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## NEW DATA ABOUT THE BLACK SEA TSUNAMI OF DECEMBER 26, 1939

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The Turkish earthquake of December 26, 1939, was one of the largest shocks ever recorded on Anatolia. The earthquake occurred at 23:57:16 GMT according to Richter, 1958. The epicenter was in Turkey near latitude 39.5°N, longitude 39.5°E, between Erzincan and Erzurum, which is about 160 km from the coast of the Black Sea. The focal depth of the earthquake was 27 km.

The main shock had a magnitude of 7.9 - 8 on the Richter scale. The intensity near the epicenter was between 11-12 degrees on the Mercalli-Cancani scale. Many other rather strong, intermittent shocks and aftershocks occurred in the week following the main shock.

The shocks and aftershocks occurred over a large epicentral zone. The zone was nearly linear with a width of 15 km and a length of about 340 km (Fig. 1). The area over which the earthquake was felt was large and elliptical in form. Many new faults were formed [Tillotson, 1940; Pamir and Ketin, 1940; Ketin, 1948].

This earthquake caused a small tsunami in the Black Sea. In Fatsa, a harbour on the Black Sea coast of Turkey, the sea receded 50 m from the shore. Then the sea dashed up the shore as far as 20 m above the normal water level. The wave action slowly diminished until the sea returned to its normal state. There is no information about the damage caused by these tsunami waves.

A small tsunami reached the Black Sea coast of the USSR and was recorded by tide gauges.

These waves were recorded by almost all of the tide gauge stations on the Black Sea coast of the Crimea and the Caucasus. The available marcographic records are shown in Fig. 2. Preliminary analysis of the tide gauge records resulted in the following conclusions or suggestions.

The tsunami began with the rise of the sea level in all places except Batumi. Batumi was the nearest USSR tide gauge to the epicenter of the earthquake. This tide gauge first recorded a fall of the sea level beginning at 23:57 on December 26, exactly the time of the principal shock. The maximum wave was 6.5 - 7 cm at this station.

The most distinctive mareographic records of the tsunami waves were those at Novorossiyk, Yalta, and Sevastopol. The largest oscillations of the sea level were observed in Novorossiysk, and the maximum wave--the first one--as recorded on the tide gauge was over 53 cm.

The seventh wave was 50 cm in height and the maximum wave recorded on the Sevastopol tide gauge.

The comparison of the calculated wave travel-time data with the observed data suggests that the source of the tsunami should have been either on the shore of the Black Sea near the coast of Turkey, between Batumi and Sinop, or inland. It is difficult to say anything definite about the mechanism of generation of this tsunami. It is not known whether it was generated by tectonic movement, or as that of a secondary phenomena, such as the landslide pointed out by B. Gutenberg [Gutenberg, 1939] in 1939 in connection with the Atacama earthquake on November 11, 1922.

References:

Gutenberg, B., 1939. "Tsunamis and Earthquakes," Bull. Seismol. Soc. Amer., vol. 29, No. 4.

Ketin, J., 1948. "Die Grossen Anatolischen Erdbeben in der Letzten Zehn Jahren," Urania, Jahrgang, 11, H.6.

Richter, C., 1958. Elementary Seismology, San Francisco, Freeman.

Pamir, H.N. and Ketin, J., 1940. "Das Erdbeben in der Turkey vom 27/28. December 1939," Geol. Rundschau, Bd. 31, H. 1/2.

Tillotson, E., 1940. "The Earthquake in Turkey," Nature, vol. 145, No. 3662.

