APPENDICES

ADAK ISLAND, ALASKA
MICROEARTHQUAKE SURVEY:
Preliminary Hypocenter Determinations

by
Arthur L. Lange & Walter Avramenko

Subcontract for
Earth Science Laboratory
University of Utah Research Institute
U.S. Department of Energy
Contract No. DE-AC07-80ID12079

5 November 1982

Arthur L. Lange

Arthur L. Lange,
Manager

MINCOMP
EXPLORATION RESOURCES
4175 Harlan Street
Wheat Ridge, Colorado
80033

APPENDIX I

APPROXIMATE HYPOCENTER SOLUTIONS

APPENDIX I

APPROXIMATE HYPOCENTER SOLUTIONS

A first order solution to microearthquake hypocenters can be obtained by assuming the earth to be a homogeneous half-space of constant velocity w. Determinations can then be made using either three or four arrival times. The calculations can be performed on a hand computer, such as the Casio FX-702-P, for which a program is supplied below.

Three-station method

This method requires that the absolute arrival times t_a, t_b, t_c, at three stations and the T_{sp} interval (t_s-t_p) at one station be known. These four pieces of information permit us to solve for the four unknowns; namely, the location and origin time of the disturbance

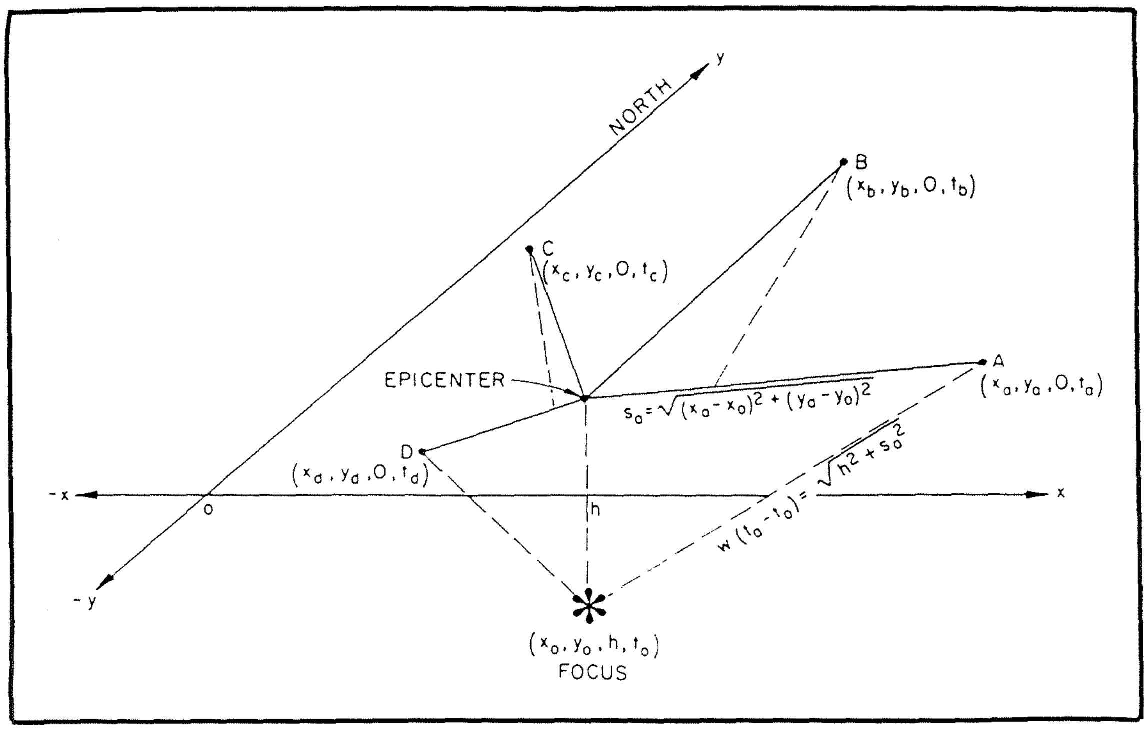


Figure A-1. Hypocenter location from the depth triangles of three or four stations.

(x_o, y_o, h_o, t_o). To do this we have the three depth triangle equations (Figure A-1)

$$w^2(t_a - t_o)^2 - h^2 = (x_a - x_o)^2 + (y_a - y_o)^2 \quad (1a)$$

$$w^2(t_b - t_o)^2 - h^2 = (x_b - x_o)^2 + (y_b - y_o)^2 \quad (1b)$$

$$w^2(t_c - t_o)^2 - h^2 = (x_c - x_o)^2 + (y_c - y_o)^2 \quad (1c)$$

and the equation relating the S-P time interval to origin time

$$t_o = t_a - \frac{T_{SP}}{0.7}. \quad (2)$$

Equations 1 may be used to find x_o, y_o by first eliminating h between any two of the three pairs of equations; for example, between Equations 1a and b, and between b and c. We then obtain two linear equations in x_o and y_o

$$x_o(x_a - x_b) + y_o(y_a - y_b) = k_1$$

$$x_o(x_c - x_b) + y_o(y_c - y_b) = k_2$$

where

$$2k_1 = x_a^2 - x_b^2 + y_a^2 - y_b^2 + w^2(t_b - t_o)^2 - w^2(t_a - t_o)^2$$

$$2k_2 = x_c^2 - x_b^2 + y_c^2 - y_b^2 + w^2(t_b - t_o)^2 - w^2(t_c - t_o)^2.$$

These equations together with Equation 2 can be used to solve for the epicenter coordinates x_o, and y_o. The solutions for x_o and y_o are

$$x_o = \frac{\begin{vmatrix} k_1 & (y_a - y_b) \\ k_2 & (y_c - y_b) \end{vmatrix}}{\det}, \qquad y_o = \frac{\begin{vmatrix} (x_a - x_b) & k_1 \\ (x_c - x_b) & k_2 \end{vmatrix}}{\det}.$$

Depth h is found by substituting these values back into any one of Equations 1 (all should give the same value); so that, finally

$$h = +\sqrt{w^2(t_a - t_o)^2 - (x_a - x_o)^2 - (y_a - y_o)^2}. \quad (3)$$

Four-station method

This method uses four arrival times at four stations of a network in order to determine the origin location and time of a seismic disturbance, x_o, y_o, h_o, t_o (Figure A-1). Again, as in Equation 1, we equate triangles, only now t_o remains an unknown. To the three parts of Equation 1 we add a fourth, in which the arrival time at a fourth station D is introduced:

$$w^2(t_d - t_o)^2 - h^2 = (x_d - x_o)^2 + (y_d - y_o)^2 \quad . \tag{1d}$$

If h^2 is eliminated between a and b, c and b, and d and b; the following three equations in x_o, y_o, and t_o result:

$$x_o(x_a - x_b) + y_o(y_a - y_b) + w^2 t_o(t_b - t_a) = k_1$$

$$x_o(x_c - x_b) + y_o(y_c - y_b) + w^2 t_o(t_b - t_c) = k_2$$

$$x_o(x_d - x_b) + y_o(y_d - y_b) + w^2 t_o(t_b - t_d) = k_3$$

where

$$2k_1 = x_a^2 - x_b^2 + y_a^2 - y_b^2 + w^2(t_b^2 - t_a^2) \ ,$$

$$2k_2 = x_c^2 - x_b^2 + y_c^2 - y_b^2 + w^2(t_b^2 - t_c^2) \ ,$$

$$2k_3 = x_d^2 - x_b^2 + y_d^2 - y_b^2 + w^2(t_b^2 - t_d^2) \ .$$

The solution is

$$x_o = \frac{\begin{vmatrix} k_1 & (y_a - y_b) & w(t_b - t_a) \\ k_2 & (y_c - y_b) & w(t_b - t_c) \\ k_3 & (y_d - y_b) & w(t_b - t_d) \end{vmatrix}}{\det} \ ,$$

$$y_o = \frac{\begin{vmatrix} (x_a - x_b) & k_1 & w(t_b - t_a) \\ (x_c - x_b) & k_2 & w(t_b - t_c) \\ (x_d - x_b) & k_3 & w(t_b - t_d) \end{vmatrix}}{\det} \ ,$$

$$t_o = \frac{\begin{vmatrix} (x_a - x_b) & (y_a - y_b) & k_1 \\ (x_c - x_b) & (y_c - y_b) & k_2 \\ (x_d - x_b) & (y_d - y_b) & k_3 \end{vmatrix}}{w(\det)}$$

and h is computed from any of the Equations 1; for example 1d.

