METHODOLOGY OF CREATION MULTI-PARAMETRICAL NETWORK

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Multi-parametrical monitoring has been carried out on deep boreholes of Georgia. Till now the network of 10 boreholes of different depths (from 300 up to 3500 m) covers the whole territory of Georgia. Boreholes characterize all basic geo-plates and open aquifers of deep circulation. Actually, they represent sensitive volumetric strain-meters. The boreholes response to all deformations between 10^{-7} -10^{-9}, which are caused by endogenous and exogenous factors. The lower value of deformation limits the sensitivity which is necessary for earthquake preparation processes ($>10^{-7}$).
Special monitoring equipment is installed at boreholes which record several parameters, i.e. water level and micro-temperature, atmosphere pressure and surface temperature, tilt, magnetic field and others. The data can be gathered in real time using the GSM net.
Regular hydrodynamic observation is experimentally established on the territory of Georgia in order to realize the process of preparation of earthquakes by the increase of deformation which causes the underground water to move.

Keywords: Multi-parameters, network.

1. Introduction

Georgia is a part of a big geodynamical active region, known as the Mediterranean Belt, which includes the whole Caucasus and Northern parts of Turkey and Iran. As a result of plate migration, the strong compressive strains are building in the crust. The energy released during sudden stress drop events may trigger the earthquakes.

All over the world and in Georgia also, various anomalies (Hydro-dynamical, hydro-chemical, micro-temperature etc) observed before earthquakes, besides in most cases, on enough distant places from epicentres. Therefore studying the geodynamical processes may help to forecast the natural catastrophes with reasonable probability.

2. Data-analysis

Since 1979, the researches for the forecast of earthquakes promoted development of a hydro-chemical network of special regime regional observation. On the territory of Georgia hydro-chemical observations are carried out on the 23 boreholes (Fig. 1).

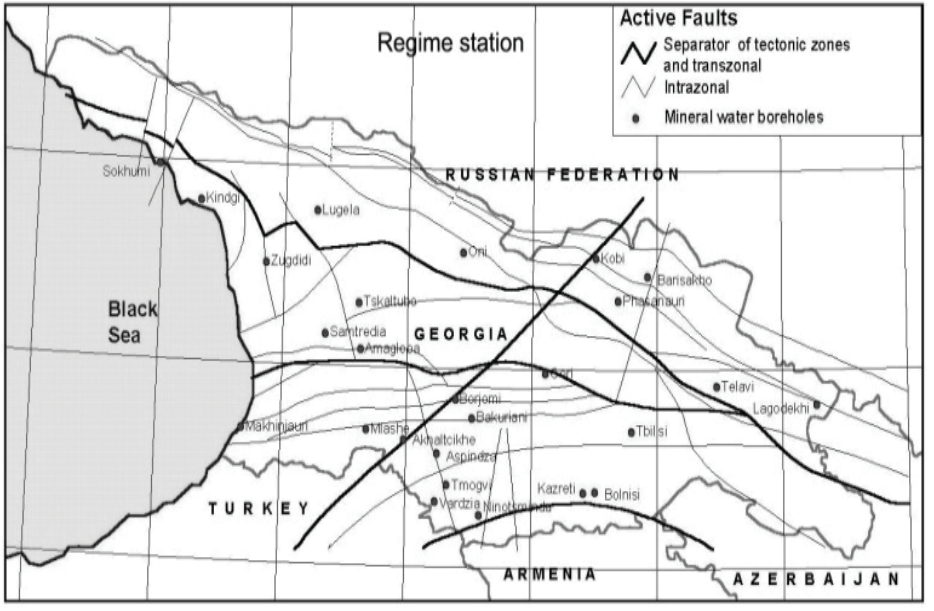

Fig.1. Scheme of hydro-chemical monitoring stations on the territory of Georgia

Measurements of water debit- by volumetric method, temperature of water and air - by mercury thermometer were daily carried out on the water

points. Helium concentration was directly defined on the water points with the same frequency. Chemical composition of water was assessed on 20 components (HCO3, Cl, SO4, Na, K, Ca, Mg, J, Br-, Zn, Cu, Fe, Mn, He etc). Water chemical analysis was done by standard methodology.

