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Reconstruction of Glacier Kolka Collapse Process of 2002 on the Basis of Seismic Records Data

Vladislav ZAALISHVILI[1,*], Valter MAKIEV[2], Dmitry MELKOV[2]

[1]Laboratory of Engineering Seismology, Center of Geophysical Investigations of VSC RAS and RNO-A, Vladikavkaz, Russia
[2]Laboratory of Instrumental Monitoring of Hazardous Natural-Technogenic Processes, Center of Geophysical Investigations of VSC RAS and RNO-A, Vladikavkaz, Russia
*Corresponding author: vzaal@mail.ru

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Abstract On 20-th September of 2002 the tragic event occurred, which took aback the entire population of the Republic of North Ossetia-Alania – sudden collapse of the glacier Kolka. Analysis of available instrumental data shows the correspondence of the basic stages, obtained on the different stations of the local network of the seismological observations of RNO-A. For the purpose of the more detailed investigation of the glacier Kolka collapse process data of the seismic stations given by Georgian collegues was investigated.

Keywords: *glacier, fall, collapse, seismic records*

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1. Introduction

On 20-th September of 2002 the tragic event occurred, which took aback the entire population of the Republic of North Ossetia-Alania – sudden collapse of the glacier Kolka. As a result the village Nizhniy Karmadon disappeared. The bigger part of houses in village Gornaya Saniba, built in recent years in the river Genaldon floodlands, turned out to be under water. People were buried by the flow, there were children among them. The group of Sergey Bodrov, that participated in filmingwas also buried.

2. Objectives

The instrumental records obtained by the local network of the Center of Geophysical Investigations (at that time – the Geophysical Center of Experimental Diagnostics (GCED)), due to the trigger start mechanism of the seismic stations, the preceding event and the large part of the glacier Kolka collapse process were registered only partially. This caused the need for the comparison of the obtained records with the data of other stations. The absence of complete information often led to different and sometimes to reinforced in no way hypotheses [1].

3. Methods

The analysis of available instrumental data shows the correspondence of the basic stages, obtained on the different stations of the local network of the seismological observations of RNO-A [1-8].

For the purpose of the more detailed investigation of the glacier Kolka collapse process data of the seismic stations (Abastumani, Ambrolauri, Akhalkalaki, Akhaltsikhe, Oni, Tbilisi) given by Georgian collegues was investigated. These analog records completely cover the period of twenty-four hours from 19-th to 20-th September of 2002. The most complete and qualitative is the data of Tbilisi station (geophysical observatory) (Figure 1, Figure 2).

4. Results and Discussion

The analysis of the earthquake catalog showed that on 20-th September of 2002 before the catastrophic collapse of the glacier Kolka the earthquake occurred. Thus on 15:43:50,3 in region of West Irian (1,68° N 134,23° E) the earthquake with magnitude Ms = 6,2 and the depth of the epicenter of h = 33 km occurred. This distance longitudinal P-waves pass in time of approximately 13 min., and shear S-waves in time of approximately 26 min. It is necessary to note that the arrival of P-wave in this case will occur in 15 h 56 m 50 s, and S-wave 16 h 09 m 50 s. The attention is immediately drawn to the good correspondence of the times of the basic phases of waves with the stages of the glacier collapse.

The registration of such remote signals by the indicated type of observations is quite possible. Moreover, even less sensitive local network of the observations of CGI RAS & RNO-A repeatedly recorded the remote earthquakes (China, Japan, etc) [8]. In connection with this, it can be assumed that the "trigger" for the glacier collapse was the

indicated earthquake. In our opinion, precisely, it caused the trigger recording of the most sensitive stations: Chikola, Vladikavkaz 31 and stations of Geodynamic Observation Center in the Energy Sector (GOCES) located in Zaramag hydroplant construction site [3].

