Data Status Report

for the

1992 Pakistan Himilayas

Passive Source Broadband Seismic Experiment

submitted by

Eric Sandvol and James Ni

New Mexico State University

ABSTRACT

The Pakistan array was deployed across the Western Himalayas and utilized Reftek digital recording systems equipped with broadband STS-2 seismometers and L-22D short-period seismometers. This report is a comprehensive description of the data collection and archiving techniques used for data from the Pakistan Himilayan broad-band seismic experiment. This report should give the reader enough information to utilize the Pakistan array data.

1. Introduction

The 1992 Pakistan Himilayan passive source seismic experiment required the cooperation of four Pakistan governmental ministries, primarily the Water And Power Development Authority (WAPDA), along with two U.S. Universities. The period of deployment extended from September, 26, 1992 to December 10, 1992. The stations in the array were deployed primarily in the Swat and Indus valleys. Figure 1 shows the locations of the broadband stations and short-period stations (see Table 1). Table 1 is a list of station parameters which includes latitude, longitude, elevation, and Reftek DAS serial number. Over 8 gigabytes of seismic data were collected and archived on both 4 millimeter DAT tapes and 8 millimeter Exabyte tapes during this time. This data is the first broadband array data to be collected in this region and should provide important constraints on crustal and mantle velocity structure. We request any users of this data set to acknowledge the extensive efforts of the people involved in this project. The following is a suitable acknowledgment:

> *Seismic data from the Pakistan Experiment were collected in a collaborative effort between the Pakistan Government, New Mexico State University and Renselear Polytechnic Institute. U.S. Funding was provided by a grant from USAID Grant # COM-5600-G-00-0019-00.*

The purpose for this report is to give the reader a working knowledge of the archiving parameters and organization of the Pakistan data set. The Passcal Instrument Center has been given seven high density 8 millimeter Exabyte tapes. Six tapes contain the seismic data in SEGY format for all eleven weeks of the experiment. The first and second tapes also contain some data which was retrieved from a broken disc brought back from Pakistan. The seventh tape contains information concerning the state-of-the-health of the DAS used in this experiment as well as software used to look at the Omega clock performance. The "log" and "err" files are contained in a directory labeled "/logfiles". The filename convention used is:

YRJDY.STTN.log and YRJDY.STTN.err

where YR is the year and JDY is the Julian day in which the log and err files were created by ref2segy. STTN is the DAS number corresponding to station from which the data was obtained. The directory containing the Passcal programs can be used to view the performance of the Omega clock for each station are contained in the directory "/progs". A postscript file of this report is also contained in the main directory of the general information tape. Also in the main directory there is a stations file "whoops.stations" which contains the location (latitude, longitude, and elevation), DAS number, and general comments concerning that station.

2. Equipment Used in the Experiment

Two types of seismometers where used in this experiment. The broadband seismometers used were STS-2 broadband seismometer. The short-period instrument used were L-22D Mark Product seismometers. Nine of the eleven stations had both the broadband and short-period instrument. Two the the stations, BASM (DAS #0475) and HLKT (DAS #0477) had only the L-22D short-period seismometers. The type of DAS used was the Reftek 72A-02 along with 180, 330, and 660 megabyte hard disks. Both 4 mm DAT portable field tape drives and Exabyte 8 mm portable field tape drives were used. The data was archived in the field on both 4 mm and 8 mm tapes.

3. Organization of the Data

There exist two data streams in the Pakistan array data set. The first data stream (labeled "R*.01") contains a continuously recorded at 10 samples-per-second broadband data. Each file contains 1800 seconds of data. The second data stream labelled "R*.02" contains triggered events that are 180 seconds in length and sampled at 50 samples per second. All files contained in both data streams are in SEGY format. All of the files are in tar format and can be extracted using the command "tar xvf /dev/rst*" (where /dev/rst* is a high density Exabyte tape drive).

The filename convention used on the archived data files were the same as that used by the Passcal program ref2segy:

HR.MN.SC.STTN.C

where HR is the hour, MN is the minute, and SC is the second of the time at which that particular file begins. The STTN is the DAS number of a particular station. The DAS number and corresponding station names are given in the station file in the general information tape. C is the channel number. The channels for the broadband seismometer are: 4 is the vertical component, 5 is the north-south component, and 6 is the east-west component. The directory structure is also that used by the ref2segy program.