The only way in the absence of criteria of estimation of information values was to make retrospective analysis on energy of occurred earthquakes (Fig. 2, 3, 4).

During observations a lot of anomalies were fixed, but because of the diversity of chemical water content it was impossible to conduct observations of the unified parameters for creating the complete picture of strains on the whole territory (Melikadze G., Adamchuk Y., et al., 1989).

This is the reason why they decided to conduct observations for those parameters which could fix tidal variations with deformation of 10^{-8} degree, what is compared with strains differences during earthquakes preparation period. Besides it was possible to conduct unified observations. The water level in the deep boreholes was such a parameter (Hsieh et al., 1987, Hsieh et al., 1988).

The modern methods of earthquakes forecast allow watching temporal and spatial changes of strain in the terrestrial crust. One of them is the monitoring method of hydrogeodeformation ground field (HGF). A regime network, according to the development of VSEGINGEO, in Caucasus has been established since 1985. Till now the network of 10 boreholes of different depth (from 250 up to 3500 m) covers the whole territory of Georgia. Boreholes characterize all basic geo-plates and open waters of deep aquifer, actually they represent sensitive volumetric strainmeters, and react on the deformations about 10^{-7} -10^{-8}, caused both by endogenous, and exogenous factors. A borehole was considered informative if it was fixing tidal variations and was included in the network (Melikadze G. et al., 1989).

They are situated in different tectonic areas. The deep boreholes with undisturbed regime were chosen for the observations which were not influenced by other boreholes.