TABLE 1

The Tsunami of December 27, 1939, as Recorded by USSR Tide Gauges

| Tide Station | Initial Rise or Fall | Number of the Maximum Height Wave | Observed Travel-time (min.) | Calculated Travel-time (min.) |
|---|---|---|---|---|
| 1. Batumi | - | | 0 | 0 |
| 2. Poti | | | | |
| 3. Tuapse | + | 1 | 50 | 53.7 |
| 4. Novorossiysk | + | 1 | 73 | 60.0 |
| 5. Kerch | + | 2 | 162 | 168.6 |
| 6. Feodosiya | + | 3 | 80 | 84.0 |
| 7. Yalta | + | 10 | 53 | 46.0 |
| 8. Sevastopol | + | 7 | 135 | 132.0 |

+ Rise

- Fall

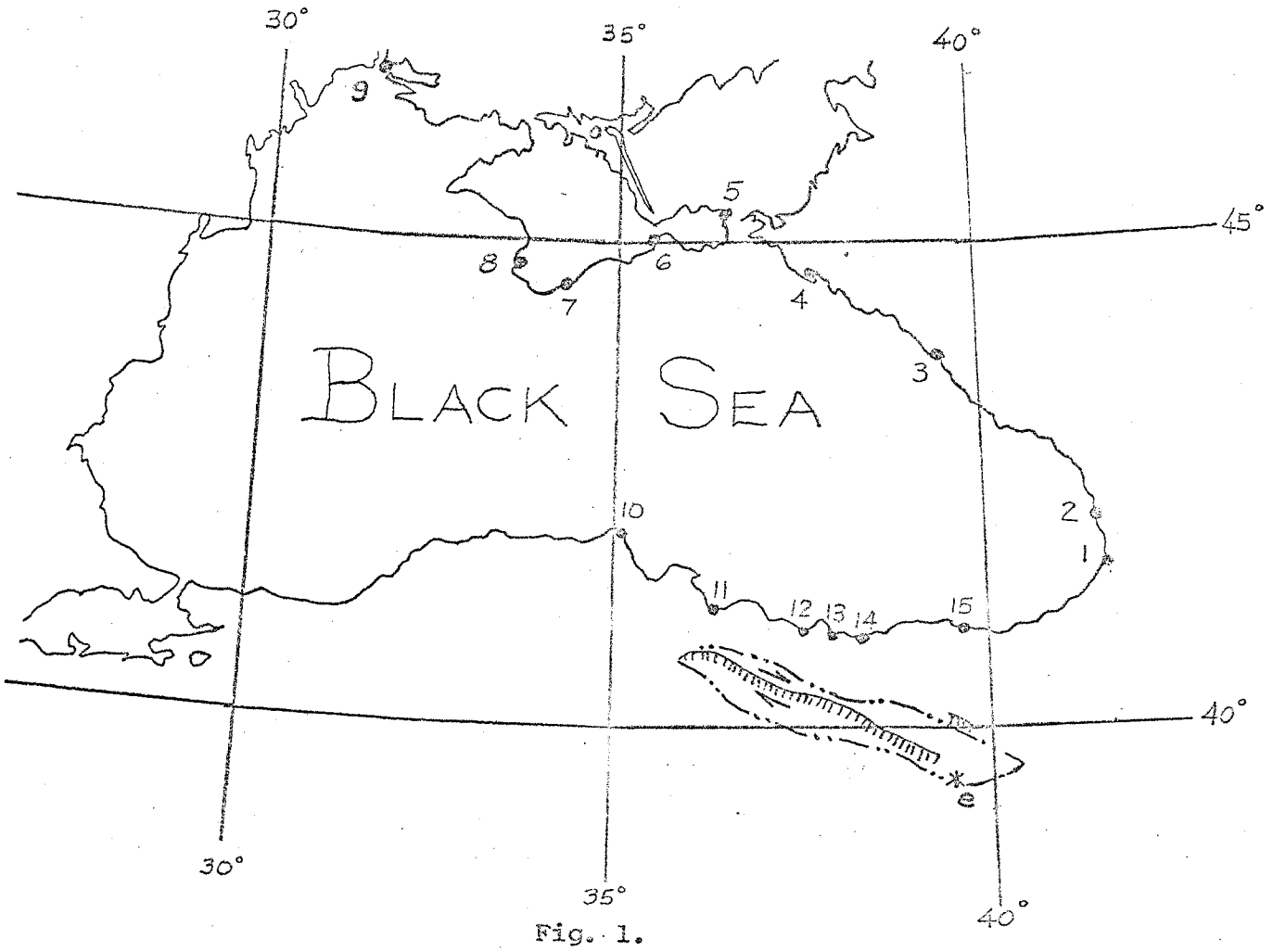


Fig. 1.

