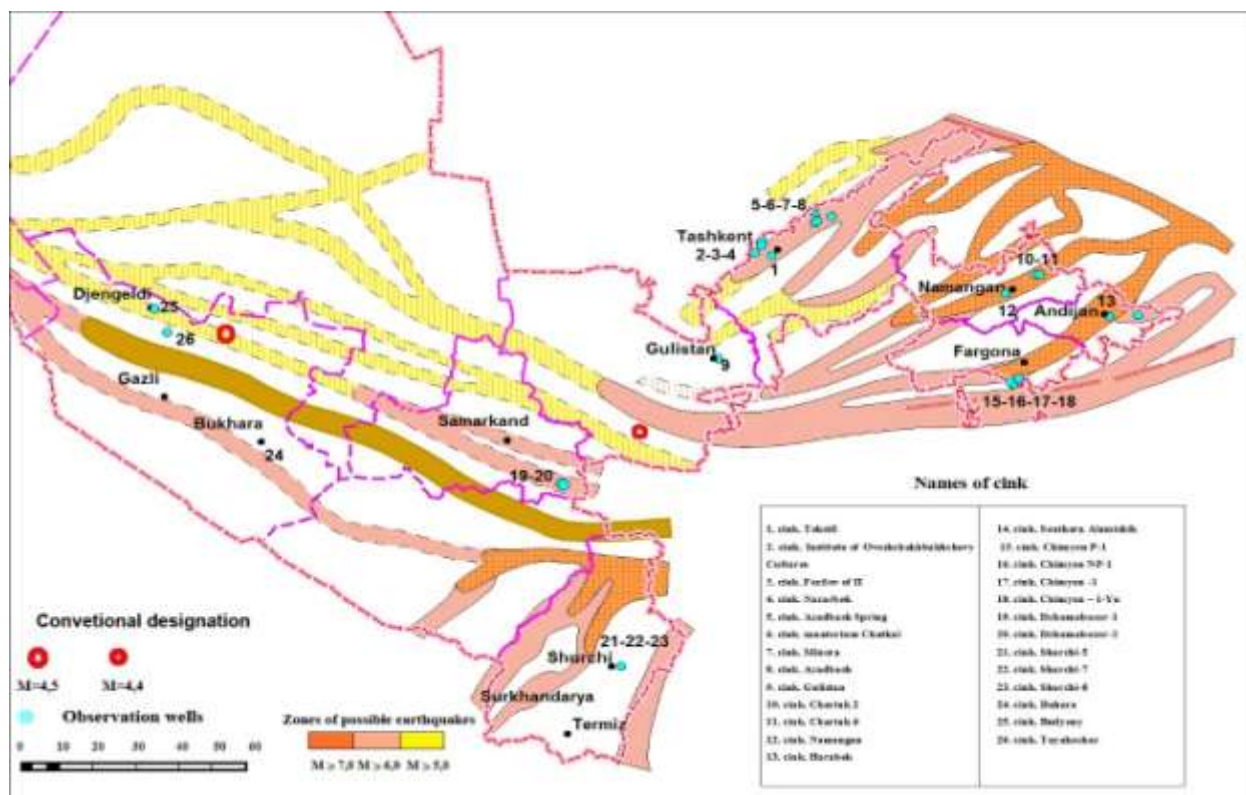


Figure 2: The schematic map of the Southern Tian-Shyan seismogenic zone



Figure 3: The temperature changing chart of pH and Eh on Gulistan well.