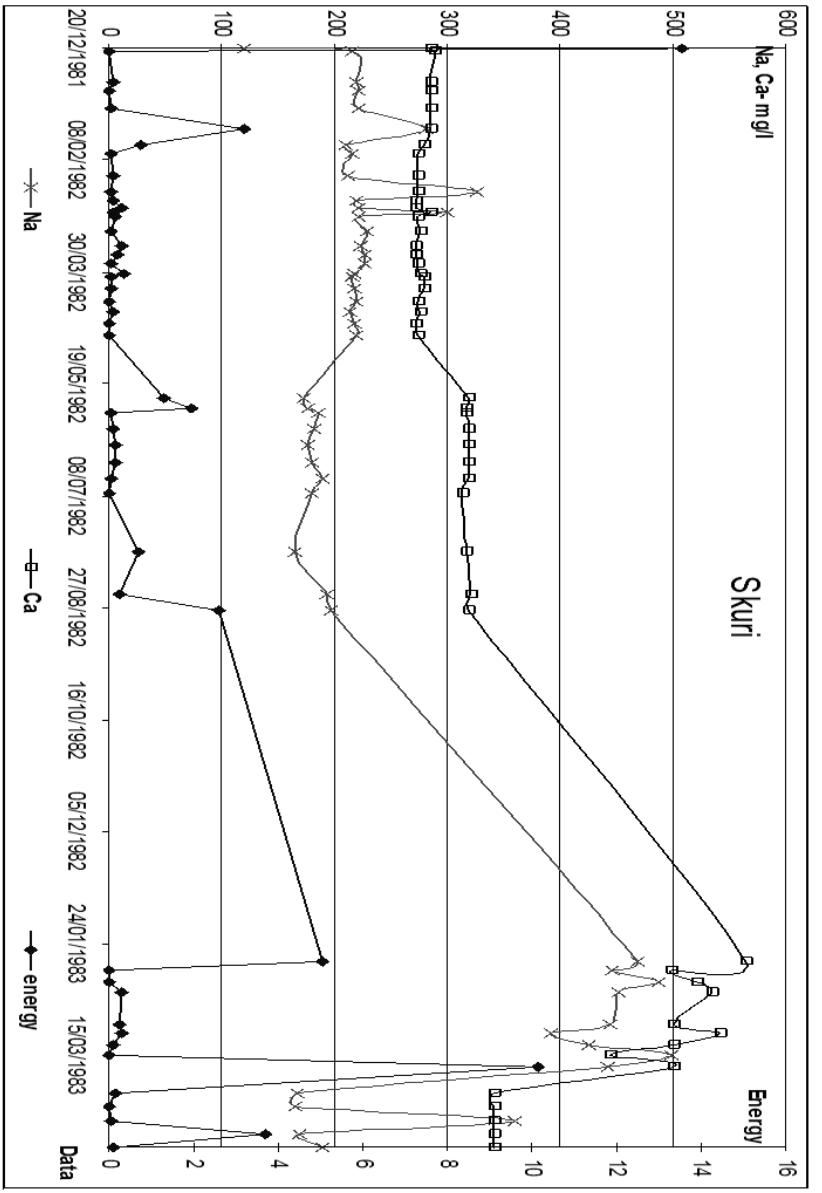

Fig. 2 Variation of hydro-chemical parameters and earthquakes energy at the Skuri station