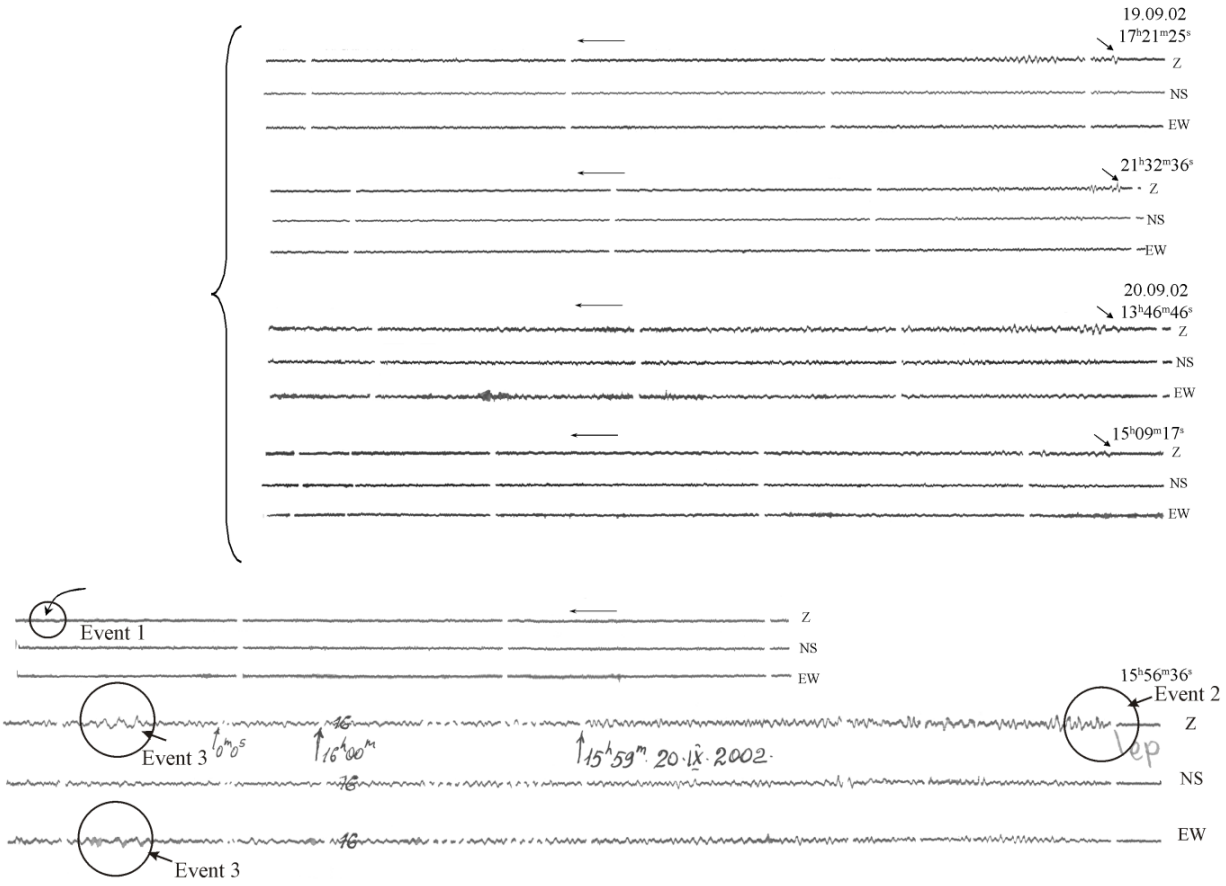

Figure 1. Records of the preceding events (time of the beginning of events is indicated in the absolute corrected values)

