TOBA

The Toba Seismic Experiment,
Northern Sumatera, Indonesia

Submitted By

Masturyono and R. McCaffrey
Rensselaer Polytechnic Institute
Troy, NY 12180

PASSCAL Data Report 96-015

IRIS DATA MANAGEMENT SYSTEM

Distributed by

Incorporated Research Institutions for Seismology
Data Management Center
1408 NE 45th Street
Suite 201
Seattle, Washington 98105

The Toba Seismic Experiment, Northern Sumatera Indonesia

Report Prepared by Masturyono

The Toba Seismic Experiment is a component of the Geophysical and Petrologic Study of the Toba Magma System, Northern Sumatera, Indonesia, a collaboration among Rensselaer Polytechnic Institute (RPI), Meteorological and Geophysical Agency (MGA) and Volcanological Survey Indonesia (VSI). The experiment is located around Lake Toba which is the largest quaternary resurgent caldera in the world. We deployed 30 short-period and 10 broadband PASSCAL instruments, spread over most of the North Sumatra Province, making up a seismic network covering an area of about 2.5° by 2.5°. The network was operated for about four months from late January 1995 to late May 1995.

As part of the Geophysical and Petrologic Study of the Toba Magma System, the Toba Seismic Experiment has as objectives: (1) to image the distribution of the magma system beneath Toba and its relation to the suducted slab and surface faults by applying a tomographic method to the earthquake data recorded by the network, and (2) to assess the tectonic setting beneath Toba by analyzing the shallow local earthquakes from the Sumateran fault, shallow to intermediate-depth earthquakes from a possible tear in the subducted slab beneath Toba caldera, and teleseismic data.

Each broadband site was equipped with Guralp CMG-3ESP as its sensor, Reftek DAS serial number 72A-08 including a Disk Recording Subsystem of 540 Mb capacity, and OMEGA timing system. To install the broadband sensor we constructed a vault using a cylindrical plastic bucket, about 70 Cm in diameter and 90 Cm in height, as its wall, and the sensor pad was made of 8-10 Cm thick concrete pad. To keep a stable temperature for the broadband sensor, we enclosed it within a rigid white styrofoam insulating box. The DAS and the Disk Recording System, as well as batteries and power board were housed inside a box covered by plastic tarpaulin, while two 30 watt solar panels were installed at the top of the box, as its roof, to recharge the two car batteries as the power supply. The OMEGA antenna was located in the best signal reception spot around the site. Most of the broadband vaults were built during the reconnaissance survey to save time and get a more stable sensor pad.

The short-period sites were equipped with simpler devices that were easier to install than those for the broadband sites. We used three component Mark Product sensors, type L22C-3D and L28LBH-3D, with natural response frequencies of 1.0 Hz and

4.5 Hz, respectively. Since we wanted to have lower frequencies on this island arc setting, Mark Product sensor type L4 and Ranger SS-1 (belonging to MGA) were used to replace the vertical component of the L28 at 7 sites. The short-period sensors were set level and lined up at the right orientation in the bottom of the 30Cm -50Cm deep holes, and then buried with dirt. The recording systems used in the short-period sites were Reftek DAS serial number 72A-07 and 72A-07/G and had 240 Mb, 540 Mb and 1 Gb disks. The Reftek DAS, power board and a car battery as its power supply were housed in the same manner as in broadband sites. Some of the short-period sites that got less sun during the day were supplied by two 30 watt solar panels, otherwise one panel was used. There were two kinds of Reftek GPS receivers used for timing. The Reftek DASs serial number 72A-07 utilize external Reftek GPS receiver, while serial number 72A-07/G utilize internal Reftek GPS receiver. The installation of all sites was completed within 17 days and the network began in full operation on February 11, 1995.

To get optimum recording process, we set up two different parameters, for broadband and short-period, that we developed during the operation. The broadband data were recorded in compressed form, in stream 1, channel 4,5, and 6 , and the sample rate was 40 samples per second. The trigger type was continuous and the record length was 3600 seconds. The short period stations used the same set up as broadband stations, except data was recorded in stream 1, channel 1,2 and 3. Later, we changed the record length of all stations to 1200 seconds, and set phantom trigger in stream 2 channel 4, for broadband stations, and stream 2 channel 1 for short-period stations. The phantom trigger was set up to record the times of possible events, for use in processing data.

