# NORSAR

ROYAL NORWEGIAN COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

Scientific Report 1-78/79

# FINAL TECHNICAL SUMMARY

1 April - 30 September 1978

D. Rieber-Mohn (ed.)

Kjeller, October 1978

## VI.8 Description of and Preliminary Results from a Seismic Network for Microearthquake Studies in Tanzania

The African continent has until now been fairly poorly covered with seismic stations, and this applies in particular to Eastern Africa. In our capacity as seismological consultants in connection with the planning of a 1200 MW hydroelectric power plant in the Rufiji Basin in Tanzania, NTNF/NORSAR has recently completed the installation of a modern network of 6 short period seismometers in the area. The installation, which is called the Stiegler's Gorge Seismic Network (SGSN), has an aperture of about 50 km (see Fig. VI.8.1), and is located around 8°S, 38°E (see Table VI.8.1). This is about 1000 km from any previously known seismic station. The individual stations of the SGSN are powered by solar panels and the data are transmitted by radio telemetry to a Central Recording Station near the future dam site (see Fig. VI.8.1), where the analog data are passing a voting detector (presently 2 out of 3) and subsequently recorded on digital magnetic tapes whenever the detection threshold is exceeded. A memory buffer (sampling in retrospect) provides a few seconds of noise data preceding the event on each channel.

The SGSN has been installed for two main purposes: (1) to provide local seismicity data for phase II of the seismic risk analysis for the planned dam (Phase I has been completed), and (2) to provide seismological background data for the possibility of induced seismicity (in accordance with, e.g., recommendations from the UNESCO International Committee on Large Dams). It is obvious, moreover, that the network will be of considerable interest also from a more general seismological point of view, in particular for the study of the East African Rift System, including the Gregory Rift in whose extension the network is located. The planned operational period for the array is 2 years, although one hopes for an extension.

Preceding the installation of the network (completed in September 1978), a portable analog seismograph was operated sporadically for a few months, mainly for site surveys. Two things became obvious quite soon: (1) the local seismicity level is quite high, and some of this activity is very close to the dam site, (2) the ambient noise level is very low (seasonal variations are possible). As to the latter point, the portable seismograph could easily be operated at a magnification of 90 000 at 1 Hz, and an analog output from the permanent stations is usually kept at a magnification of about 120 000 at 1 Hz. This means that the RMS noise level at 1 Hz is not much above 1 nm.

Following the installation of the array, two timed explosions were fired near the dam site in order to provide an initial velocity model for the area. The results indicate significant velocity variations over the array (2 of the stations are on Basement, 4 are on Karroo), while on the average the data were best satisfied by a model with a P velocity of 5.0 km/s down to 4 km, followed by a layer with 5.9 km/s. So far only a few well-recorded events have been received and analyzed, one of which is presented in Fig. VI.8.2. The earthquake is located at a depth of 10 km about 4 km NE of the dam site (see Fig. VI.8.1), a point from which other events have been recorded as well. Most of the quakes seem to occur at depths between 10 and 20 km, and connected to a fault system (Tagalala) which runs from NW to SE very close to seismometer 2 and 3 (Fig. VI.8.1). Finally, an example of a teleseismically recorded earthquake is given in Fig. VI.8.3, showing an analog recording at one of the network stations of the disastrous Iran earthquake on 16 September 1978; $M_s$=7.3 measured at NORSAR.

The installation, operation and data analysis of the Stiegler's Gorge Seismic Network are funded by the Norwegian Agency for International Development.

H. Bungum

J. Fyen

| Station | Lat. | Long. | Elev (m) |
|---|---|---|---|
| 1 | 7°56.431'S | 37°50.445'E | 204 |
| 2 | 7°44.718'S | 37°53.189'E | 334 |
| 3 | 7°51.213'S | 38° 2.819'E | 162 |
| 4 | 8° 7.226'S | 37°50.791'E | 268 |
| 5 | 7°55.327'S | 37°35.577'E | 288 |
| 6 | 7°45.009'S | 37°39.516'E | 275 |

TABLE VI.8.1

Coordinates for the Stiegler's Gorge Seismic Network (SGSN)