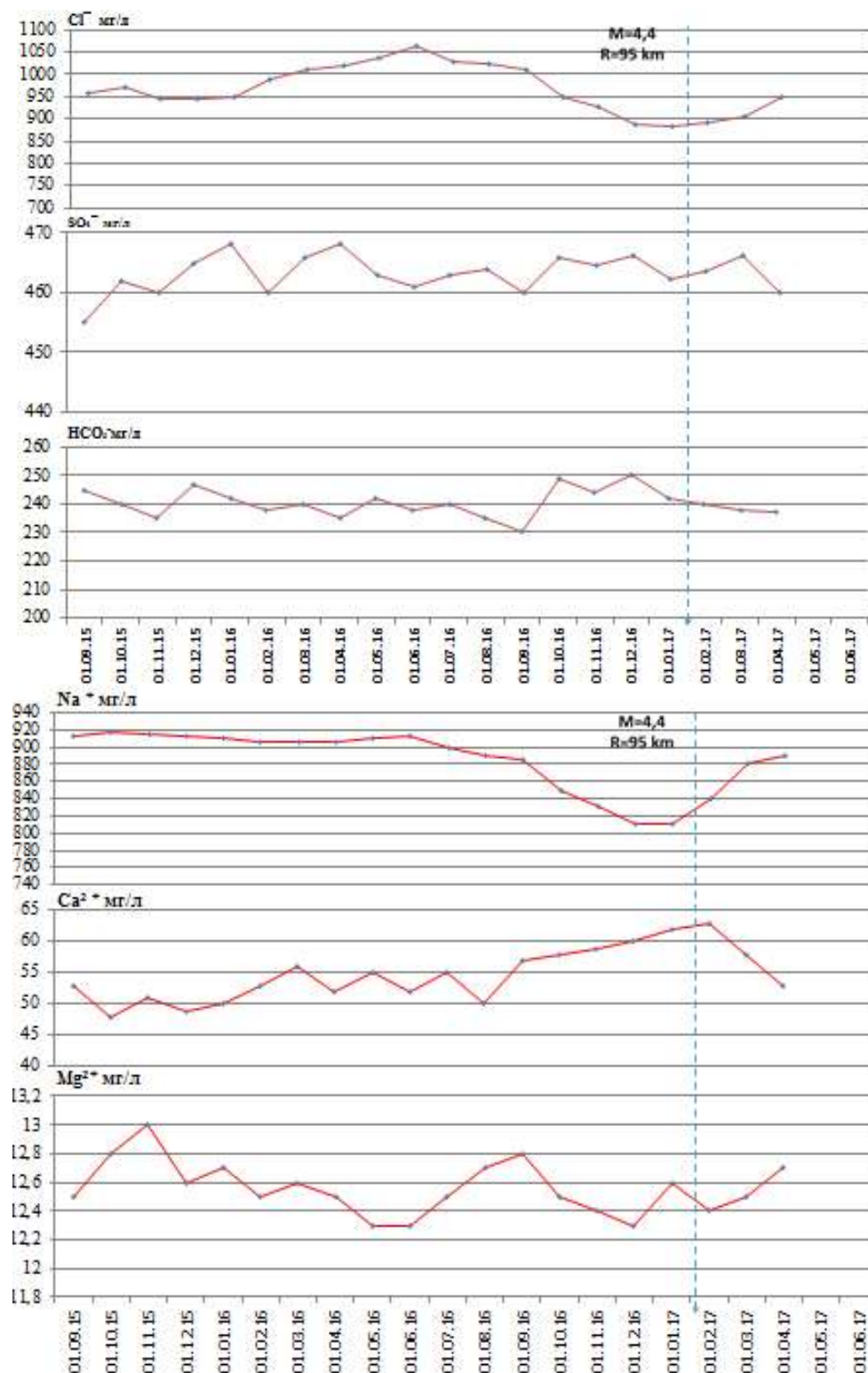


Figure 4: The macro component changing chart of underground waters of a sodium-chloride sub-type (In front of Tashkent artesian pool)

In the Gulistan well on analyzing interval from June 1, 2016 till January 30, 2017 in variations pH and Eh (see fig. 4), shown that since 01.06.2016 similar changes – tendentious increase of pH and decrease in Eh are observed in the Tuyakochar wells. On this background till 01.30.2017 were observed abnormal increase in concentration of hydrogen ions – pH on 0, 72 c.u. and oxidation-reduction potential – Eh decrease on 90 mV, at the same time observed dependence of change in concentration of the dissolved mineral salts, ions of Na^+ , Ca^{2+} , Cl^- – which came to the end with an earthquake of $R=95$ km and $M=4.4$ (See fig3-4).

Changes in maintenance of hydro geochemical parameters in underground waters of the Tuyakochar well are given below.