To maintain the operation of the 40 sites, we established a base camp at the Geophysical Station at Parapat, located in the center of the network and having the best access to reach all the sites. The farthest site in Sumatera island could be reached in 4.5 hours drive from the base camp. In the base camp we set up a field computer, and organized the equipment, logistics, data records and any field activities. A field PI who was responsible for managing the data and assisting with logistics stayed in the base camp, while two teams of four field investigators, responsible for servicing the sites moved around as scheduled in the station servicing. In general, broadband sites which had 540Mb Disk Recording Subsystems were visited every 3 weeks to swap the disk, and the short-period sites servicing schedule depended on the capacity of the disk in their Reftek DAS. The sites with 240 Mb, 540 Mb and 1Gb disks were visited every about 10 days, 3 weeks and 1 month respectively. We arranged a special schedule for the sites having a problem, to keep track and resolve the problem, until the station ran properly. In the short period

sites the data were copied by using a portable DAT Tape Drive in the field, while swap disks from the broadband sites were downloaded on the field computer at the base camp.

Preliminary data processing, archiving and quality data control, were done simultaneously in the base camp. Raw data were converted to SEGY format and archived in tar files. By inspecting the log file and data record of each station, the field PI created a list mentioning the noise level, time mark and any other comment should be taken care by the field investigator to maintain the operation of all stations. Since the space of the field computer disks were limited and there were a lot of data, we could not finish creating day-tape and event-tape files during the field work. The network operation was completed on May 27, 1995.

BB Stations

Station	*Latitude (N)*	*Longitue (E)*	*Elevation (meter)*	*DAS #*	*Sensor # CMG-3ESP*	*Date (JD-JD)*
TT001	2 53 09	98 39 54	1100	229	T3180	027-084
TT01A	2 53 33	98 40 16	1130	229	T3180	084-147
TT002	2 48 15	98 46 53	1026	359	OT317	027-068
TT02A	2 46 25	98 51 21	960	476	T3150	069-147
TT003	2 44 10	98 51 21	1140	476	T3150	026-069
TT005	2 37 15	98 59 17	1273	482	T3107	029-071
TT006	2 32 46	99 05 23	1182	149	T3111	033-089
TT06A	2 32 41	99 04 36	1122	149	T3111	089-145
TT007	2 28 36	99 09 48	930	358	T3106	029-064
TT07A	2 28 57	99 09 44	933	358	T3106	064-145
TT008	2 20 32	99 18 57	1260	482	T3107	071-146
TS001	2 36 20	98 51 37	1498	356	T3185	035-146
TS002	2 32 15	98 50 25	1560	393	OT398	035-146
TS003	2 30 55	8 45 09	900	144	OT399	035-146
TS004	2 28 29	98 40 01	1970	099	T3187	036-146
TS005	2 47 36	99 2 1	748	359	OT317	068-146

