U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Earthquake Locations Determined by the Southern Alaska Seismograph Network for October 1971 through May 1989

by

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INTRODUCTION

The U.S. Geological Survey (USGS) has operated a regional network of seismographs in southern Alaska since 1971. The principal purpose of this network has been to record seismic data to be used to precisely locate earthquakes in the seismic zones of southern Alaska, delineate seismically active faults, assess seismic risks, document potential premonitory earthquake phenomena, investigate current tectonic deformation, and study the structure and physical properties of the crust and upper mantle. A task fundamental to all of these goals is the routine cataloging of parameters for earthquakes located within and adjacent to the seismograph network.

The initial network of 10 stations, 7 around Cook Inlet and 3 near Valdez, was installed in 1971. In subsequent summers additions or modifications to the network were made. By the fall of 1973, 26 stations extended from western Cook Inlet to eastern Prince William Sound, and 4 stations were located to the east between Cordova and Yakutat. A year later 20 additional stations were installed. Thirteen of these were placed along the eastern Gulf of Alaska with support from the National Oceanic and Atmospheric Administration (NOAA) under the Outer Continental Shelf Environmental Assessment Program to investigate the seismicity of the outer continental shelf, a region of interest for oil exploration. Since then the region covered by the network has remained relatively fixed while efforts have been made to make the stations more reliable through improved electronic instrumentation and strengthened antenna systems. The majority of the stations installed since 1980 have been operated only temporarily (from one to several years) for special studies in various areas within the network. Due to reduced funding the network was trimmed substantially in the summer of 1985 with the closure of 15 stations, 13 of which were located in and around the Yakataga seismic gap. To further reduce costs, two telephone circuits were dropped and multiple radio relays were installed in their place. This economy reduced the reliability of these telemetry links. In addition, data collection from the areas around Cordova and Yakutat was compromised by the necessity of relying on triggered event recording using PC-based systems (Rogers, 1993) that were not fully developed and which proved to be less reliable than anticipated.

The principal means of recording throughout the time period of this catalog was 20-channel oscillographs on 16-mm film (Teledyne Geotech Develocorder, Model RF400 and 4000D). Initially one Develocorder was operated at the USGS headquarters in Anchorage, but recording was shifted to the National Oceanic and Atmospheric Administration (NOAA) Palmer Observatory (currently the Alaska Tsunami Warning Center) in 1972. The Develocorders were turned off at the end of May 1989, and since that time recording has been done in digital format at the Geophysical Institute of the University of Alaska in Fairbanks (GIUA). Thus, this catalog covers the entire period of film recording.

INSTRUMENTATION

The locations of seismograph stations of the USGS network that contributed to this catalog are shown in Figure 1 and listed in Table 1, along with stations operated by other institutions from which reading were obtained. Most of the USGS stations have only single, vertical-component sensors, but horizontal components seismometers are also operated at a few selected sites (see Table 1).

TABLE 1. List of seismograph stations used to determine hypocenter parameters reported in this catalog. INST - principal operating institution (USGS - U.S. Geological Survey; GIUA - Geophysical Institute, University of Alaska; NOAA - Alaska Tsumani Warning Center, Palmer; EMRC - Energy Mines and Resources, Canada [now Pacific Geoscience Center]). Open date left blank (or = 0) if unknown; closed date left blank if operation continued after May 1989.

CODE	SITE NAME	N LATITUDE DEG	N LATITUDE MIN	W LONGITUDE DEG	W LONGITUDE MIN	ELEV M	INST	OPEN	CLOSED
ABF	AUKE BAY	58	22.88	134	38.60	3	USGS	80/ 7/21	
ADK	ADAK	51	53.02	176	41.07	116	NOAA	66/ 1/ 0	
AG1	AUGUSTINE ISLAND	59	22.80	153	25.20	580	GIUA	71/ 8/ 0	76/ 1/ 0
AGA	AGASSIZ LAKES	60	9.25	141	2.00	1024	USGS	83/10/ 5	88/ 8/26
AGI	AUGUSTINE ISLAND	59	22.80	153	25.20	580	GIUA	71/ 8/ 0	76/ 1/ 0
ALC	ALCAN	62	37.35	141	0.50	582	USGS	79/10/25	82/ 9/21
ANM	ANVIL MOUNTAIN	64	34.60	165	22.28	323	GIUA	76/ 9/ 0	
ANV	ANVIL MOUNTAIN	64	33.60	165	22.28	323	GIUA	76/ 9/ 0	
AU1	AUGUSTINE ISLAND	59	22.39	153	25.23	494	GIUA	71/ 8/ 0	76/ 1/ 0
AU2	AUGUSTINE ISLAND	59	22.21	153	22.69	195	GIUA		76/ 1/ 0
AU4	AUGUSTINE ISLAND	59	20.16	153	30.77	18	GIUA	76/ 1/ 0	76/ 1/ 0
AU5	AUGUSTINE ISLAND	59	23.19	153	27.35	152	GIUA		76/ 1/ 0
AUE	AUGUSTINE EAST	59	21.54	153	22.33	172	GIUA	88/10/ 1	
AUF	AUGUSTINE FLOW	59	23.27	153	27.45	165	GIUA	77/ 7/28	80/ 8/25
AUH	AUGUSTINE DOME H	59	21.83	153	26.61	900	GIUA	92/ 8/26	
*AUI	AUGUSTINE ISLAND	59	20.11	153	25.66	293	GIUA	78/ 1/ 1	
AUK	AUGUSTINE ISLAND	59	20.05	153	25.62	293	GIUA	76/10/17	78/ 4/ 6
AUL	AUGUSTINE LAVA FLOW	59	22.93	153	26.07	360	GIUA	80/10/29	
AUM	AUGUSTINE MOUND	59	22.26	153	21.17	106	GIUA	75/ 9/ 0	80/10/29
AUP	AUGUSTINE PINICLE	59	21.74	153	25.23	1033	GIUA	88/10/ 1	
AUW	AUGUSTINE WEST	59	22.02	153	28.25	320	GIUA	91/ 7/27	
BAL	BALDY	61	2.12	142	20.83	1265	USGS	73/ 8/24	
BC3	BEAVER CREEK U3	63	3.95	141	46.96	848			
BCP	BANCAS POINT	59	57.20	139	38.10	396	USGS	79/ 9/ 4	
BCS	BANCAS POINT	59	56.90	139	37.00	10	USGS	76/ 6/25	79/ 9/ 4
BGA	BELUGA	61	13.34	150	57.95	20	USGS	75/10/ 8	76/ 3/27
BGM	BIG MOUNTAIN	59	23.56	155	13.76	625	USGS	78/ 9/ 8	
BIG	BIG MOUNTAIN	59	23.34	155	13.02	567	USGS	72/ 7/31	78/ 9/ 8
BLR	BLACK RAPIDS	63	30.10	145	50.70	810	NOAA	65/ 3/ 0	85/ 8/ 8
BLY	BURWASH LANDING	61	22.35	139	1.56	799	USGS	74/ 7/22	78/ 6/ 1
BMR	BREMNER RIVER	60	58.09	144	36.18	823	USGS	79/ 8/19	85/ 7/16
BRW	BARROW	71	18.20	156	44.90	0	GIUA	88/10/ 1	
CAE	CAETANI RIVER	60	5.05	140	59.33	716	USGS	83/ 7/25	84/ 8/27
CCB	CLEAR CREEK BUTTE	64	38.80	147	48.33	219	GIUA	83/ 9/16	
CDA	CAPE DOUGLAS	58	57.32	153	31.77	386	GIUA	78/ 1/ 1	81/ 8/16
CDD	CAPE DOUGLAS	58	55.79	153	38.58	622	GIUA	81/ 8/17	
CDL	CANDLE	66	6.84	161	39.40	312	GIUA	78/12/16	
CFI	COLLEGE FIORD	61	10.96	147	45.99	3	USGS	74/ 7/31	
CGB	CONGABUNA	61	4.14	151	27.15	160	USGS	75/10/ 8	76/ 3/27
CGL	CAPPS GLACIER	61	18.46	152	0.40	1082	USGS	81/ 9/22	
CHX	CHAIX HILLS	60	3.78	141	7.00	1067	USGS	74/ 9/ 4	85/ 8/25
CKK	CHEKOK LAKE	59	57.58	154	13.99	732	USGS	72/ 7/29	78/ 9/ 9
CNP	CHINA POOT	59	31.55	151	14.16	564	USGS	83/ 7/ 1	
COL	COLLEGE OUTPOST	64	54.00	147	47.60	320	USGS	64/ 1/ 0	
CRP	CRATER PEAK	61	16.02	152	9.33	1622	USGS	81/ 8/26	
CRQ	CIRQUE	60	45.40	143	8.35	1853	USGS	88/ 7/ 1	
CSG	CHILDS GLACIER	60	39.66	144	51.30	678	USGS	84/ 7/22	85/ 8/10
CTG	CHITNA GLACIER	60	57.96	141	20.30	1490	USGS	79/ 8/28	
CUT	CHULITNA	62	24.28	150	16.17	168	GIUA	86/ 7/18	

* Three-component site during at least part of the operation period

TABLE 1 (cont)

CODE	SITE NAME	N LATITUDE DEG	MIN	W LONGITUDE DEG	MIN	ELEV M	INST	OPEN	CLOSED
CVA	CORDOVA	60	32.84	145	44.73	120	USGS	71/ 8/31	
CYT	CAPE YAKATAGA	60	4.47	142	24.68	323	USGS	78/ 8/ 8	80/ 9/22
DDM	DONNELY DOME	63	47.14	145	51.45	900	GIUA	90/ 8/10	
DFR	DRIFT RIVER	60	35.51	152	41.16	1090	USGS	88/ 8/15	
DLY	DEZADEASH LAKE	60	22.20	137	3.90	738	EMRC		
DMA	DEVIL MOUNTAIN	66	17.80	164	31.35	238	GIUA	77/ 8/ 0	82/ 0/ 0
DMW	DELTA MICROWAVE	64	3.23	145	43.52	346	GIUA	86/ 0/ 0	90/ 8/19
DOT	DOT LAKE	63	38.92	144	3.75	671	GIUA	88/10/ 1	
DSB	DISCHANTMENT BAY	60	4.60	139	32.70	640	USGS	74/ 9/ 8	76/ 6/ 8
DSK	DISK ISLAND	60	30.12	147	38.81	15	USGS	74/ 7/27	76/ 6/ 7
DWY	DAWSON CITY	64	3.20	139	25.90	346	EMRC		76/ 6/ 7
ERN	ERNESTINE	61	26.65	145	6.74	570	USGS	71/ 9/16	73/ 8/29
FBA	COLLEGE OUTPOST	64	54.00	147	47.60	320	GIUA	91/ 8/ 1	
FID	FIDALGO	60	43.73	146	35.79	488	USGS	74/10/ 7	
FIS	FIRE ISLAND	61	8.65	150	13.11	76	USGS	74/ 9/24	76/ 5/ 4
FYU	FORT YUKON	66	33.96	145	13.90	137	GIUA	88/10/ 1	
GAR	GARNER	63	50.22	148	58.27	590	GIUA	87/10/20	
GBY	GRANITE BAY	60	25.93	147	58.70	495	USGS	85/ 7/21	
GHO	GLORYHOLE	61	46.33	148	55.45	1021	USGS	84/ 9/11	
GIL	GILMORE CREEK	64	58.50	147	29.70	350	NOAA	67/10/13	
GKC	GOLD KING CREEK	64	10.72	147	56.08	490	GIUA	76/ 7/ 0	86/ 3/10
*GLB	GILAHINA BUTTE	61	26.51	143	48.63	845	USGS	73/ 8/25	
GLC	GLACIER ISLAND	60	53.44	147	4.38	3	USGS	72/ 7/24	84/ 9/17
GLI	GLACIER ISLAND	60	52.78	147	5.65	429	USGS	84/ 9/17	
GLM	GILMORE DOME	64	59.24	147	23.34	820	GIUA	88/10/ 1	
GLN	GLENNALLEN	62	6.65	145	32.93	457	GIUA	86/ 0/ 0	
GMA	GRANITE MOUNTAIN	65	25.72	161	13.92	858	GIUA	70/ 9/17	
GYO	GUYOT	60	8.78	141	28.29	183	USGS	76/ 6/ 1	
HDA	HARDING LAKE	64	24.34	146	56.45	427	GIUA	77/ 9/ 0	
HIN	HINCHINBROOK ISLAND	60	23.81	146	30.10	611	USGS	74/10/ 3	
HMT	HAMILTON	60	20.19	144	15.64	620	USGS	77/ 8/16	
HOM	HOMER	59	39.50	151	38.60	198	GIUA	81/ 1/ 1	
HQN	HARLEQUIN	59	27.10	138	52.62	372	USGS	74/10/ 1	
HUR	HURRICANE	62	58.72	149	38.60	496	GIUA	77/ 2/14	
HYT	HAINES JUNCTION	60	49.50	137	30.24	1416	EMRC	81/ 7/27	
ILI	ILIAMNA	60	4.81	152	57.57	823	USGS	87/ 9/15	
ILM	ILIAMNA	60	10.92	152	48.97	550	USGS	71/ 8/ 7	87/ 9/16
ILN	ILIAMNA	60	10.92	152	48.97	550	USGS	71/ 8/ 7	72/ 9/30
IMA	INDIAN MOUNTAIN	66	4.11	153	40.72	1380	NOAA	79/12/28	
INK	INUVIK	68	17.50	133	30.00	40	EMRC	69/ 2/22	
KAI	KAYAK ISLAND	59	55.61	144	24.98	311	USGS	82/ 8/ 3	
KDC	KODIAK	57	44.87	152	29.50	13	NOAA	78/ 9/20	
KEY	KLUANE LAKE	61	3.00	138	30.10	785	EMRC	78/ 8/26	81/ 7/25
KLU	KLUTINA	61	29.57	145	55.21	1021	USGS	72/ 7/22	
KMP	KIMBALL PASS	61	30.78	145	1.09	1143	USGS	76/ 8/ 1	85/ 7/19
KNI	KNIGHT ISLAND	60	20.92	147	44.16	434	USGS	85/ 7/21	
KNK	KNIK GLACIER	61	24.75	148	27.34	595	USGS	73/ 8/11	
KRY	KOIDERN RIVER	61	58.20	140	24.50	686	EMRC	78/ 8/29	81/ 4/ 1
KTA	KOTZEBU	66	50.48	162	35.22	24	GIUA	76/ 9/ 8	82/ 0/ 0
KTH	KANTISHNA HILLS	63	33.19	150	55.26	1172	GIUA	88/10/ 1	
KTM	KATMAI	58	19.48	155	22.59	945	USGS	73/ 7/27	75/ 8/24
KYK	KAYAK ISLAND	59	52.10	144	31.39	375	USGS	74/10/ 2	82/ 8/ 2
LOU	LOUIS BAY	60	27.93	147	38.66	490	USGS	85/ 7/15	
LTI	LATOUCHE ISLAND	60	2.43	147	51.25	302	USGS	88/ 7/ 1	

TABLE 1 (cont)

CODE	SITE NAME	N LATITUDE DEG	N LATITUDE MIN	W LONGITUDE DEG	W LONGITUDE MIN	ELEV M	INST	OPEN	CLOSED
LVY	LEVY	64	13.00	149	15.20	230	GIUA	72/ 7/ 0	89/ 9/19
MBC	MOULD BAY	76	14.50	119	21.60	15	EMRC	61/10/18	
MCK	MCKINLEY PARK	63	43.94	148	56.10	618	GIUA	64/ 0/ 0	
MCN	MCNEIL RIVER	59	6.06	154	11.99	273	GIUA	76/10/15	81/ 8/22
MID	MIDDLETON ISLAND	59	25.67	146	20.34	37	NOAA	76/ 5/21	
MLS	MALASPINA GLACIER	59	46.00	140	9.00	30	USGS	74/ 9/ 4	81/ 9/ 5
MMN	MCNEIL RIVER	59	11.11	154	20.20	442	GIUA	81/ 8/22	
MRN	MARTIN RIVER	60	32.10	144	0.50	957	USGS	75/ 8/22	76/ 3/31
MSE	MOOSE CREEK	61	50.30	148	58.03	1318	USGS	84/ 9/11	85/ 9/30
MSP	MOOSE PASS	60	29.35	149	21.63	160	USGS	73/ 8/ 5	
MTG	MONTAGUE ISLAND	59	54.71	147	29.82	31	USGS	74/10/ 3	85/ 7/15
MTU	MONTAGUE ISLAND	59	59.27	147	39.02	434	USGS	85/ 7/21	
NCA	NELCHINA	61	59.62	146	49.45	741	GIUA	86/ 7/17	90/ 6/ 0
NCT	NORTH CRESENT	60	33.79	152	55.57	1079	USGS	88/ 8/14	
NEA	NENANA	64	34.63	149	4.63	364	GIUA	81/ 3/ 5	
NGL	NORTH GASLINE	60	49.25	149	59.89	122	USGS	74/ 9/26	76/ 3/27
NIK	NIKOLSKI	52	58.46	168	51.11	207	NOAA	71/ 5/17	76/ 3/27
NIN	NINILCHIK	60	0.67	151	32.13	110	USGS	71/ 8/28	72/ 8/24
*NKA	NIKISHKA	60	44.58	151	14.28	100	USGS	71/ 9/14	
NKI	NIKOLSKI	52	56.56	168	51.45	8	NOAA	76/ 3/27	85/12/26
NNL	NINILCHIK	60	2.66	151	17.36	381	USGS	72/ 8/24	
NRA	NORTH RIVER	63	53.51	160	30.86	107	GIUA	76/ 8/ 0	78/ 6/ 8
NTK	NUNITAK	59	52.66	139	2.11	1050	USGS	74/ 9/ 9	76/ 5/31
OCC	OCEAN CAPE	59	32.55	139	51.61	22	USGS	76/ 1/ 1	76/ 4/24
OPT	OIL POINT	59	39.16	153	13.78	450	GIUA	88/10/ 1	
PAX	PAXSON	62	58.25	145	28.12	1130	GIUA	88/10/ 1	
PCA	[see PIN]								
PCL	POINT CAMPBELL	61	8.57	150	0.93	90	USGS	73/ 9/ 4	74/ 9/30
PDB	PEDRO BAY	59	47.27	154	11.55	305	USGS	78/ 9/ 9	
PIN	PINNACLE	60	5.80	140	15.40	975	USGS	74/ 9/ 5	
PLR	PALMER (USGS)	61	35.53	149	7.85	100	USGS	84/ 9/20	
PMA	PORT MOLLER	55	58.72	160	29.83	315	GIUA	91/ 8/ 1	
PME	PALMER EAST	61	37.90	149	1.70	232	NOAA	80/ 8/19	90/ 3/ 1
PMR	PALMER OBSERVATORY	61	35.53	149	7.85	100	NOAA	67/ 9/ 1	
PMS	ARCTIC VALLEY	61	14.68	149	33.63	716	NOAA	67/ 5/25	
*PNL	PENINSULA	59	40.06	139	23.82	585	USGS	74/ 9/ 2	
*PRG	PORTAGE	60	51.87	149	1.21	55	USGS	72/ 8/29	
PTR	POTTER	61	3.45	149	43.75	695	USGS	73/ 8/12	74/ 9/15
PWA	HOUSTON	61	39.05	149	52.72	137	NOAA	77/ 7/ 1	
PWL	PORT WELLS	60	51.56	148	20.09	549	USGS	74/ 8/ 3	
RAG	RAG	60	23.22	144	40.51	739	USGS	84/ 7/22	
RAI	RASPBERRY ISLAND	58	3.63	153	9.55	520	GIUA	75/10/ 0	
RDS	RICHARD D. SIEGRIST	64	49.59	148	8.68	510	GIUA	77/ 6/12	91/ 7/18
*RDT	REDOUBT	60	34.39	152	24.32	930	USGS	71/ 8/ 9	90/ 7/19
RED	REDOUBT VOLCANO	60	25.19	152	46.31	1064	GIUA	81/11/10	
RGD	RAGGED MOUNTAIN	60	13.15	144	32.74	610	USGS	74/ 9/30	77/ 8/16
RIU	RIOU	59	52.65	141	13.80	15	USGS	76/ 8/ 3	81/ 9/28
RND	REINDEER	63	24.37	148	51.17	991	GIUA	88/10/ 1	
RON	REMOTE	62	41.47	150	12.21	470	GIUA	71/ 9/22	74/10/31
SAW	SAWMILL	61	48.49	148	19.98	740	USGS	73/ 8/31	
SCF	SHEEP CREEK FACILITY	61	59.68	150	2.35	67	GIUA	71/ 9/21	75/10/ 7
SCM	SHEEP MOUNTAIN	61	50.00	147	19.66	1020	GIUA	91/ 8/ 1	
SCT	SCOTTY LAKE	62	19.15	150	17.83	140	GIUA	71/ 9/21	75/ 6/ 0
SDE	SADIE COVE	59	26.60	151	16.92	770	USGS	83/ 7/ 4	84/ 6/28

TABLE 1 (cont)

CODE	SITE NAME	N LATITUDE DEG	N LATITUDE MIN	W LONGITUDE DEG	W LONGITUDE MIN	ELEV M	INST	OPEN	CLOSED
SDG	SOURDOUGH	62	31.62	145	32.60	625	GIUA	86/ 1/ 0	
SDN	SAND POINT	55	20.48	160	29.83	23	NOAA	78/10/11	
SGA	SHERMAN GLACIER	60	32.04	145	12.42	424	USGS	76/ 8/16	
SHU	SHUYAH ISLAND	58	37.68	152	20.93	34	GIUA	74/ 0/ 0	90/ 8/27
SII	SITKINAK ISLAND	56	33.60	154	10.92	500	GIUA	75/ 8/ 9	
SIT	SITKA	57	3.42	135	19.47	19	NOAA	40/ 0/ 0	
SIY	SILVER CITY	61	1.90	138	24.38	785	EMRC	79/12/ 5	80/ 3/27
SKD	SITKALIDAK ISLAND	57	9.85	153	4.82	135	GIUA	70/ 1/ 1	
*SKL	SKILAK	60	30.86	150	12.96	640	USGS	71/ 9/ 9	84/ 7/28
*SKN	SKWENTNA	61	58.82	151	31.78	564	USGS	72/ 8/ 8	
SLK	SKILAK	60	30.74	150	13.26	655	USGS	84/ 7/29	
SLV	SELDOVIA	59	28.28	151	34.83	91	USGS	72/ 9/30	85/ 6/29
SMY	SHEMYA	52	43.85	174E	6.18	58	NOAA	70/11/17	
SPU	SPURR	61	10.90	152	3.26	800	USGS	71/ 8/10	
SSN	SUSITNA	61	27.83	150	44.60	1297	USGS	72/ 8/15	
SSP	SUNSHINE POINT	60	12.30	142	49.80	305	USGS	74/ 9/10	
SST	SUSITNA	61	26.05	150	46.82	780	USGS	71/ 8/24	72/ 8/ 9
STG	STEPHENS GLACIER	61	25.24	146	23.69	1326	USGS	74/ 7/11	76/ 1/31
STY	STONY RIVER	61	8.67	154	12.11	1047	USGS	72/ 7/24	75/ 7/28
SUK	SUCKLING HILLS	60	4.42	143	46.62	454	USGS	74/10/ 2	85/ 8/10
SVG	SAVOONGA	63	41.70	170	28.80	15	GIUA	77/ 8/17	
SVW	SPARREVOHN	61	6.49	155	37.30	762	NOAA	67/ 8/ 0	
SWD	SEWARD	60	6.22	149	26.96	91	USGS	72/ 8/22	
TGL	TANA GLACIER	60	45.35	142	49.78	1234	USGS	88/ 7/ 1	
TLK	TALKEETNA MOUNTAINS	62	29.63	147	52.68	1719	USGS	74/ 7/10	76/ 7/ 1
TMW	TOK MICROWAVE	63	19.28	142	59.48	488	GIUA	90/ 8/20	
TNN	TANANA	65	15.40	151	54.70	504	GIUA	65/ 1/ 0	79/ 1/ 3
TOA	TOLSONA	62	6.29	146	10.34	909	NOAA	71/ 9/15	
TSI	TSINA	61	13.57	145	20.24	1113	USGS	76/ 8/15	85/ 7/17
TTA	TATALINA	62	55.80	156	1.32	914	NOAA	78/ 9/20	
TTV	TERENTIEV LAKE	61	3.29	147	7.29	533	USGS	84/ 9/19	85/ 7/14
TZO	TZERO	63	48.16	145	44.10	602	GIUA	87/10/ 0	89/ 7/17
*VLZ	VALDEZ	61	7.93	146	20.03	17	USGS	71/ 9/ 2	
VZS	VALDEZ SOUTH	61	2.65	146	18.32	668	USGS	72/ 7/22	76/ 8/15
VZW	VALDEZ WEST	61	3.54	146	33.24	796	USGS	72/ 7/17	
WAX	WAXELL RIDGE	60	26.89	142	51.06	991	USGS	75/ 8/22	
WHC	WHITEHORSE	60	44.20	135	5.90	732	EMRC	71/ 9/ 1	
WLM	WILLOW MOUNTAIN	61	46.42	145	11.88	985	USGS	71/ 9/ 1	72/ 8/ 0
WRG	WHITE RIVER GLACIER	60	2.25	142	1.97	550	USGS	74/ 9/10	
WRH	WOOD RIVER HILL	64	28.28	148	5.39	314	GIUA	83/ 9/16	
XLV	SELDOVIA	59	27.28	151	40.30	320	GIUA	91/ 6/20	
YAH	YAHTSE	60	21.51	141	44.70	2135	USGS	74/ 9/ 5	
YKA	YELLOWKNIFE ARRAY	62	29.59	114	36.32	200	EMRC	62/ 0/ 0	
YKC	YELLOWKNIFE	62	28.70	114	28.40	198	EMRC	64/ 7/15	
YKG	YAKATAGA	60	4.20	142	25.33	46	USGS	72/10/ 8	85/ 9/ 3
YKT	YAKUTAT	59	27.10	138	52.62	372	USGS	72/10/ 6	74/ 9/30
YKU	YAKUTAT	59	33.23	139	43.50	40	NOAA	78/ 9/20	
BRLK	BRADLEY LAKE	59	45.83	150	53.38	622	USGS	80/10/11	
BRNE	BRADLEY LAKE NE	59	54.65	150	39.13	1219	USGS	80/10/12	84/ 6/28
BRNW	BRADLEY LAKE NW	59	50.25	151	10.15	582	USGS	80/10/ 3	84/ 6/28
BRSE	BRADLEY LAKE SE	59	42.33	150	40.25	975	USGS	80/10/10	87/ 7/ 2
BRSW	BRADLEY LAKE SW	59	38.46	151	2.69	951	USGS	80/10/12	84/ 6/28
CBHL	HEATHER LAKE	61	1.75	146	55.88	3	USGS	83/ 7/14	83/ 9/30
CBKL	KADIN LAKE	61	6.63	147	11.61	275	USGS	83/ 7/15	83/ 9/30

