3. BROKEN RIDGE UNDERWAY GEOPHYSICS[1]

Shipboard Scientific Party[2]

Ocean Drilling Program (ODP) Leg 121, from Fremantle, Australia, to Singapore drilled seven sites (752–758), four on Broken Ridge and the remaining three sites on Ninetyeast Ridge (Fig. 1). Accordingly, presentation of the underway geophysical data for ODP Leg 121 is divided into discussions of Broken Ridge (this chapter and Driscoll et al., this volume) and Ninetyeast Ridge.

Only one geophysical survey, conducted 9 May 1988, was necessary to locate proposed drilling Sites BR-1 through BR-4 on Broken Ridge because the sites are in close proximity to one another (Fig. 2). Three separate site surveys were completed on Ninetyeast Ridge.

NAVIGATION

Navigation data were collected on the ship's bridge by a Decca Navigation System and a Magnavox MX1107 Satellite-Navigation System (SATNAV). Extremely accurate and precise Global Positioning System (GPS) satellite fixes augmented those of the transit satellites for approximately 7 hr daily during the Broken Ridge survey. We arrived at the Broken Ridge survey region (deployment point for the seismic gear) at the beginning of the GPS window. Waypoints for the survey are presented in Table 1, the latitude and longitude for the Broken Ridge sites are presented in Table 2, and ship positions for the entire survey are listed in Table 3.

PRECISION DEPTH RECORDINGS

The bathymetric log began at 0800 hr on 5 May (Julian Day [JD] 126) 1988. (All times reported in this chapter are Universal Coordinated Time, which is equivalent to Greenwich Mean Time.) Bathymetric data were obtained with both 3.5- and 12-kHz echo-sounders and were recorded on Raytheon analog records. The 3.5-kHz precision depth recorder (PDR) offers greater penetration capability (about 75–100 m below seafloor [mbsf]) than the 12-kHz PDR (0–10 mbsf). Furthermore, the 12-kHz PDR proved to be unreliable at ship speeds greater than approximately 6 kt. The seafloor return on the 3.5-kHz PDR was intermittent, at best, with minimal sub-bottom penetration at ship speeds greater than 6–8 kt. Once we slowed down to approximately 6 kt for the site surveys, the quality of both the 3.5- and 12-kHz PDR records improved dramatically (in shallow water).

MAGNETICS

JOIDES Resolution left the Fremantle dockside at 0545 hr, 5 May (JD 126) 1988; the magnetometer was deployed at 0830 hr. A Geometrics 801 Proton Precession magnetometer was towed continuously during transits and site surveys. The analog record indicates a good magnetic signal-to-noise ratio. Further shore-based processing of the acquired magnetic data is necessary to interpret the magnetic anomalies obtained.

SEISMIC-REFLECTION DATA

Two Seismic Systems, Inc., 80-in.[3] water guns provided the seismic source signal. The guns performed well throughout the Broken Ridge seismic survey, although the port water gun occasionally misfired during the last 3 min of the survey. The signal was received by hydrophone elements within the 100-m-long Teledyne streamer and summed to improve the signal-to-noise ratio. The streamer was towed approximately 500 m behind the vessel to reduce noise caused by turbulence from the ship's wake. The seismic data were digitally recorded by a Masscomp Supermicro 561 computer. The Masscomp allowed real-time processing and displaying of the acquired seismic data on a Printronix high-resolution graphic printer. The quality of the ODP *Resolution* seismic system is good, and the subsequent processing checks the seismic data written to tape.

The following filter settings were used for the analog records in an attempt to remove some of the low-frequency ship noise.

	Record 1	Record 2
High-pass filter	40 Hz	60 Hz
Low-pass filter	160 Hz	160 Hz
Range	1–5 s	1–5 s
Recorder speed	75 lines/in.	75 lines/in.

SEISMIC SURVEY OF BROKEN RIDGE

Upon reaching the deployment point (Table 1), approximately 1 hr east of the survey area, the ship's speed was decreased to 6 kt, and the magnetometer was redeployed at 0906 hr, 9 May (JD 130), after being secured on deck at 0542 hr while the ship was hove to. All of the seismic gear (two water guns and the streamer) were deployed at 0920 hr. One of the water guns had to be retrieved at 0925 hr to check the harness, but it was back in the water at 0946 hr. The survey was designed to run an initial strike line parallel to the northern edge of Broken Ridge through proposed Site BR-1, because interpretation of previously collected seismic data aboard *Robert D. Conrad* suggested that a thicker sequence of dipping and truncated sediment might occur east of proposed Site BR-1 (Fig. 3). At the alternative proposed Site BR-1, a sonobuoy was deployed at 1142 hr to attain a source signature for the water guns as *JOIDES Resolution* steamed over the deployment position on the next dip line (Fig. 2). Knowledge of the source signature for the water guns aboard *JOIDES Resolution* is important in generating synthetic seismograms. However, we had to deploy another sonobuoy at 1148 hr because the first sonobuoy failed; unfortunately, the second sonobuoy failed also.

After the initial strike line was run, a dip line from north to south across the ridge was collected (Figs. 2 and 4). This second line is between *Conrad* Cruise 2708 (RC2708) lines 10 and 20 (see Driscoll et al., this volume). Another dip line, approximately 5 km west, was collected spatially coincident with RC2708 line 20 to locate proposed Sites BR-1 through BR-4 (Figs. 2 and 5). The latitude and longitude of drill Sites 752 through 755 are presented in Table 2, and relative positions of the sites along the

[1] Peirce, J., Weissel, J., et al., 1989. *Proc. ODP, Init. Repts.*, 121: College Station, TX (Ocean Drilling Program).

[2] Shipboard Scientific Party is as given in the list of Participants preceding the contents.