Map showing epicenter (e), epicentral zone (—..—) and faulting (////) of the December 26, 1939 shock. [Richter, 1958]

1 - Batumi
2 - Poti
3 - Tuapse
4 - Novorossiysk
5 - Kerch
6 - Feodosiya
7 - Yalta
8 - Sevastopol
9 - Odessa
10 - Sinop
11 - Samsun
12 - Fatsa
13 - Ordu
14 - Giresun
15 - Trabzon

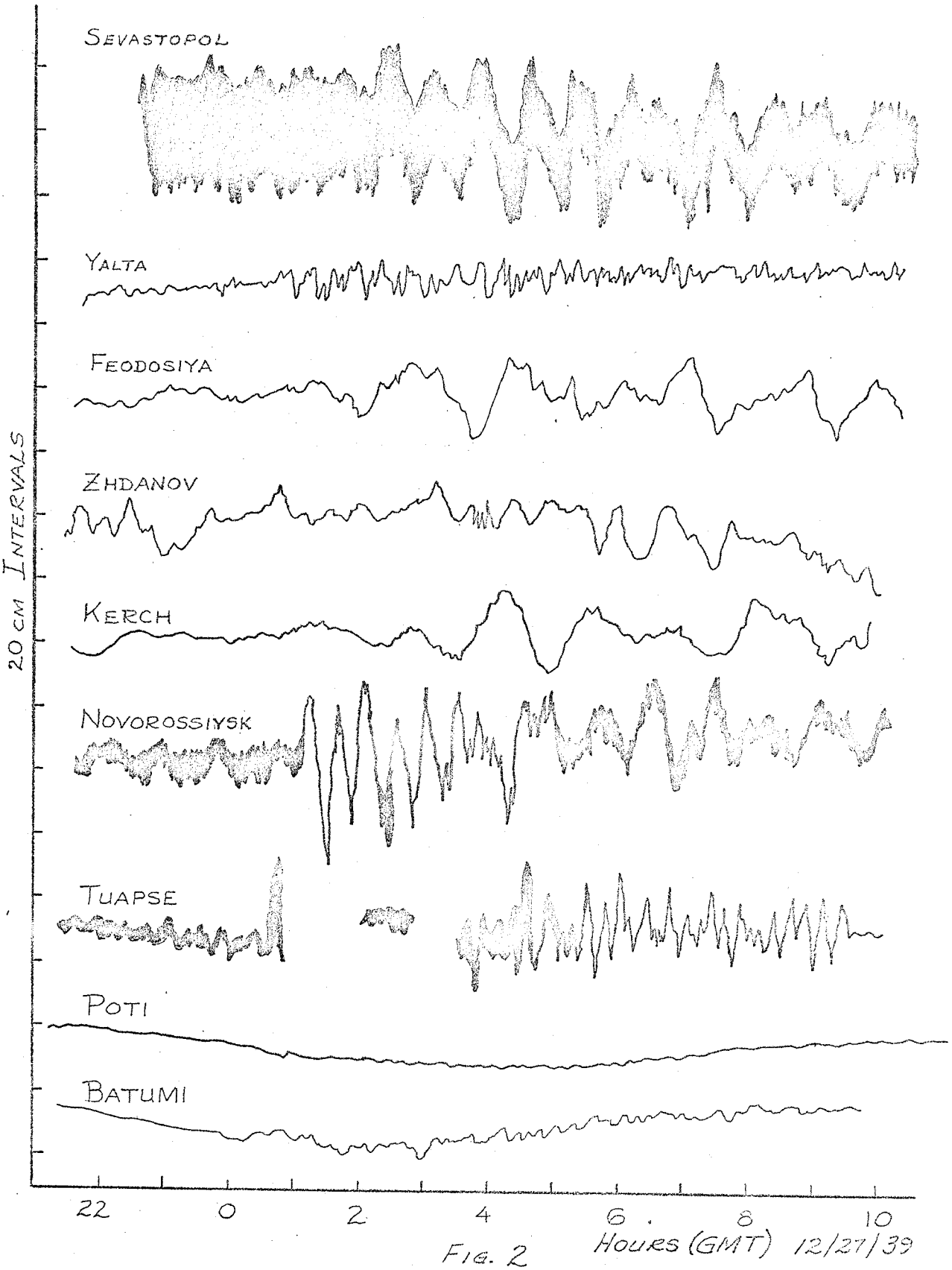
SEVASTOPOL
YALTA
FEODOSIYA
ZHDANOV
KERCH
NOVOROSSIYSK
TUAPSE
POTI
BATUMI
20 CM INTERVALS
22
0
2
4
6
8
10
HOURS (GMT) 12/27/39