Each directory in the Pakistan data set is the data recorded by the entire network for a single day. The naming convention used is as follows:

RJDY.ST

where JDY is the Julian day and ST is the stream number (either .01 or .02). The year is not included in either the directory name or filename because the experiment spanned only 1992.

4. Timing of the Data

The Omega clocks performed reasonably well except for a couple of exceptions. The most serious exception is the timing for station PATN. This station was located in a deep narrow valley in the High Himilayas near the Indus River. The topography interfered with the Omega clock signal to the degree that the clock only locked once during the entire experiment (that lock occurred on Julian day 292). Station SHAB also had some problems with the Omega clock amplifier during the last part of the experiment (Julian day 320 to 345). The performance of each station's Omega clock can be observed by using clockview and the logfiles given in the general information tape.

Intial time of the Reftek DAS at three stations (HLKT, SADU, and SBRA) was set 10 seconds later than the GMT time. The timing error was corrected using the Passcal program segyshift by substract 10 seconds from time in the data file's header.

5. Station DASU (0476)

Station DASU was not deployed until Julian day 282, approximately a week later than the rest of the network. The STS-2 seismometer also, after Julian day 292, began to have problems with its east-west component. A large number of glitches are present on the east-west component. Water seeping into the vault caused the SCSI plug to become corroded which lead to a large number glitches appearing on the east-west broadband component. Occasionally an event was well recorded at station DASU, however, the majority of the waveform data after Julian day 292 is not reliable.

6. Calibration

The STS-2 sensors utilizes a feedback loop with an effective natural period of 120 seconds. These sensors are critically damped and the published sensitivity is 1500 volts per meter/second in differential mode. Theoretically the feedback stabilized seismometers should be stable and the frequency should depend only on the feedback loop parameters and should not exhibit any significant temporal variations.

The calibration of the STS-2 broadband seismometers was performed using the Reftek calibration mode. A calibration pulse of period 250 seconds and an amplitude of 0.5 volts was sent to the seismometers every three days. The STS-2 seismometer is configured in such a way that all three components' have almost exactly the same instrument response. Therefore it is really only necessary to look at one components response to the Reftek calibration pulse.

7. Acknowledgments

The Pakistan array experiment was a cooperative effort between New Mexico State University, Renselear Polytechnic Institute, Nambe Geophysical Inc., and Pakistan Water and Power Development Authority. The Pakistani participants inlcuded Ali Inayat, M. Tariq, and Khaliq Khan. The participants in the field work were: R. Busby (PIC-LDGO), W.S. Phillips (Nambe Geophysical), T. Fairbanks (Nambe Geophysical), James Ni (NMSU), Eric Sandvol (NMSU), Steve Roecker (RPI), Arthur Chen (RPI), and John Armbruster (LDGO). All instruments and DAS's were loaned to us by the Passcal Instrument Center.

Table 1

Station Names and Parameters				
Station Name	DAS #	Latitude (degrees)	Longitude (degrees)	Elevation (meters)
DASU	0476	35.262	73.217	1220
PATN	0472	35.143	73.065	1106
KALM	0392	35.485	72.569	2255
BASM*	0475	34.900	72.886	762
SHIN	0488	35.082	72.474	1463
SADU	0478	34.732	72.336	1005
BTGM	0479	34.673	73.024	1067
HLKT**	0477	34.605	73.160	1675
MNSR	0390	34.342	73.206	1115
SHAB	0486	34.230	72.172	366
SBRA	0484	34.029	72.682	415

* This station only recorded broadband data from Julian day 329 to 344.