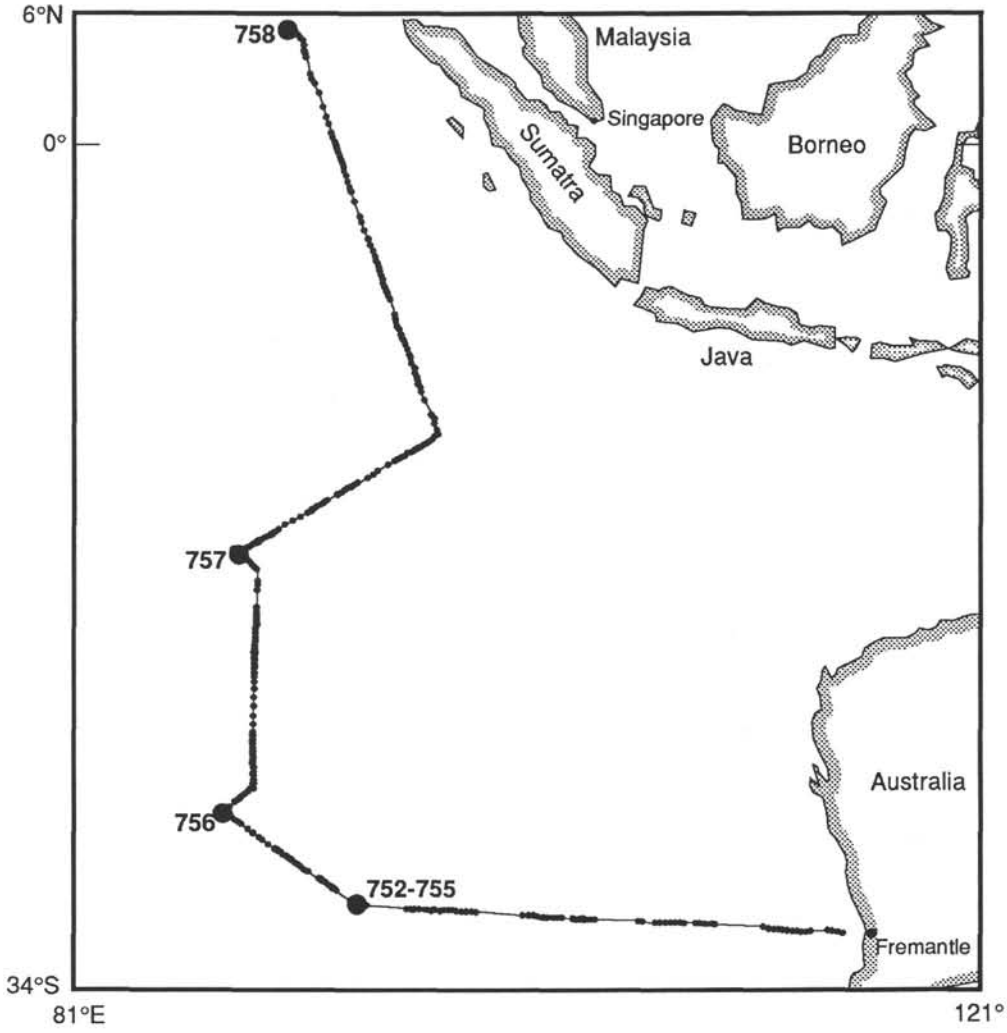

Figure 1. Cruise track for ODP Leg 121 with site locations. Dots along the ship's track indicate either a GPS satellite fix or a transit satellite fix.

seismic line are shown in Figure 5. The corresponding 3.5-kHz PDR record for this seismic line is shown in Figures 6 and 7, and the site positions are marked accordingly.

The beacon was dropped for Site 752 at 2030 hr, and the gear was secured on deck at 2134 hr.

SITE 752

Site 752 is near the northern edge of Broken Ridge, approximately 15 km north of the prominent southward-dipping scarp (Fig. 5). Together with Sites 753 through 755, Site 752 was planned to ensure that the entire northward-dipping and truncated sequences could be sampled with modest penetration at each site ($< \sim 450$ m). Site 752 was chosen as the first site because it would provide insight into the drilling complications that might be encountered in drilling the high-velocity sediments on Broken Ridge (see Driscoll et al., this volume). Approximately 100 m of foraminifer/nannofossil ooze, lithologic Unit I, and about 340 m of a truncated chalk and chert sequence, lithologic Unit II, were sampled at this site (see "Lithostratigraphy and Sedimentology" section, "Site 752" chapter, this volume). Lithologic Unit I forms the subhorizontally bedded sediments overlying the prominent angular unconformity, with lithologic Unit II below.

JOIDES Resolution started in dynamic positioning mode toward Site 753 at 0820 hr, 12 May (JD 133), and the beacon was deployed at 1130 hr. The tentative plan to shift proposed Site BR-1 (i.e., Site 753) eastward was abandoned upon examination of the recently collected seismic-reflection data.

SITE 753

Site 753 is along the northern margin of Broken Ridge, approximately 20 km north of the prominent southern scarp (Fig. 5). Site 753 was positioned to sample the youngest lithology below the prominent angular unconformity in order to further constrain the time interval over which the rifting and uplift event occurred. The youngest unit underlying the angular unconformity occurs along the northern edge of the ridge (Fig. 5). The nearly transparent acoustic character of this unit arises from the lack of any strong acoustic impedance contrasts, indicating a uniform composition. The acoustically transparent unit is one of three seismic stratigraphic units that comprise the prograding downlapping sequence (Driscoll et al., this volume).

JOIDES Resolution started in dynamic positioning mode toward Site 754 at 1013 hr, 13 May (JD 134), and the beacon was deployed at 1326 hr.

SITE 754

Site 754 is on the central part of Broken Ridge, approximately 10 km north of the prominent southern scarp (Fig. 5). Site 754 was positioned to sample the oldest lithology above the