FIG. 2

## KHABAROVSK-TOKYO-TWC COMMUNICATIONS TEST

The direct transmission of tsunami information between Khabarovsk, Tokyo, and Honolulu was suggested under Recommendation 6 of the Second Meeting of the ICG for the Tsunami Warning System in the Pacific at Vancouver, B.C., May 12-14, 1970 (ITIC NEWSLETTER, Vol III, No. 2, June 25, 1970, page 4). The technical details concerning the use of radio frequencies for the test were agreed upon through correspondence between ITIC and the Hydrometeorological Service of the USSR.

At 0200 GMT September 16, 1970, Radio Khabarovsk began broadcasting on the frequencies of 4516.7 KHz, 9230 KHz, and 14737 KHz. This broadcast continued for five minutes. There was no recordable signal received at Honolulu on 4516.7 KHz; a very weak signal with a high noise level was recorded on 9230 KHz; a good signal with its teletype printout was recorded at 14737 KHz. The test of these three frequencies was completed at 0205 GMT.

At 0215 GMT, three different frequencies were tested. At 6830 KHz there was no signal recorded; at 12253 KHz some audio tones were detected, but the signal was not strong enough for the teletype printout; at 19275 KHz a good signal was recorded and a teletype printout obtained.

During both of the high-frequency (14737 KHz and 19275 KHz) tests, the signal periodically faded, resulting in loss of teletype reception. These fade-outs were short in duration and because the test message was repeated several times, all of the text was received.

JMA Tokyo notified ITIC that they also received the tsunami dummy test but did not identify the frequencies giving the best reception.

## CANADIAN EQUIPMENT FOR THE TSUNAMI WARNING SYSTEM IN THE PACIFIC

The Canadian Government is willing to put to the disposal of countries participating in the International Coordination Group on the Tsunami Warning System in the Pacific ten Foxboro pressure-type tide gauges. If your country is interested in obtaining such instruments, please send a letter of application, through the IOC Secretariat, to the Director of the International Tsunami Information Center (ITIC) at Honolulu who will be responsible for final distribution of the instruments. A copy of this request should be sent to the Chairman of the International Coordination Group.

## TIDE GAGE DATA

The Permanent Service for Mean Sea Level requested that the ICG for the Tsunami Warning System in the Pacific furnish a listing of its tide gage stations in operation. ITIC furnished a list of stations and has requested that the Coast and Geodetic Survey (now known as the National Ocean Survey) furnish the monthly and annual mean data for the stations specified by the Permanent Service for Mean Sea Level.

## IUGG TSUNAMI SYMPOSIUM ON PREDICTION OF INUNDATION

The IUGG meetings in Moscow in August 1971 will include three short sessions related to tsunami research. Dr. Gaylord R. Miller, Director, Joint Tsunami Research Effort, University of Hawaii, has been asked to be convener for the session entitled "Prediction of Tsunami Inundation, Short Term," Dr. K. Iida of Nagoya University is convener for "Redefining of Tsunami Magnitude," and Professor S. Voyt, USSR, is convener for "Prediction of Tsunami Inundation, Long Term."