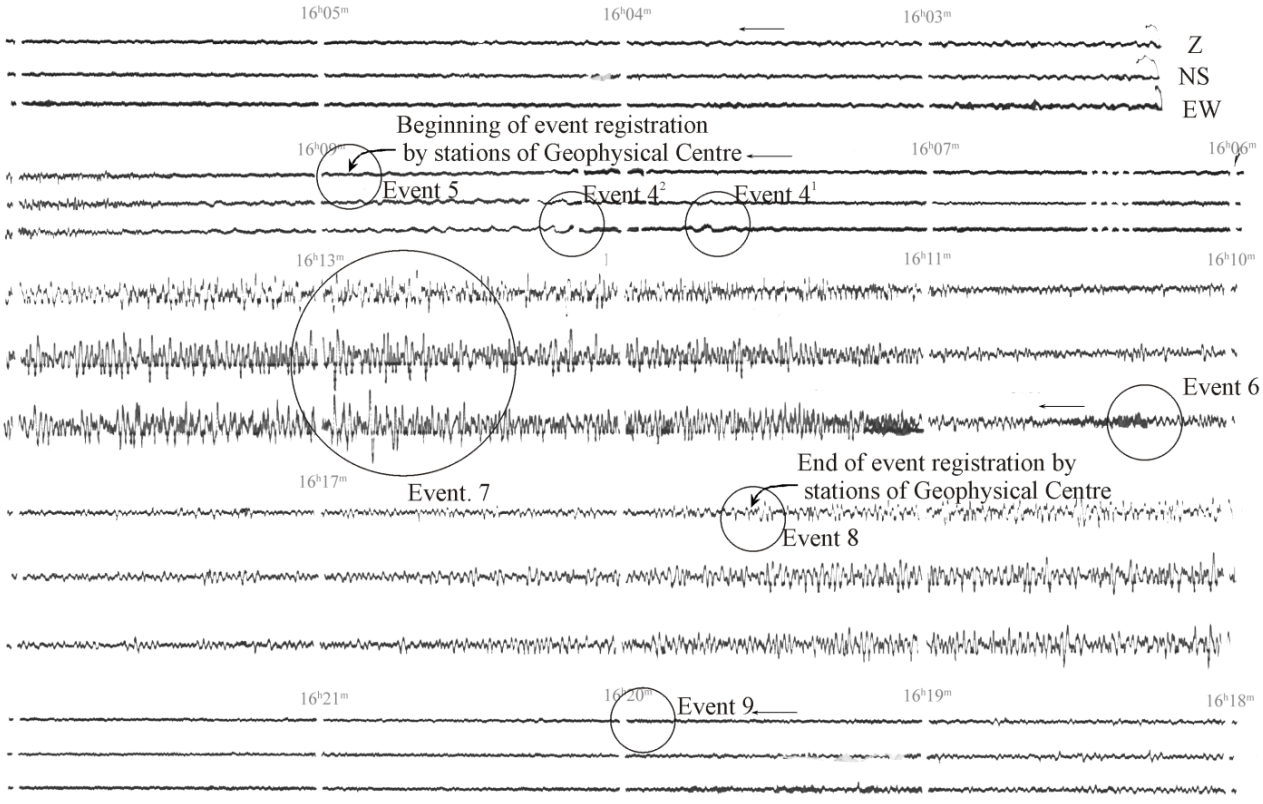

Figure 2. The glacier Kolka fall process on 20-th September 2002

Vertical component attenuates with the distance considerably more rapidly than the horizontal component. In connection with this the records of the remote earthquakes, as a rule, are characterized by relativly weak vertical component. After attenuation of the indicated vibrations it is possible to observe the long-period pulse on the vertical component (events 41, 42 in Figure 2). The horizontal component of pulse (EW) is quite significant.

On 16 h 09 m 29 s low-amplitude high-frequency vibrations (in our opinion the beginning of the glacier fall!) are observed, through 80-82 s end by large high-frequency pulse (impact on the rocks of the starboard of river Genaldon valleylower the ice tongue of the Mayli glacier) and further continues nearly the same high-frequency process, but characterized by the considerably large, distinctly expressed vibrations. According to the data of different stations, the amplitude of horizontal vibrations in this case exceeds the amplitude of vertical not less than in 2.5 times. Strictly the process of the glacier Kolka collapse before the achievement of microseismic disturbance level continued for 10 m 31 s. In this case the monotonic reduction of the amplitude of vibrations is observed already after 16 h 14 m 31 s.

The maximum duration of the process of the glacier Kolka collapse, which was controlled by GCED stations, covers, as noted above, 7 m 40 s and, undoubtedly, includes the major part of the collapse process according to its amplitude contribution (event 5, event 8, Figure 2).

Thus, the analysis of obtained data gives grounds to assert that in the region of glacier Kolkaon 15 h 56 m the echoes of the remote earthquake appeared, which was “the trigger” of the glacier Kolka collapse.

5. Conclusions

On the basis of instrumental records, the basic stages of the process of the glacier Kolka fall are established.

According to the results of analysis, undoubtedly different nature of the preceding event and basic process of the glacier Kolka collapse on 20-th September 2002 is established.

In the region of glacier Kolkaon 15 h 56 m the echoes of the remote earthquake appeared, which was “the trigger” of the glacier Kolka collapse.

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