TABLE 1 (cont)

CODE	SITE NAME	N LATITUDE DEG	N LATITUDE MIN	W LONGITUDE DEG	W LONGITUDE MIN	ELEV M	INST	OPEN	CLOSED
CBLB	LONG BAY	60	57.93	147	13.30	5	USGS	83/ 7/15	83/ 9/30
CBUI	UNAKWIK INLET	60	54.66	147	32.72	8	USGS	83/ 9/11	83/ 9/30
ECNI	CHENEGA ISLAND	60	16.94	148	2.11	4	USGS	87/ 7/ 9	87/ 8/ 7
EFLB	FOUL BAY	60	34.94	148	3.65	4	USGS	87/ 7/ 9	87/ 8/ 7
EGRI	GREEN ISLAND	60	17.53	147	23.37	4	USGS	87/ 7/ 9	87/ 8/ 7
ELAI	LATOUCHE ISLAND	60	3.68	147	49.10	4	USGS	87/ 7/ 9	87/ 8/ 7
EMTC	MONTANA CREEK	62	9.55	150	1.00	131	USGS	86/ 8/28	86/ 9/11
ENKI	NAKED ISLAND	60	37.84	147	27.55	4	USGS	87/ 7/ 9	87/ 8/ 7
EPKS	PARKS HIGHWAY	62	15.30	150	14.50	99	USGS	86/ 8/28	86/ 9/11
ETAL	TALKEETNA	62	18.25	150	4.92	137	USGS	86/ 8/28	86/ 9/11
EWTF	WEST FORK	62	19.13	150	28.55	200	USGS	86/ 8/28	86/ 9/11
GALN	GALENA BAY	60	57.47	146	44.48	3	USGS	72/ 7/14	72/ 8/13
JACK	JACK BAY	61	0.26	146	31.03	30	USGS	72/ 7/14	72/ 8/13
LOWE	LOWE RIVER	61	4.17	146	2.57	58	USGS	72/ 7/14	72/ 8/13
MNRL	MINERAL CREEK	61	12.60	146	19.16	236	USGS	72/ 7/14	72/ 8/13
SENW	SAINT ELIAS NW	60	13.80	140	54.40	1250	USGS	79/ 7/20	79/ 8/17
SHOU	SHOUP BAY	61	7.84	146	34.26	15	USGS	72/ 7/14	72/ 8/13
SWML	SAWMILL BAY	61	3.94	146	46.71	15	USGS	72/ 7/14	72/ 8/13

The instrumentation used in the USGS seismograph network is illustrated in the block diagram in Figure 2. The standard equipment at each field site includes: a vertical seismometer with a natural frequency of 1.0 Hz (Mark Products, Model L-4C); an electronics package consisting of an amplifier, voltage-controlled oscillator (Develco Model 6203 or equivalent) until about 1980, and then an A1VCO with calibrator and gain-ranging (Rogers and others, 1980); and either "air-cell" storage batteries, or a solar panel with 80 amp-hr storage batteries.

Data are telemetered via a combination of VHF (162-174 MHz) radio links and leased telephone circuits, some of which use satellite links having a 0.27 s transmission delay per hop. The radio equipment consists of low-power (100 mW) transmitters and receivers, many adapted from HT-200 Motorola handie-talkie transceivers, and either Yagi antennae with 9 db directional gain (Scala, Model CAS-150) or log-periodic antennae (Scala, Model CL-150). At the receive sites, where the seismic signals enter the telephone circuits, base-station radio receivers (G.E. Model R46AP66B) with greater sensitivity are used. The central recording facility incorporates a bank of discriminators (USGS designed NCER J101 or Develco Model 6203), four 16 mm-film 20-channel oscillographs (Teledyne Geotech Develocorder, Model RF400 and 4000D), a 14-track FM magnetic tape recorder (Bell and Howell Model VR3700B), three 3-channel drum recorders (Teledyne Geotech Helicorder, Model RV301B), and a time-code generator (Datum, Model 9100).

The principle of operation is as follows: The seismometer translates ground velocity into an electrical voltage that is fed into the amplifier/VCO unit. There the amplified voltage causes the frequency of VCO to fluctuate about its center frequency. The frequency-modulated (FM) tone from the amplifier/VCO unit is carried directly to the recording site by VHF radio links and/or voice-grade telephone circuits. Signals from eight seismograph stations can be transmitted on a single telemetry circuit using standard frequency division multiplexing techniques with a 340 Hz separation between carriers and a constant bandwidth of 250 Hz per channel. The channel center frequencies range from 680 to 3,060 Hz. A ninth channel with center frequency of 340 Hz and 125 Hz bandwidth is also commonly used. At the recording site the FM seismic signal is demodulated by a discriminator. The demodulated signal, which is simply an amplified and filtered form of the initial signal from the seismometer, is recorded on the oscillograph and tape recorder together with time signals from the time-code generator. Twenty-four hours of data from 18 stations can be recorded on a single 43 m-long roll of 16-mm film, while data from nine stations can be recorded on a single track of a 2,195 m-long, 14-track tape. Several stations are also recorded on Helicorder records for monitoring purposes.

Figure 3 illustrates the response characteristics of the entire seismic system from seismometer to film viewer. The response level at each station is adjusted in steps of 6 decibels so that the ambient seismic noise produces a small deflection of the trace on the film. As a result, the actual response for an individual station may differ from that of the typical station by a factor of 2, 4, 8, etc. The magnification of the typical station is about 6×10^4 at 1 Hz and 1×10^6 at 10 Hz.

Digital seismic-event recorders were developed internally and deployed to temporarily augment network recording in areas of interest. A description of these instruments can be found in Rogers and Lahr (1986) and Fogleman and Rogers (1987).

DATA PROCESSING

The 16-mm films, magnetic tapes, and Helicorder records are mailed weekly from the Alaska Tsunami Warning Center in Palmer, Alaska to the USGS in Menlo Park, California where the seismic data are processed by the following multi-step routine:

1. Scanning. The scan film, which records data from 18 stations distributed throughout the network, is scanned to identify all seismic events, including those of local, regional, and teleseismic origin, and to note the earliest P-arrival time, the time interval between the P and S phases (S-P time), and the duration of the signal (see section on Magnitude) for the first 3 stations. Stations not recorded on the scan film are arranged on the remaining films by geographic region.

2. Timing. For the "well-recorded" local earthquakes identified in the scanning process, the following data are read from each station: P- and S-wave arrival times, direction of first motion, duration of signal in excess of a given threshold amplitude, and period and peak-to-trough amplitude of maximum recorded signal. The P and S times are assigned weights according to the reader's confidence of the precision of the picks. The precision is influenced by the impulsiveness of the phases and the recording quality. Weights range from a full weight (coded 0) for the highest quality readings to no weight (coded 4) for times too poor to be used for hypocenter determination.

From October 1971 through the end of September 1973, the criteria for choosing earthquakes to be timed were based on S-P times and the number of stations which clearly record the earthquake. Beginning with October 1973, an additional criterion based on the signal durations is used. The area within which earthquake locations are routinely determined has changed a number of times since 1971. The various criteria used to determine which earthquakes to time from October 1971 to May 1989 are summarized in Appendix C. From September 1, 1985 to May 31, 1989, for example, the area is bounded approximately by longitudes 156° and 138°W and by latitudes 58° and 62.5°N, and is subdivided into western and eastern regions at longitude 145°W. In the western region, only events with average signal durations longer than 30s are routinely timed. In the eastern region, all earthquakes that are recorded by at least three stations and that produce at least four clear arrivals are timed. These criteria were established to select from the large number of earthquakes recorded by the network those shocks that are of greatest interest to current research objectives. In areas where special studies are being conducted, exceptions to the standard criteria may be made in order to locate more events.

Until October 1982 all of the available data recorded on the Develocorder films were read for each timeable earthquake. Since then, in order to keep the data processing current, only the scan film and the film(s) which contain the stations in the region the earthquake occurred were timed. A record of which films are timed for each earthquake is kept with the daily scan sheet.

Due to changes in the distribution of stations, to variations in seismicity rates, and to modifications in the criteria used for selecting which events to locate, the number of shocks located each month varied with time (Figure 4). The large increase seen beginning with March 1979 is due mainly to the aftershock sequence of the February 1979 M_S 7.1 St. Elias earthquake which elevated the level of activity until the mid 1980's. The gradual decay in the number of events per month from 1979 to 1988 is due partially to decay in the rate of St. Elias aftershocks and to the closure of 15 stations, 13 of which were located in and around the Yakataga seismic gap, in the summer of 1985. Large spikes in the monthly number between 1982 and 1988 are due mainly to aftershock sequences. The large increase beginning in 1989 is due predominantly to the integration of data processed by the Geophysical Institute of the University of Alaska in Fairbanks with the USGS southern Alaska data.

The bulk of the timing is done by projecting the seismic traces from the film onto a one-film wire-grid or four-film sonic (Astrue and others, 1983) computer-based digitizing table, where the P- and S-phases, maximum amplitude, and coda duration are input as x-y coordinates into a computer and reformatted for input into a hypocentral location program. Since the fall of 1983, some of the timing has utilized digital waveform data obtained by digitizing the daily FM magnetic tapes at 100 samples per second. In the latter case an interactive, computer-based processing system (Stevenson, 1978) is used to display the waveforms and to pick the phase data.

3. <u>Initial computer processing</u>. The phase data for the timed events are batch processed by computer using the program HYPOELLIPSE (Lahr, 1989) to obtain origin times, hypocenters, magnitudes and, if desired, first-motion plots for fault-plane solutions. The HYPOELLIPSE computer program determines hypocenters by minimizing differences between observed and computed traveltimes through an iterative least-squares scheme. In many respects the program is similar to HYPO71 (Lee and Lahr, 1972), from which it was derived. Important features available in HYPOELLIPSE, but not in HYPO71, include multiple velocity and delay models, calculation of confidence ellipsoids, and incorporation of a station-history data base to keep the station gains and polarities updated.

The earthquake locations are based on P- and S-arrivals. S-arrivals provide important constraints on epicenters of shocks outside the network, and depths of events in the Wadati-Benioff zones beneath Cook Inlet and the Wrangell volcanoes (see section on Focal Depths). For some large events timed from the films S-arrivals cannot be read at any station because the traces on the film overlap each other or are too faint to read. However, S-arrivals not readable from the films can often be picked on paper records generated from playbacks of the magnetic tapes.

4. <u>Analysis of initial computer results</u>. Each hypocentral solution is checked for: large traveltime residuals (see section on Analysis of Hypocentral Quality), a root-mean-square (RMS) residual greater than 1 s, a focal depth greater than 35 km in an area where no Wadati-Benioff zone is known to exist, individual station magnitudes which differ from the average event magnitude by more than 0.5, and a poor spatial distribution of stations. Events with potential timing errors are re-read and additional readings, including those from souces other than the USGS network, are sought for shocks with a poor distribution of recording stations.

Initially, when the network spanned a relatively small area , traveltime residuals greater than 0.4 s were checked for data that was cataloged. As the network expanded eastward, it became necessary to increase the threshold for checking traveltime residuals due to the increase in the average epicentral distance to the stations used to locate the earthquakes. Beginning with 1978 data, the criterion for checking traveltime residuals was to check: the five closest stations for P-residuals greater than 0.6 s and S-residuals greater than 1.0 s; the stations after the first five and up to 150 km from the epicenter for P- and S-residuals greater than 0.9 s and 1.5 s, respectively; and stations with an epicentral distance between 150 to 350 km for P-residuals greater than 1.5 s and S-residuals greater than 2.0 s. Stations with epicentral distances greater than 350 km were generally weighted out by HYPOELLIPSE and checked for P- and S-residuals greater than 2.0 s and 3.0 s, respectively.

5. Final computer processing. Poor hypocentral solutions are rerun with corrected and/or additional data, and the new solutions are checked for large residuals that might indicate remaining errors. Corrections are made as required before the final computer run. Generally no more than three computer runs were allowed for any earthquake by an analyst. Additional runs might be made by a geophysicist to correct problem events. An empirical study of 100 earthquakes from October and November 1979 revealed that correcting all large traveltime residuals for each solution regardless of the overall quality of the solution resulted in little improvement in hypocenter precision and was time consuming. The high-quality solutions with only a few large traveltime residuals generally changed less than one minute in latitude and longitude and one km in depth with additional re-reads and computer runs. Consequently, since January 1980 earthquakes with only a few large traveltime residuals are checked only if the analyst feels the hypocentral solution may be affected.

VELOCITY MODELS

Our experience with locating earthquakes in southern Alaska suggests that significant lateral variations are present in the velocity structure across the network. Such variations might be expected from the complex geology and tectonics of the region (e.g., Plafker, 1967; Page and others, 1986). Over the years different methods have been used to account for variations in the crustal structure across southern Alaska. There have also been changes in the location program HYPOELLIPSE which would modify the computed locations (Lahr, 1989). For these reasons, all of the earthquake data from October 1971 through May 1989 were relocated using a single set of control parameters. Three velocity models were used in locating the earthquakes (Table 2). The Southern Alaska Model is based on a study of earthquakes below the Kenai Peninsula (Model A, Matumoto and Page, 1969); the Northern Alaska Model was developed by the Geophysical Institute of the University of Alaska, Fairbanks (N. Biswas, personal communication, 1988); the Gulf of Alaska Model is based on a study of the 1987 and 1988 M_S 7.6 Gulf of Alaska earthquakes (Lahr and others, 1988a) and their aftershocks.

It is recognized that a model comprised of uniform horizontal layers is a poor representation of the actual velocity structure in the vicinity of a subduction zone (Mitronovas and Isacks, 1971; Jacob, 1972, McLaren and Frohlich, 1985); however, such a model does have the advantage of simplifying the computation of traveltimes. In order to determine any bias that might result from the approximation, a set of events in the Benioff zone below Cook Inlet was relocated using a raytracing program of E. R. Engdahl and incorporating a more realistic, three-dimensional velocity model (Lahr and others, 1974; Lahr, 1975). Hypocenter shifts due to the oversimplified flat-layer model ranged from near zero at a depth of 60 km to as great as 25 km at 160 km depth. The offsets were oriented in such a way that the dip of the Wadati-Benioff zone would appear to be too great for locations based on a flat-layered model.

The choice of which velocity model to use in calculating the traveltime from an earthquake to a given station is based on the location of the earthquake. Table 3 summarizes the assignment of starting depth, velocity model, and station delay models. Work continues on improving our modeling of the first-order velocity features of southern Alaska.

TRAVELTIME DELAY MODELS AND TRIAL FOCAL DEPTHS

Corrections for P-phase and S-phase traveltime delays are applied at stations in the network that have consistently large residuals for most earthquakes (Table 4). The particular correction that is used to locate an earthquake is determined by the region in which the earthquake occurs (see Table 3).

Additional corrections are applied at several stations to correct for telemetry delays associated with one or more satellite links (0.27 s transmission delay per link) used in the telephone relay of the signal and are kept updated in the station-history data base.

Because the range of depths of earthquakes in southern Alaska vary from the surface to almost 200 km, hypocenters are computed starting at several trial focal depths to find the best solution. First, fixed-depth solutions are computed at depths $z = 0$ and 75 km, and a free-depth solution starting at $z = 75$ km is determined. If the latter solution has $z < 20$ km and a significantly lower RMS than at $z = 0$, then it is taken as the final solution. If, on the other hand, the $z = 0$ depth has a significantly lower RMS, then a free-depth solution starting at $z = 0$ is used has the final solution. If neither the free-depth solution starting at 75 km nor the fixed-depth solution has significantly lower RMS, then the solution with the lower RMS is considered the best. Alternatively, if the free-depth solution starting at 75 km depth has z greater than or equal 20 km, then a solution with z fixed at 7.5 km is computed. Of the two fixed-depth solutions at 0 and 7.5 km, the one with lower RMS is used as a starting location for a free-depth solution. If the latter solution is within 7.5 km of the free solution that started at 75 km, then the solution with the lower RMS is reported as final. If the solutions are more than 5 km apart, then the one with lower RMS is reported as final. In the Gulf of Alaska where the velocity structure is poorly understood and hypocenters are not well constrained all of the depths are fixed at 10 km (see Table 3 for the border which is used to define the Gulf of Alaska).

Table 2. Alaska Velocity Models

Model 1. Gulf of Alaska

Layer	Depth (km)	P velocity (km/s)
1	0-7	5.0
2	7-12.5	6.8
3	below 12.5	8.1

Model 2. Southern Alaska

Layer	Depth (km)	P velocity (km/s)
1	0-4	5.3
2	4-10	5.6
3	10-15	6.2
4	15-20	6.9
5	20-25	7.4
6	25-33	7.7
7	33-47	7.9
8	47-65	8.1
9	below 65	8.3

Model 3. Northern Alaska

Layer	Depth (km)	P velocity (km/s)
1	0-24.4	5.90
2	24.4-40.2	7.40
3	40.2-76	7.90
4	76-301	8.29
5	301-545	10.40
6	below 545	12.60

Table 3. Geographical boundaries used to assign starting depth, velocity model, and delay models.

Earthquake Location	Trial Depth (km)	Velocity Model	Delay Model
Gulf of Alaska*	10.	1	2
Southern Alaska (South of 62.5°N)	0., 7.5, 75.	2	1
Northern Alaska (North of 62.5°N)	0., 7.5, 75.	3	1

*(south of a line connecting 56°N, 154°W; 59.5°N, 146°W; 59.7°N, 143°W, 58.2°N, 139°W, 57.9°N, 137.3°W; 56°N, 135°W).

Table 4. P-phase and S-phase traveltime delays

Station	Model 1		Model 2	
	P delay (sec)	S delay (sec)	P delay (sec)	S delay (sec)
HTP	01.10	00.00	00.00	00.00
ILI	00.44	00.78	01.11	01.98
ILM	00.44	00.78	00.44	0.783
ILN	00.44	00.78	00.44	0.783
NIN	01.47	02.59	00.67	01.19
NKA	02.16	03.82	01.45	02.58
NNL	01.47	02.59	00.75	01.34
PWA	00.70	01.25	00.41	0.730
RDT	00.36	00.64	-0.74	-1.32
SKL	00.10	00.18	00.10	0.178
SLK	00.10	00.18	-0.23	-0.41
SPU	00.39	00.69	00.39	0.694
SSN	00.67	01.19	00.30	0.534
SST	00.67	01.19	00.67	01.19
RDTE	00.36	00.64	-0.74	-1.32
RDTN	00.36	00.64	-0.74	-1.32
RDTZ	00.36	00.64	-0.74	-1.32

MAGNITUDE

Magnitudes are determined from either the coda duration or the maximum trace amplitude. Eaton and others (1970) approximated the local Richter magnitude, the definition of which is tried to maximum trace amplitudes recorded on standard Wood-Anderson horizontal torsion seismographs, by magnitude based on maximum trace amplitudes recorded on high-gain, high-frequency vertical seismographs, such as those operated in the Alaskan network. The amplitude magnitude, XMAG or M_X, used in this catalog is based on the work of Eaton and his co-workers and is given by the expression (Lee and Lahr, 1972):

$$XMAG = \log_{10} A - B_1 + B_2 \log_{10} D^2 \qquad (1)$$

where A is the equivalent maximum trace amplitude in millimeters on a standard Wood-Anderson seismograph, D is the hypocentral distance in kilometers, and B_1 and B_2 are constants. Differences in the frequency response of the two seismograph systems are accounted for in A. It is assumed, however, that there is no systematic difference between the maximum horizontal ground motion and the maximum vertical motion. The term $-B_1 + B_2 \log_{10} D^2$ approximates Richter's $-\log_{10}A_0$ attenuation function (Richter, 1958, p. 342), where A_0 is the trace amplitude for an earthquake of magnitude zero as a function of epicentral distance as observed for earthquakes in southern California. The constants used are $B_1 = 0.15$ and $B_2 = 0.08$ for D= 1-200 km, and $B_1 = 3.38$ and $B_2 = 1.50$ for D = 200-600 km. These constants have not been calibrated for southern coastal Alaska.

Coda durations are also used for determining magnitude because the maximum trace amplitude is often off scale due to the limited dynamic range of the film recording. For small, shallow earthquakes in central California, Lee and others (1972) express the duration magnitude, FMAG or M_D at a given station by the relation:

$$FMAG = -0.87 + 2.00 \log_{10} T + 0.0035\, d \qquad (2)$$

where T is the signal duration in seconds from the P-wave onset to the point on the Develocorder film where the peak-to-peak trace amplitude of the coda envelope measured on a film viewer with 20X magnification falls below 1 cm, and d is the epicentral distance in kilometers.

Comparison of XMAG and FMAG estimates from equations (1) and (2) for 77 southern Alaskan shocks in the depth range 0 to 150 km and in the magnitude range 1.5 to 3.5 reveals a systematic linear decrease of FMAG relative to XMAG with increasing focal depth. However, no systematic dependence of T on D has been found. The following equation, including a linear depth-dependence term but not a distance term, is therefore used for Alaska:

$$FMAG = -1.15 + 2.00 \log_{10} T + 0.007\, Z \qquad (3)$$

where Z is the focal depth in kilometers.

The coda duration magnitudes calculated from the network data are systematically less than the magnitudes reported in the Earthquake Data File (EDF) of NOAA (Lahr and Stephens, 1983). Based on a preliminary analysis (John Lahr, unpublished data), the empirical relationship between body-wave magnitude m_b and duration magnitude, M_D is:

$$m_b = 1.4\ M_D - 0.39 \qquad (4)$$

The magnitude preferentially assigned to each earthquake in this catalog is the mean of the XMAG (equation 1) estimates obtained for USGS stations. When no XMAG can be determined, the mean of the FMAG (equation 3) estimates for USGS stations is reported. For some earthquakes no XMAG or FMAG estimates are available and a magnitude calculated by another organization is used when available.

ANALYSIS OF HYPOCENTRAL QUALITY

Two types of errors enter into the determination of hypocenters: systematic errors limiting the accuracy and random errors limiting the precision. Systematic errors result mainly from incorrect modeling of the seismic velocity structure in the earth and from incorrect phase identification. Random errors arise primarily from timing errors; their effect on the solution for each earthquake can be estimated through the use of standard statistical techniques.