** This station only recorded short period data.

Table 2

Station Names and Instrument Numbers

Station Name	DAS #	Instrument #
DASU	0476	19040
PATN	0472	19041-B3
KALM	0392	19108
BASM*	0475	19108
SHIN	0488	19107
SADU	0478	19110
BTGM	0479	19110-B3
HLKT**	0477	-
MNSR	0390	19048
SHAB	0486	19109
SBRA	0484	19028

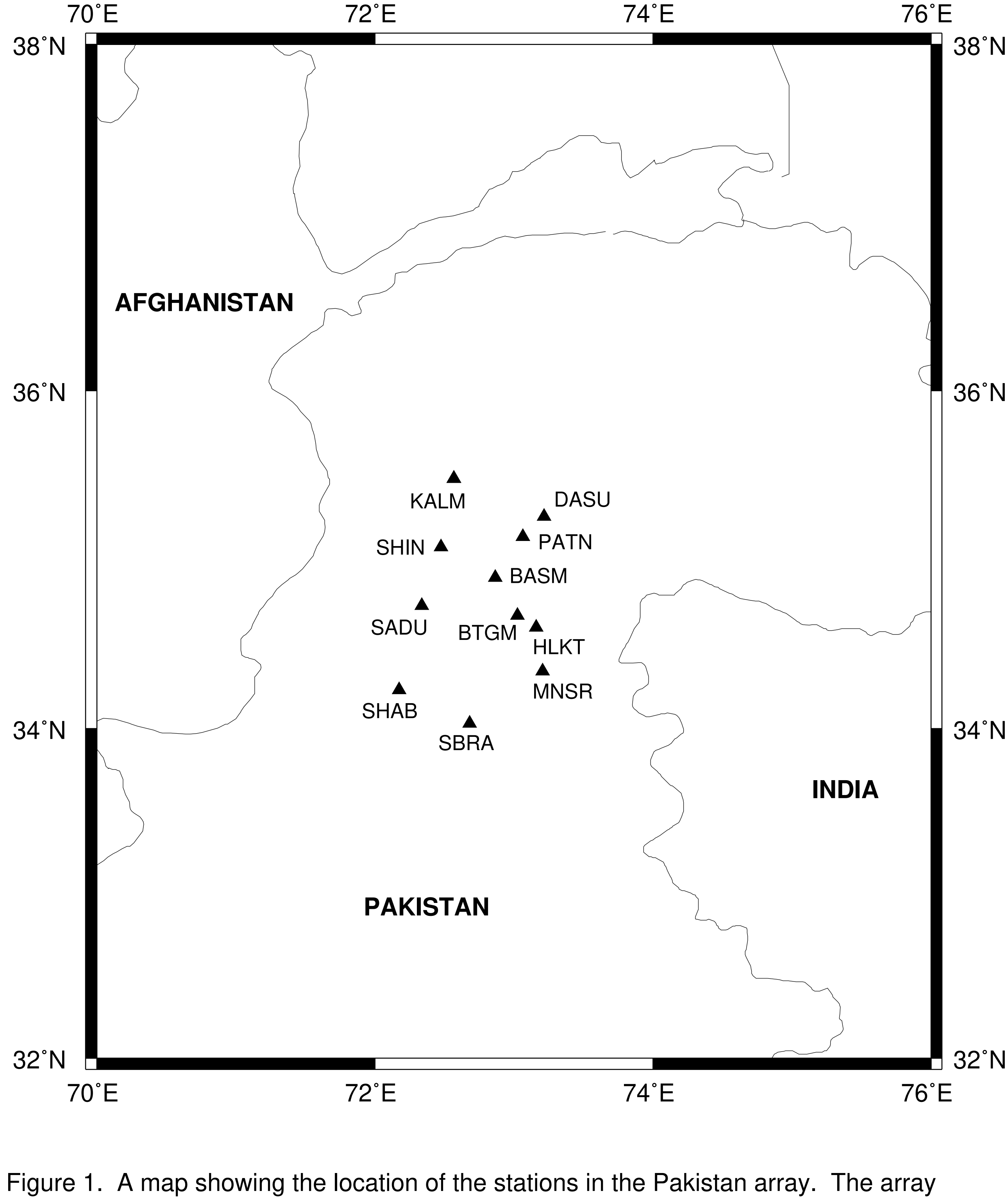

Figure 1. A map showing the location of the stations in the Pakistan array. The array spans the lower, middle, and higher Himilayas.