Journal of the Georgian Geophysical Society, ISSN: 1512-1127
Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 23(2), 2020, pp. 5-9

Reaction of the Hydrodynamic Network on the Earthquake Preparation Process in Georgia

George I. Melikadze, Tamar J. Jimsheladze, Genadi N. Kobzev, Aleksandre Sh. Tchankvetadze

M. Nodia Institute of Geophysics of I. Javakhishvili Tbilisi State University
melikadze@gmail.com

ABSTRACT

The article contain information about several hydrodynamic anomalies were observed during earthquake in Racha (04.11.2020 17:10, Mag = 4.2, Depth = 2km, Lat. 42.48°; Long. 43.41°) 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.

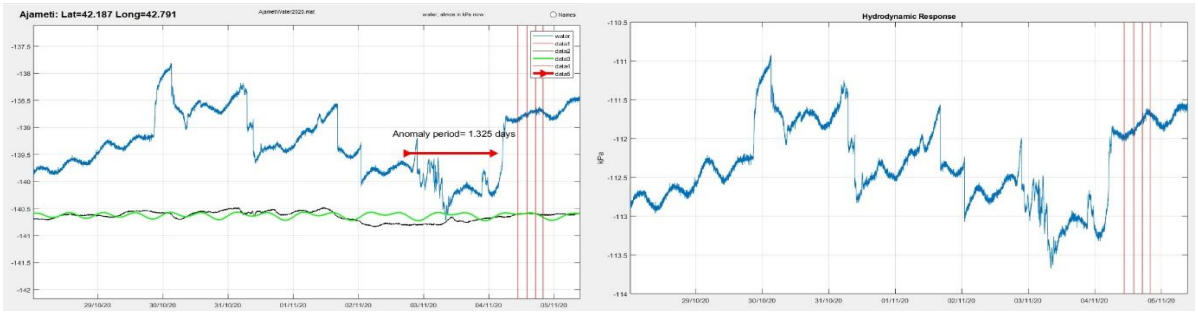
Key words: *hydrodynamic anomalies, seismic event precursors.*

1. Introduction

Georgia is very vulnerable to various natural disasters, including earthquakes [1]. Significant number of works on the registration of earthquakes and the detection of their possible precursors is here carried out [2-10]. Multiparametric data (water level, atmosphere pressure, temperature) were recorded with a minute frequency, in the deep boreholes located on the territory of Georgia. Observations were carried out using the special equipment providing measurement of deformation up to 10^{-8} degrees [11-12]. In order to exclude the influence of geological factors, the data from various stations were rated against the common value of tidal variations [13-14]. Variation and reaction of parameters to the earthquake preparation process [15-19] were analyzed.

2. Data Analysis

Let us consider the changes in parameters during the preparation of the earthquake ("Racha", 04.11.2020 17:10, Mag = 4.2, Depth = 2km, Lat. 42.48°; Long. 43.41°) in the period from 29.10.2020 to 06.11.2020 for five stations.

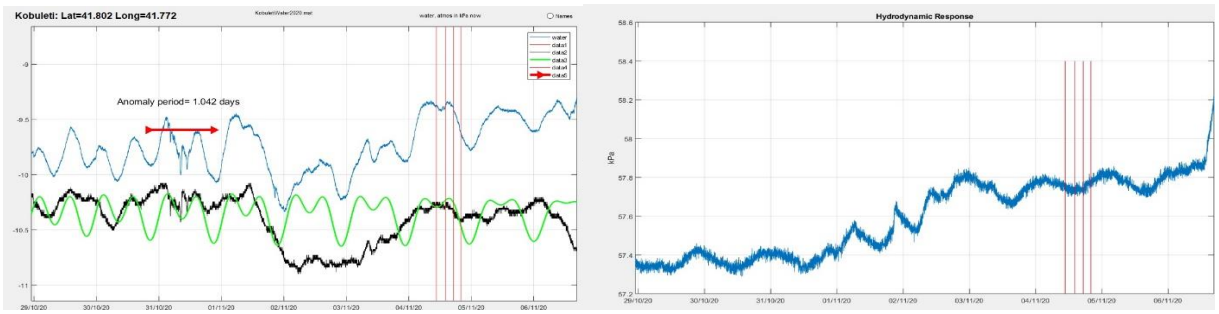


a b

Fig.1. a - Water level, atmospheric pressure and tidal variations at the Ajameti borehole. Vertical line marks an earthquake. b- Hydrodynamic Response.