The HYPOELLIPSE computer program determines hypocenters by minimizing differences between observed and computed traveltimes through an iterative least-squares process. For each earthquake, HYPOELLIPSE calculates the lengths and orientations of the principal axes of the joint confidence ellipsoid. The one-standard-deviation confidence ellipsoid describes the region of space within which one is 68 percent confident that the hypocenter lies, assuming that the only source of error is random reading errors. The confidence ellipsoid is a function of the geometry of the stations recording a particular event, the velocity model assumed, and the standard error of the arrival times; it is a measure of the precision of the hypocentral solution (see descriptions of SEH and SEZ in Appendix A). Repeated readings of the same phases by four seismologists have established that the standard deviation is as small as 0.01 to 0.02 s for the most impulsive arrivals and as large as 0.10 to 0.20s for emergent arrivals. The confidence ellipsoids are computed for a standard deviation of 0.1 s and therefore likely overestimate the 68 percent confidence regions. The standard deviation of the residuals for an individual solution is not used to calculate the confidence ellipsoid because it contains information not only about random reading errors but also about the incompatibility of the velocity model to the data.

In a few extreme cases the value calculated for one of the ellipsoid axes becomes very large corresponding to a spatial direction with very great uncertainty. In these cases an upperbound length of 50 km is tabulated. In most hypocentral solutions, the epicentral precision (SEH) is better determined than the focal depth precision (SEZ) so that SEH is generally smaller than SEZ.

To fully evaluate the quality of a hypocenter one must consider both the size and orientation of the confidence ellipsoid and the root-mean-square (RMS) residual (see description of RMS in

Appendix A). In addition to reflecting random errors, the RMS residual can be large due to the misfit of the velocity model to the actual velocities within the earth, misinterpretation of phases, and systematic timing errors. In areas where the velocity structure is accurately known, a large RMS residual would probably indicate errors in the phase data. If the assumed velocity model does not represent the true seismic velocity structure within the earth, the RMS residuals could be large and reflect the incompatibility; alternatively, the RMS residuals could be small and not indicate the actual error in a mislocated hypocenter.

Other parameters provided by HYPOELLIPSE that are helpful in evaluating the quality of a hypocentral solution are: 1) GAP, the largest azimuthal separation between stations measured in degrees at the epicenter. If GAP exceeds 180°, the earthquake lies outside the network of stations used to locate the shock, and the solution is generally less reliable than that for an event occurring inside the network. 2) D1, the epicentral distance in kilometers of the closest station used in the solution. Solutions where the calculated depth is greater than D1 generally have smaller SEZ values (better depth precision) than events that have calculated depths less than the epicentral distance to the closest station. 3) NP and NS, the number of P- and S-arrivals, respectively, used in the solution. The accuracy of the solutions generally improves with an increase in the number of P- and S-arrivals. The RMS residual may actually increase, however, if distant stations are included in locating an event, because the differences between the observed and calculated traveltimes commonly increase with increasing epicentral distance due to the errors in the assumed velocity model.

HYPOCENTER PRECISION

The precision of the hypocenters, or the relative location accuracy of neighboring events, is represented by the confidence ellipsoids. The precision of epicenters, expressed in terms of the maximum semi-axis of the projected one-standard-deviation confidence ellipsoid (SEH), averages 4.4, 1.7, and 1.9 km, respectively, in the eastern (east of longitude 145°W.), central (between longitudes 145° and 150°W.) and western (west of longitude 150°W.) parts of the network. Similarly, the precision of focal depth (SEZ) averages about 4.7, 3.0 and 3.3 km, respectively. The variation in the precision of hypocenter determination across the network is strongly influenced by differences in the station density in the different regions. Hypocenter biases equal to and larger than the dimensions of the confidence ellipsoids are not unlikely as a consequence of the over-simplified velocity models assumed in the preparation of this catalog.

FOCAL DEPTHS

Previous studies (e.g., Francis and others, 1978; Lilwall and Francis, 1978; Uhrhammer, 1980; and McLaren and Frohlich, 1985) have shown that the accuracy of focal depths for shocks occurring in the vicinity of a seismic network is primarily a function of the geometry of the network, the number of P- and S-phase arrivals read, and the adequacy of the assumed velocity model. Depths are generally more accurate for earthquakes where the distance from the epicenter to the closest station (D1) is less than the calculated focal depth used for events located within the network or on its periphery. The accuracy of focal depths usually increases as the number of S-phase arrivals increases; however, systematic S-phase timing errors (due to mistaken identification of a converted phase as S) or "bad" S picks can degrade focal depth estimation accuracy by several kilometers even when azimuthal coverage is good (Gomberg and others, 1990). Focal depths for shallow (depth less than about 20-30 km) shocks within the southern Alaska network generally are not well constrained due to the relatively large distances between stations and to a lack of knowledge about the velocity structure. Calculated depths for the same event can vary by several kilometers depending on the number of P- and S-phase arrivals used in the location, the trial focal depth, the velocity model, and the P-phase traveltime corrections used to locate the earthquake. Ambiguity in the calculated depth occasionally arises in cases where the traveltimes to receiving stations are similar for upward-leaving rays from a deep source and for downward-leaving rays from a shallow source; this situation leads to double minima in the variation of RMS residuals with depths and is common for events outside the boundaries of the network.

COMPLETENESS OF CATALOG

The magnitude threshold at which this catalog is complete varies geographically as a function of the density of stations and the criteria for timing earthquakes (see section on Data Processing and Appendix C). This catalog contains a number of time periods for which the seismic data collected by the project have not yet been processed:

November and December 1971
January, November and December 1972
May, June and August 1974
November and December 1975
December 1976
January - September 1977

The most thorough checking has been completed for time periods that have published catalogs (Appendix B) and for data processed since 1981. No attempt was made to assess the completeness for the time periods before 1981 that do not have published catalogs.

SEISMICITY OF SOUTHERN ALASKA

Reviews of the seismicity of the Aleutian arc, continental Alaska, and western Canada have been written by Taber and others (1991), Page and others (1991), and Rogers and Horner (1991), respectively. Meyers (1976) and Espinosa (1984) reviewed teleseismically recorded earthquakes in Alaska. The purpose of this section is to discuss briefly the distribution of the seismicity within southern Alaska for 50,048 earthquakes and other events recorded and located by the USGS seismograph network in southern Alaska for October 1971 to May 1989, and to cite the published literature written by the authors. No attempts were made to remove quarry and mine blasts or glacial earthquakes from the data set. The gross features of the pattern of seismicity in southern Alaska are shown in Figures 5-9.

The oceanic Pacific plate is being subducted beneath the continental North American plate (Alaska) along the Aleutian megathrust, which crops out on the seafloor at the Aleutian trench

(Figure 1). The seismicity related to various tectonic elements can be divided into five distinct source zones as follows: 1) Aleutian megathrust earthquakes along the interface between the subducting Pacific plate and the overriding North American plate; 2) subsea earthquakes within the Pacific plate beneath or seaward of the trench; 3) Wadati-Benioff Zone (WBZ) earthquakes within the subducted part of the Pacific plate landward of the trench; 4) overriding plate earthquakes in the North American plate exclusive of those along the volcanic arc; and 5) volcanic axis earthquakes within the North American plate along the axis of active volcanoes.

Aleutian megathrust earthquakes

Historically, most of the seismic energy in southern Alaska is released in major earthquakes that rupture the shallow part of the dipping thrust between the subducting and overriding plates. In September 1899 a pair of moment magnitude (M_W) 8.1 shocks ruptured the transitional segment between Yakutat Bay and Kayak Island (McCann and others, 1980). In 1964 the convergent plate boundary west of Kayak Island slipped approximately 15 m in a M_W 9.2 earthquake (Plafker, 1969; Hastie and Savage, 1970), the second largest earthquake of this century worldwide. Beneath a certain depth, estimated to be about 40 km in the Aleutian arc (Davies and House, 1979) and about 20 km in the northern Prince William Sound region (Page and others, 1989), the interface slips aseismically.

The coastal region from about Kayak Island to Yakutat Bay had been identified by the early 1970's as a seismic gap due to the lack of significant shocks since the turn of the century (Tobin and Sykes, 1968; Kelleher, 1970; Sykes, 1971). In 1979, the M_S 7.1 St. Elias earthquake (Figure 5) occurred at the eastern end of this gap and involved low-angle, north-northwest-directed thrusting (Hasegawa and others, 1980) at depths between 10-15 km (Stephens and others, 1980) in a zone that at least locally is no more than 2-3 km thick (Page and others, 1984). The Yakataga seismic gap, which extends westward from the western limit of the St. Elias aftershock zone to the eastern extent of the 1964 rupture, is considered a likely site for a great (M_S 7.8 or greater) thrust earthquake within the next few decades (McCann and others, 1980; Lahr and others, 1980; Jacob, 1984; Stephens and others, 1992).

Seismicity of the gap region has been monitored nearly continuously since 1974 when the network was extended across this region (see Appendix C). East of longitude 145°W, the apparent high rate of shallow activity is due at least in part to a lower magnitude threshold used in selecting events for processing. During this period the spatial distribution of seismicity landward of the continental margin has remained relatively stable and is characterized by broad concentrations of shallow seismicity (depths less than 30 km) beneath Icy Bay, Waxell Ridge, and the Copper River delta separated by areas of relative quiescence with most of the shocks occurring in a zone that extends about 90 km inland from the coast (Figure 7 and Figure 9, section D). The most active area has been the aftershock zone of the St. Elias earthquake, both prior to and since the mainshock. Hypocenters of better-recorded shocks from the diffuse patch of seismicity near Waxell Ridge at the center of the gap concentrate near a depth of 12 km (Stephens and others, 1992), which is comparable to the depth to the thrust plane defined by seismicity beneath the St. Elias area. The Copper River Delta seismicity on the western edge of the gap is discussed in the section on Wadati-

Benioff zone earthquakes. The largest earthquake located within the gap since 1971 is a M_X 4.1 shock on December 1980 near the southwest corner of the Waxell Ridge concentration of seismicity.

Subsea earthquakes

There is very little historical evidence of seismicity in the Gulf of Alaska seaward of the continental margin. However, in November 1987 and March 1988, two M_S 7.6 strike-slip earthquakes in the northern Gulf of Alaska ruptured a composite 250-km-long, north-striking zone in the Pacific plate (Figures 5 and 7) south of the Yakataga seismic gap (Lahr and others, 1988a). These events are thought to reflect shear stress in the Pacific plate seaward of the boundary between the locked Yakataga seismic gap and the recently slipped 1964 rupture.

Wadati-Benioff zone earthquakes

Wadati-Benioff seismic zones are associated with both the northeast-to-north-trending Aleutian volcanic arc west of Cook Inlet and the east-southeast-trending Wrangell volcanic arc east of longitude 145°E. Below 30 km depth the distribution of earthquakes is dominated by activity within the Aleutian Benioff zone west and north of the Cook Inlet region (Figures 5 and 6, and Figure 9, sections C-E). This zone dips west-northwestward from 8-10° beneath the Kenai Peninsula and Anchorage, and then steepens to about 65° west of Cook Inlet, although the latter dip may be overestimated by abut 10-15° due to the systematic bias introduced by using a flat-layered velocity model. Beneath both the southern Kenai Peninsula and Anchorage the upper surface of this zone is at a depth of 30 to 35 km, and beneath the volcanic arc west of Cook Inlet it is at a depth of about 100 km. The average dip of the shallow (depth $<$ 30 km) part of the zone decreases from about 7° beneath Prince William Sound (Page and others, 1991) to about 3-4° beneath the continental margin. On a regional scale using only events with well-constrained focal depths, the maximum thickness of the Aleutian WBZ is about 15 km. The zone appears to thicken slightly beneath the southern Kenai Peninsula and Anchorage. The maximum focal depths varies along the length of the zone from about 200 km near Iliamna (Figure 9, section E) to about 160 km beneath the northernmost Cook Inlet Volcano (Figure 9, section D) and to about 150 km beneath the Alaska Range (Figure 9, section C). Beneath continental Alaska, the Aleutian WBZ is made up of a single zone of earthquakes, in contrast to the two zones of seismicity beneath the eastern Aleutian arc near the Shumagin Islands (Taber and others, 1991). The geometry of the Aleutian WBZ changes along strike as documented in studies of both teleseismically and regionally recorded earthquakes (Van Wormer and others, 1974; Lahr, 1975; Davies, 1975; Agnew, 1980; Pulpan and Frohlich, 1985). In lower Cook Inlet near latitude 59°N, the strike of the deep WBZ rotates 15° counterclockwise (Pulpan and Frohlich, 1985), and about 350 km farther north the strike swings about 35° clockwise (Agnew, 1980). The deeper seismicity east of the Cook Inlet region appears to be bounded by a northwest-southeast trending line, which passes about 50 km northeast of Valdez (Figure 6). Such a line approximately delineates the northeastern terminus of the Aleutian Benioff zone (Stephens and others, 1984a). The diffuse appearance of the Aleutian Benioff zone in Figure 9, section C, may be attributed in part to a lack of focal depth control for earthquakes north of the USGS network (north of 62°N).

The magnitude of the largest shocks recorded by the network within the southern Alaska segment of the Aleutian WBZ since 1971 have been in the magnitude 6 class (Figure 5). In July and September of 1983 the two M_S 6.3 (m_b 6.2) Columbia Bay shocks occurred in the shallow part of the WBZ beneath the north coast of Prince William Sound and involved normal faulting on steeply northwestward-dipping planes between depths of 22-35 km (Page and others, 1985, 1989). A M_X 6.1 (m_b 5.5) earthquake occurred beneath Mt. Spurr in November 1988 with a calculated depth of 138 km. The focal mechanism for this event using local network data exhibits down-dip tension and along strike compression which is typical for the deep WBZ zone activity in the Cook Inlet region (Lahr, 1975; Engle, K. Y., 1982; Pulpan and Frohlich, 1985).

The rate and character of seismicity between the shallow and deep parts of the Aleutian WBZ are significantly different, with the higher level of activity in the deep part of the zone beneath the western Kenai Peninsula, Cook Inlet, and the volcanic arc. Since 1971 the distribution of seismicity generally has not been uniform and has a significant component of spatial and temporal clustering. Clustering is more common in the shallow WBZ with mainshocks followed by energetic aftershock sequences such as the aftershock sequences following the two 1983 Columbia Bay earthquakes. In contrast, few, if any, aftershocks have been recorded following WBZ shocks in the deep part. Three persistent, diffuse concentration of events not associated with an aftershock sequence are located about 40 km northeast, 150 km southeast, and 75 km southwest of the Columbia Bay shocks beneath the Tazlina Glacier (latitude 61°N30'N, longitude 146°35'W), the Copper River Delta, and the northern end Knight Island, respectively. The Tazlina Glacier cluster is a north-northeast-trending swath of seismicity with depths between 25-45 km (Page and others, 1989). Preliminary relocations of well-recorded earthquakes in the persistent, low-magnitude seismicity beneath the Copper River Delta at the western edge of the gap occur at depths between 20-30 km and appear to occur below the megathrust based on one teleseismically recorded thrust event that occurred in 1970 with a depth of about 21 km (Stephens and others, 1992). The northern Knight Island source area was the focus of a special field recording effort in 1987 in which eight stations were operated for one month. Relocated hypocenters from that effort define a subhorizontal tabular zone, which is 6 km thick and whose upper surface is about 18 km deep (Lahr and others, 1988b). Spacial clustering in the deep WBZ is conspicuous (Figures 5 and 6) with concentrations of events deeper than 110 km beneath Mts. Iliamna and McKinley and northwest of Anchorage, while other parts are relatively quiet, such as in the vicinity of the two points 60.8°N, 152.5°W and 62.5°N, 150.2°W.

East of the Aleutian zone lies the weakly active Wrangell WBZ, which dips to the north-northeast beneath the Wrangell volcanoes (Stephens and others, 1984a; Page and others, 1989). This zone extends at least 150 km along strike and to depths of at least 100 km (Figure 6 and Figure 9, sections A and B). The Wrangell WBZ is about two orders of magnitude less active than the Aleutian zone. The largest earthquakes located in this zone by the network are a 4.5 m_b (M_X 3.7) event in September 1986 at a depth of 48 km and a M_X 3.7 shock in February 1989 at a depth of 55 km. The deepest well constrained shock is a M_D 2.4 shock in September 1986 at 97 km depth beneath Mt. Wrangell. The seismicity in the Aleutian and Wrangell zones appears to be continuous, at least in the depth range 20-45 km, and may define adjacent limbs of a buckle in the subducted plate (Page and others, 1989).

Overriding plate earthquakes

Generally the distribution of shallow seismicity within the North American plate away from the volcanic axis since 1971 has been diffuse (Figure 7), and the majority of the events cannot be clearly associated with mapped fault traces. In a few cases, including the Talkeetna segment of the Castle Mountain fault, the Duke River fault near longitude 141°W, and the northernmost segment of the Fairweather fault, earthquakes are closely associated with mapped faults. The diffuse character of the seismicity north of latitude 62.5°N, south of latitude 59.5°N and east of longitude 138°W is at least partially attributed to these areas being outside the USGS seismograph network. The shallow seismicity does has three conspicuous concentrations: 1) a narrow zone parallel to the Duke River fault on the U.S-Canada border, 2) a diffuse north-northeast-trending band of seismicity near longitude 150°W extending between the Denali fault and Cook Inlet whose focal depths lie well above the Aleutian WBZ (Figure 9, section D), and 3) a band north of and parallel to the Castle Mountain fault east of longitude 151°W. To some degree, the apparent scatter of the seismicity near the Duke River fault reflects errors in the epicenters due to uncertainties in the velocity structure and the lack of nearby seismograph stations. Recent shocks located from both regional (Horner, 1983) and local (Power, 1988b) recordings reveal that the seismicity is mostly concentrated in the vicinity of the Duke River fault.

Since 1971 the largest shallow shocks in the overriding plate have been in the magnitude 5 class (Figure 5). The August 1984 m_b 5.7 Sutton earthquake ruptured a 10-km-long buried segment of the Castle Mountain fault and involved right-lateral slip on a steeply north-dipping plane (Lahr and others, 1986). This is the largest shock to be clearly associated with a mapped fault since the network was established. Two earthquakes, with magnitudes M_X 5.3 (m_b 5.3) and M_X 5.0 (m_b 4.9), occurred 3 days apart about 75 km northwest of Juneau and a few km east of the mapped trace of the Chatham Strait fault. A m_b 5.7 (M_X 5.6) shock occurred in November 1987 on the Duke River fault. The M_X 5.6 (m_b 4.7) shock of March 1989 was located 150 km west of Juneau near the entrance to Cross Sound is about 10 km west of the mapped trace of the Fairweather fault.

Earthquakes with reported depths of 30 km and deeper (Figure 6) east of longitude 145°W (excluding shocks beneath or more than 100 km southwest of the Wrangell Volcanoes), west and north of the Aleutian WBZ generally have poorly constrained focal depths and are probably in the overriding plate.

Volcanic axis earthquakes

Small, shallow earthquakes are abundant along both the Aleutian (Kienle and others, 1983; Stephens and others, 1984b) and Wrangell (Page and others, 1989) volcanic axes. The shocks recorded by the network west of Cook Inlet form a diffuse band, approximately 30 km wide, punctuated by pronounced clusters (Figure 7 and Figure 9, sections D and E). The volcanoes are marked by dense clusters of earthquakes shallower than 5 km, whereas elsewhere along the Aleutian axis shocks fall in the depth range 5 to 20 km (Stephens and others, 1984b).

Both the 1976 and 1986 eruptions of Augustine Volcano in lower Cook Inlet were preceded and accompanied by large numbers of small earthquakes (Lalla and Kienle, 1986; Reeder and Lahr, 1987; Power, 1988). Although the earthquakes associated with these eruptions were too small to be located by the USGS network (and do not appear in the epicenter or cross section plots), the USGS stations were used to monitor activity during the 1986 eruption after all of the stations on the island had failed, possibly due to mudslides (Reeder and Lahr, 1987).

AVAILABILITY OF DATA

The summary and phase data for the 50,048 earthquakes and other events located by the USGS southern Alaska seismograph network and also the location program and control files used to locate all of the events are available on CD-ROM (Fogleman and others, 1993). Appendix B lists previously published catalogs available from the USGS, ESIC, Open-File Report Sales, Box 25286, Federal Center, Denver, CO 80225 (telephone: 303-236-7476). Information about the availability of this and other preliminary data can be obtained by contacting the principal investigators.

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APPENDIX A

Magnitude 4 and Larger Earthquakes for October 1971 through May 1989

Earthquakes from southern Alaska are listed in chronological order. The following data are given for each event:

1. Origin time in Universal Time (UT): date, hour (HR), minute (MN), and second (SEC). To convert to Alaska Standard Time (AST) or Alaska Daylight Time (ADT) subtract 9 or 8 hours, respectively.
2. North latitude (lat n) and west longitude (lon w) in degrees (deg) and minutes (min).
3. DEPTH, depth of focus in kilometers. A "*" after the depth indicates the depth was fixed.
4. MAG, magnitude of the earthquake. The magnitude preferentially assigned to each earthquake in this catalog is the mean of the XMAG (M_X) estimates obtained for USGS stations. When no XMAG can be determined, the mean of the FMAG (M_D) estimates for USGS stations is reported. For some earthquakes no XMAG or FMAG estimates are available and a magnitude calculated by another organization is used when available. A letter following the magnitude indicates the type as follows:
   X - Amplitude magnitude (XMAG), USGS.
   F - Coda duration magnitude (FMAG), USGS.
   B - Body-wave magnitude (m_b), USGS National Earthquake Information Service (NEIS).
   S - Surface-wave magnitude (M_S), NEIS.
   O - Estimated magnitude, USGS.
5. NP, number of P arrivals used in locating earthquake.
6. NS, number of S arrivals used in locating earthquake.
7. GAP, largest azimuthal separarion in degrees between stations.
8. D1, epicentral distance in kilometers to the station closest to the epicenter.
9. RMS, root-mean-square traveltime residual in seconds:

$$RMS = \left[\frac{\sum_1^N W_i R_i^2}{\sum_1^N W_i}\right]^{\frac{1}{2}}$$

   where R_i is the observed minus computed arrival time of the i^{th} arrival and W_i is the corresponding weight of the P, S, or S-P reading used in the solution.
10. SEH, standard error in horizontal direction with least control in kilometers. SEH = MAXH/1.87, where MAXH is the largest horizontal deviation in kilometers of the one-standard-deviation confidence ellipsoid (see Figure 10). In previous catalogs MAXH was referred to as ERH. Values of SEH that exceed 50 km are tabulated as 50.0 km.

11. SEZ, standard error of depth inkilometers. SEZ = MAXZ/1.87 where MAXZ is the largest vertical deviation in kilometers of the one-standard-deviation confidence ellipsoid (see Figure 10). In previous catalogs MAXZ was referred to as ERZ. Values of SEZ that exceed 50 km are tabulated as 50.0 km.

12. Q, quality of the hypocenter. This index is a measure of the precision of the hypocenter (see section Analysis of Hypocentral Quality) and is calculated from SEH and SEZ as follows:

Q	Larger of SEH and SEZ (km)
A	≤ 1.34
B	≤ 2.67
C	≤ 5.35
D	> 5.35

13. AZ1, DIP1, and SE1 are the azimuth in degrees (clockwise from north), dip in degrees, and length in kilometers of the most nearly horizontal of the three principal semi-axes of the one-standard-deviation error ellipsoid.

14. AZ2, DIP2, and SE2 are defined as above, but correspond to the principal semi-axis of intermediate dip.

15. AZ3, DIP3, and SE3 are defined as above, but correspond to the most nearly vertical principal semi-axis. Values that exceed 99.00 km are tabulated as 99.0 km.