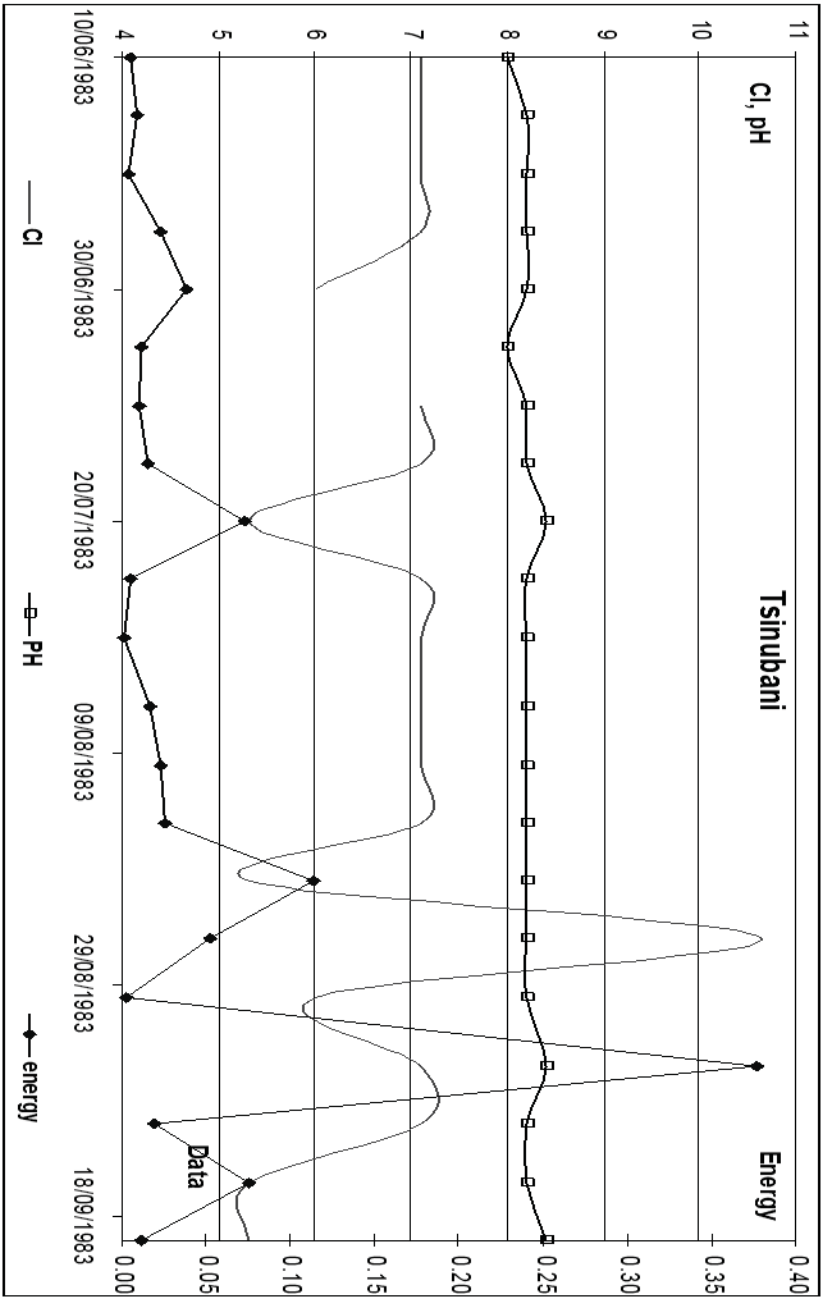

Fig. 3 Variation of hydro-chemical parameters and earthquakes energy on the Tsinubani station