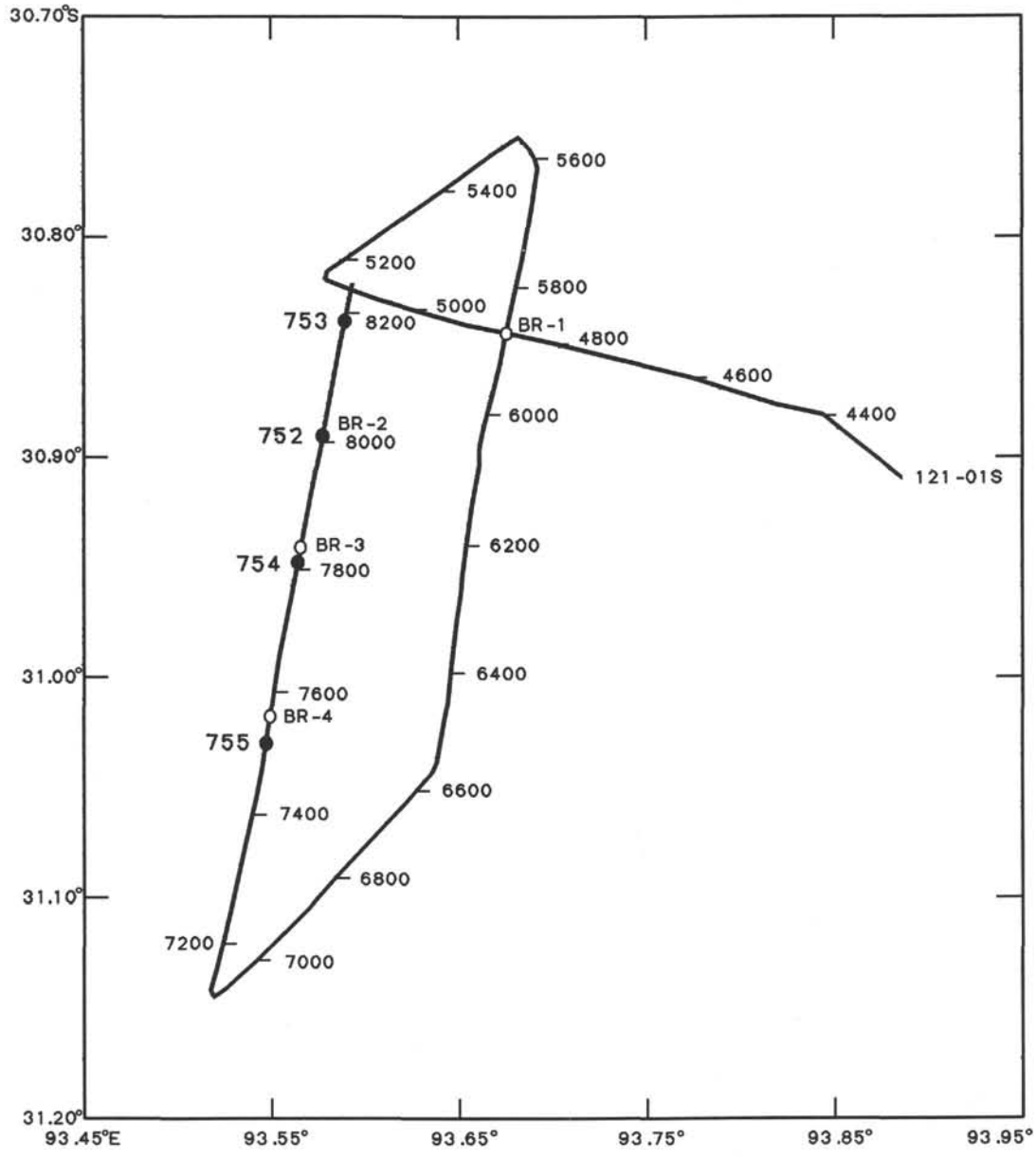

Figure 2. Trackline of the *JOIDES Resolution* site survey of Broken Ridge with proposed (BR-) and drilled site locations.

Table 1. Navigation waypoint positions for the Leg 121 Broken Ridge survey.

	Latitude	Longitude
Deployment point	30°53.50′S	93°56.00′E
Waypoint 1	30°52.25′S	93°49.00′E
Proposed Site BR-1	30°50.50′S	93°40.50′E
Waypoint 2	30°49.25′S	93°35.75′E
Waypoint 3	30°46.00′S	93°41.50′E
Waypoint 4	31°02.75′S	93°38.00′E
Waypoint 5	31°08.75′S	93°31.10′E
Proposed Site BR-4	31°01.00′S	93°33.00′E
Proposed Site BR-3	30°56.40′S	93°34.00′E
Proposed Site BR-2	30°53.50′S	93°34.50′E
Waypoint 6	30°49.25′S	93°35.75′E

Note: The survey took approximately 11 hr, at a ship speed of about 6 kt.

angular unconformity, in order to further constrain the time interval over which the rifting and uplift event occurred. The oldest unit overlying the angular unconformity occurs on the central part of the ridge in a subtle depression that dips slightly toward the west (Fig. 5). This unit onlaps the truncated and dipping limestone, chert, and chalk sequence; hence, the unit becomes progressively younger away from the center of the ridge. Another objective at Site 754 was to sample the seismic stratigraphic sequence boundary between the dipping and truncated limestone, chert, and chalk sequence and the prograding downlapping wedge (Driscoll et al., this volume).

JOIDES Resolution started toward Site 755 at 0445 hr, 22 May (JD 143), and the beacon was deployed at 0957 hr.

SITE 755

Site 755 is approximately 4 km north of the prominent southern escarpment (Fig. 5). The position of Site 755 was moved approximately 2 km farther south than that of proposed Site BR-4