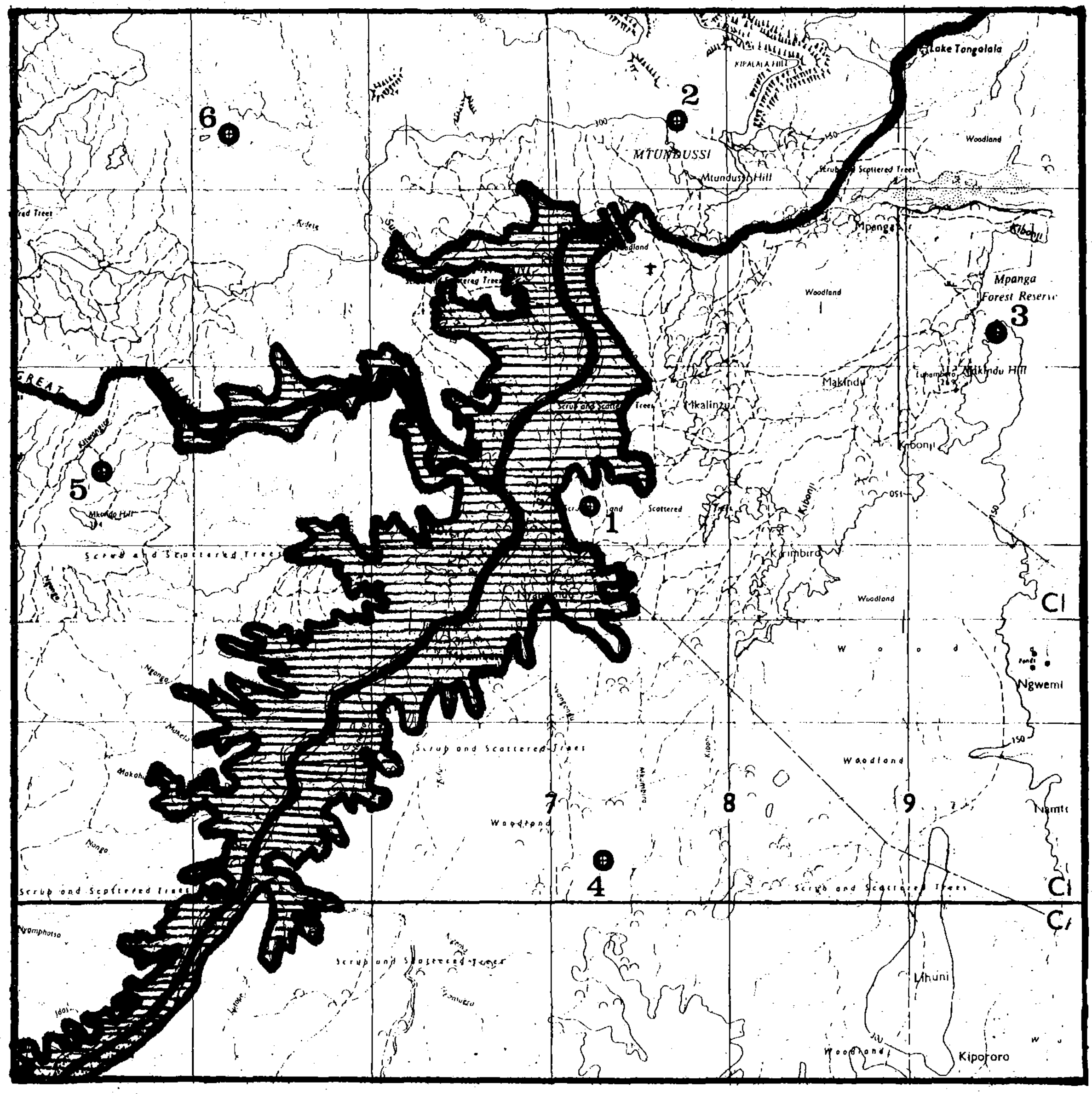


Fig. VI.8.1 Locations of the 6 stations of the Stiegler's Gorge Seismic Network (SGSN) in Tanzania. The Central Recording Station is situated just north of the dam site, close to seismometer No. 2. The water flows from SW to NE, and the hatched area is the future reservoir at a level of 150 m, which is 20-30 m below the planned maximum. The map covers 60 x 60 km.