Discussion of the Methods

The epicenters determined by the three- and four-station methods, which rely heavily on absolute arrival time information, are least subject to errors from refractive effects along the wave paths and faulty assumptions concerning the wave velocity, w. For example, with the four-station method, we could vary w by a factor of 10 and a calculated epicenter location within the station net would not shift by more than one or two kilometers. The calculated depth is very dependent on

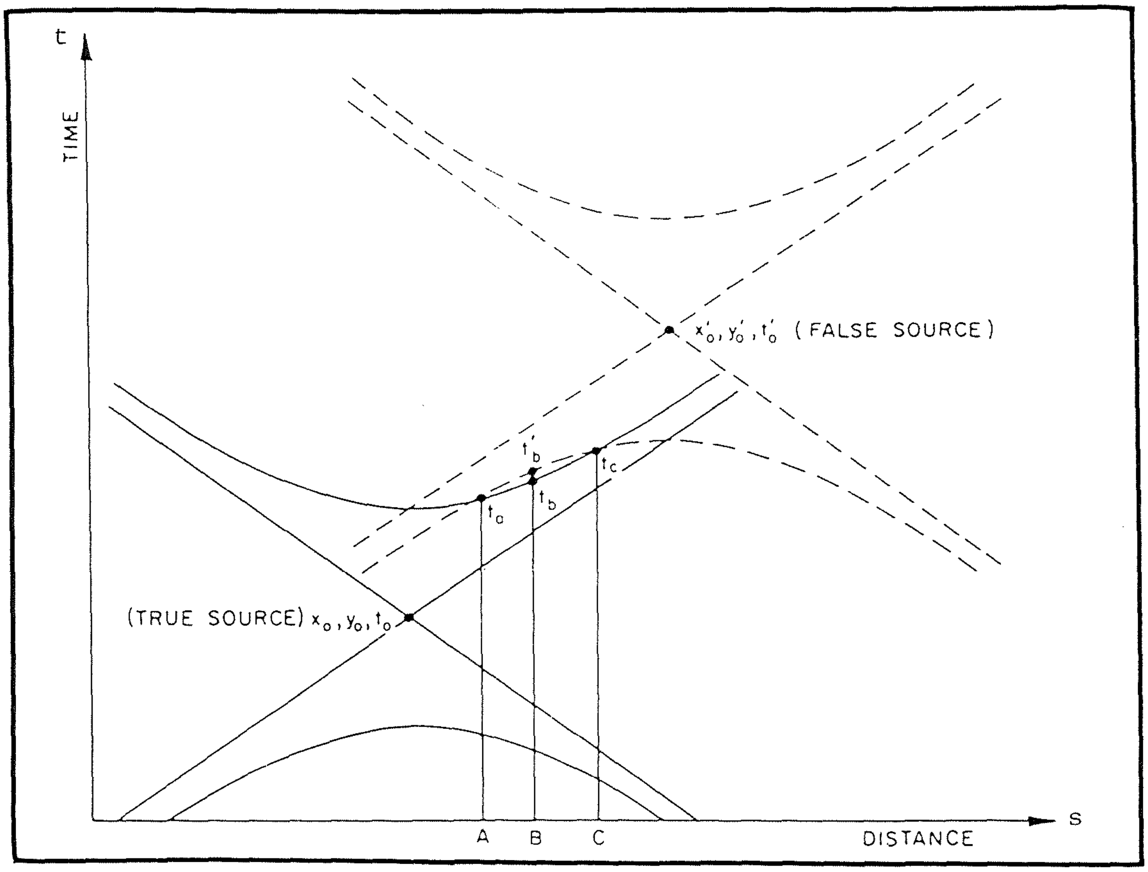


Figure A-2. Arrival times vs. distance from a source. Times t_a, t_b, t_c at stations A, B, and C, respectively, define a hyperbola whose center, or source origin, occurs earlier. A slight deviation in time at B defines a different hyperbola having an origin later. The latter if a false origin due to imperfect data at one station.

the velocity assumption, however. The epicenters calculated by the three-station method are slightly more sensitive to velocity than those calculated by the four-station method.

Under certain circumstances, results from the four-station method display a curious behavior. Some calculated epicenters may appear displaced from those determined by the three-station method, and may yield origin times later than the arrival times at the stations. That is, the wave appears to arrive there before the event took place. The problem lies in the choice of stations surrounding the epicentral region, when the emanating wavefront intercepts three of the stations almost simultaneously. Equations 1 and 2 define a hyperboloid around a time axis having x_o, y_o, t_o as the <u>center</u> of the figure. If the time axis is drawn vertically upward, through x_o, y_o, the hyperboloid surface is concave upward (Figure A-2). Its curvature, and hence center are well defined, provided the time differences between stations are substantial; when small, slight delays in arrival times or errors in reading arrivals change the curvature and shift and hyperboloid center in space and time. If one time reading inverts the curvature from concave upward to concave downward, the epicenter shifts drastically, and the time of origin appears to postdate the arrivals. The problem is analogous to locating the center of a circle given three points on its circumference. If the three points form nearly a straight line, the shift of one of them ever so slightly can invert the circle. From this experience we learn that it is best to avoid a symmetrical station arrangement around a suspected epicentral region. The three-station method is less sensitive to station symmetry because the origin time is not determined from the absolute arrival times.

<u>Use of the Hypocenter program</u>

The hypocenter program is written for a Casio FX-702P hand computer and its FP-10 printer. This system fits easily into an attache case for convenient field use. Programs can be stored on any available cassette recorder, by means of the FA-2 interface. The program computes hypocenters of events on any four of 10 stations whose coordinates have been entered into memory. A constant velocity model is used for the computation.

<u>Step 1:</u> In RUN mode with the printer connected, the program asks for your data-entry selection, as follows:

To enter station coordinates:	X,Y	Type 0
To enter arrival times:	T	Type 1
To enter velocity:	V	Type 2

Initially, one must enter station coordinates; hence "2" is typed.

<u>Step 2:</u> The program then requests the number of stations, and in this example, "6" is entered. Coordinates in kilometers for up to 10 stations may then be entered for the appropriate index number as it appears (0 = 10); unused station numbers may be entered as 0,0.

<u>Step 3:</u> "VEL = ?" appears. Enter velocity in km/sec.

Step 4: The program asks for the station numbers and arrival times in decimal seconds for the four sites to be used in the calculation. Any combination of 4 stations may be used. Here Station A is Station 1, B is 2, etc.

Step 5: The program then outputs the hypocenter coordinates and origin time. If a real solution is not possible, it prints a series of 9's for depth.