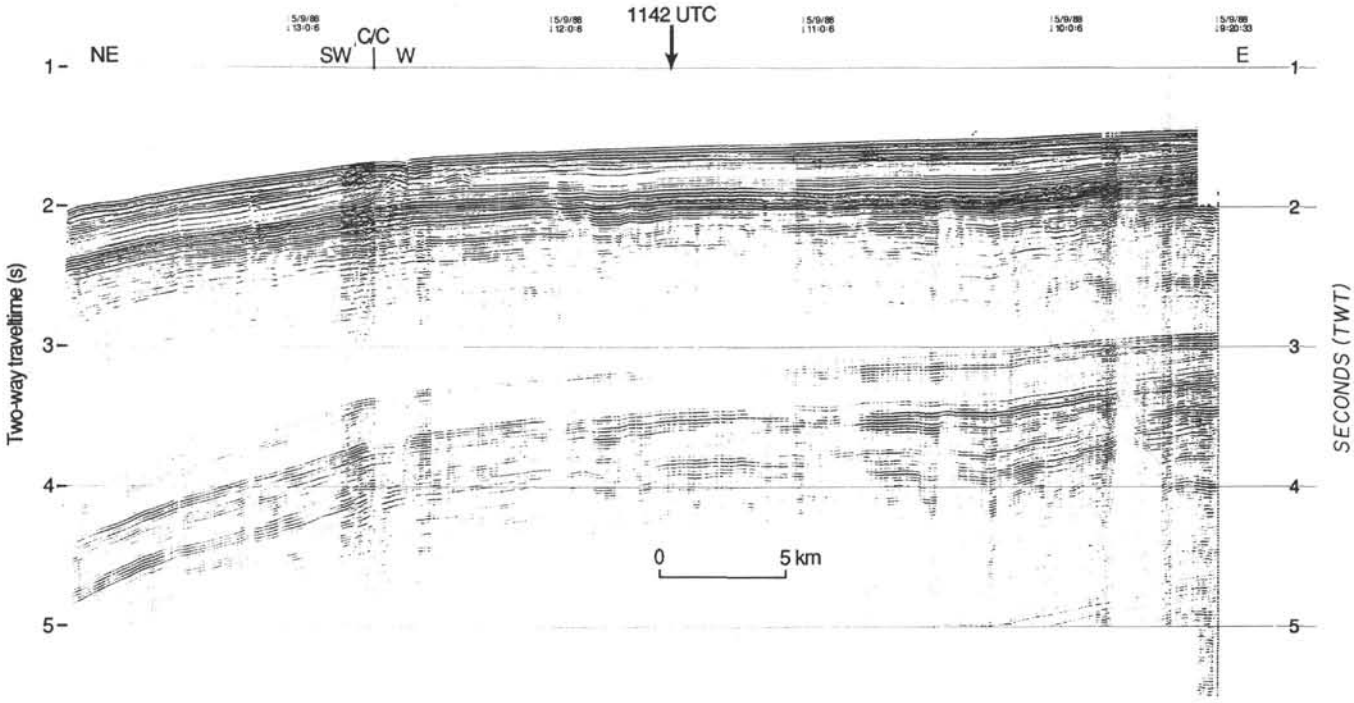

Figure 3. Single-channel seismic-reflection profile along the northern edge of Broken Ridge. The line in Figure 4 was crossed at 1142 hr (arrow).

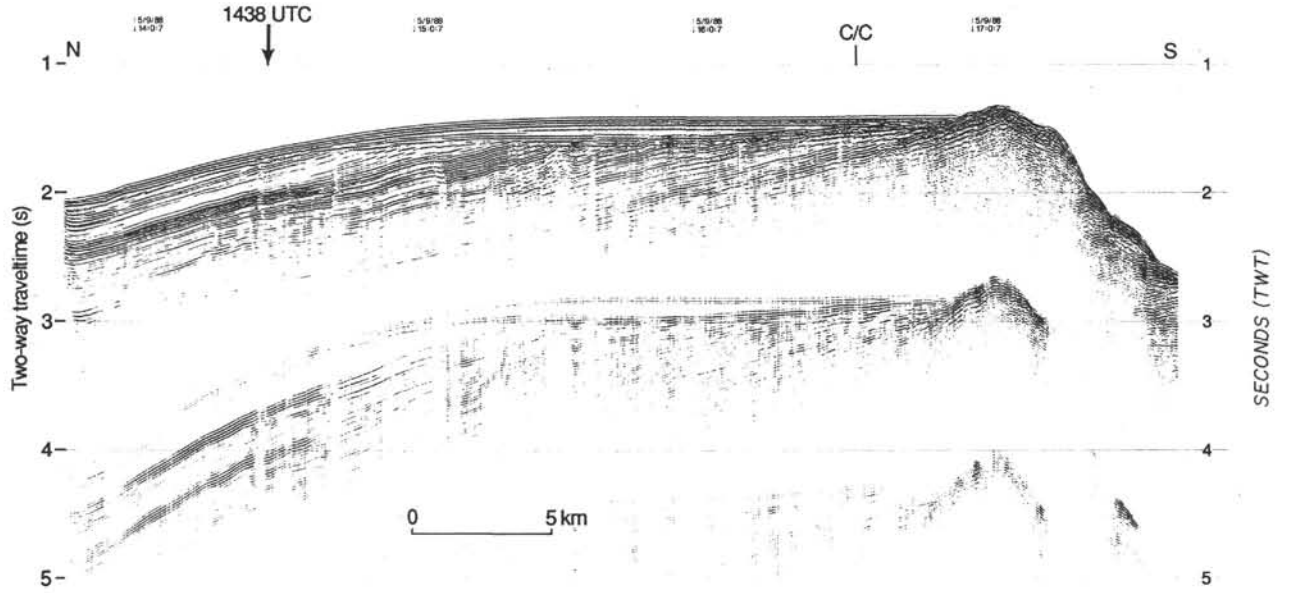

Figure 4. Single-channel seismic-reflection line, trending north-south across Broken Ridge. This line is approximately 5 km east of RC2708 line 20. The line in Figure 3 was crossed at 1438 hr (arrow).

to sample deeper within the dipping and truncated limestone, chalk, and tuff sequence. Another objective of Site 755 was to recover and determine the lithology that corresponds to the high-amplitude reflector outcropping at the crest of Broken Ridge (Fig. 5). A suspected talus deposit, apparent on both the 3.5-kHz PDR record (30 mbsf, at 1905 hr on 9 May [JD 130] 1988; Fig. 6) and the water gun seismic-reflection profile immediately north of the outcropping crest of Broken Ridge, precluded moving the site any farther south, because the risk of encountering hazardous hole conditions would be increased (Figs. 5 and 6).

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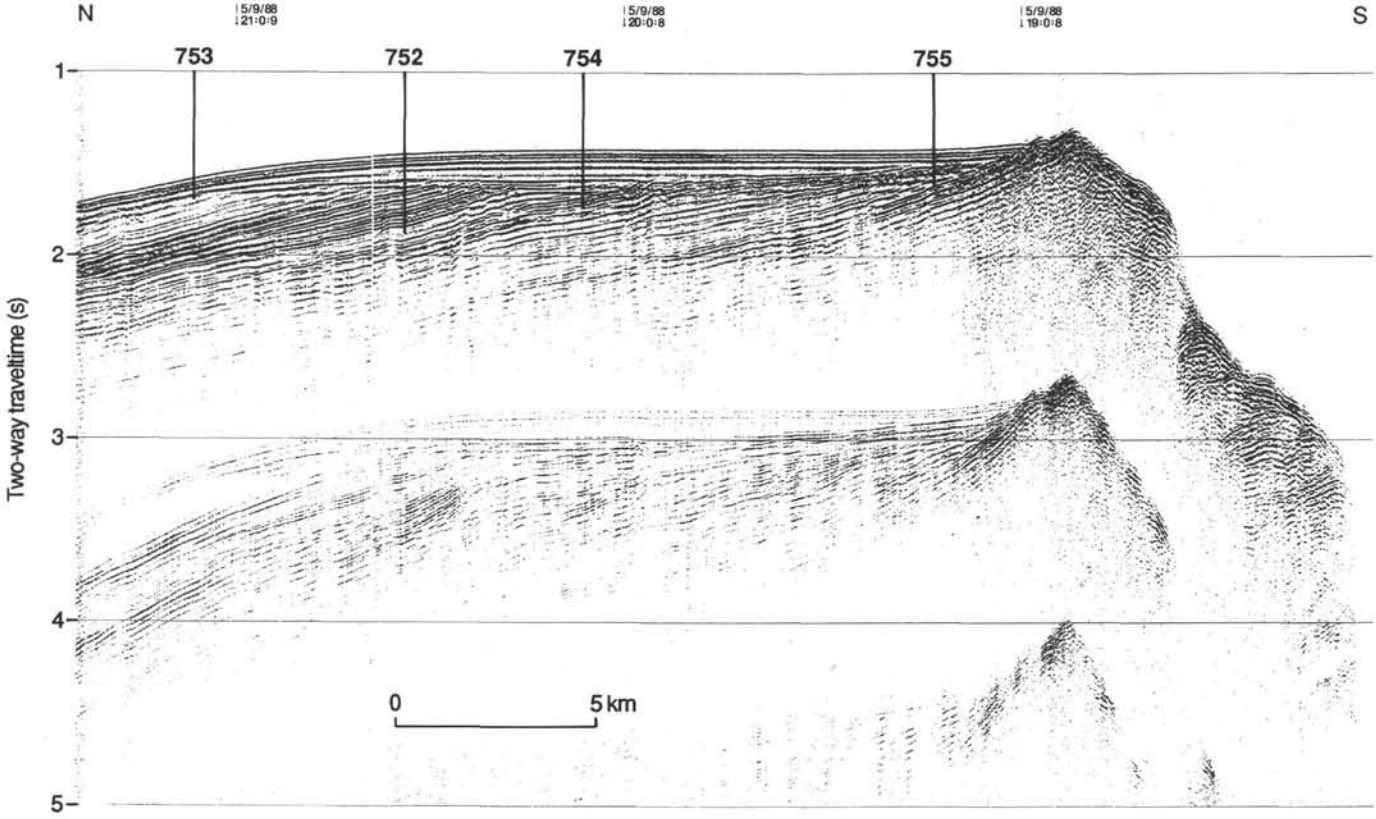