PRELIMINARY DETERMINATION OF HYPOCENTERS IN SOUTHERN ALASKA - OCTOBER 1971 TO MAY 1989

	origin time			lat n		long w		depth	mag	np	ns	gap	d1	rms	seh	sez	q	az1	dip1	se1	az2	dip2	se2	az3	dip3	se3
date	hr	mn	sec	deg	min	deg	min	km				deg	km	sec	km	km		deg	deg	km	deg	deg	km	deg	deg	km
71/10/29	13	16	36.8	60	8.7	153	11.5	173.6	4.8F	15	2	187	21	0.99	0.9	1.4	B	30	2	1.0	120	17	1.5	293	73	2.7
72/03/28	19	38	37.8	59	38.0	153	8.4	110.2	4.3P	15	0	207	64	0.29	1.3	1.5	B	7	0	1.0	98	38	1.8	277	52	3.4
72/03/29	21	0	46.1	59	49.4	153	2.8	120.8	5.1B	15	2	178	62	0.38	1.4	1.1	B	28	24	0.7	280	35	2.9	145	45	1.7
72/03/30	16	8	49.5	63	11.6	149	1.0	64.6	4.1X	13	0	114	162	0.57	0.7	1.5	B	202	1	0.6	293	19	1.0	109	71	2.9
72/04/02	13	8	19.6	59	53.9	153	18.9	129.7	4.6F	16	0	162	42	0.33	0.8	1.1	A	94	4	1.5	3	5	1.1	222	84	2.2
72/04/07	3	16	24.8	59	58.0	152	24.5	98.8	4.6F	15	1	174	49	0.48	0.9	1.2	A	20	1	0.8	110	25	1.4	288	65	2.4
72/04/20	17	27	15.4	59	49.4	153	27.7	147.2	4.3F	16	2	156	51	0.39	0.8	0.8	A	10	20	0.6	118	42	1.4	261	42	1.7
72/05/07	9	15	14.2	61	9.3	152	2.6	100.8	4.1F	16	1	148	3	0.30	0.7	1.2	A	45	6	0.7	315	8	1.3	161	81	2.3
72/06/10	22	50	38.2	59	56.0	152	39.3	100.8	4.0F	15	2	129	29	0.37	1.7	1.6	B	32	18	0.6	139	42	1.5	285	43	4.2
72/06/14	0	52	35.3	60	17.8	152	59.0	168.5	5.0F	17	1	79	16	0.54	0.9	1.1	A	226	7	0.8	320	28	1.4	123	61	2.3
72/07/18	9	35	15.2	59	32.2	154	6.6	188.4	4.6F	11	2	237	41	0.25	3.4	3.1	C	7	1	1.5	276	41	7.6	98	49	4.1
72/08/17	13	48	3.5	59	14.1	152	43.0	86.6	4.1F	9	1	117	41	1.97	1.3	2.4	B	15	8	1.0	108	24	1.3	268	65	5.0
72/10/01	10	8	51.3	62	34.1	149	2.0	90.1	5.1F	15	0	224	109	0.29	1.7	3.8	C	84	5	1.1	354	8	3.1	206	81	7.1
72/10/03	7	30	18.2	56	21.8	150	13.1	10.0*	4.4X	5	0	328	462	1.01	50.0	50.0	D	271	0	21.4	1	0	99.0	0	90	99.0
72/10/21	19	52	6.0	63	2.4	150	53.3	129.4	4.6F	16	0	202	123	0.25	2.5	4.2	C	98	5	1.8	6	21	3.9	201	68	8.4
73/03/05	8	30	49.6	63	43.6	148	25.4	107.2	4.0B	15	1	284	214	0.46	4.8	6.6	D	270	0	1.6	180	14	8.7	0	76	12.6
73/05/18	18	32	57.2	62	59.5	150	52.0	127.3	4.1F	16	0	273	118	0.18	4.0	4.9	C	78	12	2.0	175	30	6.1	329	57	10.2
73/05/26	23	4	38.0	59	56.3	153	43.5	155.3	4.3F	15	0	163	28	0.32	1.7	3.4	C	100	11	1.2	6	21	1.8	216	66	6.9
73/08/22	18	14	36.6	56	55.2	153	44.0	24.8	4.3F	12	1	283	185	0.26	7.1	22.4	D	93	5	2.1	184	9	11.5	334	80	42.5
73/08/31	2	30	57.0	61	3.6	147	8.4	11.3	4.2F	15	0	62	19	0.33	0.5	0.8	A	24	12	0.7	289	22	0.5	141	65	1.6
73/09/06	10	59	37.1	60	58.8	146	44.2	14.9	4.4F	15	0	65	13	0.38	0.5	0.4	A	251	13	0.6	152	36	0.9	358	51	0.7
73/09/10	6	53	36.0	56	57.9	153	50.7	65.5	4.0F	15	0	295	177	0.37	17.3	47.1	D	88	4	2.2	357	18	14.7	190	72	92.8
73/09/28	14	2	25.1	60	38.7	153	9.8	166.6	4.2F	16	0	95	42	0.21	0.9	2.9	C	54	5	1.3	144	5	1.6	279	83	5.5
73/10/27	7	5	46.9	72	20.8	159	55.4	0.0	4.0F	12	0	343	999	2.21	50.0	50.0	D	247	0	51.0	337	0	99.0	0	90	99.0
73/11/11	16	44	56.7	59	57.8	153	31.5	147.8	4.4F	15	0	95	40	0.18	0.8	1.8	B	57	5	1.0	148	5	1.5	283	83	3.6
73/12/13	7	56	43.1	61	39.4	153	21.8	250.0	4.3F	13	0	240	73	0.66	11.8	23.7	D	76	7	2.4	169	25	5.0	331	64	49.3
73/12/31	17	4	51.6	58	35.2	155	50.5	147.8	4.0F	10	1	240	40	0.11	6.2	4.0	D	272	13	11.8	8	25	1.8	157	61	7.9
74/01/07	8	27	5.2	59	38.9	153	37.2	123.6	4.5F	16	0	64	49	0.27	0.7	2.1	B	50	5	0.9	141	6	1.3	281	82	4.0
74/01/22	10	43	6.0	60	6.7	153	18.0	151.5	4.4F	16	0	86	71	0.19	0.8	3.1	C	276	0	1.2	6	2	1.4	186	88	5.7
74/01/22	11	13	47.3	61	53.0	152	5.0	117.2	4.0F	17	1	78	31	0.28	0.7	1.6	B	24	8	1.2	293	9	1.0	155	78	3.0
74/01/24	18	43	27.4	61	31.4	147	26.2	20.0	4.2F	15	0	65	35	0.36	0.5	1.3	A	288	0	0.5	198	14	0.7	18	76	2.5
74/02/02	15	55	29.0	61	29.9	147	25.6	19.8	4.3F	15	0	62	38	0.33	0.5	1.4	B	287	0	0.5	197	13	0.7	17	77	2.7
74/02/04	14	6	52.2	59	58.6	152	55.4	109.5	4.0F	16	0	118	72	0.18	0.7	2.3	B	269	1	1.0	359	5	1.3	168	85	4.4
74/02/05	2	29	23.0	62	37.8	148	50.2	76.1	4.4F	17	0	130	95	0.33	0.8	2.4	B	53	2	1.0	323	11	1.3	153	79	4.6
74/02/10	22	5	47.4	58	59.4	152	24.4	62.4	4.0F	16	1	130	71	0.33	0.6	1.8	B	33	1	0.9	303	7	1.1	131	83	3.4
74/02/11	0	7	39.2	59	39.7	152	16.8	59.1	4.3X	15	2	143	45	0.32	0.9	2.0	B	264	6	0.9	356	17	1.3	150	71	3.9
74/02/15	6	6	29.5	63	6.4	150	40.8	118.8	4.3F	18	1	78	167	0.18	1.8	7.9	D	62	5	3.0	331	7	1.2	187	81	15.0
74/03/06	15	15	47.1	59	50.2	153	55.6	161.3	4.1F	15	1	76	22	0.17	1.1	3.5	C	336	2	1.8	66	13	1.4	237	77	6.8
74/03/10	10	0	15.1	63	8.8	150	32.6	113.5	4.2F	19	1	81	170	0.18	1.9	9.4	D	62	5	3.1	332	7	1.2	187	81	17.9
74/04/06	3	56	25.1	55	52.2	158	16.9	76.6	4.8F	17	0	323	325	0.27	28.8	27.4	D	310	0	4.4	41	34	56.0	220	56	49.0
74/04/06	5	12	23.0	57	16.2	153	43.4	69.5	4.0F	16	0	267	91	0.39	9.8	8.8	D	279	8	1.4	182	42	24.4	18	47	3.0
74/09/08	5	27	32.6	58	16.1	155	12.7	346.4	4.1X	8	0	195	12	1.62	4.6	10.4	D	104	14	3.3	10	18	2.1	230	67	21.2
74/09/24	15	39	22.8	59	42.0	153	21.2	128.4	4.4X	14	2	83	57	0.27	1.0	2.0	B	47	2	1.1	138	17	1.6	310	73	3.8
74/10/09	7	38	10.0	58	59.4	157	24.0	347.6	6.0F	10	0	294	132	1.11	11.6	16.0	D	29	20	2.6	131	28	3.9	269	54	36.8
74/10/10	19	2	27.7	55	49.3	144	23.9	10.0*	4.5X	15	3	264	418	0.74	27.6	48.1	D	276	0	5.1	6	26	31.4	186	64	99.0
74/11/02	5	6	24.2	70	10.5	156	47.8	75.0	4.0F	15	0	330	883	1.43	50.0	50.0	D	243	0	29.2	333	0	99.0	0	90	99.8
74/11/06	9	23	10.4	60	11.9	153	48.7	206.4	4.2F	15	1	127	55	0.32	1.1	3.0	C	39	2	1.7	129	10	1.8	298	80	5.7
74/11/14	4	48	51.8	58	30.0	154	36.2	12.3	4.4F	15	0	124	49	0.32	1.7	15.5	D	144	1	0.9	54	6	0.8	243	84	29.1
74/11/22	18	4	2.2	60	1.3	153	24.6	150.5	4.6B	17	1	105	38	0.24	0.8	2.6	B	329	2	1.5	59	4	1.2	212	86	4.9
74/12/01	15	56	34.6	62	10.2	150	24.7	38.7	4.0B	17	0	192	64	0.27	1.1	3.3	C	58	1	0.9	328	7	1.9	156	83	6.1

PRELIMINARY DETERMINATION OF HYPOCENTERS IN SOUTHERN ALASKA - OCTOBER 1971 TO MAY 1989

date	origin time hr	mn	sec	lat n deg	min	long w deg	min	depth km	mag	np	ns	gap deg	d1 km	rms sec	seh km	sez km	q	az1 deg	dip1 deg	se1 km	az2 deg	dip2 deg	se2 km	az3 deg	dip3 deg	se3 km
74/12/13	11	47	54.9	61	24.4	146	53.1	34.9	4.0X	8	1	113	26	0.31	1.4	3.2	C	151	3	0.6	243	22	0.9	54	68	6.5
74/12/17	18	40	25.5	63	59.1	144	30.5	47.5	4.5X	3	2	341	430	6.64	50.0	49.4	D	358	22	32.3	99	25	99.0	232	56	99.0
74/12/29	18	25	2.4	61	28.5	150	26.6	48.7	4.5F	17	0	102	16	0.19	0.5	1.1	A	196	8	0.8	104	11	0.8	321	76	2.1
74/12/30	3	33	18.5	61	52.7	149	34.6	50.2	4.2F	15	0	174	30	0.36	0.8	1.3	A	277	3	0.8	187	13	1.4	20	77	2.5
75/01/01	3	55	13.4	61	52.5	149	33.2	50.6	4.7F	14	0	179	30	0.35	0.8	1.4	B	276	5	0.8	185	12	1.4	28	77	2.6
75/01/13	0	31	56.2	61	17.1	150	30.8	50.3	4.0F	16	0	94	22	0.37	0.4	1.0	A	38	1	0.8	128	6	0.8	299	84	1.9
75/02/10	14	3	32.0	60	7.9	153	30.1	154.4	4.0F	15	0	156	39	0.25	1.4	2.7	C	325	4	2.6	55	6	1.3	201	83	5.1
75/03/06	9	2	15.7	58	40.2	155	10.0	160.9	4.4F	17	1	160	40	0.30	4.0	7.2	D	133	16	1.9	36	23	1.4	255	61	15.4
75/03/20	13	31	17.3	63	9.7	150	41.7	128.8	4.0F	15	2	276	139	0.30	4.4	6.9	D	70	3	1.9	161	28	5.3	334	62	14.3
75/04/30	4	29	11.4	60	6.0	153	14.8	137.8	4.2F	15	1	148	26	0.26	1.2	2.6	B	316	3	2.2	46	5	1.2	195	84	4.9
75/05/18	15	43	0.4	62	60.0	150	3.2	109.7	5.0F	15	0	216	125	0.33	1.4	2.4	B	142	1	2.6	232	4	0.9	38	86	4.4
75/05/20	16	29	49.8	62	43.3	150	9.3	175.1	4.0F	14	2	240	109	0.70	3.7	7.0	D	237	1	2.1	147	18	5.7	330	72	13.7
75/05/21	6	34	55.3	60	10.5	147	25.2	33.3	4.2F	16	0	123	101	0.34	8.5	50.0	D	271	0	0.7	1	0	0.9	0	90	99.8
75/05/25	19	4	31.9	57	2.7	149	59.6	10.0*	4.4F	18	0	259	169	0.29	7.4	50.0	D	241	0	1.9	331	0	13.9	0	90	99.8
75/05/31	23	35	20.2	57	59.1	156	11.5	144.4	4.3F	13	1	284	61	0.16	9.8	8.3	D	331	2	2.1	239	40	23.9	63	50	2.7
75/06/01	13	10	57.3	59	38.6	153	53.4	135.3	4.2F	15	2	135	80	0.36	1.1	2.4	B	45	5	1.0	136	14	1.9	296	75	4.7
75/06/24	7	15	5.5	60	15.7	153	42.7	144.5	4.0F	13	4	169	50	1.25	1.3	3.1	C	315	2	2.5	45	4	1.3	198	86	5.8
75/06/24	12	15	30.6	63	2.7	150	55.8	154.2	4.2F	13	1	275	123	0.19	7.7	7.1	D	83	9	2.9	345	42	18.1	183	47	7.6
75/06/29	10	45	28.8	59	9.9	154	30.9	131.6	5.0F	5	0	160	47	0.64	21.4	48.3	D	177	6	1.6	84	23	1.8	281	66	99.0
75/07/29	22	1	55.3	60	10.1	153	22.9	157.3	4.4F	16	1	83	31	0.25	1.0	2.5	B	333	3	1.8	63	4	1.2	206	85	4.7
75/08/21	22	19	22.5	60	18.0	151	7.7	48.9	4.1F	16	0	93	30	0.37	0.5	1.2	A	323	4	0.9	53	6	0.7	199	83	2.2
75/08/22	15	50	16.5	60	7.3	153	24.4	154.8	4.2F	15	1	86	34	0.14	0.9	2.7	C	73	4	1.2	342	5	1.7	201	84	5.2
76/01/26	1	41	36.3	60	7.3	153	11.2	142.5	4.2F	15	1	134	22	0.18	1.0	2.2	B	63	7	1.1	154	7	1.8	289	80	4.2
76/02/05	9	36	37.4	60	2.7	149	9.2	12.0	4.0F	16	1	134	18	0.36	1.0	0.8	A	63	26	0.8	315	33	2.0	183	46	1.5
76/02/19	7	49	31.8	62	20.5	151	21.0	87.3	4.0F	15	1	273	41	0.60	3.0	3.0	C	72	8	1.5	170	44	2.6	334	45	7.6
76/03/14	3	31	48.1	60	0.5	153	20.6	145.6	4.8F	16	0	124	35	0.31	1.0	2.2	B	50	3	1.1	140	14	1.6	308	76	4.2
76/04/10	19	36	33.0	59	10.9	152	26.1	137.1	4.1F	15	1	124	58	1.65	0.8	2.4	B	43	1	1.2	313	1	1.4	178	89	4.4
76/04/18	10	32	48.6	59	46.9	153	19.7	134.3	4.2F	15	4	89	53	0.22	1.3	2.3	B	62	9	1.1	154	14	2.3	300	73	4.5
76/05/03	17	47	30.8	58	52.7	154	41.3	130.3	4.3F	14	1	199	65	0.08	2.8	5.6	D	148	10	1.5	53	23	1.8	260	65	11.6
76/06/17	2	44	56.4	57	2.4	154	19.6	116.7	4.5F	11	0	292	267	0.26	6.3	8.5	D	106	10	2.1	11	25	9.9	216	63	17.3
76/08/22	2	1	46.5	59	59.8	153	6.5	135.1	5.4F	17	0	70	26	0.24	0.9	2.1	B	71	3	1.1	341	5	1.6	192	84	3.9
76/08/30	8	17	52.2	59	51.7	153	14.3	116.4	4.3F	14	1	148	43	0.10	1.2	2.1	B	319	4	1.4	50	13	2.2	212	76	4.0
76/09/04	23	23	47.1	62	52.9	150	40.9	114.3	4.0F	15	0	159	110	0.21	1.9	4.0	C	287	1	1.4	17	18	2.7	194	72	7.9
76/10/18	0	36	32.5	63	8.4	150	33.5	135.7	4.4F	16	0	127	139	0.17	1.8	5.5	D	288	2	1.5	18	12	2.6	189	78	10.6
76/10/22	18	35	31.7	56	18.0	153	9.6	10.0*	4.0F	15	0	304	166	0.45	50.0	50.0	D	270	0	35.9	0	0	99.0	0	90	99.0
76/10/24	17	19	52.9	62	31.8	149	8.7	114.0	4.3F	16	0	149	130	0.19	2.6	4.8	C	21	2	1.6	112	18	4.2	285	72	9.5
76/11/03	16	40	45.2	63	1.9	150	58.4	141.3	4.2F	18	1	127	221	0.15	2.8	4.9	C	357	4	5.3	87	9	2.1	243	80	9.2
76/11/06	0	8	18.9	60	1.3	153	19.3	150.7	4.4F	15	0	125	33	0.24	1.1	2.3	B	152	2	2.0	61	13	1.1	251	77	4.3
77/10/11	16	50	51.9	63	11.3	151	26.0	142.2	4.0F	16	2	89	139	0.42	3.2	10.3	D	222	4	5.4	313	12	3.1	114	77	19.8
77/10/19	2	16	2.9	62	44.0	150	32.3	103.5	4.2F	21	1	76	125	0.12	1.0	4.0	C	259	1	1.8	349	9	1.0	163	81	7.5
77/10/24	7	9	47.6	56	17.3	160	39.0	176.2	4.5F	15	3	309	472	0.48	21.1	23.6	D	145	1	7.4	54	26	38.0	237	64	45.5
77/11/06	19	11	1.5	62	9.8	145	8.9	0.1	4.0X	15	2	139	54	0.54	0.6	1.9	B	166	3	0.7	75	11	0.9	271	79	3.7
77/11/27	15	5	7.7	58	17.2	155	12.0	119.9	4.5F	15	0	246	122	0.21	2.0	2.6	B	325	2	1.4	56	32	3.0	232	58	5.5
77/12/16	21	49	23.4	59	43.3	153	21.1	119.7	4.1F	15	3	65	43	0.24	0.7	1.9	B	320	1	1.4	51	9	0.9	224	61	3.7
77/12/27	15	9	51.7	60	19.4	153	28.0	175.2	4.8F	15	1	91	39	0.22	0.8	2.8	C	315	0	1.5	45	2	1.2	225	88	5.2
78/01/28	2	25	2.1	63	2.1	151	1.6	128.8	4.2F	18	1	74	165	0.12	1.5	9.1	D	66	1	2.7	336	7	1.2	164	83	17.2
78/02/12	8	56	39.5	59	15.6	152	22.2	75.5	4.2F	15	0	123	61	0.21	1.2	2.4	B	320	8	2.2	52	13	0.9	199	75	4.6
78/02/13	1	16	55.6	59	41.3	153	41.7	127.6	4.3F	15	1	82	42	0.25	0.9	2.6	B	301	1	1.6	32	15	1.1	207	75	4.6
78/03/20	3	59	5.8	60	4.8	153	26.4	163.7	4.6F	16	0	82	79	0.17	0.9	3.7	C	301	3	1.5	32	4	1.1	175	85	7.0
78/03/20	8	15	38.9	59	48.2	153	17.3	136.1	4.0F	15	1	72	53	0.18	0.9	2.9	C	305	6	1.5	36	8	1.0	179	80	5.4