Step 6: At this point, you are asked if you wish to enter a new set of times (1), a new velocity (2) or new coordinates (3) and the program then returns to the proper point in the calculations.

Hypocenter program

Program listing

```
READY P0
LIST
  1 WAIT 30
  2 MODE 7
  3 PRT "HYPOCENTER
    S"
  4 SET N
 10 INP "ENTER X,Y:
    0; T:1; V:2",C
 11 IF C=1 THEN 56
 12 IF C=2 THEN 48
 22 INP "NO.OF STAS
    ",U
 23 PRT
 24 PRT " I     X
       Y"
 30 FOR I=0 TO U-1
 31 MODE 8
 34 PRT "X";I;"="
 36 INP A(I)
 40 PRT "Y";I;"="
 42 INP A(I+10)
 43 MODE 7
 45 PRT I;###.###;A
    (I);A(I+10)
 46 NEXT I
 48 PRT
 50 INP "VEL= ",W
 52 V=W*W
 54 PRT "VEL= ";W;#
    #.###;"KM/SEC"
 56 PRT
 62 INP "ST.A",I,"
    T=",A
 64 E=A(I):M=A(I+10
    )
 66 INP "ST.B",I,"
    T=",B
 68 F=A(I):N=A(I+10
    )
 70 INP "ST.C",I,"
    T=",C
 72 G=A(I):O=A(I+10
    )
 74 INP "ST.D",I,"
    T=",D
 76 H=A(I):P=A(I+10
    )
 80 J=(E↑2-F↑2+M↑2-
 81 K=(G↑2-F↑2+O↑2-
    N↑2+V*(B↑2-C↑2)
    )/2
 82 L=(H↑2-F↑2+P↑2-
    N↑2+V*(B↑2-D↑2)
    )/2
 90 Q=C:A=B-A:C=B-D
    :B=B-Q
 92 Q=G:E=E-F:G=H-F
    :F=Q-F
 94 Q=O:M=M-N:O=P-N
    :N=Q-N
100 Q=E*(N*C-O*B)
102 R=M*(F*C-G*B)
104 S=A*(F*O-G*N)
106 I=(Q-R+S)*W
120 Q=J*(N*C-O*B)
122 R=M*(K*C-L*B)
124 S=A*(K*O-L*N)
126 X=(Q-R+S)*W/I
130 Q=E*(K*C-L*B)
132 R=J*(F*C-G*B)
134 S=A*(F*L-G*K)
136 Y=(Q-R+S)*W/I
140 Q=E*(N*L-O*K)
142 R=M*(F*L-G*K)
143 S=J*(F*O-G*N)
144 T=(Q-R+S)/W/I
150 Z=V*(D-T)↑2-(H-
    X)↑2-(P-Y)↑2
152 IF Z≥0 THEN 160
153 Z=9999↑2
160 Z=SQR Z
199 SET F2
200 PRT "X0=";X
202 PRT "Y0=";Y
204 PRT "Z0=";Z
205 SET F3
206 PRT "T0=";T
207 SET N
208 PRT
300 INP "NEW T: 1;
    V: 2; XY:3",Q
302 IF Q=3 THEN 22
304 IF Q=2 THEN 48
306 IF Q=1 THEN 56
400 END
```

Example

```
HYPOCENTERS
ENTER X,Y:0; T:1; V:
2?
0
NO.OF STAS?
6

 I    X      Y
 0  1.000  3.000
 1  0.500  3.000
 2  2.700  0.000
 3  4.000  2.700
 4  3.600  3.300
 5  9.900  6.600

VEL= ?
4
VEL=  4KM/SEC

ST.A?
1
 T=?
2.736
ST.B?
2
 T=?
3.008
ST.C?
3
 T=?
2.642
ST.D?
4
 T=?
2.561
X0= 2.60
Y0= 3.50
Z0= 1.99
T0= 2.081
```

Table A-1. Principal facts for local events.

Event	Date	Sta	UTC Time	Epicenter (Grid units) X	Y	Focal Depth km	Origin Time
1	11-Sp	1	0258:29.9	65.6	82.5	10.5	0258:27.7
		4	:30.2				
		5	:30.45				
		7	:30.5				
2	11-Sp	6	1930:03.1	no rational solution			
		7	:03.35				
		5	:03.6				
		4	:03.8				
		9	:04.05				
		1	:04.15				
		2	:04.25				
3	11-Sp	7	1932:19.1	no rational solution			
		5	:19.5				
		4	:19.7				
		9	:20.0				
		1	:20.2				
4	12-Sp	2	0608:23.5	48.3	87.5	5.4	0608:22.2
		9	:23.8				
		4	:24.0				
		3	:24.05				
5	12-Sp	1	1640:48.4	74.8	74.2	2.7	1640:46.9
		9	:48.5				
		4	:48.8				
		5	:49.0				
6	15-Sp	4	0002:32.2	no rational solution			
		5	:32.3				
		7	:32.4				
		8	:33.4				
		3	:34.0				
7	15-Sp	4	0438:24.95	50.4	57.6	3.9	0438:24.2
		9	:25.0				
		5	:25.25				
		7	:25.2				
8	15-Sp	4	0450:23.4	47.9	58.7	1.8	0450:23.0
		9	:23.5				
		7	:23.7				
		5	:23.95				
9	15-Sp	4	1007:48.0	46.5	58.3	5.4	1007:46.9
		9	:48.05				
		7	:48.1				
		5	:48.3				
10	20-Sp	1	0615:36.0	56.3	67.7	5.8	0615:34.8
		4	:36.05				
		5	:36.35				
		6	:36.5				
11	20-Sp	1	1345:31.4	46.6	70.1	4.8	1345:30.4
		4	:31.5				
		7	:31.65				
		5	:32.0				
12	20-Sp	2	1534:59.2	64.5	78.5	4.0	1534:58.4
		1	:59.35				
		4	:59.8				
		8	:59.4				
13	21-Sp	6	1735:41.0	no rational solution			
		4	:41.1				
		7	:41.15				
		5	:41.5				
		1	:41.75				
		3	:41.85				
		8	:42.0				

Event	Date	Sta	UTC Time	Epicenter (Grid units) X	Y	Focal Depth km	Origin Time
14	25-Sp	2	0514:13.8	31.4	118.3	34.5	0514:06.6
		4	:14.05				
		8	:14.05				
		5	:14.35				
15	27-Sp	1	0456:03.0	74.1	110.0	14.6	0455:59.5
		4	:03.5				
		3	:03.32				
		5	:03.8				
16	27-Sp	2	0456:22.8	62.9	92.9	9.4	0456:20.9
		9	:23.2				
		4	:23.4				
		3	:23.27				
17	1-Oc	1	0637:06.4	56.6	75.0	4.0	0637:05.6
		9	:06.55				
		8	:06.6				
		5	:07.2				
18	2-Oc	9	0650:32.45	68.5	68.3	?	0650:32.1
		1	:32.6				
		4	:32.85				
		5	:33.1				
19	2-Oc	2	1524:19.0	65.8	72.3	2.2	1524:18.4
		9	:19.2				
		5	:19.75				
		7	:20.0				
20	2-Oc	3	2011:06.58	59.8	57.3	3.2	3011:05.9
		4	:06.7				
		5	:06.8				
		1	:07.05				
21	3-Oc	8	0017:08.1	76.6	62.7	7.3	0017:06.4
		5	:08.4				
		4	:08.45				
		7	:08.9				
22	3-Oc	2	0642:32.05	no rational solution			
		4	:32.4				
		5	:32.55				
		8	:32.55				
		1	:32.8				
		7	:33.05				
23	3-Oc	1	2116:41.65	86.9	113.2	19.1	2116:37.2
		9	:41.9				
		5	:42.3				
		7	:42.4				
24	4-Oc	5	1526:34.9	no rational solution			
		4	:35.05				
		9	:35.55				
		8	:36.0				
25	4-Oc	4	1912:05.15	56.8	55.9	1.4	1912:04.7
		3	:05.15				
		9	:05.2				
		5	:05.35				
26	2-Oc	1	1531:39.8	48.1	76.0	8.3	1531:38.1
		9	:39.9				
		4	:40.0				
		8	:40.05				
27	14-Sp	2	1938:46.9	68.9	81.6	5.2	1938:45.8
		1	:47.1				
		4	:47.55				
		7	:48.0				

