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Revealed of Hydrodynamic Anomalies in Boreholes of Georgia Caused by Earthquakes

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ABSTRACT

The article contain information about several hydrodynamic anomalies were observed during January 2021 on the multiparametric monitoring network of M. Nodia institute of Geophysics. Data were analyzed by the special program which gives possibility to exclude the influence of geological factors by the common value of tidal variations. Was analyzed reaction of parameters to the earthquake preparation process.

Key words: *hydrodynamic anomalies, seismic event precursors.*

1. Introduction

It is known that variations of water level represent itself an integrated response of aquifer to different periodic as well as non-periodic influences, including earthquake related strain generation in the earth crust [1-2]. Quantitative analysis of impacts of separate components in observed integral dynamics remains one of the main geophysical problems. It is especially important for non-periodic processes related to the earthquake generation, taking into account their possible prognostic value [3-4].

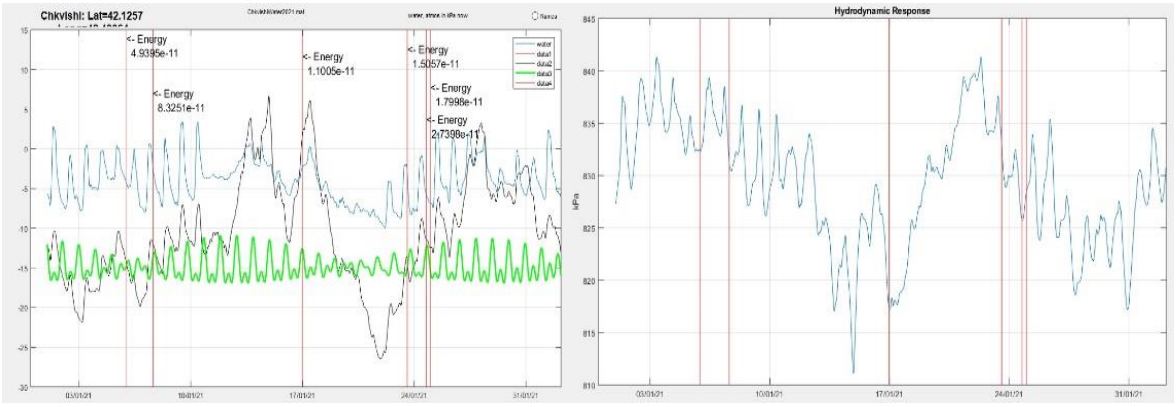
Determination of earthquake precursors is a task of global importance. The article deals about detected anomalies during preparation of average grade earthquake. For this purpose, was developed data of the water level and atmospheric pressure from the Hydrodynamic monitoring network. Has fixed the hydrogeodeformation field variation caused by the earthquake preparation process and reflection of the critical stress in the water level. As a result, have been identified preliminary anomalies and has been confirmed high sensitivity to the geodynamic processes.

2. Data Analysis

Therefore, were analyzing the value of stress field by hydrodynamical parameters [5-6] variations during preparation of several earthquake processes on the territory of Caucasus were calculated and analyzed:

Earthquake in Akhalkalaki area -05.01.2021-25.01.2021 period (Mag=3.4 05.01.2021, Mag=2.9 16.01.2021, Mag=3.0 23.01.2021, Mag=3.2 24.01.2021).

The earthquakes of Akhalkalaki, anomalies were observed on the Chkvishi, Akhalkalaki, Ajameti, Kobuleti, Oni and Gori boreholes.



a b

Fig.1. a - Water level, atmospheric pressure and tidal variations at the Chkvishi borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Hydrodynamic Response.