PRELIMINARY DETERMINATION OF HYPOCENTERS IN SOUTHERN ALASKA - OCTOBER 1971 TO MAY 1989

	origin time			lat n		long w		depth	mag	np	ns	gap	dl	rms	seh	sez	q	az1	dip1	se1	az2	dip2	se2	az3	dip3	se3
date	hr	mn	sec	deg	min	deg	min	km				deg	km	sec	km	km		deg	deg	km	deg	deg	km	deg	deg	km
78/03/31	0	38	14.9	61	41.3	151	15.2	78.1	4.1F	17	1	108	36	0.16	1.0	1.7	B	66	5	0.9	158	24	1.2	325	65	3.5
78/04/12	3	42	11.8	56	48.3	152	8.9	0.0*	4.6F	15	0	282	107	0.32	26.6	50.0	D	267	0	10.1	357	0	49.7	0	90	99.0
78/04/19	1	49	4.2	60	4.3	153	29.8	171.4	4.5F	15	0	83	82	0.18	0.8	4.0	C	314	2	1.5	45	3	1.3	191	86	7.4
78/04/25	7	36	7.9	60	3.8	153	28.3	168.1	4.2F	15	1	82	82	0.08	0.9	4.6	C	38	2	1.3	308	2	1.6	173	87	8.7
78/05/05	5	32	47.8	63	8.7	151	0.3	137.0	4.4F	17	0	111	176	0.11	1.3	6.5	D	259	2	2.4	349	6	1.1	151	84	12.2
78/05/12	12	16	5.9	62	12.3	149	11.2	47.2	4.0F	17	0	113	68	0.20	0.7	2.0	B	316	2	1.2	46	7	1.1	210	83	3.7
78/06/07	12	37	49.7	59	56.4	152	30.5	78.8	4.2X	16	4	100	69	0.15	1.1	1.9	B	70	6	2.0	339	8	1.2	196	80	3.7
78/07/15	12	21	14.4	59	32.7	152	42.5	96.4	4.3X	16	2	103	64	0.15	1.0	2.1	B	294	6	1.8	25	9	1.0	171	79	3.9
78/07/20	5	44	41.5	60	41.3	152	45.8	137.9	4.7X	15	1	107	23	0.18	0.9	2.0	B	160	1	1.6	69	3	1.3	268	87	3.8
78/08/18	18	52	28.5	59	42.9	153	26.2	130.2	4.7F	15	0	140	42	0.53	0.9	2.3	B	100	3	1.6	10	10	1.1	207	80	4.3
78/08/21	15	18	52.4	57	24.5	157	19.5	213.4	4.3F	13	1	292	292	0.23	13.7	18.7	D	185	4	2.6	278	34	7.1	89	56	44.4
78/09/22	16	14	32.0	60	24.4	153	10.4	166.5	4.2X	16	7	192	32	0.26	2.4	3.9	C	120	14	2.6	23	25	2.1	236	61	8.2
78/12/06	11	5	35.5	60	4.7	153	15.3	152.1	4.0F	16	1	142	116	0.34	1.0	3.3	C	118	3	1.4	20	9	1.5	218	81	6.3
78/12/09	0	50	50.0	60	21.3	152	19.7	103.4	4.0F	15	2	78	33	0.14	0.8	1.9	B	117	6	1.3	26	13	1.1	231	76	3.7
78/12/17	13	15	28.1	63	57.2	147	36.2	59.1	4.0F	15	0	123	106	0.28	1.6	3.2	C	183	8	1.0	274	10	2.7	55	77	6.1
78/12/28	16	20	30.3	62	58.9	150	55.8	123.6	4.1F	18	1	123	116	0.16	1.4	4.3	C	354	8	2.1	85	10	1.7	226	77	8.3
79/01/25	19	30	7.4	60	1.6	152	49.7	119.2	4.8F	17	0	92	44	0.37	0.8	2.0	B	125	2	1.4	35	3	0.9	249	86	3.8
79/02/01	12	29	7.8	60	8.5	152	42.1	98.3	4.2F	17	0	100	79	0.24	0.6	2.1	B	295	4	1.0	26	10	0.9	184	79	4.0
79/02/09	18	49	26.7	59	57.5	152	27.5	80.2	4.1F	15	3	81	66	0.37	0.7	1.6	B	38	4	0.7	307	13	1.1	145	76	3.1
79/02/28	21	27	6.9	60	38.8	141	31.7	0.0	7.1s	17	8	67	34	0.56	0.4	0.8	A	313	1	0.5	43	15	0.7	218	75	1.5
79/02/28	21	30	18.5	60	22.3	141	14.5	2.0	4.80	4	2	272	28	0.09	6.0	3.7	D	198	24	12.1	90	34	7.9	316	46	2.7
79/02/28	21	31	40.1	60	6.8	140	46.0	0.0	4.80	5	2	156	28	0.49	19.2	4.0	D	275	0	0.7	5	2	36.0	185	88	7.4
79/02/28	21	31	55.0	60	25.1	141	19.0	0.0	5.00	3	2	233	32	0.55	7.7	8.2	D	159	14	13.6	59	36	9.4	267	51	18.1
79/02/28	21	36	34.3	60	16.5	140	27.8	4.0	4.00	6	3	228	23	0.15	4.1	2.1	C	294	6	0.8	202	19	8.1	41	70	3.2
79/02/28	21	36	55.4	60	20.5	140	40.0	0.0	4.20	5	4	230	36	0.27	3.0	3.8	C	299	20	1.5	41	29	2.7	180	54	8.8
79/02/28	21	38	56.0	60	27.3	140	41.6	0.0	4.70	5	2	239	47	0.13	7.2	3.1	D	280	18	1.0	17	18	14.2	149	64	4.0
79/02/28	21	39	54.1	60	22.7	140	8.9	1.9	4.60	7	4	241	32	0.38	2.4	1.7	B	304	25	1.1	196	33	5.4	63	46	1.4
79/02/28	21	51	56.8	60	14.9	140	35.3	10.0	4.30	15	3	81	25	0.90	0.6	0.9	A	292	1	0.5	22	22	0.9	200	68	1.8
79/03/02	9	34	46.2	60	21.8	140	40.7	0.0	4.0F	17	1	54	38	0.61	0.6	0.8	A	102	3	0.5	10	27	0.9	198	63	1.6
79/04/04	8	16	17.4	60	20.6	153	25.7	172.6	4.3F	15	1	92	112	0.25	0.8	4.3	C	320	1	1.5	50	2	1.1	203	88	8.0
79/05/20	8	14	0.3	56	27.7	156	31.7	51.2	4.6F	15	0	307	283	0.26	12.6	3.4	D	215	2	23.5	305	6	2.7	107	84	6.4
79/05/30	19	20	28.1	56	2.9	161	26.6	213.9	4.7F	15	0	142	99	0.35	3.7	4.0	C	29	24	1.5	284	32	3.8	149	48	9.7
79/07/10	4	6	21.1	63	10.2	150	37.0	133.8	4.3F	17	2	207	174	0.26	2.5	6.6	D	11	3	1.5	102	11	4.2	266	79	12.1
79/07/16	21	46	0.0	60	39.2	152	56.6	120.5	4.1F	16	0	96	31	0.30	0.8	2.0	B	218	3	1.0	308	3	1.5	83	86	3.8
79/10/25	17	1	2.6	63	4.3	150	39.2	131.8	4.0F	16	1	124	130	0.16	1.5	3.4	C	301	9	2.0	33	15	2.2	181	72	6.7
79/11/14	23	0	44.3	61	17.5	150	0.0	38.3	4.0F	17	0	57	24	0.31	0.4	1.1	A	262	1	0.7	171	7	0.6	0	83	2.2
80/03/17	7	37	36.0	60	1.5	153	11.1	127.0	4.2F	16	0	83	27	0.20	0.9	1.9	B	57	5	1.0	326	7	1.6	182	81	3.7
80/04/03	3	46	4.9	63	6.7	149	29.1	75.4	4.4F	17	0	112	157	0.33	1.1	1.7	B	302	14	1.2	38	22	1.5	182	63	3.4
80/04/06	14	47	43.7	61	19.9	147	38.0	29.9	4.0F	18	1	64	18	0.30	0.4	1.1	A	94	2	0.5	4	3	0.7	218	86	2.1
80/05/07	3	6	16.5	62	56.6	150	46.8	120.2	4.3F	19	0	72	114	0.21	2.7	6.9	D	335	8	1.3	67	18	2.3	222	70	13.6
80/06/15	19	1	55.1	60	3.6	153	20.2	129.4	4.1F	15	1	133	32	0.17	0.9	2.3	B	305	4	1.5	35	12	1.5	197	77	4.4
80/06/17	9	16	13.1	60	15.3	153	26.4	173.7	4.2F	15	1	127	67	0.31	1.0	2.9	C	346	2	1.9	77	3	1.2	223	86	5.5
80/08/01	23	7	17.0	59	38.1	148	46.9	25.6	4.3F	15	0	198	64	1.26	1.0	5.8	D	269	0	1.0	359	0	1.8	0	90	10.8
80/08/07	19	16	10.8	63	17.7	151	30.9	106.5	4.7F	17	0	157	146	0.56	0.9	5.0	C	309	0	1.8	39	2	1.5	219	88	9.4
80/08/12	14	44	31.0	59	59.6	152	54.0	100.2	4.1F	16	1	136	22	0.17	1.1	1.8	B	323	4	1.3	55	22	1.8	223	68	3.6
80/08/22	0	43	50.3	61	32.3	152	14.8	128.9	4.2F	17	2	87	41	0.18	0.7	1.0	A	290	5	1.3	198	23	1.0	32	66	2.1
80/08/30	0	18	22.6	59	26.3	152	44.1	76.7	4.0F	18	1	145	66	0.24	0.9	1.7	B	355	2	1.1	265	4	1.7	112	86	3.1
80/09/04	10	54	1.1	59	25.9	143	36.3	10.0*	4.6F	17	0	201	71	0.31	2.1	50.0	D	277	0	0.9	7	0	4.0	0	90	99.0
80/09/13	7	24	14.5	59	49.2	152	15.9	84.6	4.0F	16	0	126	51	0.17	1.5	2.1	B	106	14	1.3	9	26	2.1	222	60	4.4
80/11/22	16	27	29.3	59	15.5	154	32.7	145.6	4.0F	16	3	148	42	0.20	1.0	1.2	A	350	6	1.5	85	40	1.0	253	49	2.7

PRELIMINARY DETERMINATION OF HYPOCENTERS IN SOUTHERN ALASKA - OCTOBER 1971 TO MAY 1989

date	origin time hr	mn	sec	lat n deg	min	long w deg	min	depth km	mag	np	ns	gap deg	d1 km	rms sec	seh km	sez km	q	az1 deg	dip1 deg	se1 km	az2 deg	dip2 deg	se2 km	az3 deg	dip3 deg	se3 km
80/11/30	21	31	47.0	59	18.4	153	22.1	100.2	4.3F	16	0	156	8	0.92	0.9	1.9	B	359	3	1.3	90	18	1.2	260	72	3.8
80/12/02	3	10	35.5	60	18.5	143	30.8	0.1	4.1X	15	7	129	40	0.35	2.5	1.6	B	80	3	0.7	172	32	5.4	345	58	1.4
81/01/19	21	20	6.8	63	11.2	150	43.5	126.6	4.1F	16	5	129	177	0.22	1.3	6.8	D	276	2	2.5	7	3	1.8	153	86	12.8
81/01/20	6	20	57.9	57	28.0	155	55.3	98.6	4.0F	15	5	282	207	0.54	6.0	8.1	D	317	2	2.0	69	33	7.2	224	57	17.5
81/02/17	2	41	1.3	63	8.2	150	40.4	116.6	4.1F	17	3	127	171	0.21	1.4	7.9	D	15	3	1.8	285	3	2.5	150	86	14.8
81/03/21	23	1	40.2	58	52.6	154	39.3	122.6	4.4F	15	3	197	66	0.20	1.3	1.5	B	14	19	1.6	117	33	0.9	259	51	3.5
81/05/21	20	29	34.1	59	45.5	152	58.7	103.9	4.0F	15	1	144	48	0.20	1.0	1.7	B	144	1	1.3	54	14	1.8	238	76	3.3
81/08/01	1	42	18.4	60	0.6	152	54.3	101.6	4.6F	16	1	115	20	0.27	0.7	1.8	B	110	2	0.9	20	5	1.4	222	85	3.5
81/09/16	12	11	6.0	63	3.2	150	54.4	132.9	4.1F	17	3	126	124	0.28	1.7	4.6	C	348	4	3.1	79	9	2.0	234	80	8.7
81/11/16	23	49	50.2	60	5.1	153	1.4	118.6	4.2F	18	2	110	16	0.29	0.8	1.1	A	136	15	1.0	232	20	1.2	12	65	2.3
81/11/17	11	28	43.0	60	15.6	151	34.3	57.7	4.0F	16	0	107	29	0.31	0.6	1.6	B	327	4	0.6	57	10	0.9	215	79	3.1
82/02/26	7	16	59.2	59	59.3	153	0.9	122.9	4.5F	17	0	70	24	0.35	0.8	1.8	B	120	6	1.0	211	8	1.4	354	80	3.5
82/02/27	12	18	9.1	62	17.5	147	50.9	52.5	4.0F	16	1	102	58	0.27	0.6	1.6	B	248	2	0.9	338	7	1.1	142	83	3.0
82/05/05	19	49	55.2	61	12.1	149	36.9	48.5	4.2F	18	0	47	6	0.26	0.4	1.0	A	251	3	0.6	161	6	0.8	8	83	1.9
82/07/06	17	33	10.0	59	6.9	152	29.9	70.0	4.1F	16	0	123	59	0.24	0.7	1.7	B	252	1	0.8	162	2	1.4	9	88	3.3
82/07/14	12	15	51.7	60	23.1	153	15.6	135.9	4.7F	17	0	88	33	0.39	1.0	2.9	C	21	1	1.1	111	8	1.7	284	82	5.6
82/08/02	2	34	19.7	63	0.0	150	54.0	132.6	4.1F	17	3	124	118	0.19	2.7	2.0	C	63	31	1.5	177	34	5.8	302	40	2.9
82/08/10	16	25	42.1	60	5.7	153	5.7	121.1	4.0F	16	3	71	18	0.38	0.7	1.8	B	65	1	1.0	156	9	1.3	329	81	3.4
82/09/06	7	48	56.8	56	46.5	151	28.8	10.0*	4.1F	15	1	308	124	0.72	22.5	36.3	D	260	1	3.2	350	29	22.6	168	61	76.8
82/11/06	10	43	18.4	65	46.0	151	5.9	68.0	4.2X	11	0	337	423	2.30	50.0	50.0	D	266	0	8.6	356	0	99.0	0	90	99.0
83/01/01	11	18	8.8	61	16.9	146	58.3	25.2	4.0F	16	1	75	38	0.25	0.4	3.1	C	293	1	0.4	23	1	0.7	158	89	5.8
83/03/15	23	53	22.1	59	30.2	153	12.3	111.9	4.4F	15	0	157	79	0.28	1.6	2.8	C	150	1	1.5	59	12	2.8	245	78	5.4
83/03/30	18	6	16.5	61	25.0	140	9.1	0.0	4.1F	16	1	203	81	1.40	2.5	7.6	D	113	3	1.3	23	7	4.4	226	82	14.4
83/04/19	19	12	49.6	63	17.4	149	50.1	118.4	4.7F	19	2	95	170	0.26	0.7	4.0	C	252	2	1.3	342	6	0.9	144	84	7.5
83/04/20	10	18	33.5	58	46.2	156	9.0	197.0	4.6F	15	2	250	243	0.36	5.3	6.9	D	129	5	2.8	222	25	8.9	28	64	13.6
83/04/23	6	13	48.2	60	24.5	153	25.5	215.5	4.7F	15	3	170	42	0.77	1.2	2.8	C	139	4	1.6	230	6	2.2	16	83	5.3
83/06/16	21	19	25.5	60	4.1	151	44.3	81.8	4.0F	16	0	110	41	0.31	0.8	2.4	B	337	10	0.8	69	11	1.2	206	75	4.7
83/06/28	3	25	17.7	60	11.9	141	10.8	7.2	4.3F	15	0	108	15	0.26	0.5	0.5	A	110	5	0.5	15	42	0.7	205	48	1.1
83/07/12	15	10	3.6	61	2.0	147	10.8	7.1	6.3B	18	1	56	47	0.34	0.3	2.5	B	193	1	0.6	283	2	0.4	76	88	4.6
83/07/21	17	35	17.0	58	6.1	152	58.5	94.6	4.2F	15	2	218	49	0.20	3.8	8.3	D	276	0	5.1	6	24	1.2	186	66	17.1
83/08/06	16	34	0.8	60	22.7	152	57.5	123.5	4.7F	16	1	140	23	0.31	1.2	3.0	C	331	0	1.1	241	8	2.1	61	82	5.7
83/08/19	4	59	33.6	60	9.0	152	44.1	90.3	4.2F	16	0	170	6	0.26	1.9	2.9	C	163	2	0.9	72	20	3.1	258	70	5.6
83/09/07	19	22	5.6	60	57.8	147	19.8	14.5	6.3B	14	0	70	34	0.32	0.4	0.9	A	197	5	0.8	106	9	0.5	316	80	1.7
83/09/07	22	22	10.9	60	59.5	147	21.1	14.8	4.1X	14	1	125	31	0.33	0.4	1.5	B	286	4	0.5	16	4	0.8	151	84	2.8
83/09/10	9	12	39.7	60	57.9	147	16.4	20.1	4.2X	16	3	60	36	0.27	0.4	1.6	B	294	0	0.5	204	3	0.7	24	87	3.8
83/09/14	2	35	11.5	60	57.3	147	15.6	29.1	4.0X	22	5	60	2	0.27	0.3	0.4	A	107	4	0.4	16	16	0.6	211	73	0.8
83/09/21	22	50	48.4	60	14.8	152	38.5	100.3	4.1F	16	0	133	12	0.29	0.7	1.9	B	162	3	0.9	72	7	1.2	275	82	3.7
83/09/26	23	52	54.4	57	8.3	156	5.1	122.4	4.3F	16	6	292	226	0.72	7.7	13.1	D	59	16	12.2	325	17	3.5	190	66	26.5
83/10/06	11	10	12.8	62	22.0	151	15.8	96.8	4.7F	18	1	103	45	0.34	0.7	1.8	B	93	1	0.9	3	13	1.2	187	77	3.4
84/01/14	11	44	27.7	59	48.6	153	30.3	129.3	4.1F	18	3	99	57	0.25	1.0	2.5	B	127	1	1.7	217	19	1.2	34	71	4.9
84/02/06	7	48	28.4	62	58.3	150	46.3	128.8	4.1F	17	2	122	117	0.17	1.9	3.8	C	287	2	1.4	18	14	3.1	189	76	7.4
84/03/23	8	38	5.8	58	46.8	154	8.0	119.2	4.6F	18	2	115	150	0.24	1.9	6.3	D	89	4	3.5	359	5	1.5	218	84	11.9
84/04/18	19	31	30.8	60	42.1	151	51.2	79.7	4.3F	22	0	101	33	0.26	0.7	1.8	B	167	8	0.7	76	10	1.1	295	77	3.5
84/04/20	4	24	49.3	61	40.4	152	6.6	118.6	4.1F	16	6	95	41	0.25	0.6	0.9	A	134	3	1.1	225	26	1.0	38	64	1.8
84/05/04	23	3	20.3	59	13.4	153	10.8	73.8	4.1F	15	0	205	95	0.15	1.2	3.4	C	171	1	1.2	261	7	2.0	73	83	6.4
84/07/25	4	59	51.0	62	40.4	149	46.3	75.2	4.0F	17	2	87	114	0.27	1.3	2.7	C	69	6	1.1	336	23	0.8	173	66	5.5
84/08/14	1	2	9.2	61	47.9	148	59.2	15.1	5.7B	19	1	81	19	0.55	0.4	0.9	A	58	9	0.5	326	11	0.7	186	76	1.6
84/08/14	1	54	37.7	61	47.9	149	0.9	15.4	4.2B	16	7	90	19	0.50	0.5	0.8	A	78	6	0.6	347	18	0.8	186	71	1.6
84/09/20	4	17	24.4	60	14.9	145	52.1	1.8	4.1F	18	2	83	34	0.31	0.3	0.7	A	91	3	0.4	182	14	0.6	349	76	1.3
85/01/09	19	28	21.1	60	18.8	140	38.4	9.4	5.7X	16	7	110	32	0.45	0.5	1.4	B	290	6	0.4	199	10	0.8	51	78	2.7

PRELIMINARY DETERMINATION OF HYPOCENTERS IN SOUTHERN ALASKA - OCTOBER 1971 TO MAY 1989

date	origin time hr	mn	sec	lat n deg	min	long w deg	min	depth km	mag	np	ns	gap deg	d1 km	rms sec	seh km	sez km	q	az1 deg	dip1 deg	se1 km	az2 deg	dip2 deg	se2 km	az3 deg	dip3 deg	se3 km
85/01/09	19	30	52.2	60	17.8	140	38.0	12.1	4.0x	12	7	151	30	0.54	0.7	1.1	A	40	1	1.4	310	14	0.6	134	76	2.2
85/02/11	18	59	54.5	58	7.5	154	25.8	105.8	4.1r	15	3	123	122	0.29	1.1	2.9	C	198	2	1.1	289	14	1.6	100	76	5.7
85/03/03	13	38	50.5	59	43.8	152	39.7	85.1	4.2r	16	1	90	51	0.35	0.7	1.8	B	333	5	1.4	64	8	0.8	211	81	3.5
85/03/31	15	58	18.5	60	60.0	152	55.0	156.8	4.0r	15	6	89	51	0.34	0.8	1.0	A	157	9	1.2	253	30	1.1	52	58	2.0
85/04/22	20	41	26.4	59	45.5	153	28.5	117.7	4.3r	15	3	97	40	0.24	1.2	2.3	B	341	6	2.1	73	19	1.5	234	70	4.6
85/04/26	23	23	41.9	58	4.9	154	30.7	111.0	4.1r	15	5	244	125	0.21	2.7	3.9	C	337	14	1.5	73	22	4.4	217	63	7.9
85/08/02	13	41	44.0	60	11.1	140	56.5	5.3	4.3x	16	3	118	6	0.51	0.5	0.4	A	288	1	0.4	198	26	1.0	20	64	0.7
85/08/08	9	24	19.5	60	17.4	153	21.3	162.2	4.0r	16	5	95	32	0.38	0.9	2.2	B	112	3	1.3	22	8	1.5	222	81	4.2
85/09/10	17	20	7.5	61	18.9	151	38.0	80.4	4.3x	16	2	96	20	0.72	0.8	1.9	B	67	13	0.9	160	14	1.1	296	71	3.8
85/09/15	1	28	20.7	59	7.3	136	23.8	66.4	4.5r	12	0	143	194	0.22	0.8	17.6	D	315	0	1.0	225	1	1.3	45	89	33.0
85/09/25	20	50	54.6	59	34.2	154	23.7	185.0	5.5x	16	2	118	27	0.33	1.1	0.9	A	333	16	1.8	234	30	2.2	87	55	1.4
85/10/05	2	44	26.6	61	14.4	149	18.7	42.7	4.0x	23	4	47	13	0.31	0.3	0.8	A	98	4	0.6	189	11	0.4	348	78	1.6
85/10/27	19	3	43.5	58	23.7	153	56.1	68.5	5.4x	15	2	214	112	0.25	3.4	12.6	D	77	8	3.2	345	12	1.1	200	75	24.4
85/11/05	1	28	2.3	62	24.3	151	18.8	85.1	4.4r	18	3	86	49	0.41	0.6	1.6	B	292	3	0.9	23	15	0.8	181	75	3.1
85/11/16	7	11	13.1	59	7.0	136	26.6	0.0	4.5x	9	3	214	193	0.19	14.3	10.5	D	319	4	4.6	52	31	30.1	222	59	14.0
85/12/08	7	32	23.6	59	53.8	150	16.0	35.7	4.3x	15	6	148	38	0.34	0.7	1.0	A	62	5	0.5	330	24	1.0	163	65	2.0
85/12/30	6	6	14.6	59	46.8	153	45.2	141.4	4.0r	15	4	164	69	0.27	1.1	0.9	A	296	17	1.1	37	30	2.3	181	54	1.5
85/12/30	12	41	5.0	61	27.0	150	17.9	42.0	4.3r	15	0	92	24	0.14	0.5	1.2	A	256	1	0.6	166	11	0.8	351	79	2.3
86/02/24	18	55	16.1	63	2.0	150	27.9	110.4	4.0r	15	1	268	130	0.26	3.8	5.6	D	82	7	1.8	174	14	6.8	326	74	10.8
86/02/28	17	1	46.4	60	12.4	153	1.2	117.4	4.0r	15	9	109	12	0.35	0.5	0.6	A	60	16	0.8	322	27	0.9	177	58	1.2
86/03/22	5	30	1.8	60	20.4	153	16.4	166.9	5.4x	15	5	85	31	0.38	0.8	1.8	B	212	1	1.3	122	4	1.5	316	86	3.5
86/05/23	23	18	43.7	58	47.6	153	15.6	75.1	4.1r	15	1	102	64	0.24	0.9	2.0	B	355	3	0.9	86	14	1.4	253	76	3.9
86/07/28	14	31	14.6	60	35.7	150	26.8	40.0	4.4x	16	5	69	15	0.25	0.4	1.1	A	273	3	0.6	3	5	0.7	152	84	2.0
86/09/18	20	56	7.7	61	45.7	149	43.6	41.2	4.9x	17	3	89	15	0.33	0.6	1.0	A	278	2	0.6	188	4	1.1	35	86	1.9
86/09/29	17	13	33.9	58	48.4	156	7.0	217.8	4.1r	16	4	243	155	0.30	4.6	3.7	C	316	6	3.4	223	27	9.2	58	62	6.2
86/10/09	1	21	7.8	62	6.1	149	32.7	45.0	4.0x	18	4	111	49	0.19	0.7	1.7	B	271	3	0.8	2	17	1.0	171	73	3.3
86/10/15	23	35	54.0	59	43.0	153	5.1	95.3	4.6x	15	5	107	54	0.23	0.9	2.2	B	106	9	1.1	14	11	1.6	234	76	4.2
86/10/26	22	19	45.3	57	49.0	156	16.6	133.2	4.2x	16	4	140	225	0.13	5.1	9.2	D	60	5	9.5	329	6	2.3	189	82	17.4
86/10/27	19	39	36.7	60	56.0	149	32.1	35.9	4.0x	21	6	45	29	0.18	0.3	0.9	A	280	0	0.6	10	6	0.4	190	84	1.7
86/11/04	6	14	18.9	61	20.1	151	55.4	96.2	4.6x	18	3	73	15	0.25	0.6	1.0	A	197	12	0.8	104	15	1.0	324	71	1.9
86/11/04	6	55	55.3	61	19.1	150	39.9	43.7	4.5x	17	4	63	17	0.32	0.3	1.2	A	99	4	0.5	189	4	0.6	324	84	2.3
87/02/15	16	55	5.9	61	29.2	151	37.6	81.6	4.2x	17	5	78	37	0.21	0.6	1.2	A	65	4	0.9	155	4	1.1	290	84	2.3
87/02/25	12	26	34.3	60	24.5	147	37.0	20.2	4.5x	18	8	56	9	0.29	0.4	0.7	A	68	3	0.5	337	8	0.7	178	81	1.4
87/03/17	11	12	27.1	61	34.6	150	40.6	53.0	4.1x	16	4	68	13	0.27	0.4	1.1	A	206	4	0.8	115	10	0.6	317	79	2.1
87/04/18	2	1	39.7	61	22.0	150	41.9	55.0	5.3x	17	7	83	54	0.28	0.6	1.7	B	234	1	0.6	144	6	1.1	333	84	3.2
87/04/18	2	13	39.7	61	21.5	150	39.1	53.7	4.1x	14	7	148	52	0.33	0.6	1.7	B	237	4	0.6	146	6	1.1	0	83	3.2
87/05/11	11	30	11.3	61	27.4	152	25.5	131.2	4.8x	17	5	86	26	0.15	1.6	2.8	C	24	0	1.6	114	24	2.2	294	66	5.6
87/06/10	1	44	42.0	59	18.2	152	21.2	59.2	4.3x	15	3	115	68	0.29	0.6	2.3	B	177	2	0.9	267	5	1.0	65	85	4.3
87/06/13	13	9	23.4	60	44.5	147	36.1	26.3	4.5x	19	5	60	31	0.33	0.3	1.9	B	225	1	0.6	316	3	0.6	117	87	3.6
87/06/20	7	12	38.8	58	30.0	156	15.6	198.8	4.0r	15	4	149	186	0.15	3.0	4.4	C	333	1	2.0	64	12	5.5	238	78	8.4
87/07/25	1	11	50.9	59	59.1	153	35.0	158.6	5.5x	15	3	82	41	0.34	1.2	2.7	C	103	3	1.4	12	14	1.8	205	76	5.3
87/09/09	9	35	29.4	60	9.0	153	19.0	144.4	4.2x	16	5	90	69	0.40	0.9	2.2	B	158	5	1.2	249	8	1.7	36	81	4.1
87/10/24	2	49	46.0	64	3.0	147	51.8	0.0	4.7p	6	0	107	95	0.71	1.1	2.8	B	280	15	1.4	184	20	0.8	44	65	4.1
87/10/24	5	6	45.6	61	35.9	147	50.3	25.7	4.3x	22	6	48	35	0.40	0.3	1.5	B	103	1	0.4	193	1	0.6	328	89	2.7
87/10/31	1	27	59.8	60	14.1	149	55.6	61.3	4.6x	21	10	105	30	0.42	0.5	1.1	A	257	0	0.6	347	3	1.0	167	87	2.0
87/11/04	0	33	26.2	61	33.7	149	25.0	37.0	4.7x	21	5	69	16	0.38	0.4	0.8	A	279	2	0.5	189	14	0.7	17	76	1.5
87/11/14	15	48	30.0	58	57.0	134	58.8	0.8	5.3x	15	2	165	66	0.80	4.6	9.8	D	331	15	3.1	236	16	7.0	102	68	18.1
87/11/17	6	46	52.2	56	32.0	143	15.0	10.0*	6.9B	18	0	195	181	0.31	1.1	50.0	D	287	0	1.1	17	0	2.1	0	90	99.0
87/11/17	9	38	12.0	58	36.8	143	5.5	10.0*	5.5B	18	2	190	165	0.25	1.8	24.3	D	273	0	1.2	3	0	3.4	0	90	45.6
87/11/17	13	26	12.4	58	58.6	134	57.6	0.0	5.0x	12	4	167	69	0.38	6.4	6.3	D	334	5	2.4	70	44	15.3	239	45	7.2