Event	Date	Sta	UTC Time	Epicenter (Grid units) X	Y	Focal Depth km	Origin Time
28	15-Sp	2	1405:40.45	70.5	83.0	7.7	1405:38.8
		9	:40.8				
		4	:41.0				
		5	:41.25				
29	15-Sp	4	1614:39.05	50.9	53.5	1.0	1614:38.8
		5	:39.4				
		1	:39.85				
		3	:39.42				
30	25-Sp	1	1057:05.0	53.3	67.6	1.6	1057:04.4
		4	:05.1				
		8	:05.2				
		5	:05.8				
31	25-Sp	1	1124:53.3	no rational solution			
		8	:53.6				
		4	:53.7				
		9	:53.8				
		5	:54.0				
		3	:54.7				

APPENDIX II

LOGISTICS REPORT

MINCOMP EXPLORATION RESOURCES: Logistics Report August 29 to

Client UURI/USN PROJECT Adak ME Survey Week of September 4, 1982

	Day	Personnel	Task	Hrs	Comments
S	29	Walter Avramenko	Fly to San Francisco;	8	
			supply shopping		
M	30	Art Lange	Checkout on service	9	
		Walter Avramenko	and operation of		
			seismographs		
T	31	AL	Purchased needed	9	
		WA	supplies; air cargo;		
			Flew to Anchorage		
W	1	AL	Flew to Adak	10	
		WA			
Th	2	AL	Field recon work	10	Seismographs delayed
		WA			
F	3	AL	Checked potential	10	Seismographs arrived in
		WA	sites.		P.M.

Vehicle mileage for week: Mob/demob ______ mi.; Survey ______ mi.

	Day	Personnel	Task	Hrs	Comments
S	4	AL	5 seismographs placed in		
		WA	the field; other		
			instruments checked	10	

MINCOMP EXPLORATION RESOURCES: Logistics Report

Client UURI/USN PROJECT Adak ME Survey Week of September 5-11, 1982

	Day	Personnel	Task	Hrs	Comments
S	5	Art Lange	Remaining seismographs		
		Walter Avramenko	placed in field,		
			recording commenced	10	
M	6	AL	Relocated 1 instrument		
		WA	site; collected		
			recorded data.	10	
T	7	AL	Moved 2 instrument		
		WA	sites; collected		
			recorded data	12	
W	8	AL	Moved 1 instrument		
		WA	site; collected		
			recorded data.	11	
Th	9	AL	Field operations;		Art Lange returns to
		WA	collected, preserved		Denver, CO.
			recorded info.	10	
F	10	WA	Same as above	11	

Vehicle mileage for week: Mob/demob mi.; Survey mi.

S	11	WA	Same as above	11	

MINCOMP EXPLORATION RESOURCES: Logistics Report

Client UURI/USN PROJECT Adak ME Survey Week of September 12-18, 1982

	Day	Personnel	Task	Hrs	Comments
S	12	WA	Field operations,	11	
			recording info,		
			calculating, etc.		
M	13	WA	Same as above.	12	
T	14	WA	Same as above.	12	
W	15	WA	Same as above.	11	
Th	16	WA	Same as above.	11	Clam Lagoon seismograph
					damaged in early evening.
F	17	WA	Same as above.	10	

Vehicle mileage for week: Mob/demob mi.; Survey mi.

	Day	Personnel	Task	Hrs	Comments
S	18	WA	Day off.	0	

MINCOMP EXPLORATION RESOURCES: Logistics Report

Client UURI/USN PROJECT Adak ME Survey Week of September 19-25, 1982

	Day	Personnel	Task	Hrs	Comments
S	19	Walter Avramenko	Field operations:	10	
			gathering records,		
			recording info, calcultaions, etc.		
M	20	WA	Same as above.	11	
T	21	WA	Same as above.	10	
W	22	WA	Same as above.	10	
Th	23	WA	Same as above.	10	
F	24	WA	Same as above.	11	

Vehicle mileage for week: Mob/demob ____ mi.; Survey ____ mi.

	Day	Personnel	Task	Hrs	Comments
S	25	WA	Same as above.	10	

MINCOMP EXPLORATION RESOURCES: Logistics Report

Client UURI/USN PROJECT Adak ME Survey Week of September 26 to October 2, 1982

Day		Personnel	Task	Hrs	Comments
S	26	Walter Avramenko	Field operations; gathering records, recording info, calculations, etc.	11	
M	27	WA	Day off	0	
T	28	WA	Field operations	11	
W	29	WA	Same as above.	11	
Th	30	WA	Same as above.	10	
F	1	WA	Same as above.	10	

Vehicle mileage for week: Mob/demob mi.; Survey mi.

Day		Personnel	Task	Hrs	Comments
S	2	WA	Same as above.	10	

MINCOMP EXPLORATION RESOURCES: Logistics Report

Client UURI/USN PROJECT Adak ME Survey Week of October 3-9, 1982

	Day	Personnel	Task	Hrs	Comments
S	3	Walter Avramenko	Field operations	10	5.1 earthquake shakes the
			continued. Cape		the evening
			station pulled in.		
M	4	WA	Field operation:	12	
			all remaining stations		
			dismantled.		
T	5	WA	Cleaned and packed	10	
			all seismic equipment.		
W	6	WA	Packed remaining	9	
			equipment and delivered		
			to airport.		
Th	7	WA	Flew from Adak Island		
			to Anchorage, Alaska	10	
F	8	WA	Flew from Anchorage	13	
			to Denver, CO		

Vehicle mileage for week: Mob/demob ______ mi.; Survey ______ mi.

S					

APPENDIX III

INSTRUMENTATION

APPENDIX III

INSTRUMENTATION

Nine Sprengnether MEQ-800-RT seismographs, using smoked paper, were employed in the survey. Drum speeds employed were 60 and 120mm/sec and a stylus width of 0.05mm. Amplifier gains available were 60 to 120db. Cut-off filters could be selected at .2 (out), 5 and 10Hz on the low end and 10, 20, 30 and 100 Hz (out) on the high end. The response of the seismograph is shown in Figure C-1.

The seismographs contain internal clocks having a drift rate of less than ± 1 part in 10^7 or about ± 10msec per day. The clocks are triggered either directly from a WWV time signal or a portable clock previously set by WWV.