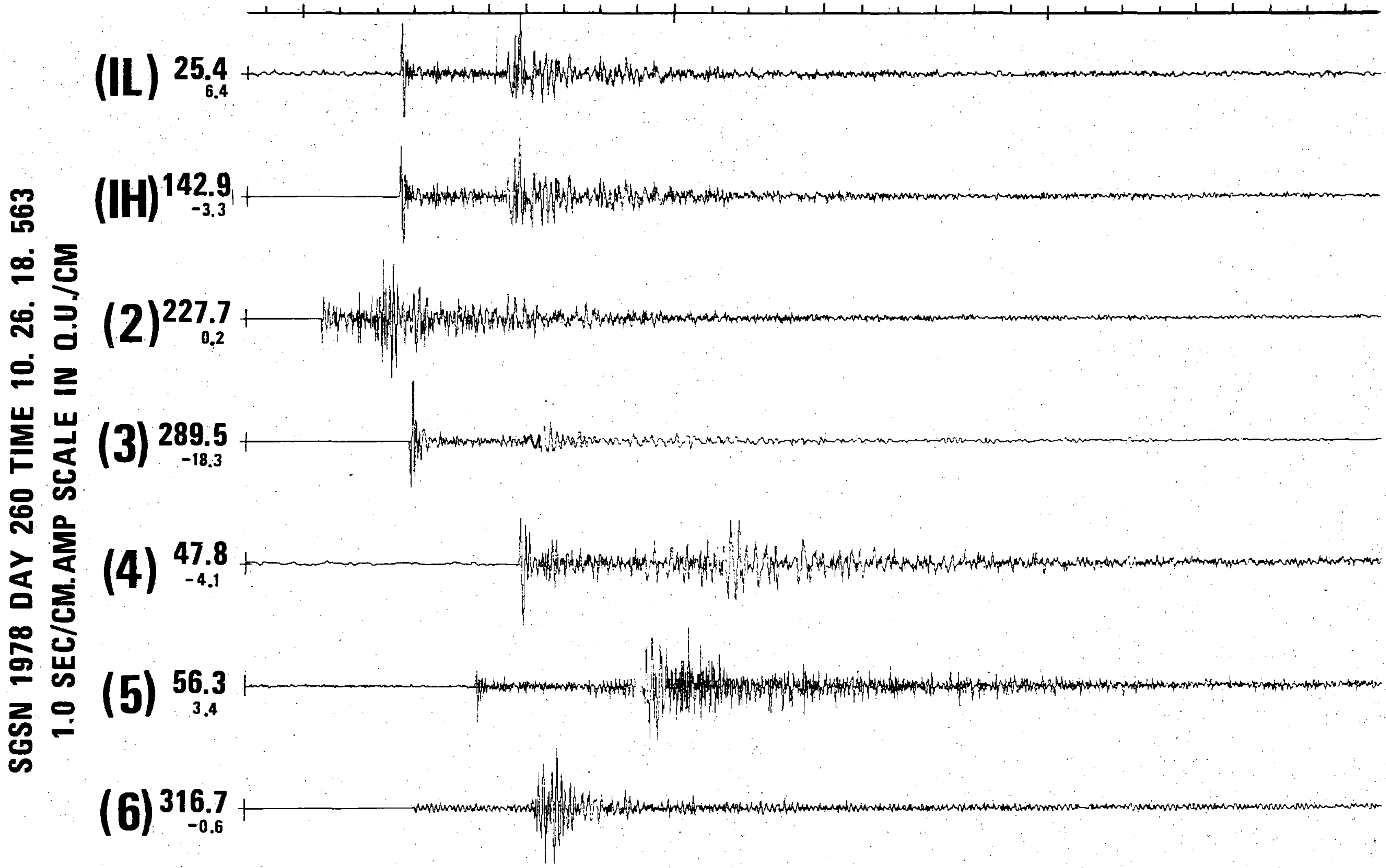


Fig. VI.8.2 A local earthquake on 17 September 1978 recorded by the Stiegler's Gorge Seismic Network. The time marks on the top are one second apart, and the first trace is a low-gain version of Station 1. The earthquake is located near Station 2 at 7°46.36'S, 37°52.34'E and at a depth of 10.1 km. Note especially the clear onsets and the changes in polarity.