PRELIMINARY DETERMINATION OF HYPOCENTERS IN SOUTHERN ALASKA - OCTOBER 1971 TO MAY 1989

date	origin time hr	mn	sec	lat n deg	min	long w deg	min	depth km	mag	np	ns	gap deg	d1 km	rms sec	seh km	sez km	q	az1 deg	dip1 deg	se1 km	az2 deg	dip2 deg	se2 km	az3 deg	dip3 deg	se3 km
87/11/18	13	1	54.7	58	39.0	143	10.2	10.0*	4.3F	19	4	189	159	0.19	3.9	47.2	D	253	0	1.8	343	0	7.3	0	90	88.5
87/11/23	7	18	21.6	61	36.2	141	24.4	0.0	5.6X	16	6	95	129	1.20	1.7	3.3	C	302	1	1.1	212	15	2.8	36	75	6.3
87/11/30	17	59	47.4	58	39.7	142	48.2	10.0*	4.0X	18	10	186	159	0.36	1.6	5.9	D	89	1	1.1	359	5	2.8	190	85	11.1
87/11/30	19	23	15.5	58	43.0	142	46.8	10.0*	7.6S	19	0	183	153	0.33	1.6	50.0	D	271	0	1.1	1	0	3.0	0	90	99.0
87/11/30	19	48	23.8	58	8.4	142	33.8	10.0*	5.9X	15	3	260	213	0.20	3.2	28.6	D	269	0	1.6	359	1	5.9	179	89	53.7
87/11/30	20	50	6.2	58	39.7	142	41.4	10.0*	4.0X	18	6	185	158	0.29	2.0	5.7	D	274	0	1.3	4	12	3.1	184	78	11.0
87/11/30	23	48	18.4	58	6.3	142	51.9	10.0*	4.0F	18	4	206	220	0.20	2.8	23.7	D	264	0	1.7	354	1	5.2	174	89	44.4
87/12/01	2	37	18.4	58	7.2	141	35.7	10.0*	4.0X	16	6	195	193	0.29	6.6	14.4	D	266	0	2.4	356	19	8.8	176	71	28.4
87/12/01	4	25	15.2	58	42.9	142	34.7	10.0*	4.4X	15	4	225	151	0.27	2.6	11.7	D	263	0	1.3	353	1	4.9	173	89	21.9
87/12/01	12	4	0.4	58	2.9	142	36.5	10.0*	5.3X	16	2	206	224	0.36	2.6	22.2	D	276	0	1.4	6	1	4.8	186	89	41.6
87/12/01	21	35	31.1	58	18.2	141	36.6	10.0*	4.2X	16	4	189	177	0.21	3.4	13.3	D	270	0	2.0	0	6	5.8	180	84	25.0
87/12/01	23	14	25.3	58	58.6	142	18.8	10.0*	4.2X	15	9	211	119	0.36	1.7	8.1	D	283	0	0.9	13	4	3.1	193	86	15.2
87/12/02	1	53	29.7	58	58.2	142	53.3	10.0*	4.1F	17	3	217	128	0.12	1.9	13.6	D	275	0	1.1	5	2	3.5	185	88	25.5
87/12/02	21	50	6.9	59	4.8	142	43.7	10.0*	4.2X	15	2	205	114	0.24	2.0	13.8	D	288	0	1.2	18	1	3.7	198	89	25.8
87/12/03	1	29	5.8	58	9.5	142	56.0	10.0*	4.0X	17	7	205	215	0.24	3.0	9.1	D	269	0	1.6	359	11	4.6	179	79	17.4
87/12/03	9	20	17.6	58	30.4	142	38.9	10.0*	5.6X	15	5	235	174	0.26	2.0	10.9	D	276	0	1.2	6	1	3.8	186	89	20.5
87/12/06	2	32	1.6	58	7.1	142	36.5	10.0*	4.2X	17	4	204	216	0.25	4.1	12.7	D	85	1	2.7	354	9	6.7	181	81	24.1
87/12/08	5	12	34.2	58	38.8	142	49.8	10.0*	4.3X	20	7	186	161	0.22	2.0	14.3	D	264	0	1.4	354	1	3.6	174	89	26.7
87/12/12	0	27	3.2	57	51.6	142	51.8	10.0*	4.3X	17	6	214	247	0.19	3.5	10.6	D	262	0	1.9	352	10	5.7	172	80	20.1
87/12/26	0	1	30.8	58	2.0	143	17.9	10.0*	4.0F	18	4	206	220	0.39	1.4	7.6	D	111	1	1.0	21	2	2.7	228	88	14.2
88/01/01	2	10	59.1	61	21.8	150	0.5	36.3	4.1X	17	7	106	27	0.34	0.4	1.2	A	143	3	0.8	233	7	0.5	30	82	2.2
88/01/04	6	33	32.1	58	37.2	142	46.3	10.0*	4.0X	18	2	187	163	0.65	2.5	23.0	D	278	0	1.2	8	1	4.7	188	89	43.1
88/01/08	18	50	55.7	58	7.0	142	48.8	10.0*	4.1X	16	8	206	219	0.24	4.2	10.7	D	292	0	2.7	22	8	7.5	202	82	20.2
88/01/26	13	58	56.6	58	5.9	142	49.4	10.0*	4.9X	16	5	206	241	0.34	1.5	30.2	D	293	0	1.2	23	0	2.7	0	90	56.7
88/02/07	8	46	59.0	60	17.0	152	57.0	133.4	5.4F	17	3	78	18	0.33	0.9	2.7	C	52	2	1.3	321	7	1.5	158	83	5.1
88/02/15	19	16	13.9	59	0.4	142	50.0	10.0*	4.2X	16	3	209	185	0.38	1.9	20.2	D	275	0	0.9	5	0	3.5	0	90	37.9
88/02/20	14	48	50.9	61	50.6	141	26.0	0.0	4.0X	13	5	232	134	0.71	16.2	11.2	D	292	3	2.2	24	34	36.4	198	56	6.6
88/03/06	22	35	35.7	56	50.0	143	8.1	10.0*	7.8X	15	2	244	345	0.21	7.9	46.4	D	275	0	2.5	5	3	14.1	185	87	87.1
88/03/06	23	14	36.5	57	21.5	143	3.6	10.0*	4.3F	15	2	188	297	0.26	8.7	24.7	D	78	1	7.1	168	2	16.3	321	88	46.2
88/03/10	4	16	33.4	59	8.5	144	31.2	10.0*	4.3F	14	2	224	88	0.83	5.7	30.0	D	254	0	2.5	344	1	10.6	164	89	56.1
88/03/10	14	25	19.2	57	12.5	143	26.9	10.0*	4.0F	14	5	227	300	0.42	27.3	44.2	D	272	0	10.2	2	31	15.3	182	59	96.1
88/03/10	16	55	38.3	61	21.0	147	26.9	13.6	4.3X	18	3	68	54	0.33	0.4	1.9	B	287	3	0.4	197	3	0.7	62	86	3.6
88/03/15	23	56	17.0	57	5.6	142	54.5	10.0*	4.7X	17	4	236	328	0.21	8.3	16.1	D	266	0	2.7	356	25	7.2	176	65	33.2
88/03/22	3	41	27.8	61	41.7	150	8.0	41.4	4.6X	18	5	80	14	0.24	0.5	0.9	A	255	8	0.6	346	11	0.9	129	76	1.8
88/03/26	18	49	21.2	62	16.4	147	17.2	48.8	4.6X	16	3	112	49	0.33	0.6	1.5	B	358	4	1.1	268	5	0.8	127	84	2.8
88/04/03	2	0	32.6	60	17.9	153	25.3	165.9	4.0F	15	5	90	35	0.37	0.9	2.2	B	90	4	1.4	359	8	1.6	206	81	4.3
88/04/04	11	42	51.7	60	34.7	150	51.3	44.4	4.5X	14	6	67	28	0.23	0.4	0.8	A	13	3	0.8	282	9	0.5	121	80	1.5
88/04/13	0	2	48.3	57	14.3	143	15.0	10.0*	5.6X	18	6	235	304	0.35	2.6	22.7	D	254	0	1.5	344	1	4.7	164	89	42.5
88/04/15	6	0	39.2	63	12.2	150	40.2	133.0	4.0F	16	6	81	178	0.26	2.3	7.2	D	272	4	4.3	2	6	2.2	148	83	13.6
88/04/25	1	8	3.3	61	32.9	149	56.4	48.7	4.0X	17	6	120	12	0.29	0.6	1.0	A	241	11	0.6	148	12	1.0	12	74	2.0
88/04/26	1	47	34.6	57	34.0	143	4.2	10.0*	5.8X	16	3	217	282	0.26	4.5	23.6	D	274	0	1.6	4	4	8.0	184	86	44.4
88/04/27	4	16	38.8	59	49.1	153	8.8	112.4	4.7X	15	5	91	31	0.25	0.9	1.8	B	146	1	1.7	56	16	1.1	239	74	3.5
88/05/08	5	33	33.8	60	6.8	153	26.8	158.6	4.0F	15	7	85	27	0.36	0.9	2.0	B	324	6	1.6	55	12	1.2	208	77	3.8
88/05/09	16	33	39.3	61	20.4	146	4.9	27.1	4.6X	17	8	85	19	0.33	0.4	0.9	A	195	3	0.6	285	6	0.8	78	83	1.8
88/05/10	13	4	2.2	57	13.2	142	55.7	10.0*	4.7X	16	6	233	314	0.26	6.1	13.0	D	106	2	4.8	15	18	8.8	202	72	25.4
88/05/29	0	49	1.6	60	20.8	153	35.7	199.2	4.6F	15	4	100	46	0.44	1.2	2.4	B	82	9	1.4	349	14	2.0	204	73	4.7
88/08/13	18	6	35.5	59	59.5	146	40.8	7.7	4.4X	18	7	107	46	0.20	0.4	1.7	B	51	1	0.7	321	2	0.8	168	88	3.3
88/08/13	18	43	50.9	60	0.2	146	39.3	11.2	4.8X	17	6	104	45	0.21	0.4	1.2	A	140	1	0.8	230	5	0.6	39	85	2.2
88/09/02	9	11	47.3	58	35.3	156	6.9	198.7	4.1F	15	7	147	173	0.12	3.5	5.0	C	335	0	2.0	245	26	5.3	65	64	10.1
88/09/27	22	55	39.4	61	51.2	148	13.4	34.2	4.0X	16	5	107	8	0.50	0.6	0.9	A	4	5	1.1	95	11	0.6	250	78	1.6

PRELIMINARY DETERMINATION OF HYPOCENTERS IN SOUTHERN ALASKA - OCTOBER 1971 TO MAY 1989

date	origin time hr	mn	sec	lat n deg	min	long w deg	min	depth km	mag	np	ns	gap deg	d1 km	rms sec	seh km	sez km	q	az1 deg	dip1 deg	se1 km	az2 deg	dip2 deg	se2 km	az3 deg	dip3 deg	se3 km
88/09/30	4	50	3.9	61	7.4	151	30.1	85.1	5.0X	15	7	64	30	0.31	0.7	1.6	B	138	12	1.0	45	13	0.7	269	72	3.1
88/10/21	14	19	33.8	57	57.7	151	51.5	73.8	4.0X	16	3	177	45	0.35	4.2	7.1	D	289	13	4.5	25	26	1.1	175	61	15.2
88/10/30	9	32	44.3	60	20.6	152	4.2	71.6	4.8X	17	5	49	32	0.24	0.6	1.7	B	313	1	1.1	43	5	1.0	212	85	3.1
88/10/31	4	17	33.8	60	20.0	152	4.2	77.8*	4.1X	17	6	48	32	0.23	0.7	2.0	B	122	1	1.2	32	6	1.1	221	84	3.9
88/11/30	8	35	31.5	61	17.7	152	12.3	137.9	6.1X	18	7	117	4	0.35	0.8	1.4	B	74	4	1.2	343	9	1.4	188	80	2.7
88/12/04	22	17	13.8	60	55.7	151	3.5	18.2	4.1X	17	5	56	23	0.30	0.4	0.8	A	64	2	0.4	334	8	0.7	166	81	1.5
88/12/06	16	11	36.9	59	31.9	152	53.6	91.8	4.9X	15	5	119	61	0.32	0.6	1.3	A	82	5	1.1	183	7	0.9	327	81	2.5
89/01/07	12	17	26.7	59	26.4	152	34.7	85.6	4.2X	14	12	91	46	0.30	0.6	1.6	B	339	0	1.0	249	1	0.8	69	89	3.0
89/02/06	22	23	16.7	57	24.0	154	26.9	0.0	4.1X	16	2	291	123	0.71	8.7	21.3	D	306	3	1.6	37	15	12.8	205	75	41.2
89/02/11	1	40	39.5	64	20.8	153	20.3	97.6	4.0X	15	0	134	148	0.18	0.9	6.4	D	262	0	1.5	352	3	1.5	172	87	12.1
89/02/24	19	2	43.7	59	7.8	144	54.9	10.0*	4.2X	18	7	211	88	0.33	3.6	9.9	D	264	0	2.0	354	12	5.5	174	78	18.9
89/03/12	14	6	56.9	60	4.9	152	53.8	120.2	4.4X	17	3	72	4	0.34	0.7	1.4	B	12	0	1.0	102	11	1.2	282	79	2.7
89/03/16	8	13	27.8	58	28.1	152	46.6	63.5	4.0F	17	3	144	72	0.22	0.8	3.1	C	346	6	0.9	77	9	1.2	223	79	5.9
89/03/17	17	26	22.8	58	23.4	155	43.9	139.1	4.4X	16	6	166	120	0.21	3.5	4.2	C	161	3	2.5	71	5	6.5	282	84	7.8
89/03/20	1	6	34.4	59	44.4	153	28.8	130.2	4.4X	19	4	64	17	0.26	0.7	1.9	B	306	0	1.3	36	9	1.0	216	81	3.7
89/03/30	13	33	19.3	58	21.0	137	18.0	10.0*	5.6X	8	2	175	187	1.49	50.0	11.5	D	49	3	99.0	139	4	6.9	282	85	21.1
89/04/08	1	22	23.1	57	3.3	143	29.5	10.0*	4.6X	16	7	282	313	0.29	18.3	50.8	D	273	0	3.2	3	10	30.0	183	80	99.0
89/04/14	19	45	8.5	67	42.4	142	51.5	70.9	4.2X	15	4	235	164	0.29	9.6	1.8	D	210	1	17.9	300	12	8.2	115	78	2.9
89/04/17	15	39	46.6	60	3.9	152	50.0	102.2	4.4X	23	11	71	7	0.24	0.6	1.7	B	213	2	0.7	123	10	1.0	314	80	3.3
89/04/23	19	11	28.9	66	58.0	156	5.7	10.0*	4.0B	14	1	178	147	0.24	13.3	21.9	D	48	7	18.2	142	29	7.2	306	60	47.2
89/04/23	19	21	5.5	66	58.8	156	25.0	10.0*	5.8B	14	1	181	159	0.16	12.8	33.4	D	56	1	7.4	146	13	19.7	322	77	64.1
89/04/23	21	31	22.0	66	52.6	156	6.8	10.0*	4.2X	15	1	178	141	0.20	15.0	25.3	D	220	2	12.2	129	30	7.2	313	60	54.6
89/04/24	1	35	31.0	59	32.1	152	49.0	87.0	4.8X	15	4	118	27	0.28	0.5	1.8	B	65	5	0.7	334	5	1.0	200	83	3.4
89/04/24	8	47	44.1	66	59.8	155	54.3	10.0*	4.0X	15	1	176	143	0.31	3.8	6.8	D	337	0	2.1	67	18	6.2	247	72	13.1
89/04/24	9	18	7.0	66	53.2	156	3.2	10.0*	4.0X	14	4	177	140	0.42	15.6	25.1	D	49	11	10.9	145	29	6.9	300	59	54.8
89/04/24	13	38	17.9	66	57.0	156	0.5	10.0*	4.0X	14	1	177	143	0.30	11.8	19.8	D	64	17	9.2	161	24	6.6	302	60	42.6
89/04/25	6	16	32.3	66	59.9	156	13.0	10.0*	4.0X	14	1	179	153	0.23	1.7	7.6	D	162	2	2.0	71	3	3.1	285	86	14.3
89/04/25	7	21	4.3	66	54.4	156	12.3	10.0*	4.4X	14	1	179	146	0.43	3.5	9.5	D	41	1	5.2	132	14	4.9	307	76	18.3
89/04/25	16	44	34.3	66	55.6	156	12.7	10.0*	4.0X	14	1	179	148	0.35	2.9	8.8	D	66	6	4.9	157	9	4.2	303	79	16.8
89/04/25	22	12	38.4	66	54.5	156	15.5	10.0*	4.1X	14	1	180	148	0.31	3.7	10.0	D	40	0	5.5	129	15	5.0	310	75	19.3
89/04/27	13	15	36.9	63	0.5	149	25.3	83.4	4.0X	17	7	87	11	0.21	0.8	1.0	A	16	4	0.6	108	27	1.4	278	63	2.0
89/04/27	18	39	54.1	66	59.8	156	7.9	10.0*	5.1X	15	0	178	150	0.44	17.7	50.0	D	270	3	32.8	0	4	26.4	143	85	99.8
89/04/27	19	8	47.4	67	0.8	156	23.2	10.0*	4.7X	15	0	181	160	0.35	3.2	16.2	D	255	2	5.9	345	3	4.4	131	86	30.3
89/04/29	3	16	32.5	67	2.0	156	24.1	10.0*	4.0X	15	0	181	162	0.29	6.8	44.1	D	238	0	3.2	328	1	12.7	148	89	82.7
89/04/29	15	52	52.8	67	0.9	156	26.6	10.0*	4.5X	15	0	181	162	0.16	24.6	50.0	D	240	1	8.1	330	15	39.8	146	75	99.0
89/04/30	0	48	21.8	66	56.8	156	16.5	10.0*	4.6X	15	8	180	151	0.29	3.5	50.8	D	26	0	5.4	296	0	6.5	8	90	94.5
89/04/30	9	10	56.7	61	21.5	149	43.2	27.8	4.1X	15	9	89	34	0.24	0.4	2.1	B	141	3	0.7	231	6	0.5	24	83	4.0
89/05/01	15	33	4.0	67	1.0	156	15.7	10.0*	4.0X	15	0	179	156	0.24	15.9	50.0	D	38	4	17.2	308	5	28.5	167	84	99.8
89/05/02	5	11	1.7	66	56.9	156	12.6	10.0*	4.1X	14	1	179	149	0.40	12.2	20.6	D	94	20	6.5	192	21	8.1	324	60	44.3
89/05/03	2	56	25.3	60	7.9	146	58.5	8.4	4.7X	14	3	115	39	0.21	0.6	2.3	B	174	2	0.8	264	7	1.1	68	83	4.3
89/05/08	13	46	10.9	66	55.6	155	55.2	10.0*	4.2X	15	1	176	138	0.21	9.1	11.0	D	36	21	11.1	139	30	6.9	277	52	25.3
89/05/09	16	12	26.8	64	39.0	156	20.5	30.0*	4.2X	15	0	222	192	0.16	1.9	50.0	D	16	0	1.2	286	0	3.5	0	90	99.0
89/05/13	4	36	32.8	59	28.3	152	40.7	83.8	4.1X	15	6	85	37	0.19	0.5	1.4	B	62	1	0.7	332	4	0.9	146	86	2.7
89/05/16	17	5	11.3	59	38.0	151	41.8	47.7	4.3X	15	5	61	4	0.31	0.7	1.1	A	21	20	0.9	283	21	0.7	151	60	2.4
89/05/19	2	21	58.2	53	50.3	165	4.2	149.2	6.1B	15	0	203	811	0.57	11.8	50.0	D	246	0	9.4	336	2	21.8	156	88	99.8
89/05/22	3	16	14.0	63	20.5	150	15.0	13.1	4.0X	17	4	102	41	0.23	0.4	0.5	A	187	2	0.6	277	12	0.7	88	78	1.0
89/05/22	4	18	31.1	66	55.8	156	18.5	10.0*	4.2X	14	1	180	152	0.43	3.3	9.3	D	49	3	5.2	140	13	4.8	306	77	17.9
89/05/31	0	46	40.5	58	57.3	154	22.8	134.8	4.1X	15	12	119	26	0.23	1.7	2.1	B	168	3	1.8	76	34	2.6	262	56	4.4

APPENDIX B

List of Previously Published Catalogs

Lahr, J. C., Page, R. A., and Thomas, J. A., 1974, Catalog of earthquakes in south central Alaska, April-June 1972, U.S. Geological Survey Open-File Report, 35 p.

Fogleman, K. A., Stephens, Christopher, Lahr, J. C., Helton, S. M., and Allan, M. A., 1978, Catalog of earthquakes in southern Alaska, October-December 1977, U.S. Geological Survey Open-File Report 78-1097, 28 p.

Stephens, C. D., Lahr, J. C., Fogleman, K. A., Allan, M. A., and Helton, S. M., 1979, Catalog of earthquakes in southern Alaska, January-March 1978, U.S. Geological Survey Open-File Report 79-718, 31 p.

Stephens, C. D., Astrue, M. A., Pelton, J. R., Fogleman, K. A., Page, R. A., Lahr, J. C., Allan, M. A., and Helton, S. M., 1982, Catalog of earthquakes in southern Alaska, April-June 1978, U.S. Geological Survey Open-File Report 82-488, 36 p.

Stephens, C. D., Lahr, J. C., Fogleman, K. A., Helton, S. M., Cancilla, R. S., Tam, Roy and Baldonado, K. A., 1980, Catalog of earthquakes in southern Alaska, October-December 1979, U.S. Geological Survey Open-File Report 80-2002, 53 p.

Stephens, C. D., Fogleman, K. A., Lahr, J. C., Helton, S. M., Cancilla, R. S., Tam, Roy and Freiberg, J.A., 1980, Catalog of earthquakes in southern Alaska, January-March 1980, U.S. Geological Survey Open-File Report 80-1253, 55 p.

Fogleman, K. A., Stephens, C. D., Lahr, J. C., Rogers, J. A., Helton, S. M., Cancilla, R. S., Tam, Roy, Freiberg, J. A., and Melnick, J. P., 1983, Catalog of earthquakes in southern Alaska, July-September 1980, U.S. Geological Survey Open-File Report 83-15, 54 p.

Fogleman, K. A. Stephens, C. D., Lahr, J. C., and Rogers, J. A., 1986, Catalog of earthquakes in southern Alaska for 1984, U.S. Geological Survey Open-File Report 86-99, 106 p.

Fogleman, K. A., Stephens, C. D., and Lahr, J. C., 1988, Catalog of earthquakes in southern Alaska for 1985, U. S. Geological Survey Open-File Report 88-31, 113 p.

APPENDIX C

Summary of Timing Criteria

Routine network processing.

October 1, 1971 - September 31, 1973

Time all shocks with:

A. Cook Inlet (west of longitude 150°W):
S-P ≤ 25 s **and** recorded at 6 or more stations (clearly recorded at 4 or more of these).