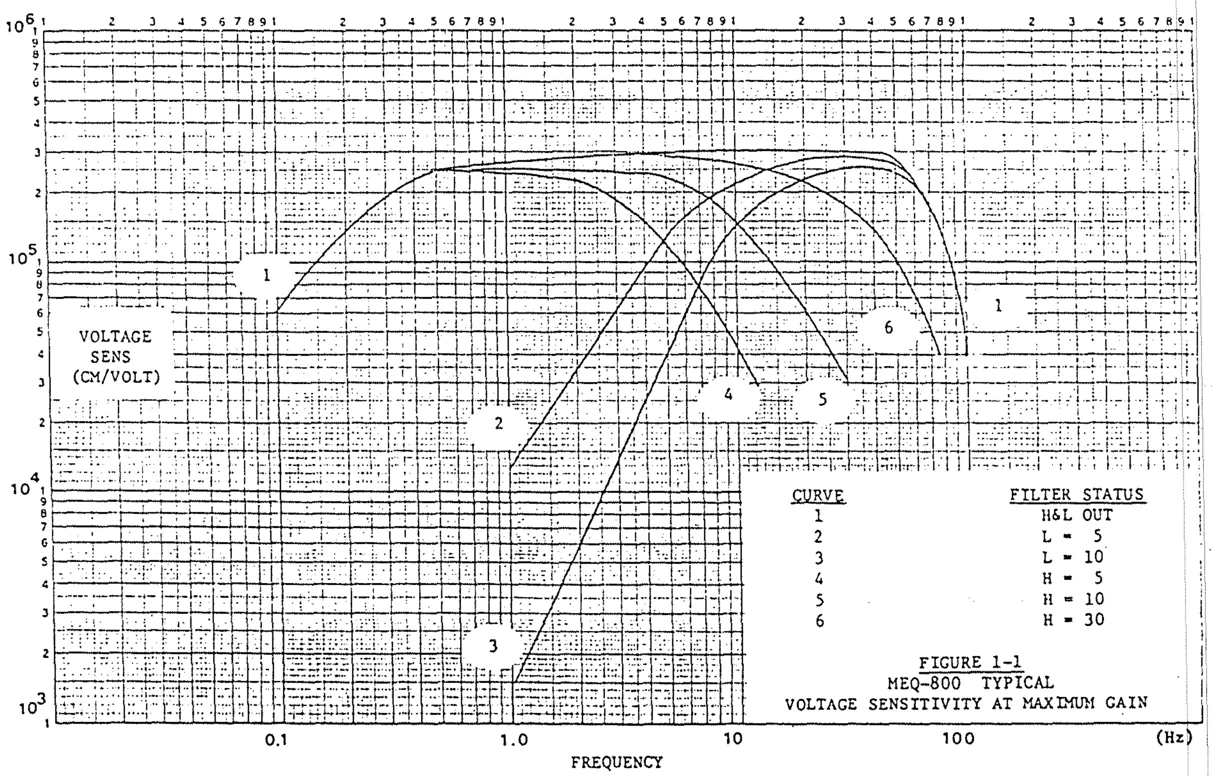


Figure C-1. Response of Sprengnether MEQ-800 system.

The portable clock employed was a Sprengnether Model TS-400 timing system. Its temperature-compensated crystal oscillator provides timing stability with an aging rate of 5×10^{-8}/mo. The clock was set each day using a Caringella WWVB Time Code Receiver.

Mark Products L4-C vertical component seismometers provided the signal input to the seismographs. This transducer has a one-Hertz natural frequency and open-circuit damping of 0.28 critical, with an output of 2.7 volts per cm/sec. It is equipped with an internal calibration coil. The response L4-C seismometer is shown in Figure C-2.

A list of equipment is provided in Table C-1. The equipment was supplied to Mincomp by Woodward-Clyde Associates of San Francisco. The

Table C-1. Inventory of seismograph equipment supplied for Adak microearthquake survey.

Quantity	Item, Model No.	Manufactuer	Serial No.
10	MEQ-800-RT Seismograph	Sprengnether/WCC	5246 5247 5351 5354 5496 5500 5501 6455 6458 6529
11	L4-C Seismometers	Mark Products	V2208 V2765 V2766 V3009 V3102 V3103 V3145 V3505 V3592 V3679 V3107
11	Seismometer Cables	Mark Products	none
11	External Power Cables	WCC	none
10	MEQ-800 Recorder Drums	Sprengnether	none
10	Carrying Cases with smoking kits and adjustment tools	Sprengnether	none
2	MEQ-800-59 Battery chargers	Sprengnether	none
2	WWVB Time Code Receiver	Caringella	none
6	Time Code Receiver Cable	Sprengnether	none
2	TS-400 Timing System	Sprengnether	145, 135
2	MEQ-800 User's Manual	Various	none
28	Battery Gell/Cel	Various	none
SPARE PARTS			
2	1/6 RPM Motor	Sprengnether	none
2	1 RPM Motor	Sprengnether	none
2	Motor-drive Amplifiers	Sprengnether	none
5	MEQ-800 Stylus	Sprengnether	none

supplier provided calibration records that accompany the seismograph records.

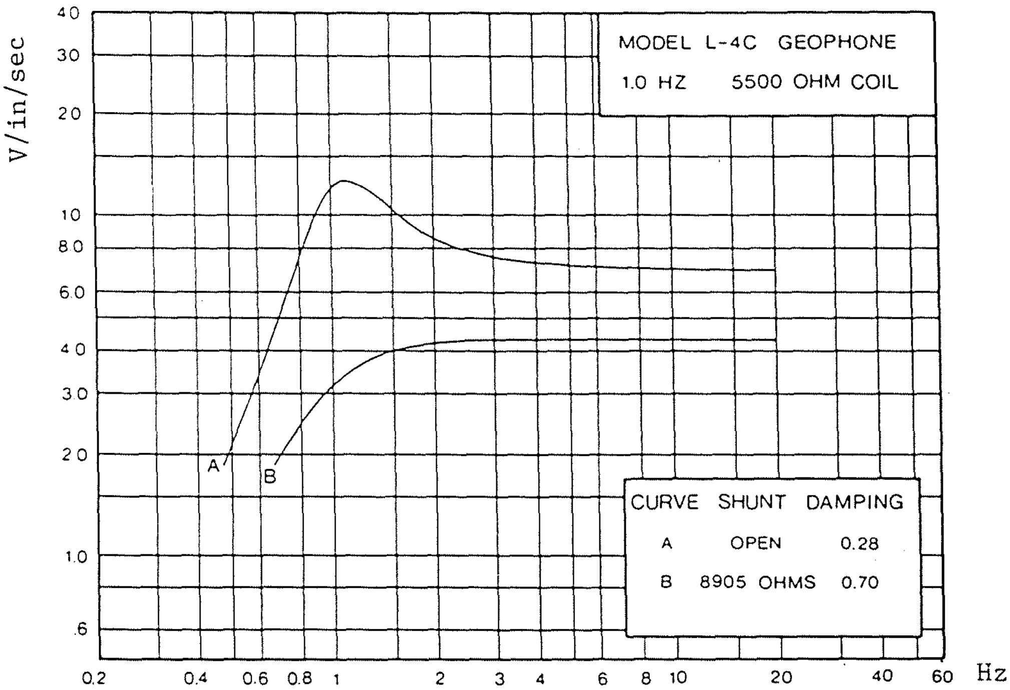


Figure C-2. Response of Mark Products L4-C seismometer.