The first of them - "Ajameti", is located 60 km from the epicenter, the second, "Kobuleti", is located 154 km from the epicenter, "Lagodekhi" - at 247 km, "Nakalakevi" - at 117 km, and finally "Oni" is located in epicentral area.

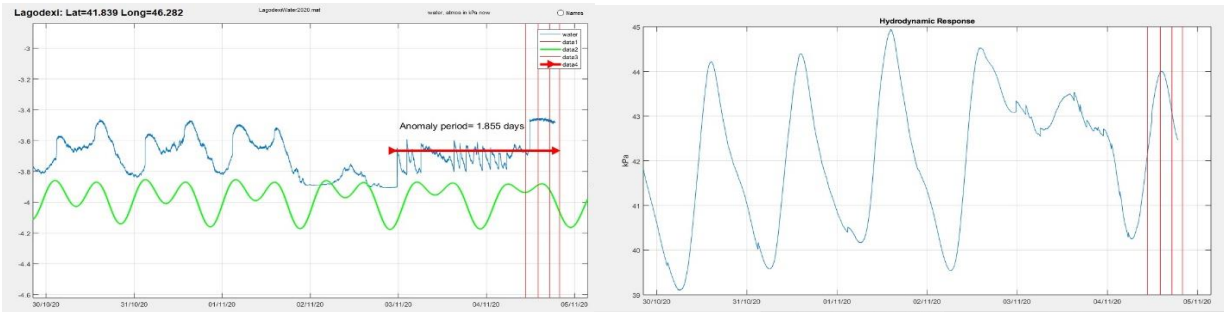
Anomaly was revealed on Ajameti station before 4 November 2020 earthquake, 5 days earlier. Water level falling can be seen on the graph (Fig.1 a, b). Earthquake happened in 60 km far from the station. The duration of the anomalous period is fixed on figure.



a b

Fig.2. a - Water level, atmospheric pressure and tidal variations at the Kobuleti borehole. Vertical line marks an earthquake. b- Hydrodynamic Response.

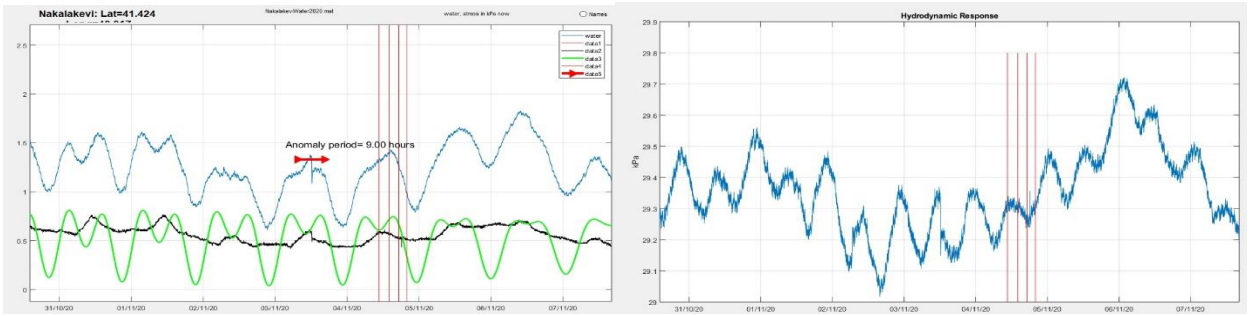
At Kobuleti borehole, which is 154 km away from the epicenter, the anomaly was observed 4 days prior to the earthquake. The duration of the anomalous period is shown on figure.



a b

Fig.3. a - Water level and tidal variations at the Lagodekhi borehole. Vertical line marks an earthquake. b- Hydrodynamic Response.