Figure 5. Single-channel seismic-reflection profile spatially coincident with RC2708 line 20, showing Leg 121 site locations.

Table 2. Leg 121 Broken Ridge site locations.

Site	Latitude[a]	Longitude[a]
752	30.8910°S	93.5780°E
753	30.8380°S	93.5900°E
754	30.9406°S	93.5650°E
755	31.0298°S	93.5467°E

[a] Decimal expression.

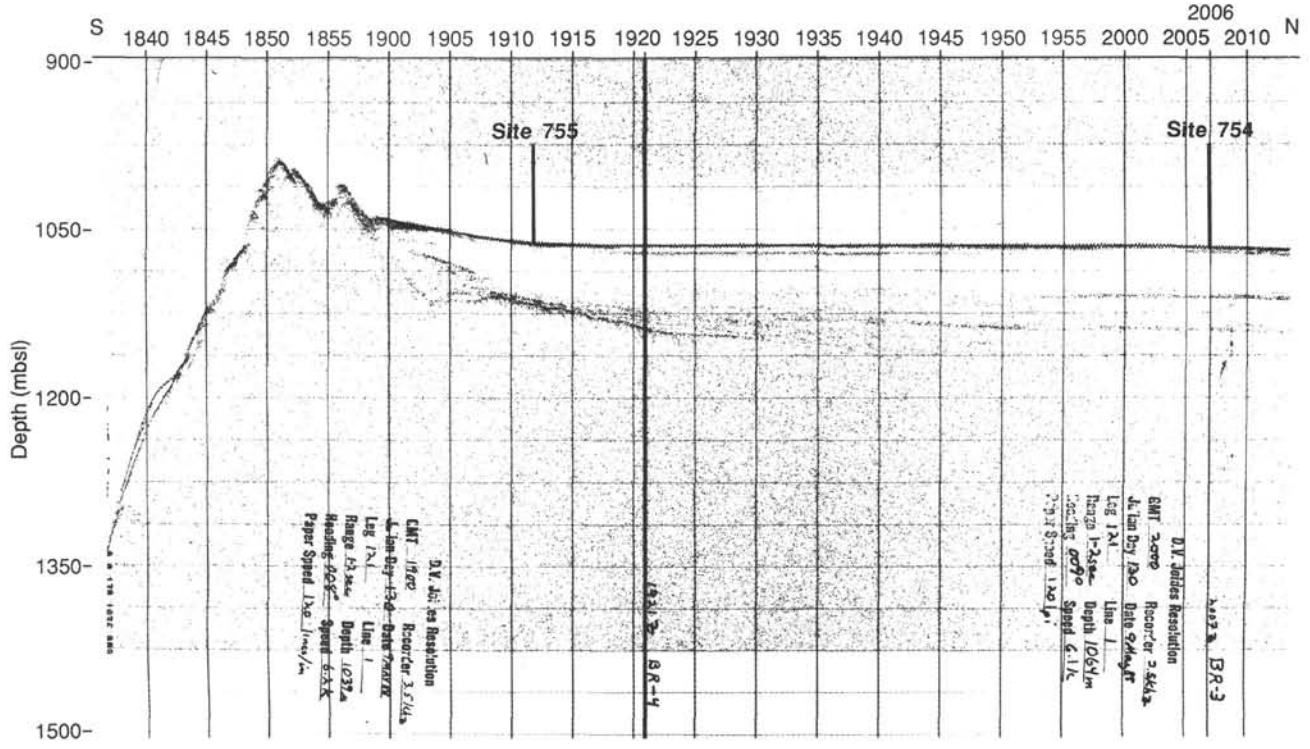

Figure 6. The 3.5-kHz PDR record corresponding to the single-channel profile in Figure 5. Site locations are marked accordingly.