If you plan to present a paper related to the real-time forecasting of tsunami run-up, Dr. Miller would very much appreciate copies of the abstract by March 1, 1971. Professor Voyt requests that titles of reports for his session be sent to him by November 15, 1970. The format for abstracts as requested by the IUGG Organizing Committee is as follows:

The material is to be typed in English or French, in black type (ribbon copy by standard typewriter, or by "Varityper" or similar machine), on white paper, free of erasures. The dimensions are:

| | |
|---|---|
| Paper size: | 210 x 297 mm |
| Left-hand margin: | 3 cm |
| Maximum length of abstract: | equivalent to 1 full page, at a spacing of 1.5 lines |
| First page to be started 1/3 | down from top, with: |
| | Author's Surname, followed by initials, |
| | Author's Institute, |
| | Country, |
| | Title of paper |

The abstract may, of course, run to a second page, because of the space lost at the top of page 1. The second page should bear the number "2" at the top.

The Organizing Committee has indicated that it will not accept abstracts which do not conform to the above.

## CASPIAN TSUNAMI

At 1812 GMT on May 14, 1970, there was a 6.5 (C&GS, $M_S$) magnitude earthquake in the Eastern Caucasus region. The earthquake had a focal depth of 44 km and was located at latitude 43.0°N, longitude 47.1°E. This earthquake and its foreshock caused heavy casualties and extensive damage in Dagestan. A UPI press release from Moscow stated that, "The quakes began about noon last Thursday and continued through Friday, tumbling houses, triggering rockslides, opening fissures, and setting off tidal waves that submerged sand dunes along the Caspian Seacoast." The newspaper Zary Vostoka (Dawn of the East) of Tbilisi said the intensity reached as high as VIII and spread over the Dagestan region.

## NEW SEISMIC EQUIPMENT INSTALLED

During July and August 1970, new seismic visual recording systems were installed by U. S. Coast and Geodetic Survey personnel at TWS observatories at Hong Kong and Manila. The new recording systems utilize a helicorder, photo-tube amplifier, standby power supply and if required, a crystal controlled timing system with time comparator. At Hong Kong, the seismic signal and timing is supplied by the World-Wide Standard Seismograph System which has been operating at the Royal Observatory since 1963. A Benioff short-period vertical seismometer at Manila Observatory is used with the new visual recorder.

This equipment, which is being furnished to various participating TWS stations on indefinite loan, is expected to improve seismic data reporting.

## JAPAN TSUNAMI

At 2241 GMT on July 25, 1970, there was a magnitude 7 (C&GS, $M_S$) earthquake in Kyushu, Japan. The earthquake was located at latitude 32.2°N, longitude 131.7°E, at depth of 34 km. The earthquake caused slight damage at and near Miyazaki and was felt throughout Kyushu. A small tsunami was generated with a double amplitude of 52 cm at Tosa-Shimizu, 42 cm at Aburatsu, and 10 cm near Murotomisaki. ITIC has not received any mareographic records of this tsunami from stations outside of Japan.

## DIGITIZED TSUNAMI DATA

Dr. T. S. Murty, Department of Energy, Mines and Resources, Canada, has furnished the ITIC Library with the punched computer cards that digitize the Canadian tide gage records of the tsunami generated by the 1964 great Alaskan earthquake.

## NEW CHIEF OF PACIFIC TIDE PARTY

LTJG Kenneth E. Lilly, Jr., has been assigned as Chief of Pacific Tide Party to replace LCDR Gerald M. Ward who has returned to Florida.

## TSUNAMI WARNING CENTER INVESTIGATIONS - June 1, 1970-September 30, 1970

During the four-month interval from June 1, 1970 to September 30, 1970, the TWC investigated eight earthquakes. Of these eight investigations, the following actions were taken: The Alaska Region Tsunami Warning Center issued a WATCH for the June 24 Queen Charlotte Islands earthquake. The WATCH was canceled as soon as it was determined that a tsunami had not been generated; the June 25 Kyushu, Japan, earthquake generated a small local tsunami for which the TWC issued a press release; the August 30 Sea of Okhotsk earthquake resulted in the USSR Warning System issuing a WARNING for the Kamchatka Peninsula and the Kuril Islands. This WARNING was canceled by the USSR as soon as it was determined that a tsunami had not been generated.