SP Stations

Station	*Latitude (N)*	*Longitue (E)*	*Elevation (meter)*	*DAS #*	*Sensor*	*Date (JD-JD)*
BANGE	2 20 32	99 18 57	1290	7321	L22-4350	031-071
BGAJA	2 47 36	99 2 2	627	7066	L22-359	031-068
BINTA	2 45 20	98 20 32	1125	7305	L22-1494L	038-144
BONAN	2 18 50	99 6 55	990	7345	L22-350	032-080
				7109	L22-350	080-144
FALLS	2 43 32	98 35 45	930	7306	L22-448L	035-147
GAROG	2 0 59	99 21 45	1014	7064	L28-G085/SS-1	036-046
				7101	L28-G085/SS-1	046-143
GSITO	1 18 12	97 34 30	170	7294	L28- /SS-1	042-143
LOPUK	2 35 49	98 32 23	1727	7350	L22-469L	036-146
MAHAL	2 37 14	98 16 25	740	7284	L28-414/SS-1	042-144
MANDO	2 47 54	99 13 56	295	7070	L22-503	037-142
PADAN	2 33 54	99 22 20	200	7341	L22-475	031-141
PARSI	2 21 12	98 45 1	1367	7350	L22-357	030-144
PBATU	3 15 34	99 6 55	82	7105	L28-G184/L4	030-051
				7348	L28-G184/L4	051-141
PENGA	2 55 20	98 30 36	1487	7298	L22-355	032-144
PERTU	3 2 53	98 7 49	546	7283	L28-G019a/SS-1	038-081
				7283	L22-	081-144
PINAN	1 33 20	98 53 58	20	7103	L22-352	073-142
SAMNE	2 43 8	98 48 5	999	7101	L22-640L	026-044
SAMNW	2 38 1	98 41 39	1000	7333	L22-467L	029-145
SAMSE	2 32 24	98 54 48	1400	7102	L22-640L	028-145
SAMSO	2 27 52	98 58 58	900	7318	L22-1500L	033-145
SAMSW	2 27 12	98 52 20	1040	7347	L22-5121	029-133
SARUL	1 47 19	99 7 9	478	7065	L22-351	034-078
				7468	L22-351	078-118
				7340	L22-351	118-143
SIBOL	1 45 57	98 45 51	40	7109	L28-G153/SS-1	035-072
				7108	L28-G153/SS-1	073-080
				7345	L22-353	083-142
SIGAO	2 24 20	99 4 29	921	7468	L22-367	034-078
				7065	L22-367	078-143
SIGOD	2 55 29	98 53 8	970	7348	L22-358	032-048
				7064	L22-358	048-061
				7103	L22-358	062-107
				7106	L22-358	107-142
SINAR	2 27 25	99 39 47	4	7292	L28-G087/L4	027-142
SINGG	2 57 2	98 37 5	1453	7357	L22-1504	027-142
SITOP	2 36 20	98 51 37	1498	7352	L22-468L	028-035
SOSOR	2 10 16	98 55 57	1250	7097	L22-359	032-142
TARUT	2 1 6	98 59 50	1170	7071	L22-1498	032-147
WHITE	2 13 13	98 39 2	1300	7106	L22-356	033-098
				7064	L22-356	098-144

BB Timing Note

Most of the BB-stations get OMEGA LOCK regularly, except station TT01A and TT02A never get OMEGA LOCK along their operation time. Part of the data have been corrected by using WWV radio signal. Below are time correction note from the fieldwork and data processing.

Station TT01A

JD 086-105 No Omega Lock. DAS clock had been set many times using hand held GPS. There is no time correction applied either SEGY or DV.
JD 105-111 Segyshift Corr were applied base on WWV radio signal. (average stepping perday)
JD 112-115 Clockcorr time corection using caldrift rating (only DV and EV)
JD 115-126 Clockcorr time corection using caldrift rating (SEGY, DV and EV)
JD 126-147 Clockcorr time corection using caldrift rating (only DV and EV)

Station TT02A

JD 069-087 No Omega Lock. Time corr using Segyshift -3800 ms.
JD 087-105 Time corr using Segyshift +5200 ms
JD 112-115 Clockcorr time corection using caldrift rating (only DV and EV)
JD 115-126 Clockcorr time corection using caldrift rating (SEGY, DV and EV)
JD 126-147 Clockcorr time corection using caldrift rating (only DV and EV)

Station TT003

JD 040-061 Time corr using Segyshift -7700 ms
JD 061-069 Time corr using Segyshift -6000ms

Station TT005

JD 042-071 Time corr using Segyshift -10000ms

Station TT008

JD 071-137 Time corr using Segyshift -10000ms

Station TS004

JD 074-085 Time corr using Segyshift -10000ms
JD 086-128 Possible time error -10000ms, no time corr applied
JD 128-145 Time corr using Segyshift -10000ms (only DV and EV)

SP Timing Note

No time correction applied for all SP data. Most of the SP station get GPS LOCK. The only possible time error is :

Station MAHAL

JD 054-081 No GPS Lock (antenna problem)

File stucture on tapes

DV tapes

ERRS/error files
LOGS/log files
Rxxx/hh/data files

error files	: *.err
log files	: *.log
data files	: *.E (E-W component)
	*.N (N-S component)
	*.Z (Vertical componen)
xxx	: Julian day (026-147)
hh	: hours (00,01,.....22,23)

EV Tapes

EV/LOCAL/events/01/data files
/REGIONAL/events/01/data files
/TELESEISMIC/events/01/data files

/events/01/data files
/log file

data files	: *.e (E-W component)
	*.n (N-S component)
	*.z (Vertical component)