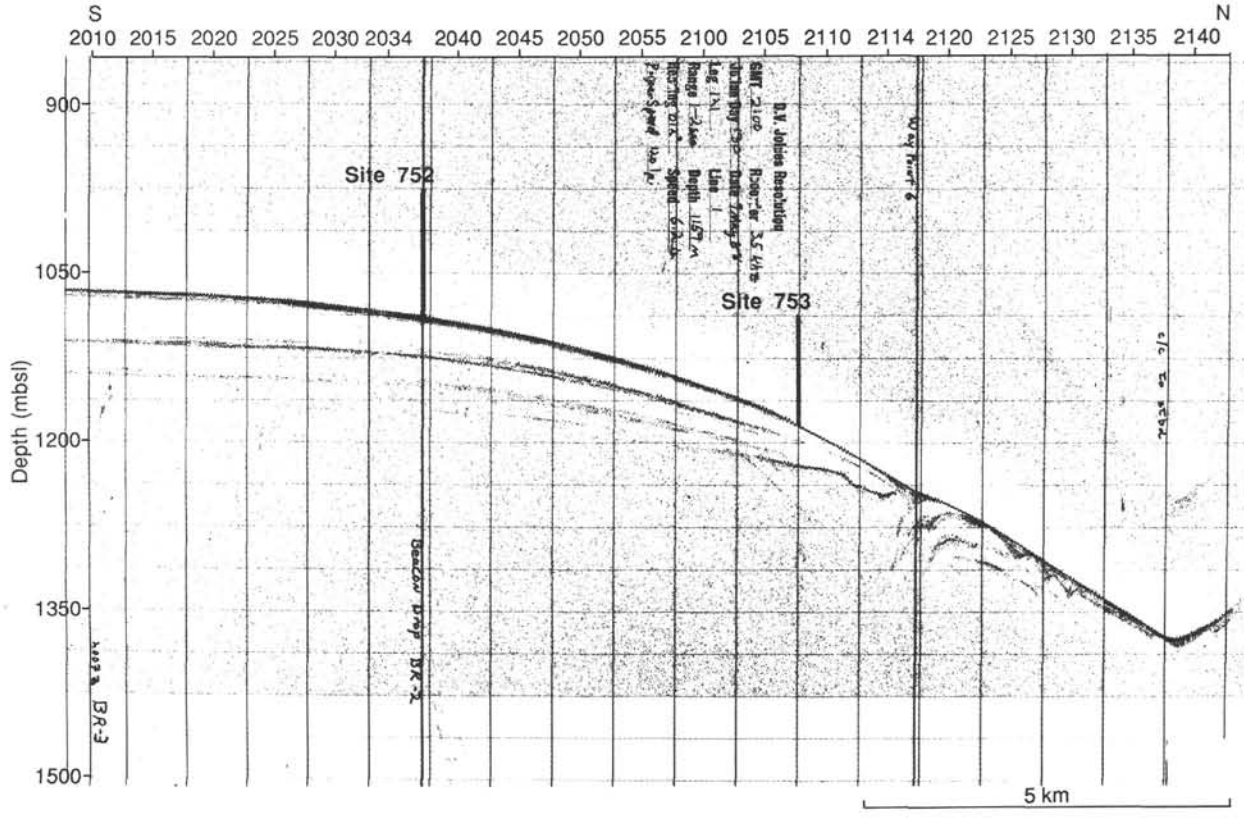

Figure 7. The 3.5-kHz PDR record corresponding to the single-channel profile in Figure 5. Site locations are marked accordingly.

Table 3. Navigation fixes for the Broken Ridge survey.

Julian day (1988)	Time (UTC)	Latitude	Longitude
130	0900	30°58.203′S	95°16.108′E
130	0907	30°58.076′S	95°14.410′E
130	0941	30°54.542′S	93°53.237′E
130	0945	30°54.294′S	93°52.870′E
130	0949	30°54.040′S	93°52.500′E
130	0953	30°53.787′S	93°51.118′E
130	0957	30°53.531′S	93°51.734′E
130	1001	30°53.269′S	93°51.343′E
130	1005	30°53.005′S	93°50.951′E
130	1009	30°52.772′S	93°50.592′E
130	1013	30°52.688′S	93°50.186′E
130	1018	30°52.586′S	93°49.655′E
130	1022	30°52.505′S	93°49.228′E
130	1026	30°52.391′S	93°48.811′E
130	1033	30°52.190′S	93°48.066′E
130	1037	30°52.067′S	93°47.653′E
130	1041	30°51.958′S	93°47.237′E
130	1046	30°51.814′S	93°46.727′E
130	1050	30°51.715′S	93°46.320′E
130	1055	30°51.586′S	93°45.823′E
130	1100	30°51.468′S	93°45.296′E
130	1105	30°51.352′S	93°44.752′E
130	1110	30°51.242′S	93°44.203′E
130	1115	30°51.137′S	93°43.652′E
130	1120	30°51.025′S	93°43.081′E
130	1127	30°50.864′S	93°42.261′E
130	1132	30°50.749′S	93°41.679′E
130	1137	30°50.643′S	93°41.088′E
130	1142	30°50.542′S	93°40.515′E
130	1147	30°50.440′S	93°39.938′E
130	1152	30°50.336′S	93°39.356′E
130	1156	30°50.242′S	93°38.903′E
130	1200	30°50.131′S	93°38.469′E
130	1205	30°49.998′S	93°37.943′E
130	1210	30°49.869′S	93°37.381′E
130	1215	30°49.741′S	93°36.834′E
130	1220	30°49.606′S	93°36.306′E
130	1225	30°49.452′S	93°35.771′E
130	1230	30°49.265′S	93°35.218′E
130	1235	30°49.100′S	93°34.721′E
130	1240	30°48.884′S	93°34.826′E
130	1245	30°48.633′S	93°35.245′E
130	1250	30°48.354′S	93°35.701′E
130	1254	30°48.108′S	93°36.101′E
130	1258	30°47.889′S	93°36.462′E
130	1303	30°47.614′S	93°36.920′E
130	1308	30°47.334′S	93°37.384′E
130	1312	30°47.106′S	93°37.750′E
130	1316	30°46.895′S	93°38.125′E
130	1321	30°46.624′S	93°38.609′E
130	1326	30°46.318′S	93°39.092′E
130	1331	30°45.999′S	93°39.570′E
130	1336	30°45.673′S	93°40.055′E
130	1345	30°45.197′S	93°40.909′E
130	1350	30°45.536′S	93°41.323′E
130	1355	30°46.019′S	93°41.548′E
130	1400	30°46.536′S	93°41.452′E
130	1405	30°47.029′S	93°41.349′E
130	1410	30°47.545′S	93°41.239′E
130	1414	30°48.034′S	93°41.135′E
130	1418	30°48.453′S	93°41.034′E
130	1424	30°49.073′S	93°40.871′E
130	1428	30°49.484′S	93°40.761′E
130	1432	30°49.890′S	93°40.657′E
130	1437	30°50.414′S	93°40.546′E
130	1453	30°52.099′S	93°40.131′E
130	1458	30°52.625′S	93°39.970′E
130	1503	30°53.168′S	93°39.811′E
130	1508	30°53.735′S	93°39.682′E
130	1513	30°54.208′S	93°39.713′E
130	1518	30°54.760′S	93°39.577′E
130	1523	30°55.307′S	93°39.463′E
130	1528	30°55.837′S	93°39.383′E
130	1533	30°56.401′S	93°39.259′E
130	1538	30°56.921′S	93°39.199′E
130	1543	30°57.436′S	93°39.144′E
130	1548	30°57.995′S	93°39.040′E
130	1553	30°58.568′S	93°38.932′E
130	1556	30°58.866′S	93°38.906′E
130	1601	30°59.407′S	93°38.831′E

Table 3 (continued).