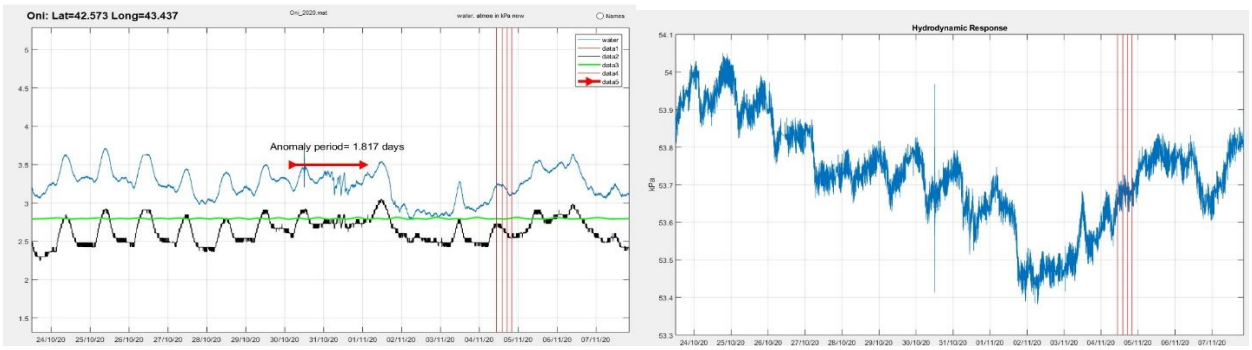
In Lagodekhi, which is 247 km away from the epicenter, we observed an anomaly that continued for 2 days.



a b

Fig.4. a - Water level, atmospheric pressure and tidal variations at the Naqalaqevi borehole. Vertical line marks an earthquake. b- Hydrodynamic Response.

Anomaly was observed in Naqalaqevi borehole 1 day earlier before event of 4 November 2020. The Earthquake occurred in 117 km far from a station.



a b

Fig.5. a - Water level, atmospheric pressure and tidal variations at the Oni borehole. Vertical line marks an earthquake. b- Hydrodynamic Response.

At Oni station anomaly behavior was 5 day earlier before the earthquake and continued for 2 days. Earthquake epicenter was located in 10 km far from the station.

3. Conclusion

Results of data analysis demonstrate the informatively of water level as an indicator of tectonic activity. Variations in hydrodynamic parameters are caused by the earth stress. During normal period it change according tidal variation and has “background” value. Before seismic event character of variation changed above “background” value, as indicator of tectonic activity. During the observed time period were fixed earthquake with Magnitude 4.2, between 60-150 km from the station, occurred on the territory of Caucasus.

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] Bella F., Della Monica G., Ermini F., Sgrigna V., Biagi P.F., Manjgaladze P., Zilpimiani D. Underground Monitoring System of Electromagnetic Emissions. Nuovo Cimento, vol. 10, Iss. 5, September 1987, pp. 495–504, doi:10.1007/BF02507246

[3] Areshidze G., Chkuaseli V., Mandjgaladze P., Zilpimiani D., Bella F., Caputo M., Della Monica G., Ermini A., Sgrigna V., Biagi P.F., Melikadze G. Abnormal Behaviour of Some Parameters Revealed in the Georgian SSR Before the Armenia Earthquake of December 7, 1988. A Preliminary Report. Nuovo Cimento C., vol. 13, Iss. 3, 1988, May 1990, pp. 617–630.

[4] Shengelaia G., Danelia K., Zardiashvili K., Khunjua A., Khunjua T. On Possible Precursor of the Tbilisi Earthquake on April 25, 2002. Bull. of the Georgian National Academy of Sciences, 166, N 3, 2002, pp. 499-501.

[5] Amiranashvili A.G., Chikhladze V.A., Gambashidze R.A., Khunjua A.T., Nodia A.G. Preliminary Results of Investigations of Variations of Atmospheric Electric Parameter Peculiarities Over Tectonic Fractures and During Earthquakes, Proc. 12th Int. Conf. on Atmospheric Electricity, Versailles, France, 9-13 June, vol.1, 2003, pp. 403-406.

[6] Amiranashvili A.G., Matiashvili T.G., Nodia A.G., Khunjua A.T., Chikhladze V.A. Connection of Soil Radon and Air Electrical Conductivity with the Earthquakes. Trans. of Mikheil Nodia Institute of Geophysics, ISSN 1512-1135, vol. 60, Tbilisi, 2008, pp. 195–201.