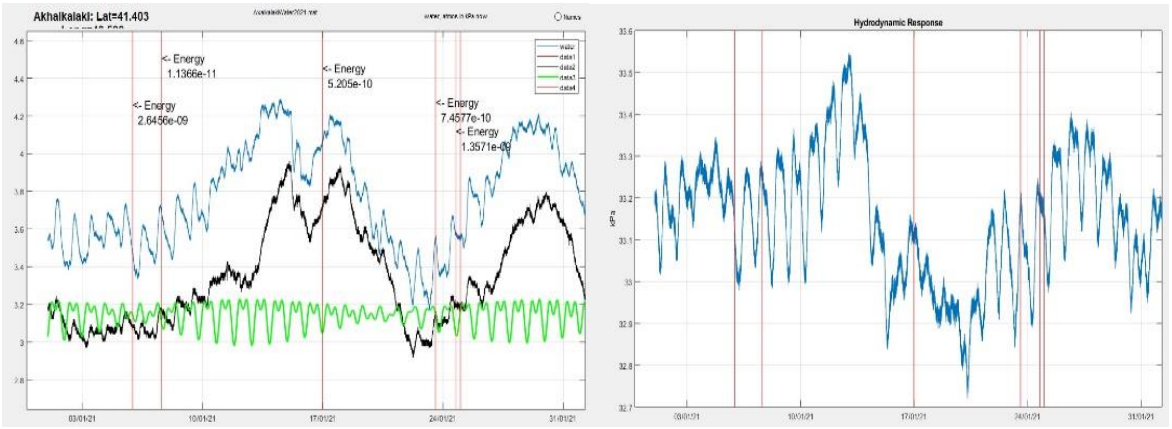


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Fig.2. a - Water level, atmospheric pressure and tidal variations at the Akhalkalaki borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Hydrodynamic Response.

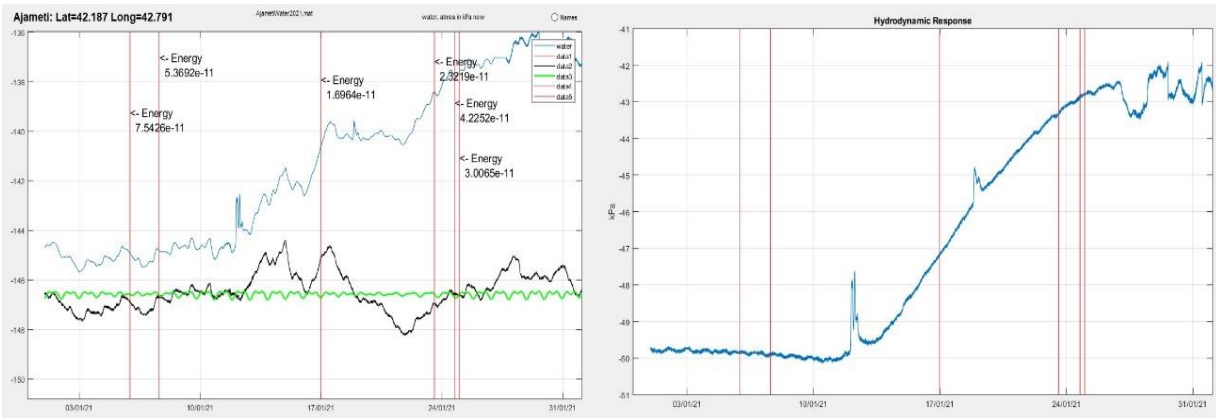

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Fig.3. a - Water level, atmospheric pressure and tidal variations at the Ajameti borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Hydrodynamic Response.