Julian day (1988)	Time (UTC)	Latitude	Longitude
130	1606	30°59.828′S	93°38.779′E
130	1610	31°0.280′S	93°38.701′E
130	1614	31°0.724′S	93°38.624′E
130	1618	31°1.177′S	93°38.523′E
130	1621	31°1.482′S	93°38.472′E
130	1625	31°1.868′S	93°38.410′E
130	1629	31°2.279′S	93°38.323′E
130	1633	31°2.629′S	93°38.117′E
130	1638	31°2.939′S	93°37.750′E
130	1643	31°3.310′S	93°37.411′E
130	1648	31°3.672′S	93°37.026′E
130	1653	31°4.026′S	93°36.632′E
130	1658	31°4.389′S	93°36.245′E
130	1703	31°4.742′S	93°35.857′E
130	1708	31°5.092′S	93°35.463′E
130	1713	31°5.440′S	93°35.081′E
130	1718	31°5.796′S	93°34.708′E
130	1723	31°6.140′S	93°34.363′E
130	1728	31°6.458′S	93°33.985′E
130	1733	31°6.793′S	93°33.593′E
130	1738	31°7.116′S	93°33.206′E
130	1743	31°7.445′S	93°32.802′E
130	1748	31°7.770′S	93°32.396′E
130	1753	31°8.105′S	93°31.982′E
130	1758	31°8.444′S	93°31.590′E
130	1803	31°8.644′S	93°31.194′E
130	1806	31°8.456′S	93°31.105′E
130	1811	31°8.060′S	93°31.265′E
130	1816	31°7.569′S	93°31.405′E
130	1821	31°7.054′S	93°31.540′E
130	1826	31°6.536′S	93°31.687′E
130	1831	31°6.027′S	93°31.834′E
130	1836	31°5.515′S	93°31.960′E
130	1841	31°5.009′S	93°32.080′E
130	1846	31°4.501′S	93°32.211′E
130	1851	31°3.983′S	93°32.354′E
130	1856	31°3.476′S	93°32.497′E
130	1901	31°2.980′S	93°32.618′E
130	1906	31°2.485′S	93°32.722′E
130	1910	31°2.114′S	93°32.797′E
130	1912	31°1.877′S	93°32.847′E
130	1915	31°1.603′S	93°32.899′E
130	1917	31°1.365′S	93°32.946′E
130	1920	31°1.092′S	93°32.995′E
130	1922	31°0.847′S	93°33.038′E
130	1925	31°0.581′S	93°33.089′E
130	1927	31°0.348′S	93°33.126′E
130	1930	31°0.057′S	93°33.179′E
130	1932	30°59.845′S	93°33.223′E
130	1935	30°59.581′S	93°33.268′E
130	1937	30°59.344′S	93°33.318′E
130	1940	30°59.087′S	93°33.379′E
130	1942	30°58.848′S	93°33.429′E
130	1945	30°58.588′S	93°33.497′E
130	1947	30°58.348′S	93°33.559′E
130	1950	30°58.090′S	93°33.617′E
130	1952	30°57.846′S	93°33.680′E
130	1955	30°57.590′S	93°33.739′E
130	1957	30°57.347′S	93°33.796′E
130	2000	30°57.067′S	93°33.855′E
130	2002	30°56.848′S	93°33.902′E
130	2005	30°56.588′S	93°33.964′E
130	2007	30°56.335′S	93°34.021′E
130	2010	30°56.076′S	93°34.075′E
130	2012	30°55.826′S	93°34.134′E
130	2015	30°55.564′S	93°34.198′E
130	2017	30°55.303′S	93°34.263′E
130	2020	30°55.034′S	93°34.325′E
130	2022	30°54.768′S	93°34.387′E
130	2025	30°54.497′S	93°34.452′E
130	2027	30°54.218′S	93°34.519′E
130	2030	30°53.921′S	93°34.582′E
130	2032	30°53.676′S	93°34.634′E
130	2035	30°53.420′S	93°34.689′E
130	2037	30°53.156′S	93°34.747′E
130	2040	30°52.906′S	93°34.796′E
130	2041	30°52.747′S	93°34.827′E
130	2042	30°52.646′S	93°34.852′E
130	2043	30°52.546′S	93°34.870′E
130	2045	30°52.402′S	93°34.899′E

Table 3 (continued).