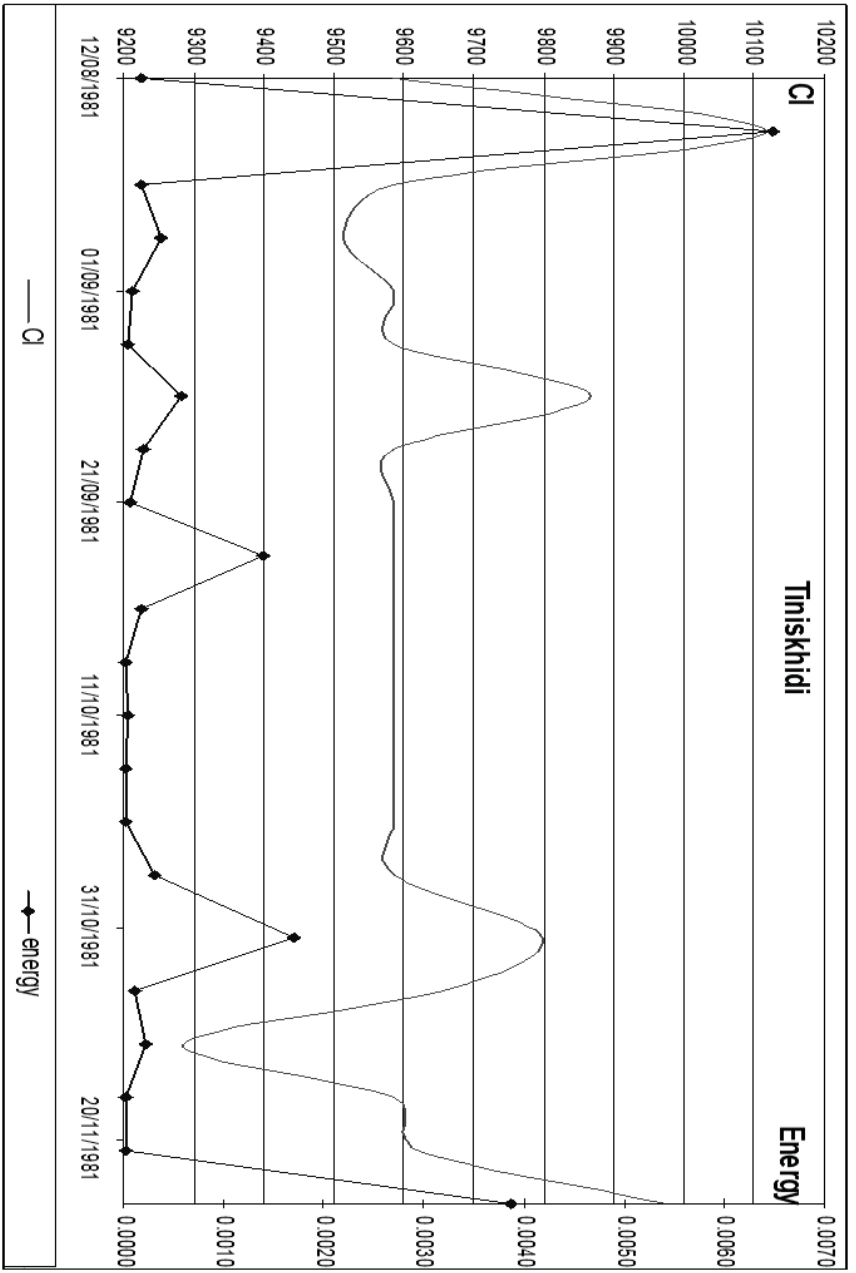

Fig. 4 Variation of hydro-chemical parameters and earthquakes energy on the Tiniskhidi station

Boreholes are equally spread all over the territory, basically on main geo-plates. These wells record all kinds of deformation caused by

exogenous (atmospheric pressure, tidal variations and precipitation), as well as endogenous\ tectonic processes (Rojstaczer S. et al., 1998, Melikadze et al., 2002). On some boreholes, reaction of tidal-variation or atmosphere pressure dominated. For example, the atmospheric pressure is dominant at Adjameti and Oni boreholes and then tidal variations. But the tides are dominant on the Marneuli and Lagodekhi boreholes (Melikadze et al, 2004).

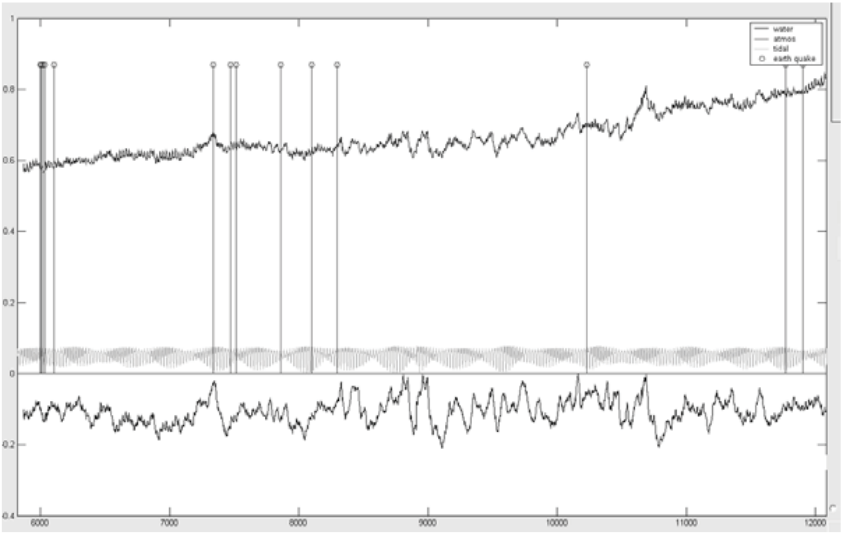

Fig. 5 Variations in time of water level (the bottom line), atmospheric pressure (the top line) and the tides (an average line) in the Adjameti borehole. Vertical lines correspond to the occurrence of earthquakes.

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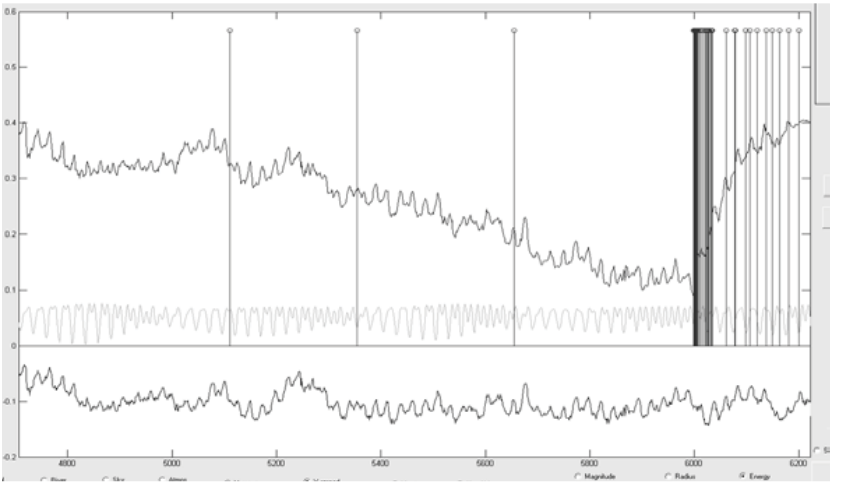