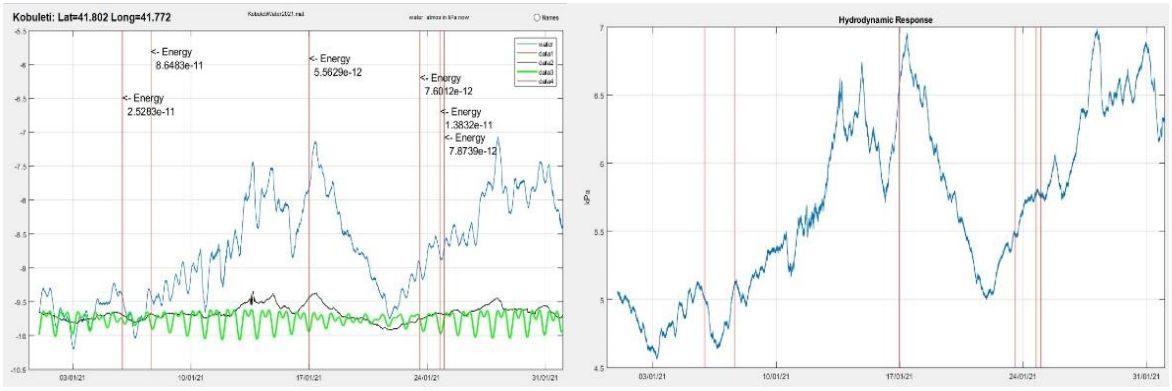

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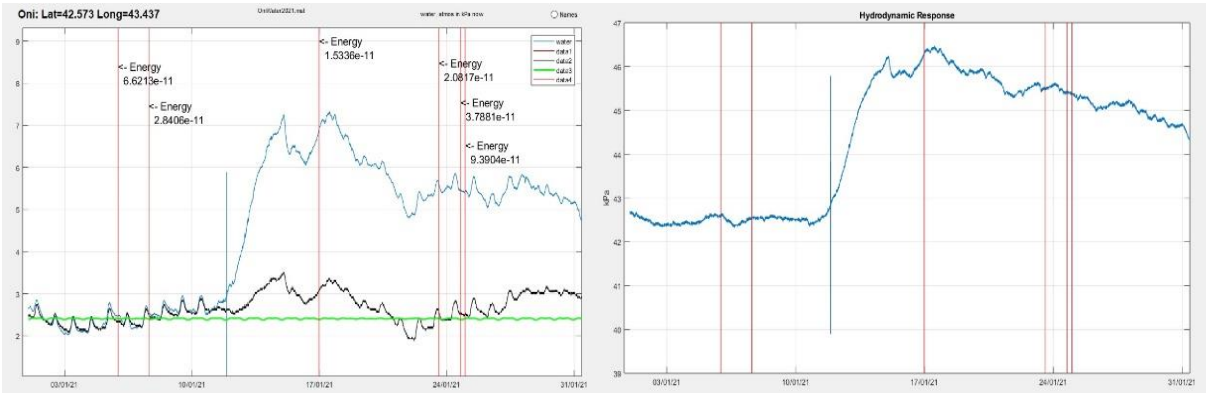
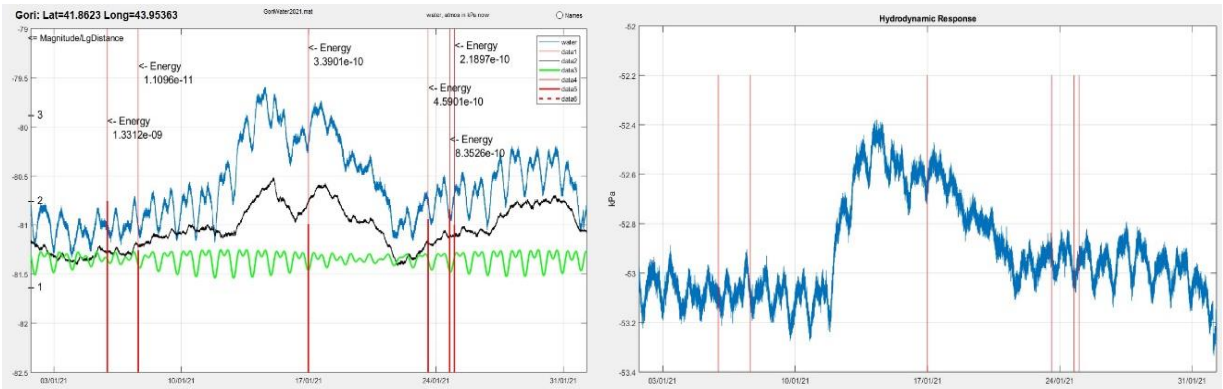
Fig.4. a - Water level, atmospheric pressure and tidal variations at the Kobuleti borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Hydrodynamic Response.



a b

Fig.5. a - Water level, atmospheric pressure and tidal variations at the Oni borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Hydrodynamic Response.



a b

Fig.6. a - Water level, atmospheric pressure and tidal variations at the Gori borehole. Vertical line marks an earthquake. On abscise axis time is in hours. b- Hydrodynamic Response.