Julian day (1988)	Time (UTC)	Latitude	Longitude
130	2046	30°52.243′S	93°34.933′E
130	2047	30°52.138′S	93°34.955′E
130	2048	30°52.033′S	93°34.980′E
130	2049	30°51.926′S	93°35.003′E
130	2050	30°51.884′S	93°35.014′E
130	2051	30°51.716′S	93°35.051′E
130	2052	30°51.611′S	93°35.074′E
130	2053	30°51.503′S	93°35.101′E
130	2055	30°51.352′S	93°35.132′E
130	2056	30°51.180′S	93°35.162′E
130	2057	30°51.073′S	93°35.182′E
130	2058	30°50.965′S	93°35.213′E
130	2100	30°50.786′S	93°35.262′E
130	2101	30°50.636′S	93°35.298′E
130	2102	30°50.524′S	93°35.317′E
130	2103	30°50.415′S	93°35.342′E
130	2105	30°50.264′S	93°35.374′E
130	2106	30°50.089′S	93°35.415′E
130	2107	30°49.981′S	93°35.441′E
130	2108	30°49.871′S	93°35.465′E
130	2110	30°49.729′S	93°35.501′E
130	2111	30°49.552′S	93°35.552′E
130	2112	30°49.448′S	93°35.579′E
130	2113	30°49.343′S	93°35.609′E
130	2115	30°49.199′S	93°35.651′E
130	2116	30°49.025′S	93°35.700′E
130	2117	30°48.920′S	93°35.729′E
130	2118	30°48.816′S	93°35.758′E
130	2120	30°48.677′S	93°35.797′E
130	2121	30°48.509′S	93°35.845′E
130	2122	30°48.410′S	93°35.872′E
130	2123	30°48.310′S	93°35.902′E
130	2125	30°48.176′S	93°35.939′E
130	2126	30°48.005′S	93°35.984′E
130	2127	30°47.900′S	93°36.013′E
130	2128	30°47.798′S	93°36.042′E
130	2130	30°47.635′S	93°36.092′E
130	2131	30°47.486′S	93°36.134′E
130	2132	30°47.382′S	93°36.164′E
130	2133	30°47.275′S	93°36.193′E
130	2135	30°47.135′S	93°36.232′E
130	2136	30°47.122′S	93°36.386′E
130	2137	30°47.207′S	93°36.399′E
130	2138	30°47.303′S	93°36.371′E
130	2140	30°47.462′S	93°36.324′E
130	2141	30°47.679′S	93°36.278′E
130	2142	30°47.828′S	93°36.245′E
130	2143	30°47.982′S	93°36.209′E
130	2145	30°48.182′S	93°36.163′E
130	2146	30°48.445′S	93°36.108′E
130	2147	30°48.602′S	93°36.076′E
130	2148	30°48.767′S	93°36.038′E
130	2150	30°48.972′S	93°36.000′E
130	2151	30°49.242′S	93°35.943′E
130	2152	30°49.402′S	93°35.907′E
130	2153	30°49.559′S	93°35.876′E
130	2155	30°49.774′S	93°35.835′E
130	2156	30°50.045′S	93°35.781′E
130	2157	30°50.206′S	93°35.750′E
130	2158	30°50.357′S	93°35.715′E
130	2200	30°50.629′S	93°35.665′E
130	2201	30°50.872′S	93°35.625′E
130	2202	30°51.038′S	93°35.590′E
130	2203	30°51.203′S	93°35.552′E
130	2205	30°51.428′S	93°35.515′E
130	2206	30°51.703′S	93°35.464′E
130	2207	30°51.870′S	93°35.437′E
130	2208	30°52.039′S	93°35.410′E
130	2210	30°52.265′S	93°35.373′E
130	2211	30°52.542′S	93°35.330′E
130	2212	30°52.696′S	93°35.302′E
130	2213	30°52.828′S	93°35.276′E
130	2215	30°52.996′S	93°35.251′E
130	2216	30°53.200′S	93°35.224′E
130	2217	30°53.304′S	93°35.200′E
130	2218	30°53.356′S	93°35.145′E
130	2220	30°53.372′S	93°35.099′E
130	2221	30°53.366′S	93°35.063′E
130	2222	30°53.348′S	93°35.048′E
130	2223	30°53.330′S	93°35.019′E
130	2225	30°53.326′S	93°34.961′E

Table 3 (continued).

Julian day (1988)	Time (UTC)	Latitude	Longitude
130	2226	30°53.345′S	93°34.897′E
130	2227	30°53.354′S	93°34.865′E
130	2228	30°53.361′S	93°34.843′E
130	2230	30°53.370′S	93°34.827′E
130	2231	30°53.383′S	93°34.822′E
130	2232	30°53.392′S	93°34.818′E
130	2233	30°53.402′S	93°34.816′E
130	2235	30°53.415′S	93°34.817′E
130	2236	30°53.428′S	93°34.813′E
130	2237	30°53.437′S	93°34.813′E
130	2238	30°53.444′S	93°34.813′E
130	2240	30°53.459′S	93°34.816′E
130	2241	30°53.471′S	93°34.817′E
130	2242	30°53.480′S	93°34.819′E
130	2243	30°53.488′S	93°34.826′E
130	2245	30°53.497′S	93°34.831′E
130	2246	30°53.515′S	93°34.844′E
130	2247	30°53.522′S	93°34.847′E
130	2248	30°53.527′S	93°34.852′E
130	2250	30°53.533′S	93°34.856′E
130	2251	30°53.543′S	93°34.862′E
130	2252	30°53.548′S	93°34.859′E
130	2253	30°53.548′S	93°34.852′E
130	2255	30°53.549′S	93°34.837′E
130	2256	30°53.551′S	93°34.809′E
130	2257	30°53.551′S	93°34.793′E
130	2258	30°53.546′S	93°34.775′E
130	2300	30°53.530′S	93°34.752′E
130	2301	30°53.510′S	93°34.745′E
130	2302	30°53.501′S	93°34.743′E
130	2303	30°53.492′S	93°34.743′E
130	2305	30°53.488′S	93°34.730′E
130	2306	30°53.483′S	93°34.717′E
130	2307	30°53.478′S	93°34.708′E
130	2308	30°53.473′S	93°34.699′E
130	2309	30°53.466′S	93°34.689′E
130	2310	30°53.465′S	93°34.687′E
130	2311	30°53.469′S	93°34.681′E
130	2312	30°53.469′S	93°34.680′E
130	2313	30°53.466′S	93°34.680′E
130	2315	30°53.468′S	93°34.683′E
130	2316	30°53.468′S	93°34.687′E
130	2317	30°53.465′S	93°34.687′E
130	2318	30°53.466′S	93°34.685′E
130	2320	30°53.466′S	93°34.685′E
130	2321	30°53.642′S	93°34.681′E
130	2322	30°53.464′S	93°34.683′E
130	2323	30°53.465′S	93°34.683′E
130	2325	30°53.465′S	93°34.681′E
130	2326	30°53.466′S	93°34.687′E
130	2327	30°53.468′S	93°34.688′E
130	2328	30°53.469′S	93°34.688′E
130	2330	30°53.465′S	93°34.687′E
130	2331	30°53.465′S	93°34.685′E
130	2332	30°53.462′S	93°34.685′E
130	2333	30°53.464′S	93°34.685′E
130	2335	30°53.465′S	93°34.685′E
130	2336	30°53.461′S	93°34.685′E
130	2337	30°53.461′S	93°34.685′E
130	2338	30°53.461′S	93°34.687′E
130	2340	30°53.459′S	93°34.685′E
130	2341	30°53.461′S	93°34.685′E
130	2342	30°53.460′S	93°34.685′E
130	2343	30°53.460′S	93°34.685′E
130	2345	30°53.461′S	93°34.684′E
130	2346	30°53.460′S	93°34.685′E
130	2347	30°53.461′S	93°34.687′E
130	2348	30°53.462′S	93°34.685′E
130	2349	30°53.459′S	93°34.685′E
130	2350	30°53.459′S	93°34.684′E
130	2351	30°53.459′S	93°34.684′E
130	2352	30°53.460′S	93°34.681′E
130	2353	30°53.460′S	93°34.681′E
130	2355	30°53.459′S	93°34.680′E
130	2356	30°53.459′S	93°34.680′E
130	2357	30°53.457′S	93°34.678′E
130	2358	30°53.456′S	93°34.676′E

Note: GPS fixes.