On the analyzed interval from October 1, 2014 to March 30, 2017 on the Tuyakochar well in variations pH and Eh (see fig. 4), since 01.01.2015 is observed tendentious increase of pH and decrease in Eh. On its background till 08.11.2015 there is an abnormal increase of pH on 0.75 c.u. and Eh decrease on 60 m, at the same time dependences of change of concentration of the dissolved mineral salts are observed, i.e. ions of Na^+ , Ca^{2+} , Cl^- , SO_4^{2-} , which has come to an end with an earthquake of $R=60$ and km $M=4.5$ (see fig. 5-6-7).

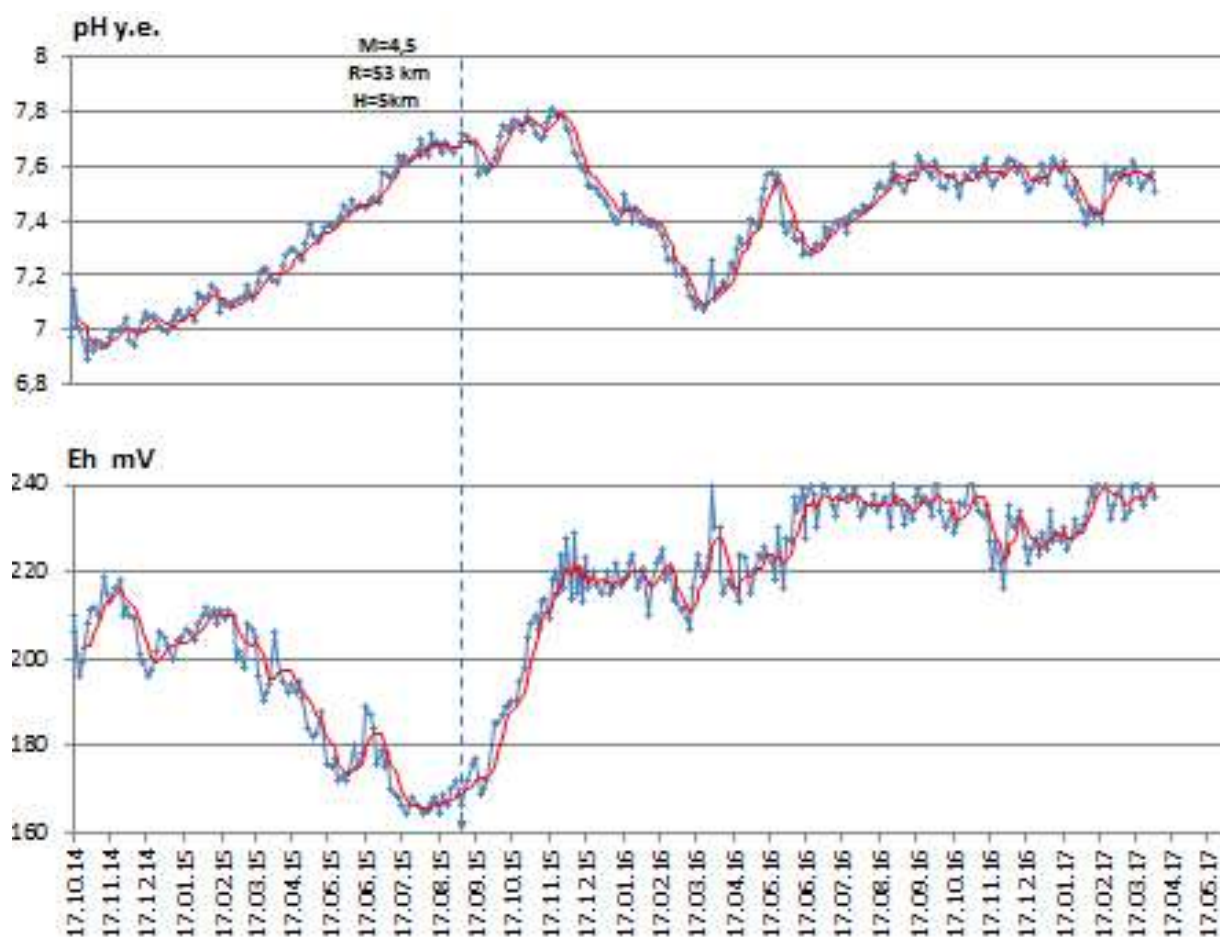


Figure 5: Schedule of concentration changing of water solution, pH on the Tuyakochar wells.