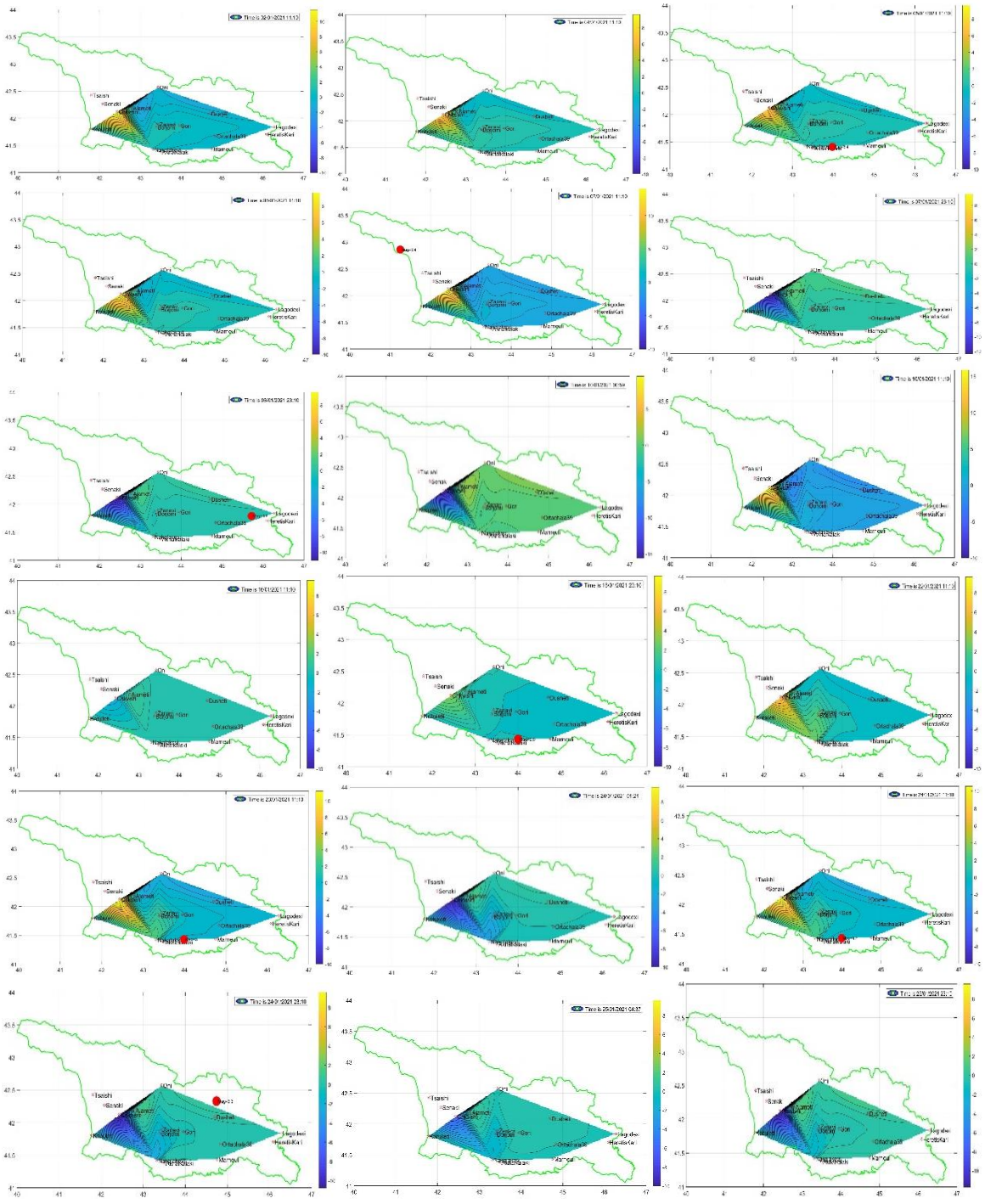


Fig.7. Geodeformation field changes for period 01-25 January 2021.

