INDEPTH III reflection/refraction, central Tibet 1998

Project Description

The reflection/refraction (active-source) component of INDEPTH III was carried out to provide new information on the crustal structure of central Tibet. Instruments were provided by PASSCAL and by the GeoForschungsZentrum (GFZ) instrument pool. The 400-km transect ran from the southwest corner of Nam Tso, across the Bangong-Nujiang Suture (BNS), to Longwei Tso (about 80 km north of the town of Shuang Hu). A permanent (one year of teleseismic recording) array of broadband and intermediate-period instruments was deployed at 10-km intervals, with denser (5-km) spacing near the BNS. During shooting, this array was supplemented with 14 short period instruments and a 60-channel Geometrics unit successively deployed at each of 4 locations of dynamite shot groups. Shot groups consisted of (nominally) 40 shots of 50 kg each, in addition to some smaller shots. The array also recorded 11 large (up to 2000 kg) shots which were fired from the ends of the transect, and from the center.

Stations

PASSCAL Broadband stations were equipped with either RefTek 72A-08 of 72A-08/G DAS, 72A-05 4.4 Gb disk subsystems, and Streckeisen STS-2 seismometers. Power at each site was provided by two 60 Ahr gel cell automotive batteries, charged by two solar panels, operating through a V 1.0 Station Power Box. Timing information was provided by RefTek 111A GPS systems (for 72A-08 DAS) or Trimble external GPS antennae (for 72A-08/G DAS). Instruments were deployed in one-meter deep (approx.) vaults, with open-cell foam insulation surrounded by a hard plastic form. Seismometers were placed on granite slabs embedded in concrete oriented to magnetic north (local declination = 1 degree). Data was recorded in two data streams. Stream 1 featured a sample rate of 20 Hz while stream 2 recorded at 100 Hz. Gain was set to 1.

GFZ broadband stations were equipped with RefTek DAS and either Guralp 40T or Guralp 3T seismometers. Intermediate-period stations were equipped with RefTek DAS and intermediate-period seismometers. All GFZ stations were deployed similarly to PASSCAL instruments (vaults, power, timing, etc). The availability of this data to the

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Broadband and intermediate-period stations are number sequentially from south to north (00 to 40). Stations labeled with a number followed by 'a' were positioned to the north of the corresponding number, halfway to the next station. (Station 12a is between stations 12 and 13). This naming convention is altered for headers (where the letter 'a' is not allowed). The 'a' is changed to a '1'. Thus station 12a becomes station 121, etc.

Short-period stations were equipped with RefTek DAS, external 1 Gb disk subsystems, and Mark Products L-28 3-component geophones with resonant frequency 4.5 Hz. Timing information was provided by Trimble external GPS antennae. Power was provided by two 50 Ahr automotive batteries operating through a PASSCAL power board. Deployments were of short duration such that the use of solar panels was unnecessary. Geophones were buried approximately 6 inches deep. Data was recorded at 125 Hz with gain of 32. Short period instruments were deployed in three locations, with some overlap between the first two deployments (north of the "southern" shot group, and south of the "middle" shot group). The third deployment was between the "north" and "Shuang Hu" (farther north) shot groups; instruments were left in place for both of these shot groups. Short period instruments were interspersed with instruments in the permanent array to achieve receiver spacing of 1 to 2 km near the shot groups. Stations are numbered with three digit numbers. The first digit refers to the deployment number. The second and third indicate the position of the station relative to the shot group, ascending away from the shots. Thus, station 103 is the fourth short period station away from the southern shot group (north of 100, 101, 102). Some stations from the first deployment were left in place for the second deployment. Thus, station 111 is in the same location as station 207.

Shooting

Shot groups consisted of (nominally) 40 shots of 50 kg each and about 10 smaller (6-kg and 2-kg) shots at 250-m spacing, in line with the seismometer array. 50-kg shots consisted of dynamite at a nominal depth of 20 m below the surface in drilled holes. 6-kg shots were fired in shallower drilled holes. 2-kg shots were fired in hand-dug holes

approximately 1 meter deep. The 2-kg shots were used as refraction test charges for the Geometrics unit and provide little useful signal to the RefTek stations. Shots were fired using Seismic Source Synchronizer System SSS-300 to allow remote firing. The firing pulse was provided by a GPS Master Clock. Shot times in headers and in accompanying files reflect the 600ms delay between trigger pulse ('on the minute') and actual shot time.

Large shots were fired from the ends of the transect and from two shot points in the central transect. These generally consisted of explosive paste in 50-m drill holes (up to three holes per shot) with explosive at least 20 m below the ground surface. Shots were fired directly by an SIE Hi Voltage Blaster shot box, timed by a GPS master clock. Large shots have various delays between nominal trigger time and actual shot time. Variation is due to false triggers, problems with GPS master clocks, etc. Shot times in headers reflect this variation and are thought to be accurate.

All shot locations were determined using hand-held GPS, generally by averaging successive measurements. Elevation values in accompanying spreadsheet are from hand-held GPS measurements. Elevation values in trace headers have been checked against Soviet 1:200,000 topographic maps and are presumed to be more accurate.

Data Processing

Data were converted to PASSCAL SEG-Y format using the utility "ref2segy". Timing corrections have been made using "refrate" and "clockcor". Station locations were determined using a combination of hand-held GPS units and the GPS clocks in the RefTek's. Gathers have been assembled as follows, using a modified version of "segygather" to produce standard SEG-Y output with appropriate information in headers.
Short Period Instruments: Receiver gathers for each receiver location incorporating any shots (large and small) which occurred during that deployment. Traces are cut with 15.00 seconds "static" before shot time. Total trace length is 120 seconds. Station numbers are used in file names as described above.
Broadband Instruments: Receiver gathers for each receiver location for small shots, and shot gathers for each large shot, including all receivers (broadband and short period). Some traces (short period data of large shots) are in both of two separate gathers. All traces in these two groups of gathers are cut to 120 seconds, including a 14.60-second

"static" before shot time. Station numbers used in file names are described above, with the exception that 'a' is replaced by the numeral '1'. (Station 12a becomes st121 for file naming purposes.)