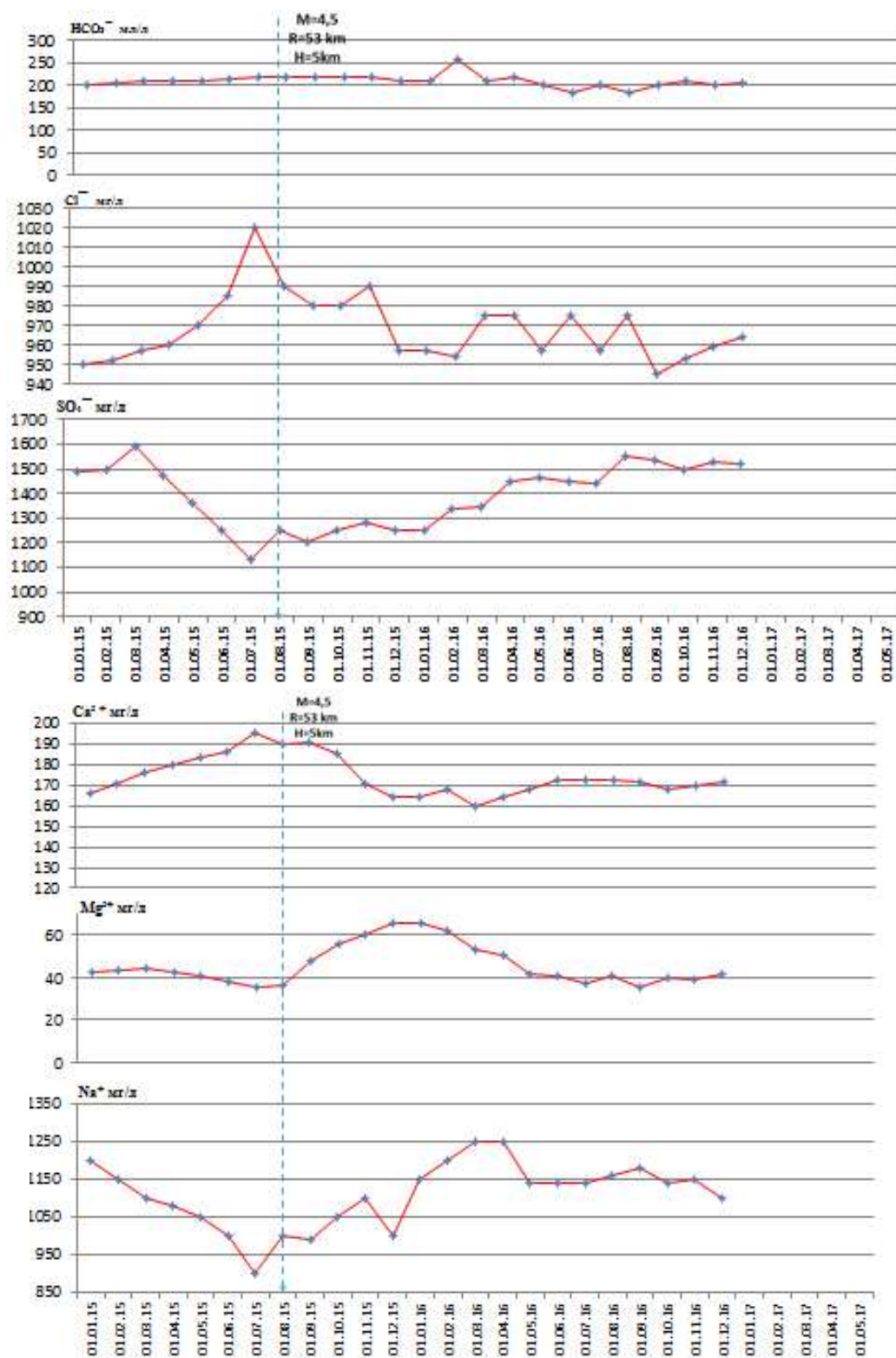


Figure 6: Schedule of macro components change of underground waters of a sulphate-sodium subtype (Kyzyl-Kum artesian basin).