[7] Matiashvili T., Amiranashvili A., Amiranashvili V., Sharadze Z., Chikhladze V., Chikhladze A. ULF Electromagnetic Variations Connected with a Seismic Center. Journal of the Georgian Geophysical Society, Iss. A. Physics of Solid Earth, ISSN 1512-1127, vol. 12A, Tbilisi, 2008, pp. 70–74.
[8] Kereselidze Z.A., Kachakhidze N.K., Kachakhidze M.K. In Connection with Mechanism of Very Low Frequency Electromagnetic Emission Generated in Seismoactive Zone. Journal of the Georgian Geophysical Society, Iss. B, Physics of Atmosphere, Ocean and Space Plasma, vol. 14, 2010, pp.183-191.
[9] Conti L., Sgrigna V., Zilpimian, D., Assante D. Method for Signal Conditioning and Data Acquisition System, Based on Variable Amplification and Feedback Technique. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 756, 2014, pp. 3–29, DOI: http://doi.org/10.1016/j.nima.2014.04.009.
[10] Kvavadze N., Kvavadze K., Tsereteli N., Gventsadze A., Gogoladze Z. Development of Strong Motion Network in Georgia. Journal of the Georgian Geophysical Society, Iss. A. Physics of Solid Earth, ISSN 1512-1127, vol. 20A, Tbilisi, 2017, pp. 2–9.
[11] 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
[12] 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
[13] 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).
[14] Kobzev G., Melikadze G. Methods of Hydrogeodynamical Analysis for Revealing Earthquakes Precursors. Workshop materials "Exploration and exploitation of groundwater and thermal water systems in Georgia", Tbilisi, Georgia, 2010, pp. 60-69.
[15] Chelidze T., Matcharashvili T., Melikadze G. Earthquakes' Signatures in Dynamics of Water Level Variations in Boreholes. In: Synchronization and Triggering: from Fracture to Earthquake Processes, Eds.V.de Rubeis, Z. Czechowski, R. Teisseyre, Geoplanet: Earth and Planetary Sciences, vol. 1, Part 3, 2010, pp .287-304, DOI: 10.1007/978-3-642-12300-9_20, Springer.
[16] Jimsheladze T., Kobzev G., Melikadze G., Zhukova N. Geodynamical Impact on the Water Level Variations in the Boreholes, Workshop materials "Exploration and exploitation of groundwater and thermal water systems in Georgia", Tbilisi, Georgia, 2010, pp. 69-83.
[17] Jimsheladze T., Melikadze G., Chankvetadze A., Gogua R., Matiashvili T. The Geomagnetic Variation in Dusheti Observatory Related with Earthquake Activity in East Georgia. Journal of the Georgian Geophysical Society, Iss. A. Physics of Solid Earth, vol. 15A, 2012, pp.118-128.
[18] Chelidze T., Shengelia I., Zhukova N., Matcharashvili T., Melikadze G., Kobzev G. Coupling of Multiple Rayleigh Waves and Water Level Signals during 2011 Great Tohoku Earthquake Observed in Georgia, Caucasus. Bull. of the Georgian National Academy of Sciences, vol. 8, No. 2, 2014, pp. 75-79.
[19] Melikadze G., Jimsheladze T., Kobzev G., Benderev A., Botev E. Linear Methods of Studying the Water Level Variation Related with Seismicity". Journal of the Georgian Geophysical Society, Iss. A. Physics of Solid Earth, vol. 17A, 2014, pp.65-75.
[20] 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.
[21] 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).

ჰიდროდინამიური ქსელის რეაქცია მიწისძვრის მომზადების პროცესზე საქართველოში

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

რეზიუმე

სტატია გადმოგვცემს ინფორმაციას სხვადასხვა ჰიდროდინამიკურ ანომალიებზე, რომლებიც დაფიქსირებულია მიწისძვრის დროს რაჭაში (04.11.2020 17:10, მაგ.=4.2) ნოდიას სახ. გეოფიზიკის ინსტიტუტის მულტიპარამეტრიკულ ქსელზე. მონაცემები მუშავდებოდა სპეციალური პროგრამის მეშვეობით, რათა გამორიცხულიყო გეოლოგიური ფაქტორების გავლენა. სხვადასხვა სადგურების მონაცემები კალიბრებოდა მიმოქცევითი ვარიაციებით. გაანალიზდა პარამეტრების ვარიაციები და რეაქციები მიწისძვრის მომზადების პროცესზე.

Реакция гидродинамической сети на процессы подготовки землетрясений в Грузии

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

Резюме

Статья содержит информацию о гидродинамических аномалиях в период землетрясения в Рача (04.11.2020 17:10 Маг. =4.2) по данным наблюдений мультипараметрическом 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.