3. Conclusion

The information content of hydrodynamic boreholes from the earthquake prognostics point of view are ascertained. The recorded anomalies coincide with the preparation period for strong earthquakes. Characteristics of anomalies (amplitude, period, etc) are correlated with earthquake strength. However, in certain cases, high levels of anomalies are recorded in boreholes located relatively far from the epicentre.

References

[1] Varazanashvili O., Tsereteli N., Amiranashvili A., Tsereteli E., Elizbarashvili E., Dolidze J., Qaldani L., Saluqvadze M., Adamia Sh., Arevadze N., Gventcadze A. Vulnerability, Hazards and Multiple Risk Assessment for Georgia. Natural Hazards, v. 64, N. 3, 2012, pp. 2021-2056, DOI: 10.1007/s11069-012-0374-3, http://www.springerlink.com/content/ 9311p18582143662/fulltext.pdf
[2] Melikadze G., Kobzev G., Kapanadze N., Machaidze Z., Jimsheladze T. Analyze of Underground Water Regime Factors for Determine Tectonic Component. LEPT Institute of Hydrogeology and Engineering Geology, Collection articles, vol. XYI. Proceeding of Conference Dedicate to the 100-th Anniversary of Professor Josef Buachidze, Tbilisi, 2007, 20.
[3] Dovgal N., Melikadze G. Methodology of Creation of Multi-Parametrical Network, Workshop materials "Exploration and exploitation of groundwater and thermal water systems in Georgia", Tbilisi, Georgia, 2010, pp. 50-59, http://dspace.nplg.gov.ge/handle/1234/9081
[4] Kartvelishvili K., Melikadze G., Kobzev G. Influence of Atmosphere Pressure and Tidal Variation of Gravity of the Hydrosphere. Trans. of Mikheil Nodia Institute of Geophysics, ISSN 1512-1135, vol. 65, 2010, pp. 169 -173, (in Russian).
[5] Melikadze G., Kobzev G., Jimsheladze T. Some Methods of Analyze Geodynamic Imfuct on the Deep Aquifare. Journal of the Georgian Geophysical Society, Iss. A. Physics of Solid Earth, vol. 17A, 2014, pp.47-52.
[6] Jimsheladze T., Melikadze G., Kobzev G. Construction and Analysis of the Stress State of Environment During the Preparation of the Racha Earthquake 2009. ISSN 1512-1135, vol. 64, 2013, pp. 36-45, (in Russian).

მიწისძვრებით გამოწვეული ჰიდროდინამიური ანომალიების გამოვლენა საქართველოს ჭაბურღილებში

გ. მელიქაძე, თ. ჯიმშელაძე, გ. კობზევი, ა. ჭანკვეტაძე

რეზიუმე

სტატია გადმოგვცემს ინფორმაციას 2021 წლის იანვარში, ახალქალაქის ტერიტორიაზე დაფიქსირებული მიწისძვრების ჯგუფის დროს ნოდიას სახ. გეოფიზიკის ინსტიტუტის მულტიპარამეტრიკულ ქსელზე გამოვლენილ ჰიდროდინამიკურ ანომალიებზე. მონაცემები მუშავდებოდა სპეციალური პროგრამის მეშვეობით, რათა გამორიცხულიყო გეოლოგიური ფაქტორების გავლენა. სხვადასხვა სადგურების მონაცემები კალიბრებოდა მიმოქცევითი ვარიაციებით. გაანალიზდა პარამეტრების ვარიაციები და რეაქციები მიწისძვრის მომზადების პროცესზე.

Выявление гидродинамических аномалии в скважинах Грузии, вызванные землетрясениями

Г.И. Меликадзе, Т. Дж. Джимшеладзе, Г.Н. Кобзев, А. Ш. Чанкветадзе

Резюме

Статья содержит информацию о гидродинамических аномалиях в период групп землетрясений в Ахалкалаки (январь 2021) по данным наблюдений мультипараметрической мониторинговой сети Института геофизики им. М. Нодиа. Данные проанализированы с помощью специальной программы. С целью исключения влияния геологических факторов, данные с различных станций были откалиброваны с помощью значений приливных вариаций. Осуществлен анализ вариаций и реакции параметра на процесс подготовки землетрясения.