Fig. 6. Variations in time of water level (the bottom line), an atmospheric pressure (the top line) and the tides (an average line) in the Oni borehole. Vertical lines correspond to the occurrence of earthquakes.

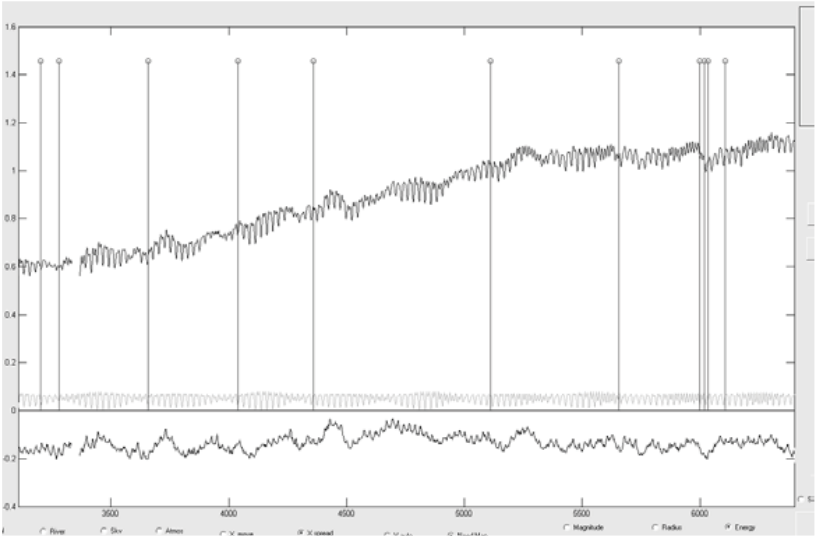

Fig. 7 Variations in time of water level (the bottom line), atmospheric pressure (the top line) and the tides (an average line) in the Marneuli borehole. Vertical lines correspond to the occurrence of earthquakes.

Distinctions in dominating factors are caused by depth of a borehole, its design, originality of a geological and hydro-geological structure water aquifer, value of the gas factor, etc.

For the conductance of qualitative observations appropriate equipment is necessary which could ensure frequent parameters inquiry, data transmission of determined frequency. After searching we have chosen data logger by American production to which 8 analogue ports and one pulse port are attached as well as corresponding sensors of water level or water pressure, atmospheric pressure and temperature.

This equipment ensures attachment of other informative sensors, which were chosen for such observation as magnetic and tiltmeter, Radon and Helium gases. The registration of this data occurs with a frequency of one time in a minute.

The data collection takes place with a frequency of one time in a day or more rarely. The data reception is ensured with the help of software of American data-logger.

All the data is collected in Matlab for the following processing, water level, atmospheric pressure, temperature, tilt-meter, which we get from the boreholes, tidal variations, which we calculate from the special program (GRAV To) and earthquakes data, which we receive from seismic station. In Matlab we calculate the stress condition from the earthquakes data, for each borehole by Dobrovolsky's $e=10^{1,\ 3M-8,\ 19}/R^3$ equation.

Conclusion

According to the new methodology, we have selected informatively deep boreholes for the special network, which covers the whole territory of Georgia and characterize all basic geo-plates. They represent sensitive strainmeters and fixed the deformations processes about 10^{-7} -10^{-8}, caused both by endogenous and exogenous factors.

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