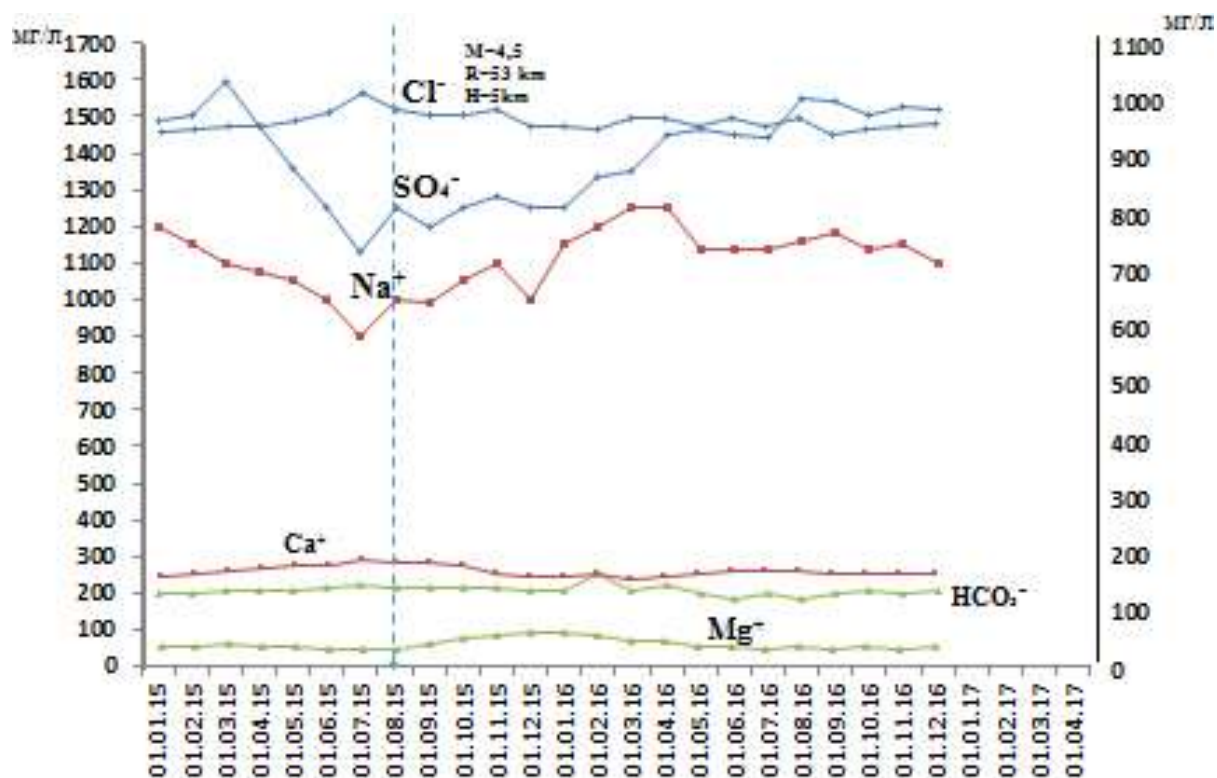


Figure 7: Migratory curve of macro components of underground waters of a sulfate-sodium subtype (Kyzyl-Kum artesian basin).

In general, variations of underground water components in the Gulistan and Tuyakochar wells demonstrates that the mineralization on thermo mineral waters in front of Tashkent natrium-sodium subtype and a sulphatic-natrium subtype in KyzylKum artesian basin remains within a characteristic tendency, and moderate abnormal changes are obviously connected with processes of preparation for the earthquakes, which have occurred 11.08. 2015 and 2.2.2017.

SUMMARY

1. Observing the changes in Eh and pH is an informative method of evaluation of stress-strain state and dynamics of seismogenic processes in seismic active zones, in order to diagnose earthquake precursors.
2. Abnormal changes of pH and Eh are possibly connected with macro component changes in water – HCO_3^- , Cl^- , SO_4^{2-} , Ca^{2+} , Mg^{2+} , Na^+ and caused by deformation processes in a tectonic active zone.
3. For clearing the mechanics of abnormal changes of these parameters we need more observations. The possibility is not ruled out that these processes are due to increasing mineralization of groundwater at the expense of cracking and increasing of contacting surface of fluid with rock or makeup from the deep layers.

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