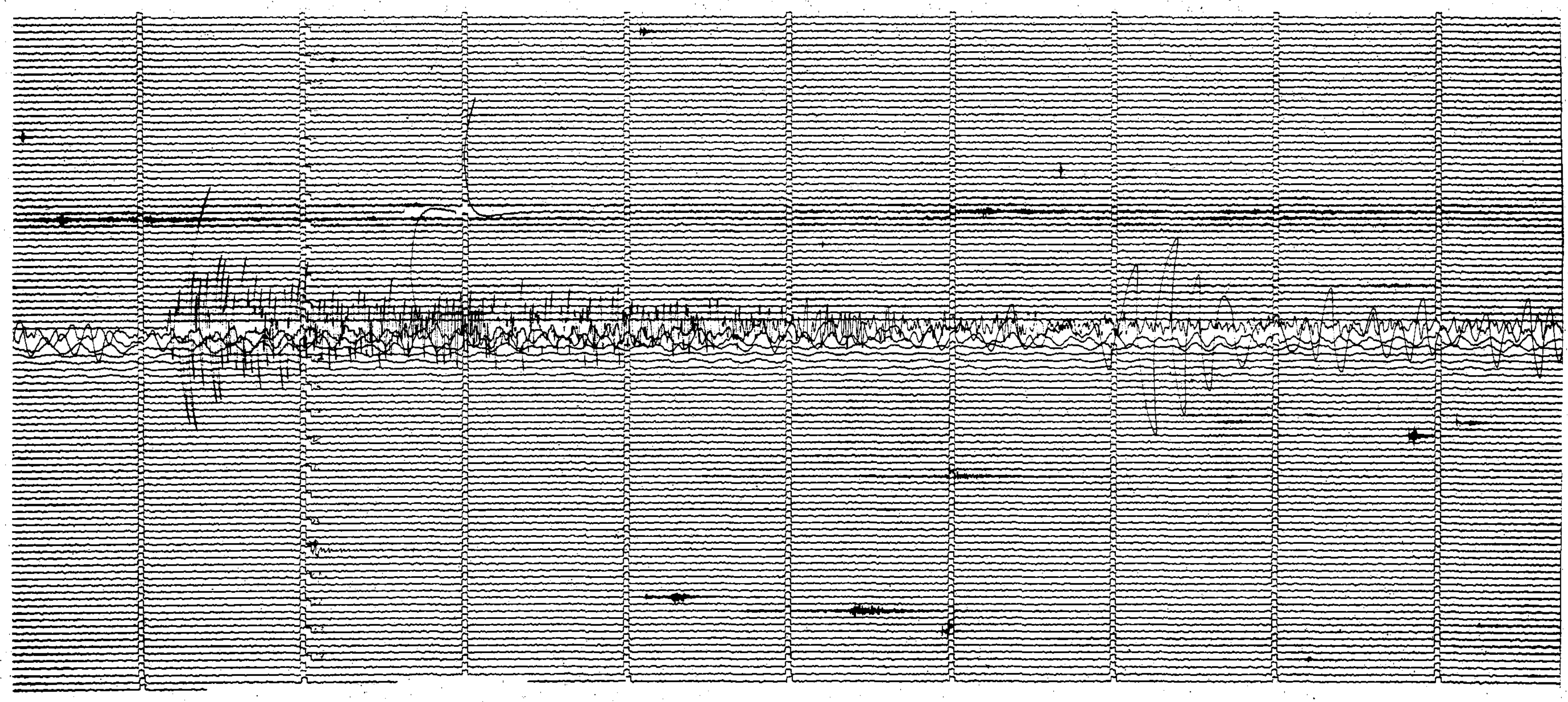

Fig. VI.8.3 Analog recording from Station 2 of the Stiegler's Gorge Seismic Network showing the disastrous Iran earthquake on 16 Sep 1978. Note especially the strong surface waves.