APPENDIX IV

STATION RECORDING INTERVALS

APPENDIX IV

STATION RECORDING INTERVALS

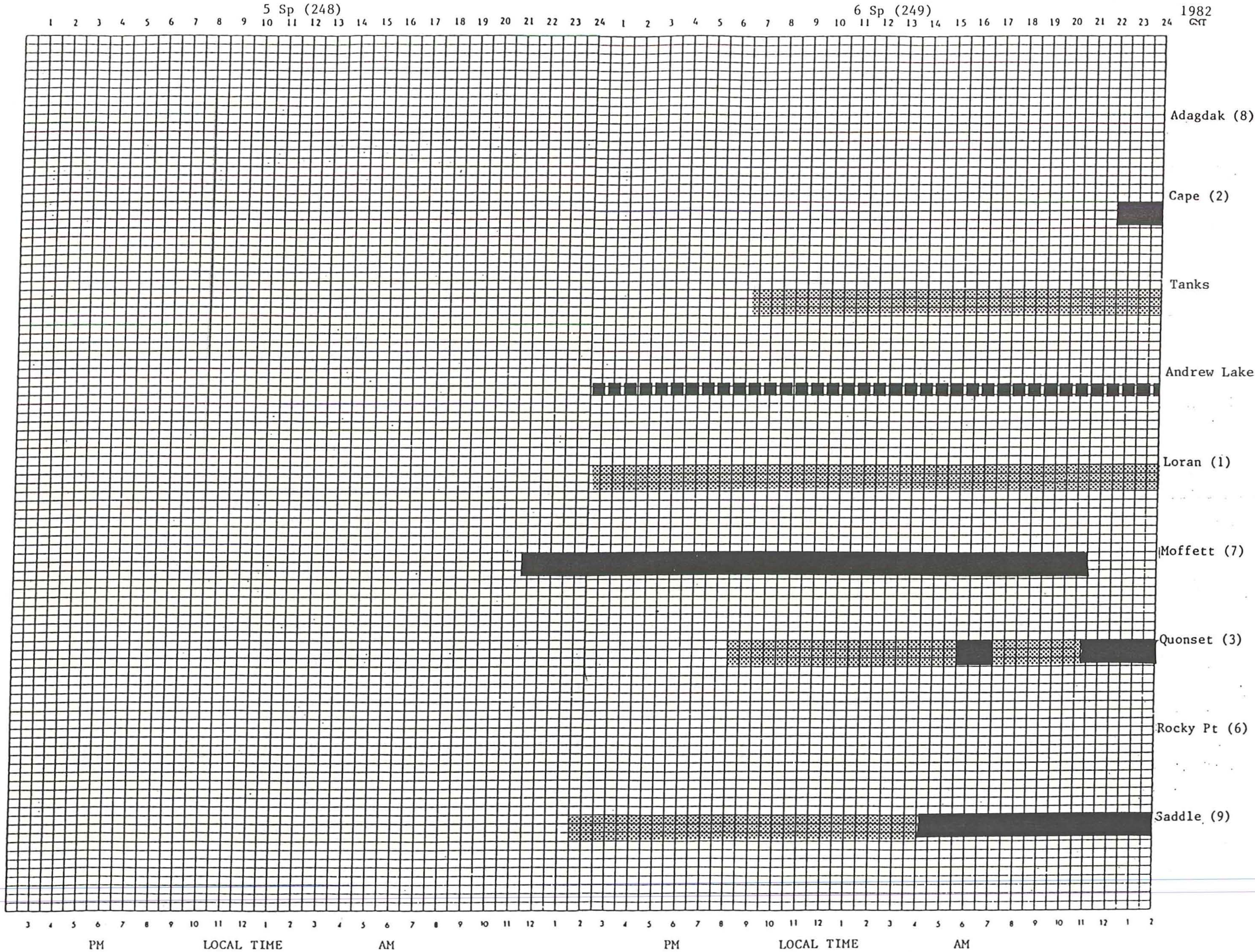
Times of operation of each of the seismograph stations is given in UTC (Greenwich) time as well as local time (Bering Daylight Time).

The following symbols are used for characterizing the nature of the records:

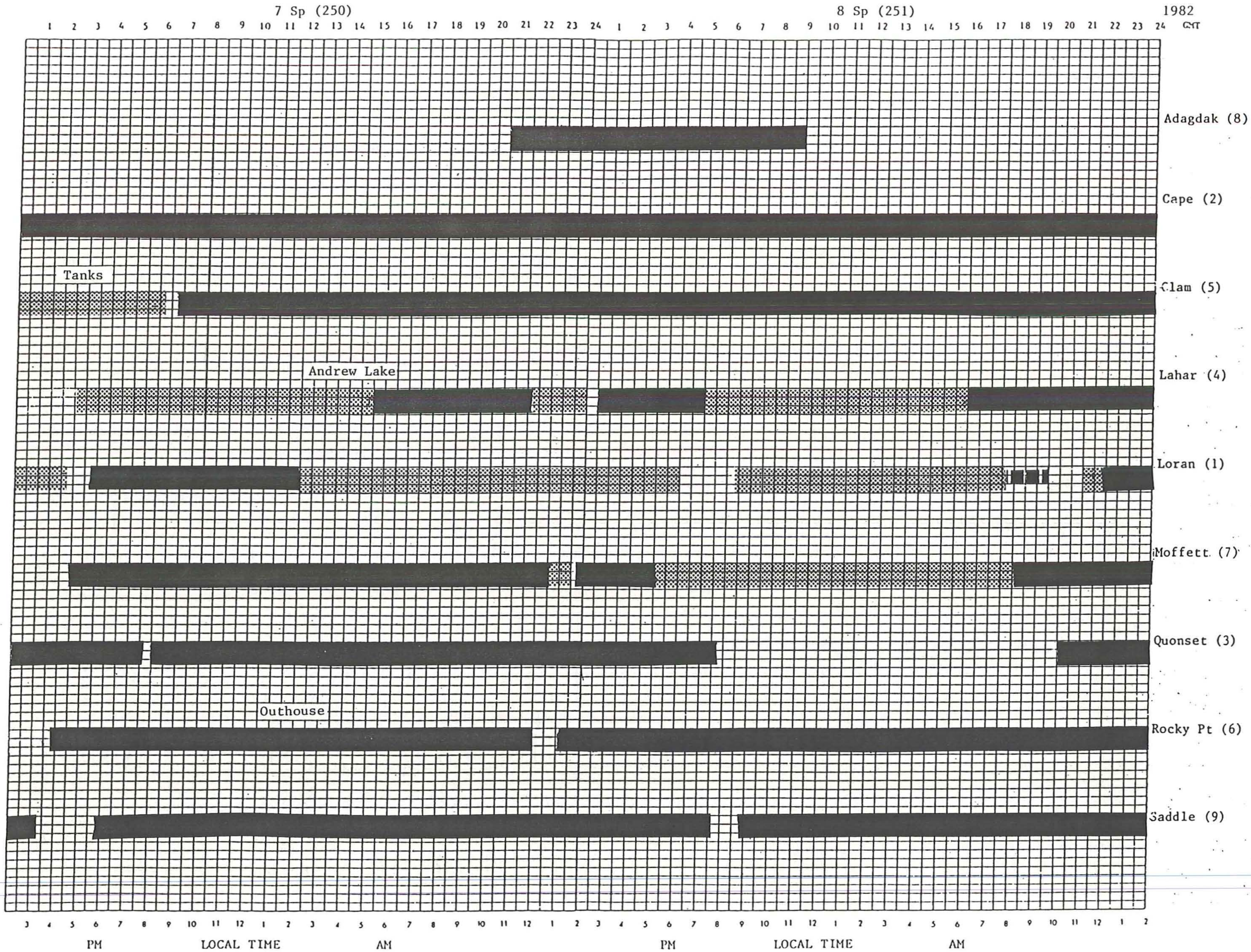
usable record

noisy record (wind, rain, etc.)