B. Valdez (east of 150°W):
1. S-P ≤ 20 s **and** clearly recorded at 4 or more stations including 2 of WLM, ERN, VLZ and CVA.

or

2. S-P ≤ 10 s **and** clearly recorded at 3 stations including 2 of WLM, ERN, VLZ and CVA.

C. Well recorded regional events that have clipped traces **and** do not come from the Aleutians.

October 1, 1973 - September 31, 1974

Time all earthquakes with:

A. F-P ≥ 30 s. F-P is signal duration (see section on magnitude).

or

B. F-P ≥ 15 s **and** S-P ≤ 5 s.

October 1, 1974 - January 31, 1975

Time all local events in network with F-P ≥ 20 s.

February 1, 1975 - September 31, 1977

Time all shocks with:

A. WEST (west of 150°W): F-P ≥ 80 s.

B. CENT (between 150°W and 145°W): F-P ≥ 20 s.

C. EAST (east of 145°W): All events with 3 clearly recorded P-arrivals **and** 1 S-arrival **or** 4 P-arrivals.

October 1, 1977 - September 31, 1980

Time all shocks within the area 58-64°N and 134-156°W (eastern border moved to 134°W from 136°W) with:

A. WEST: F-P ≥ 80 s.

B. CENT: F-P ≥ 20 s.

C. EAST: All events with 3 clearly recorded P-arrivals **and** 1 S-arrival **or** 4 P-arrivals on SCAN **and/or** EAST films.

October 1, 1980 - June 30, 1981

Time all shocks within the area 58-64°N and 134-156°W with:

A. WEST (West of 145°W): F-P ≥ 30 s (WEST and CENT regions combined)

B. EAST: All events with 3 clearly recorded P-arrivals **and** 1 S-arrival **or** 4 P-arrivals on SCAN **and/or** EAST films.

July 1, 1981 - September 30 ,1981

Time all shocks within the area 58-64°N and 134-156°W with:

A. WEST: F-P ≥ 30 s.

B. EAST:

1. All events with 3 clearly recorded P-arrivals **and** 1 S-arrival or 4 P-arrivals on SCAN film only.

or

2. If an event has a coda on the SCAN film F-P ≥ 10 s but does not have 4 P's or 3 P's **and** 1 S, check the EAST film for additional arrivals and time if have 4 P's **or** 3 P's **and** 1 S on SCAN **plus** EAST.

or

3. If at any time less than five stations are operating east of 145°W use both SCAN **plus** EAST films to see if have 4 P-arrivals **or** 3 P-arrivals **and** 1 S-arrival.

December 1, 1980 - May 31, 1989

No rereads on magnitude M < 1.0 events unless solution is unacceptable.

October 1, 1981 - March 31, 1984

Network borders for timing reduced to decrease the number of earthquakes processed per month. Northern border moved from 64°N to 63°N. Less emphasize placed on rereading events between latitude 58-59°N and longitude 134-138°W.

Time all shocks within the area 58-63°N and 134-156°W with:

A. WEST: F-P ≥ 30 s.

B. EAST:

1. All events with 3 clearly recorded P-arrivals **and** 1 S-arrival **or** 4 P-arrivals on SCAN film only.

or

2. If an event has a coda on the SCAN film F-P ≥ 10 s but does not have 4 P's **or**

2. If an event has a coda on the SCAN film F-P ≥ 10 s but does not have 4 P's **or** 3 P's **and** 1 S, check the EAST film for additional arrivals and time if have 4 P's **or** 3 P's **and** 1 S on SCAN **plus** EAST.

or

3. If at any time less than five stations are operating east of 145°W use both SCAN **plus** EAST films to see if have 4 P-arrivals **or** 3 P-arrivals **and** 1 S-arrival.

April 1, 1984 - August 31, 1985

Time all shocks within the area 58-62.5°N (northern border moved from 63.0°N to 62.5°N) and 134-156°W with:

A. WEST: F-P ≥ 30 s.

B. EAST:

1. All events with 3 clearly recorded P-arrivals **and** 1 S-arrival **or** 4 P-arrivals on SCAN film only.

or

2. If an event has a coda on the SCAN film F-P ≥ 10 s but does not have 4 P's **or** 3 P's **and** 1 S, check the EAST film for additional arrivals and time if have 4 P's **or** 3 P's **and** 1 S on SCAN **plus** EAST.

or

3. If at any time less than five stations are operating east of 145°W use both SCAN **plus** EAST films to see if have 4 P-arrivals **or** 3 P-arrivals and 1 S-arrival.

C. Time any earthquake with S-P ≤ 2 s on SCAN film station except for AGA whose S-P time must be ≤ 1.75 s.

September 1, 1985 - May 31, 1989

Time all shocks within the area 58-62.5°N and 138-156°W (eastern borders moved from 134°W to 138°W due to major reduction of recordable stations in east) with:

A. WEST: F-P ≥ 30 s.

B. EAST:

1. All events with 3 clearly recorded P-arrivals **and** 1 S-arrival **or** 4 P-arrivals on SCAN film only.

or

2. If an event has a coda on the SCAN film F-P ≥ 10 s but does not have 4 P's **or** 3 P's **and** 1 S, check the EAST film for additional arrivals and time if have 4 P's **or** 3 P's **and** 1 S on SCAN **plus** EAST.

or

3. If at any time less than five stations are operating east of 145°W use both SCAN **plus** EAST films to see if have 4 P-arrivals **or** 3 P-arrivals **and** 1 S-arrival.

C. Time any earthquake with S-P ≤ 2 s on SCAN film station except for AGA whose S-P time must be ≤ 1.75 s.

Special Studies

1. Special study of microearthquakes around Anchorage.
Time all shocks with:

January 1, 1979 - December 31, 1979

A. S-P ≤ 13.5 s at KNK

and

B. P-arrival at SPU **or** MSP **or** SKL before TOA **and** VZW.

January 1, 1980 - March 31, 1984

A. S-P ≤ 10 s at PMS

and

B. at least one station other than PMS with a F-P coda above 1 cm pk-to-pk for at least 5 s.

April 1, 1984 - May 31,. 1989

A. S-P ≤ 5 s at PMS **or** SSN

and

B. At least one station other than PMS with a F-P coda above 1 cm pk-to-pk for at least 5 s.

2. Special criterion for reduction in timing of aftershocks of February 28, 1979 St. Elias earthquake.

April 1 - September 30, 1979

A. If CHX is operational **and** YAH **or** PIN is working, do not time shocks where:

1. CHX S-P < 6 s.

and

2. YAH **or** PIN F-P < 40 s (changed to 25 s for May - September).

and

3. GYO P-arrival ≤ 4 s before CHX P-arrival.

B. If CHX is not working but GYO is, do not time events where:

1. GYO S-P < 7 s.

and

2. YAH **or** PIN F-P < 25 s.

and

3. GYO P-arrival is before SSP P-arrival.

C. If CHX and GYO are out, do not time events where:

1. SSP and PIN P-arrivals are approximately the same time

and

2. SSP and PIN S-P < 10 s.

May 2-19, 1982

Special criterion for large aftershock sequence in St. Elias aftershock zone. Time only aftershocks with a measureable coda seen on SCAN film station or if YAH amplitude ≥ 20 mm pk-to-pk. This coda crtiteria only applied to shocks where YAH, WRG, and PIN were first three stations seen on SCAN and their S-P intervals were about 7 to 9 s.

April 1, 1984 - September 4, 1985

Do not locate events near Icy Bay with:

A. S-P ≤ 4 s at AGA (or S-P ≤ 5 s at CHX if AGA out)

and

B. F-P at YAH and PIN < 10 s. (or F-P < 8 s at AGA if YAH and PIN are dead)

3. Bradley Lake array on southern Kenai Peninsula

November 27, 1980 - January 31, 1981

Time any event with S-P ≤ 10 s at any Bradely Lake station (BRLK, BRNE, BRNW, BRSE, and BRSW).

February 1, 1981 - September 31, 1981

Time any shock with S-P ≤ 12 s at any Bradley Lake station.

October 1, 1981 - February 28, 1983

Time any shock with S-P ≤ 12 s at any Bradley Lake station excluding events which arrive at ILM or RDT before SLV, or BRNE, or BRSW, or BRSE.

March 1, 1983 - February 28, 1985

Time any earthquake with S-P ≤ 6 s at one of the Bradley Lake stations or SLV or SWD.

March 1, 1985 - September 19, 1986

Time all events with S-P ≤ 3.5 s at BRLK.

4. Cook Inlet volcanoes

July 1, 1981 - May 31, 1989

Time any earthquake with S-P ≤ 5 s at SPU, RDT, or ILM on SCAN film.

5. Aftershocks of August 14, 1984, Sutton m_b 5.7 event

September 11, 1984 - April 30, 1986

Time all earthquakes with GHO S-P ≤ 4 s **and** KNK F-P ≥ 8 s on SCAN film.

6. Knight Island in Prince William Sound

July 7, 1985 - August 31, 1985

Timed all earthquakes which:

A. Have O wt. P arrivals on KNI, LOU, GBY

and

B. KNI P-arrival is before GLI **and** MTU P-arrivals

and

C. GBY S-P ≤ 8 s.

and

D. A measurable coda on KNI **or** LOU **or** GBY **or** pk-to-pk amplitude ≥ 10 mm on all three stations (KNI, LOU, GBY).

September 1, 1985 - December 31, 1987

Time all shocks with KNI S-P ≤ 7 s **and** F-P ≥ 8 s.

7. Montague Island in southern Prince William Sound

September 1, 1985 - April 30, 1986

Time all events with MTU S-P ≤ 5 s.

8. Joint USGS/GIUA data set

January 1, 1989 - May 31 1989

Starting in 1989, the Geophysical Institute of the University of Alaska (GIUA), Fairbanks began recording 13 USGS stations along with their own network. The GIUA locates all events triggered on by their automatic detection and recording system regardless of magnitude or location. Consequently, the GIUA locates shocks within the USGS routine processing borders which would normally not be processed by the USGS. Duplicate readings from USGS stations taken by GIUA staff for earthquakes also processed by the USGS are weighted out.

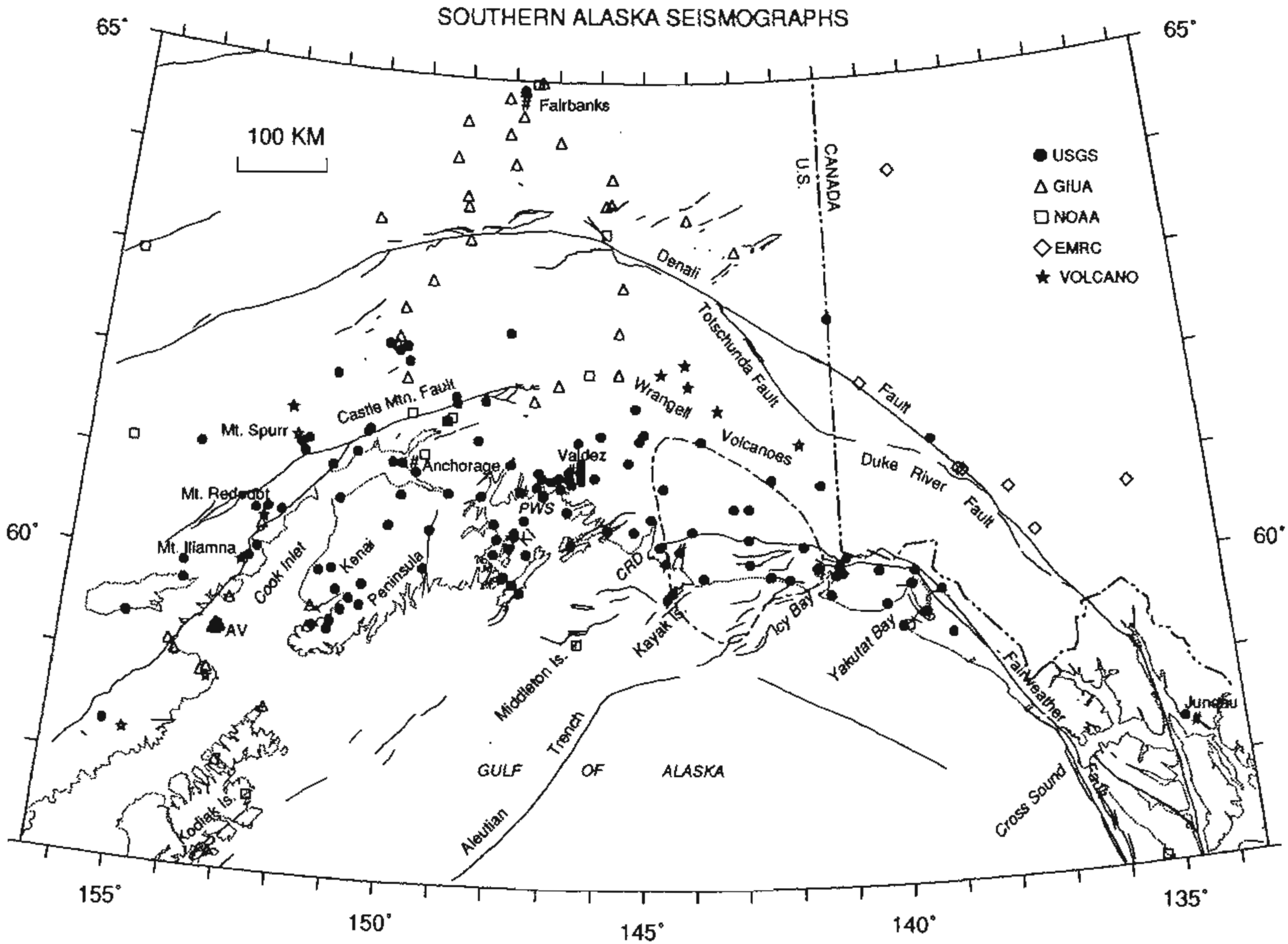

Figure 1. Map showing the locations of all USGS seismograph stations in southern Alaska along with stations operated by other institutions used in the prepartation of this catalog. Contour with alternating long and short dashes outlines inferred extent of Yakataga seismic gap. Neogene and younger faults (George Plafter, personal communication, 1988) are shown as solid lines. AV, Augustine volcano; CRD, Copper River Delta; KI, Knight Island; PWS, Prince William Sound. Quaternary volcanoes are indicated by stars.

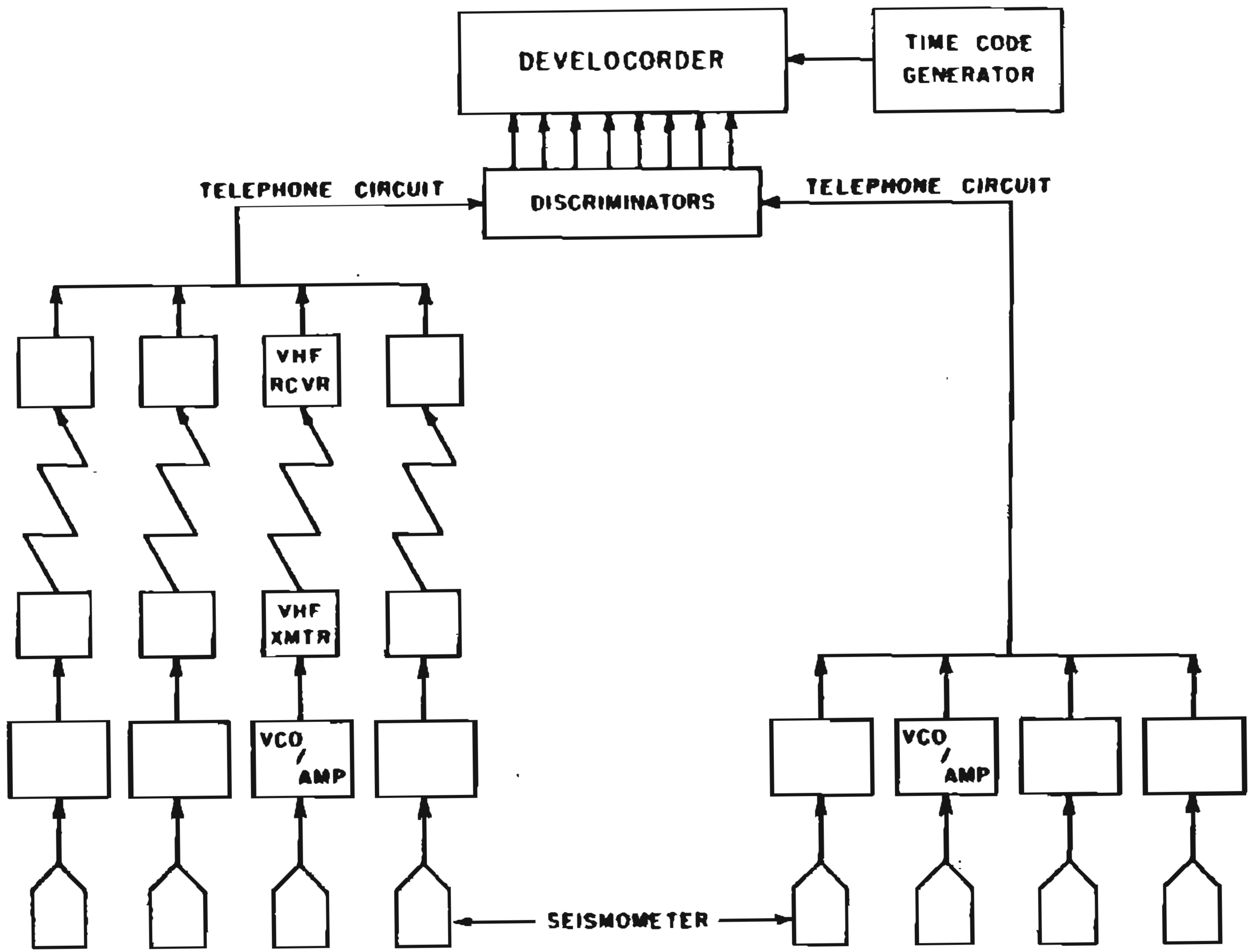

Figure 2. Block diagram of telemetered seismograph system in the USGS Alaska seismic network.

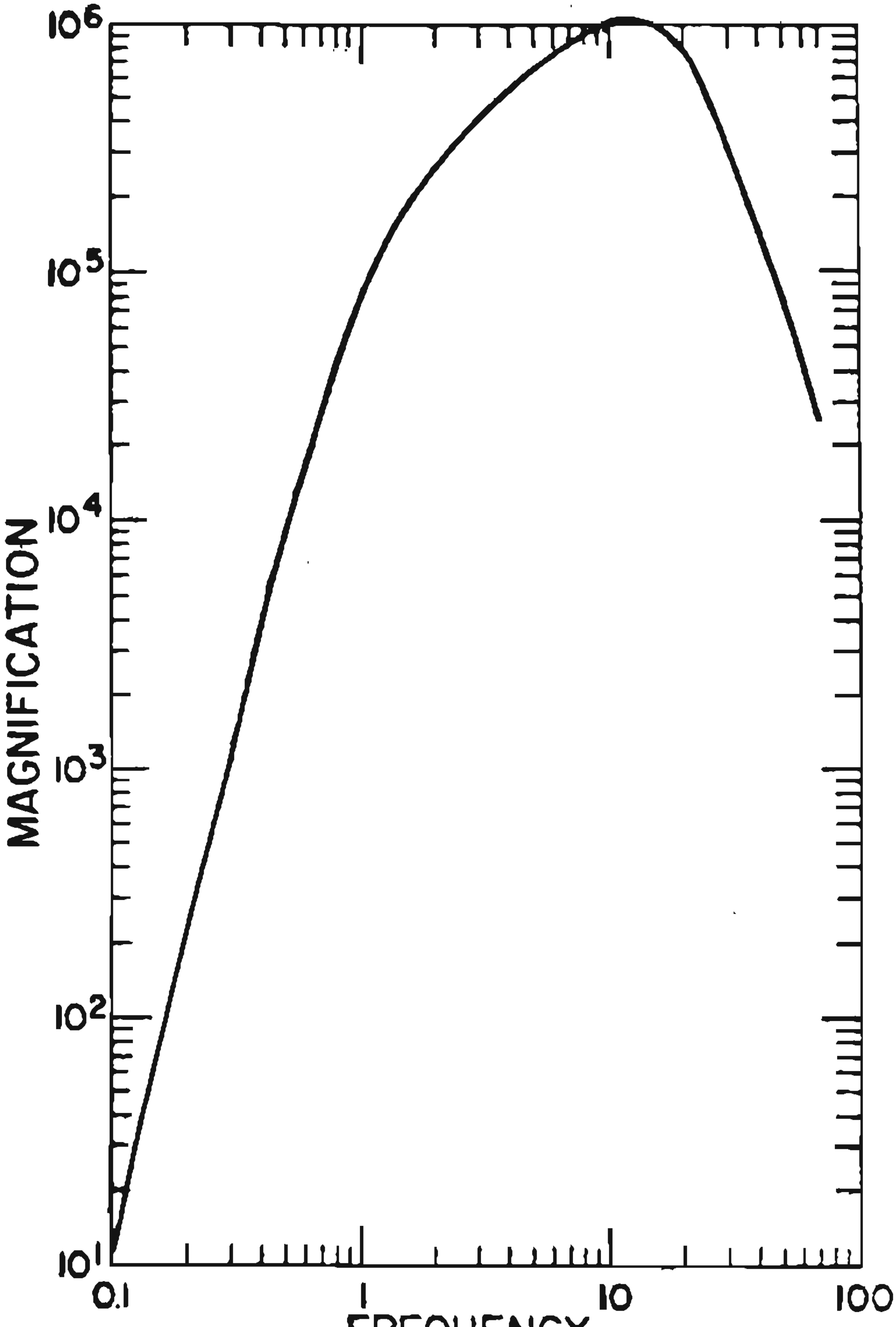

Figure 3. System response curve for typical USGS Alaska seismographs that incorporate the A1VCO unit.

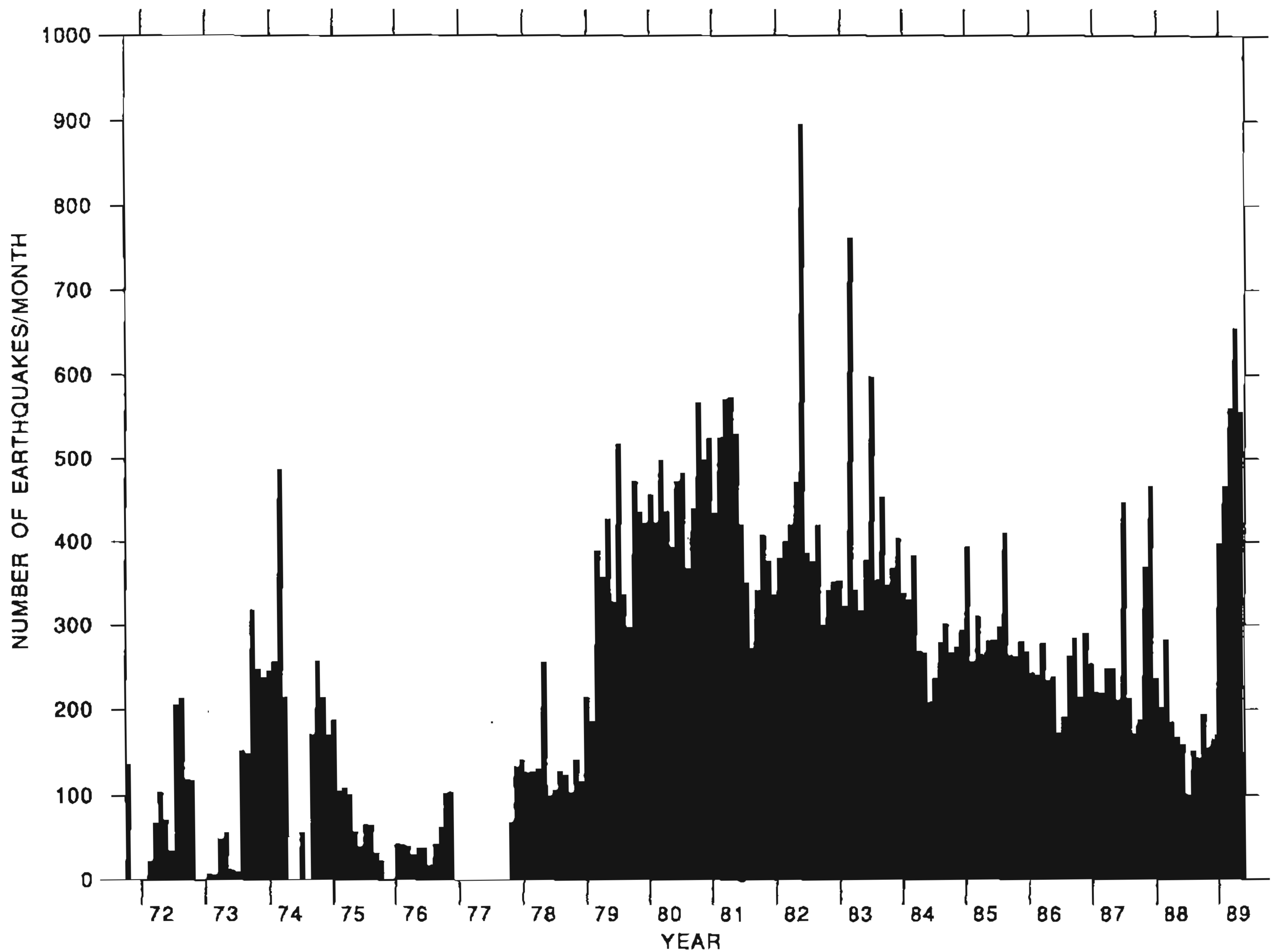

Figure 4. Histograph showing the number of earthquakes per month located by the network between October 1971 and May 1989.