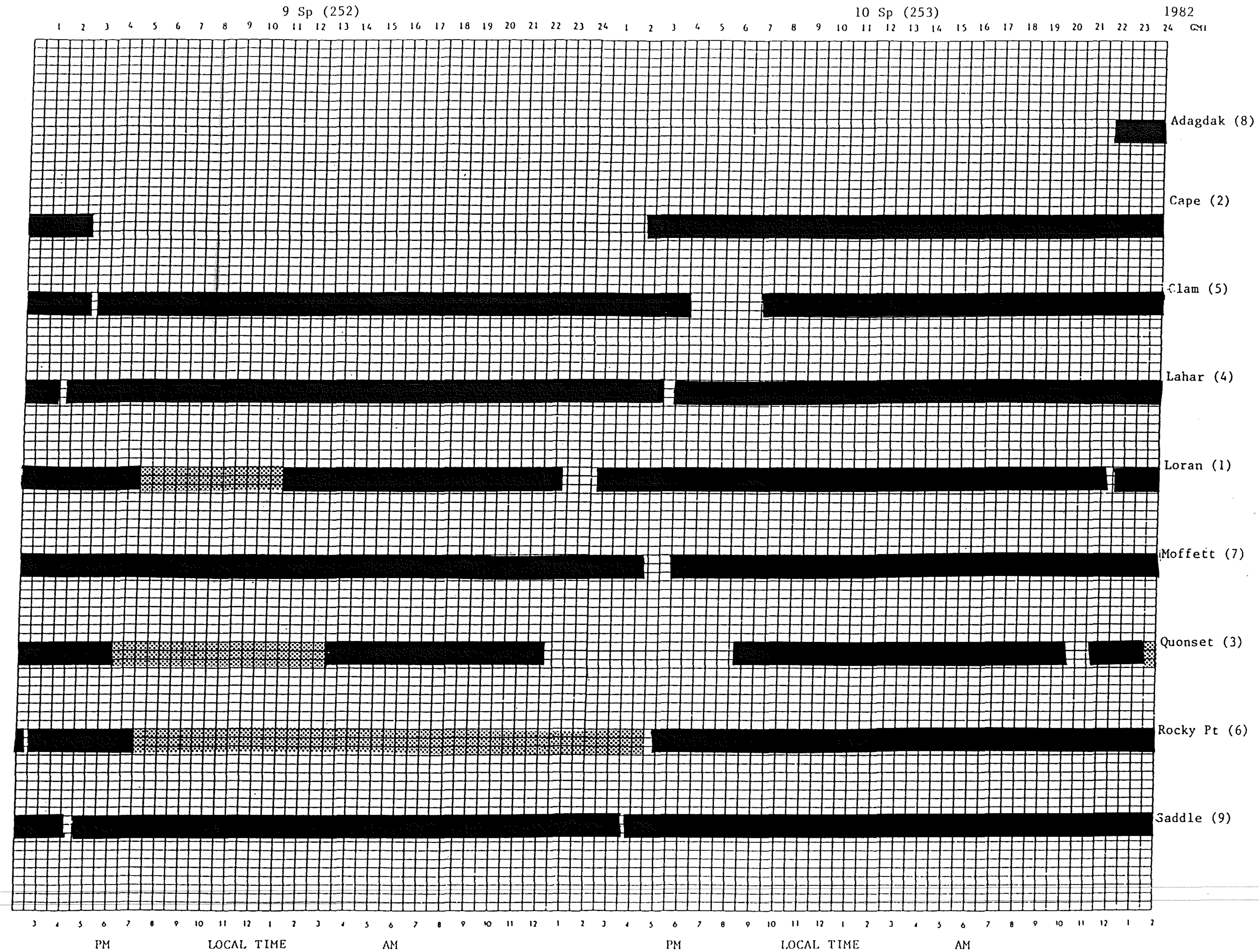
loss of timing



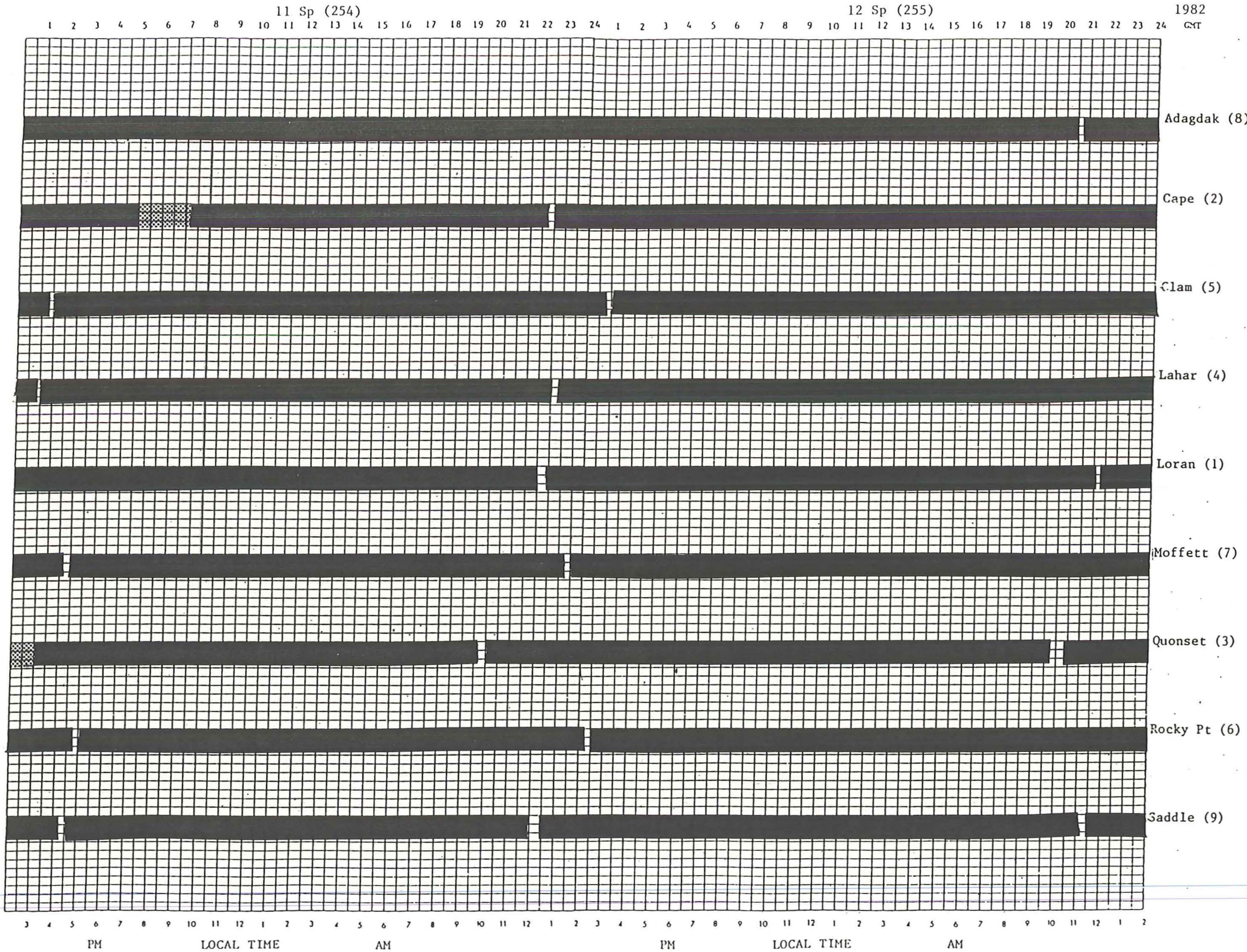
Seismograph Schedule: ADAK IS., ALASKA