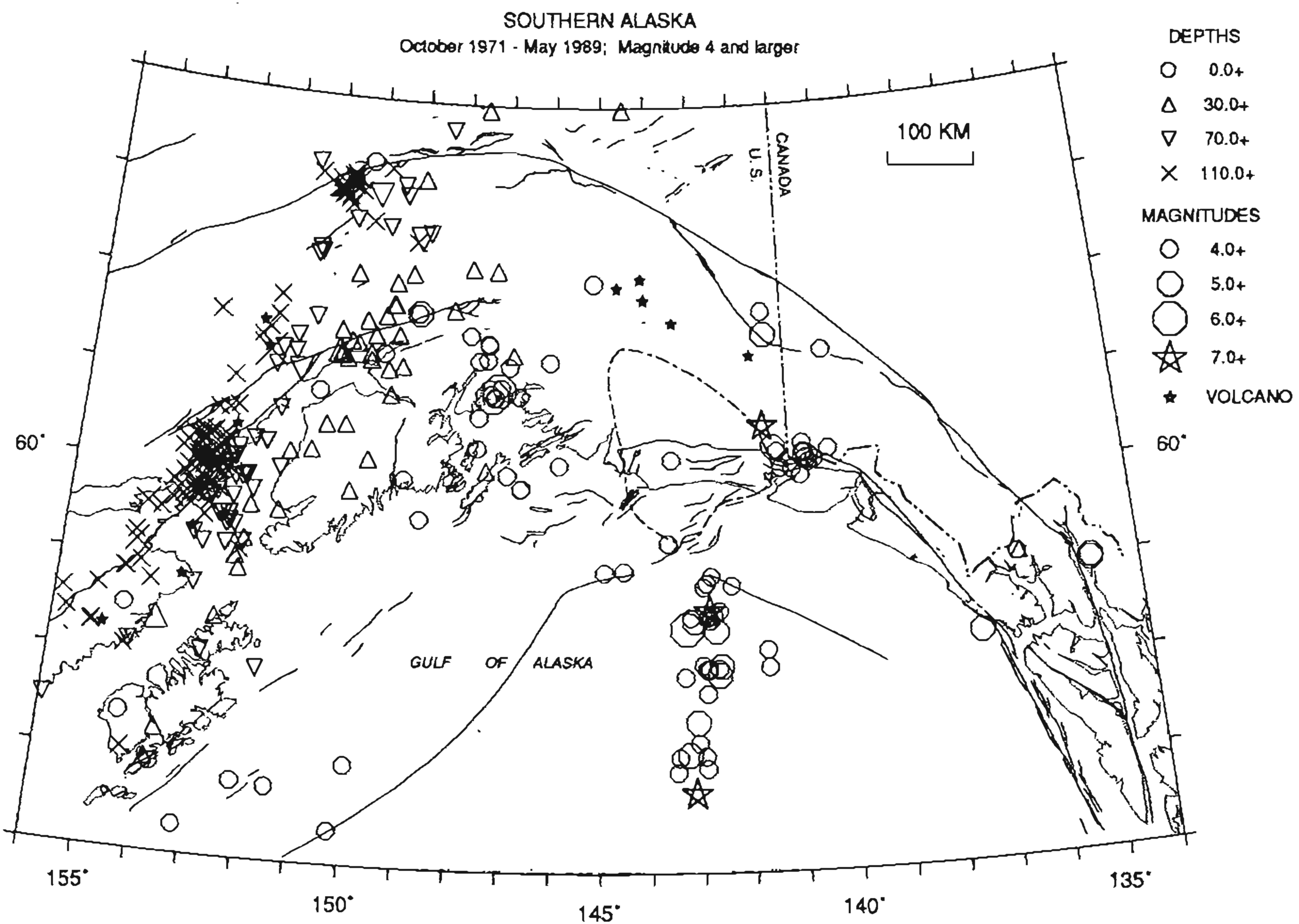

Figure 5. Epicenters of 307 earthquakes of magnitude of 4.0 or larger that occurred between October 1971 and May 1989. See Figure 1 for details about identification of map features.

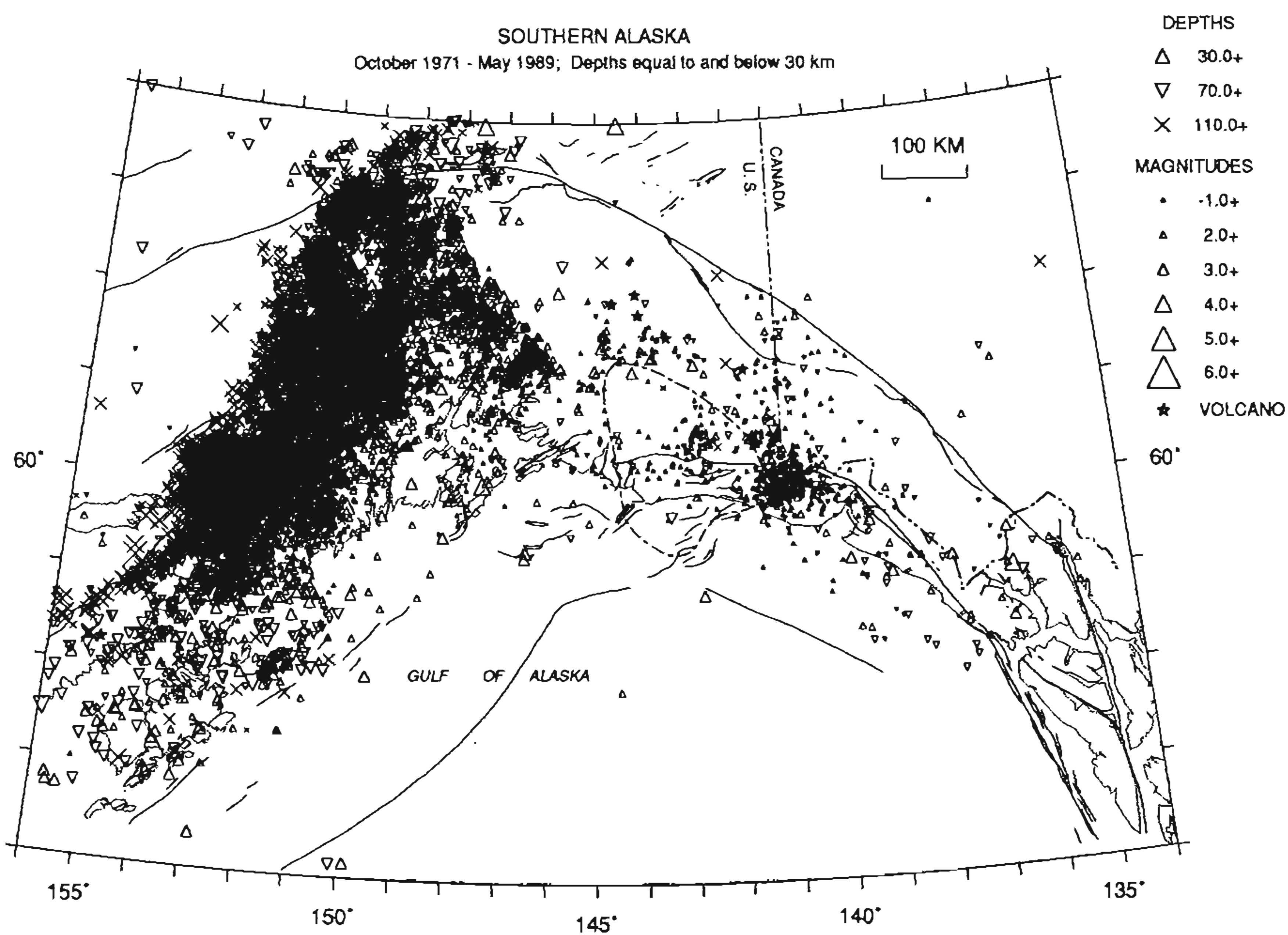

Figure 6. Epicenters of 14,013 earthquakes with depths equal to and below 30 km that occurred between October 1971 and May 1989.

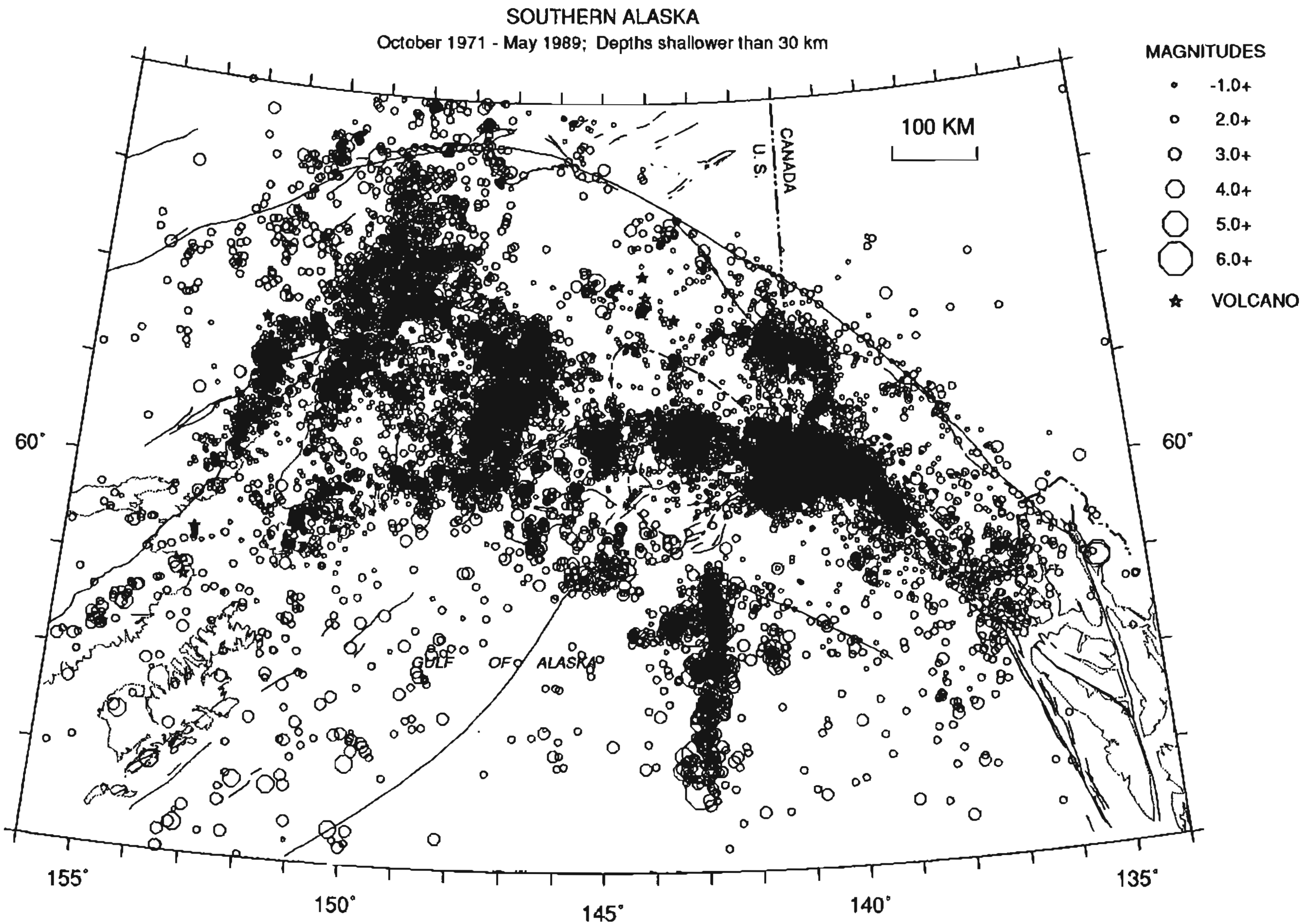

Figure 7. Epicenters of 35,225 earthquakes with depths shallower than 30 km that occurred between October 1971 and May 1989.

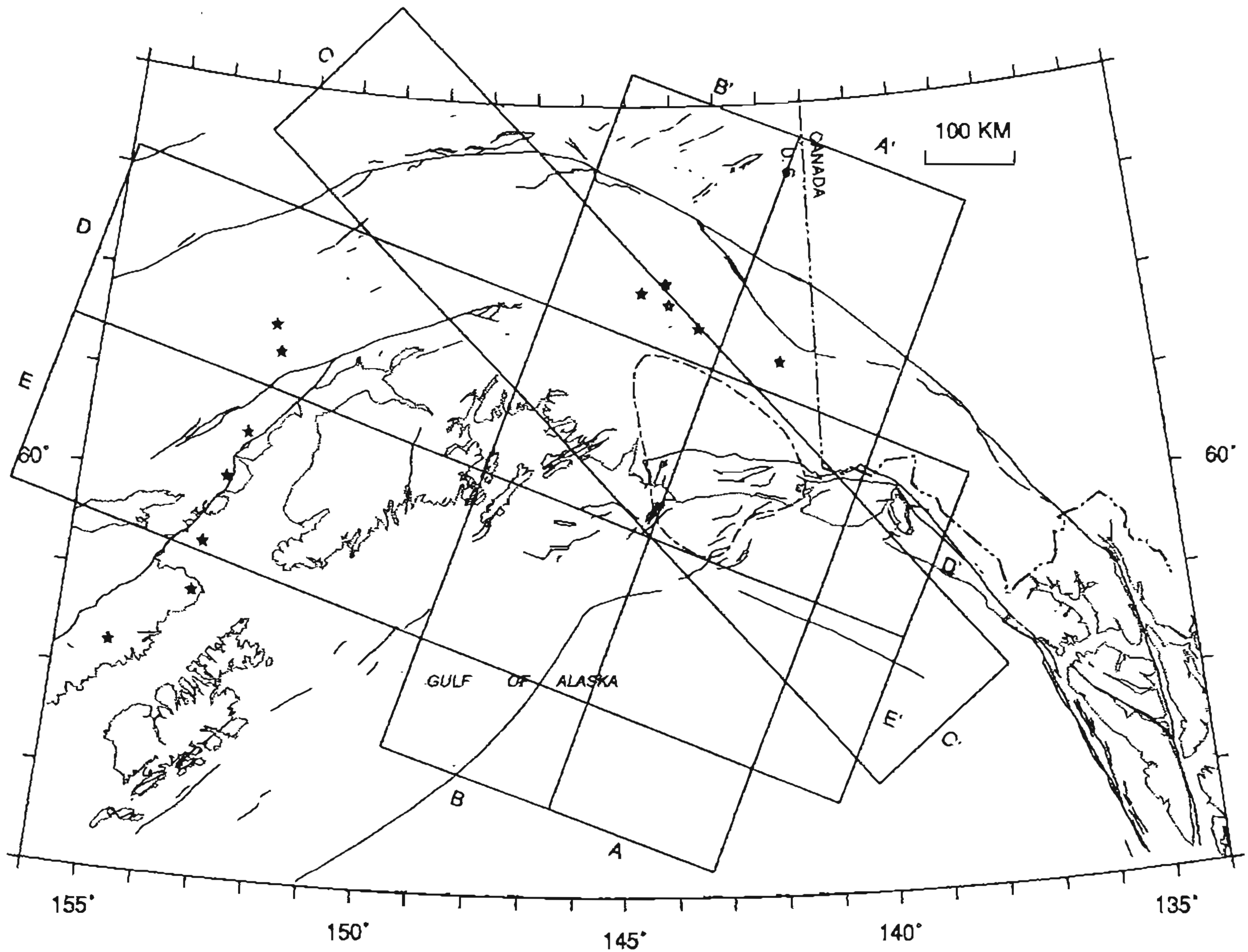

Figure 8. Reference map showing the areas represented in the cross sections in Figure 9.

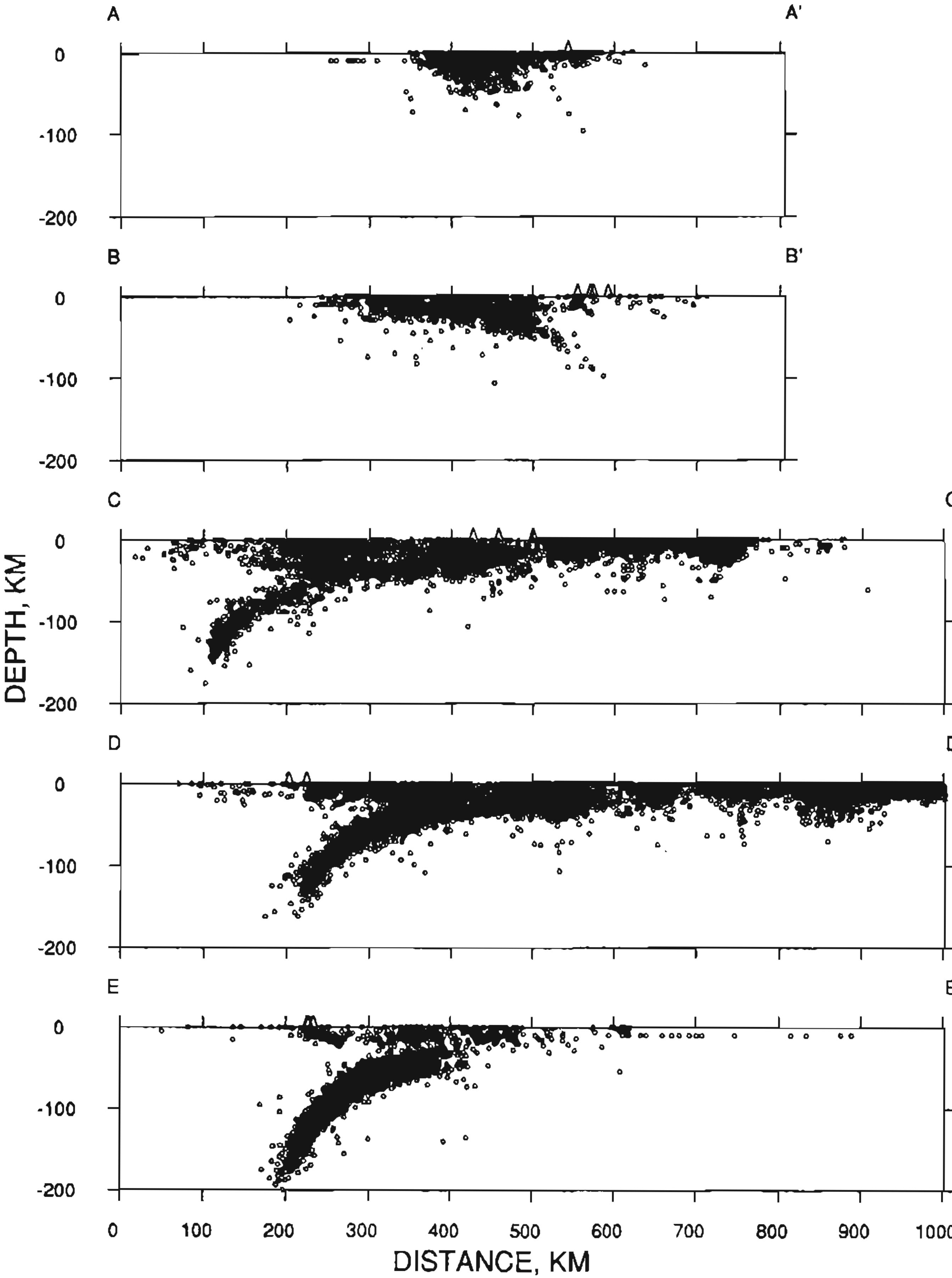

Figure 9. Sections of better-constrained hypocenters (SEH ≤ 5 km and SEZ ≤ 10 km) for areas indicated in Figure 8. Quaternary volcanoes plotted as triangles above zero depth. No vertical exaggeration.

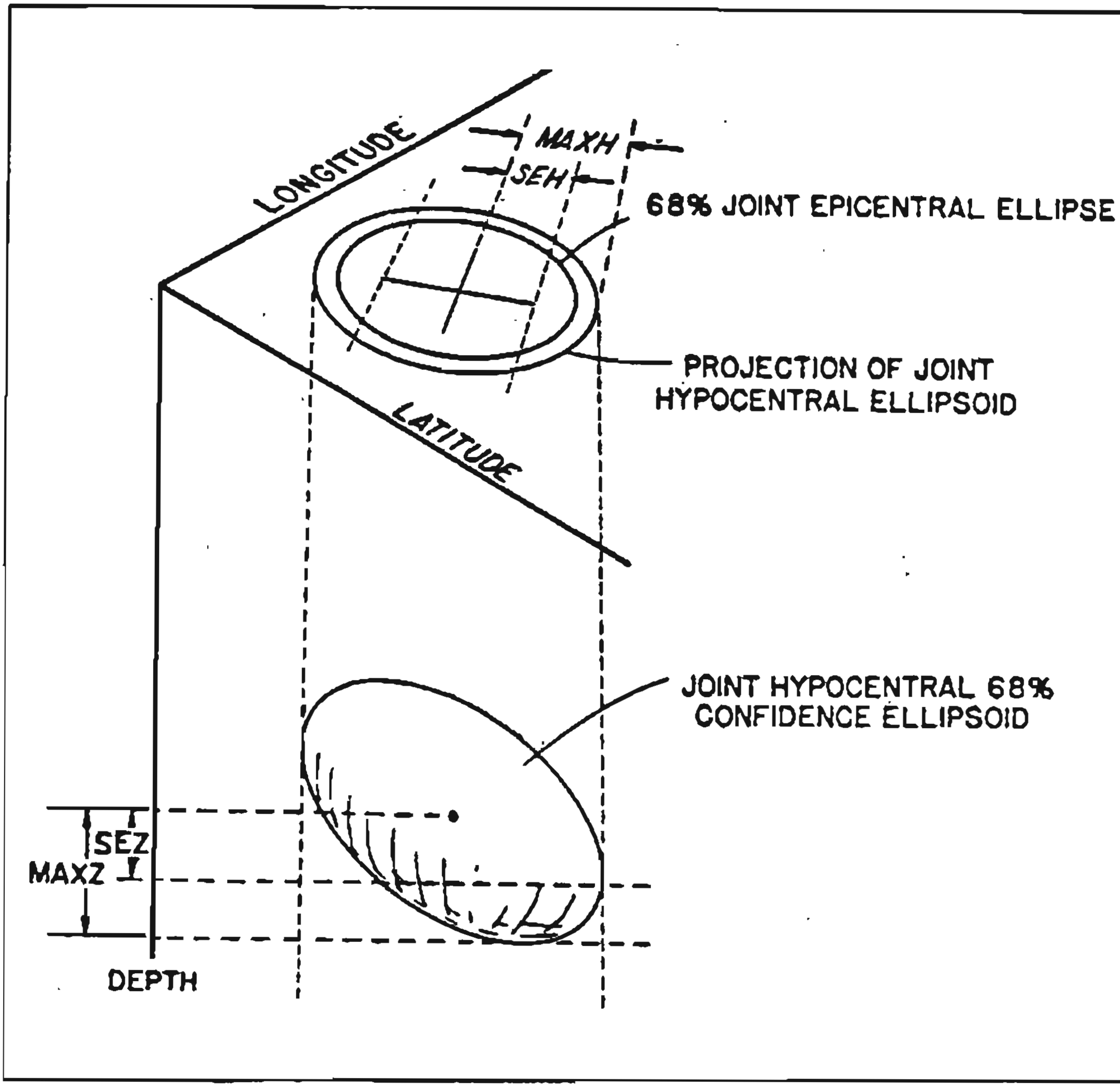

Figure 10. Relationship between the confidence ellipsoid and SEH, MAXH, SEZ, and MAXZ. The projected ellipse has the same orientation and eccentricity as the joint epicentral 68-percent confidence region, but is 1.23 times larger. The error ellipsoid is calculated assuming a constant standard deviation of 0.1 sec for the arrival time readings.