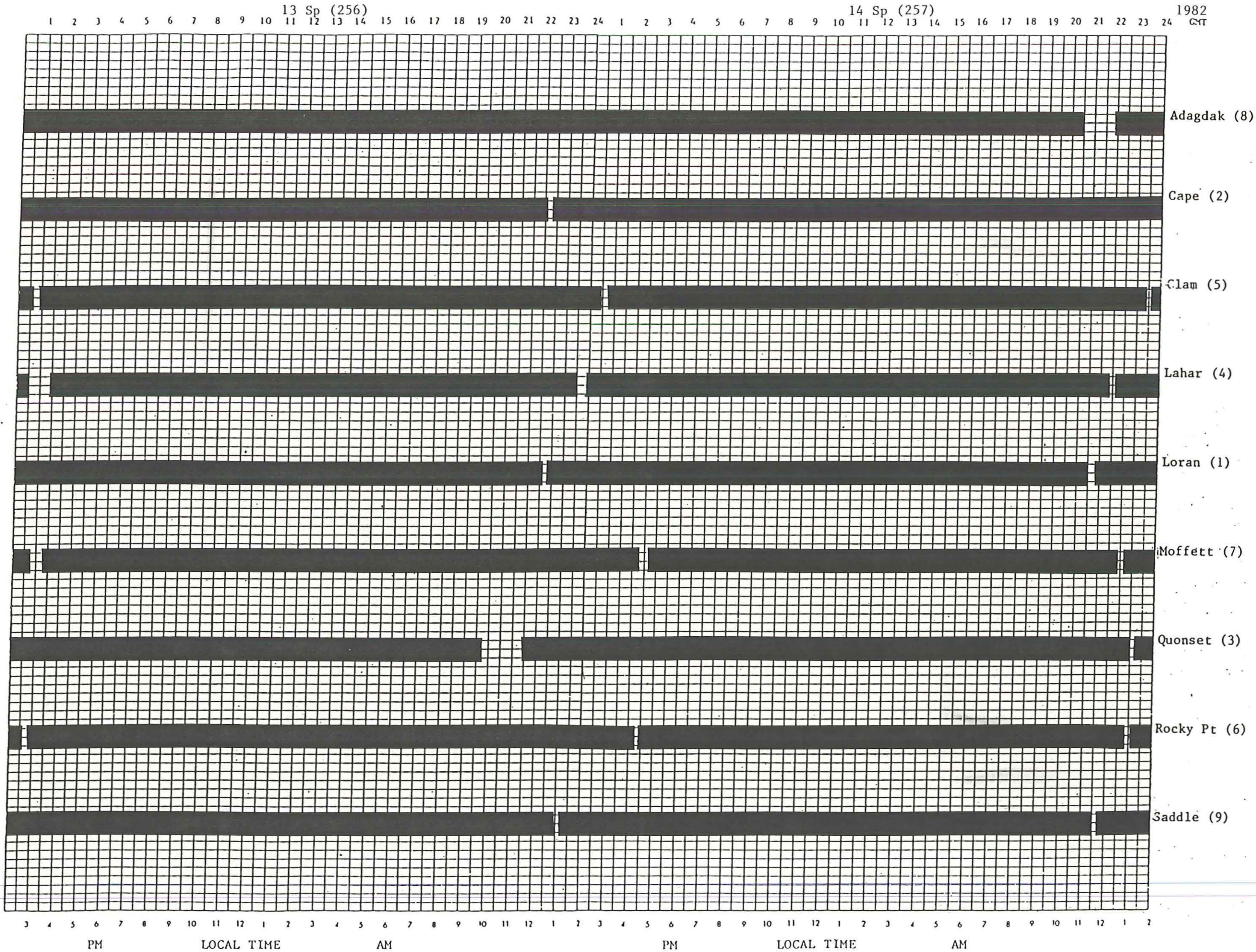
Seismograph Schedule: ADAK IS., ALASKA



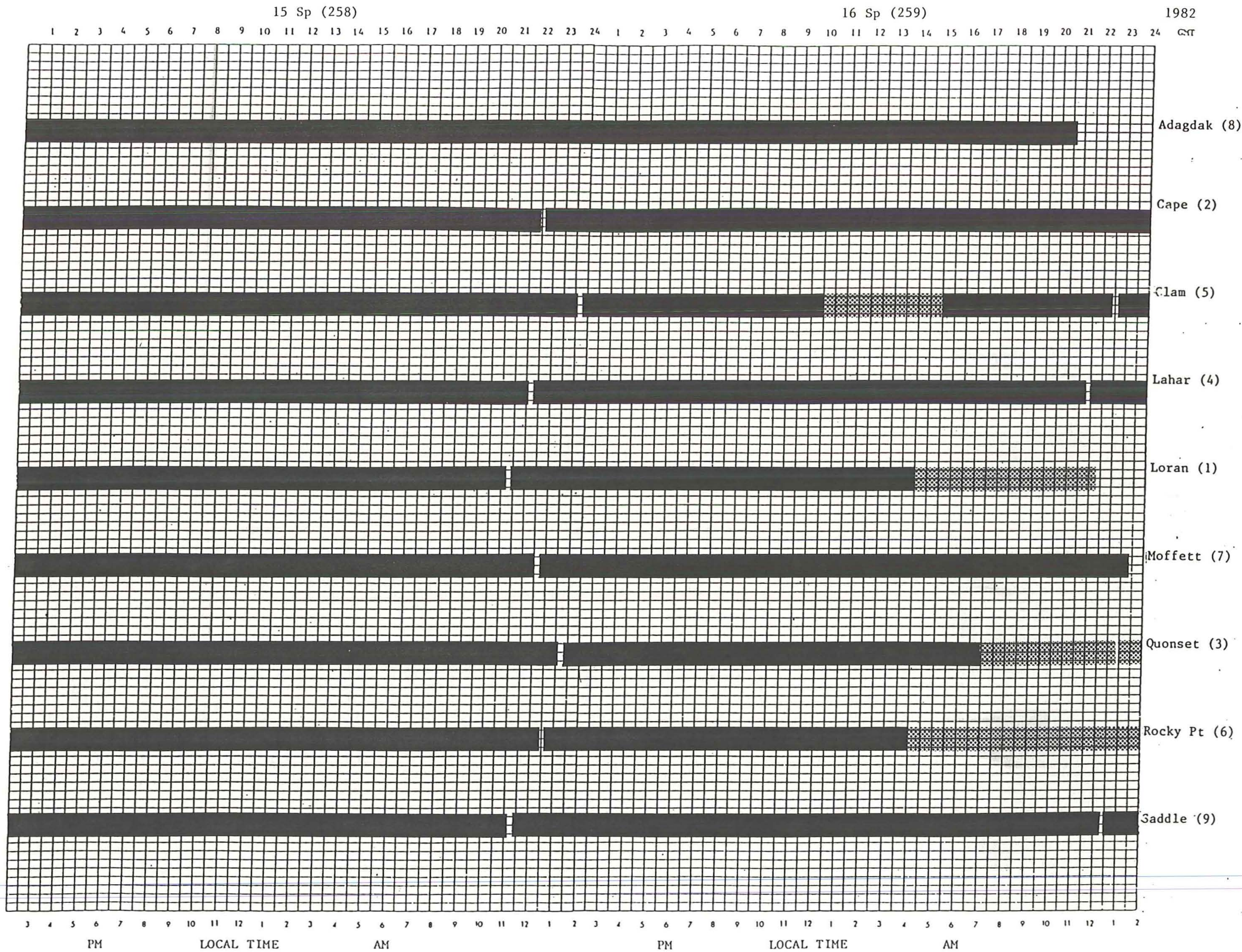
Seismograph Schedule: ADAK IS., ALASKA



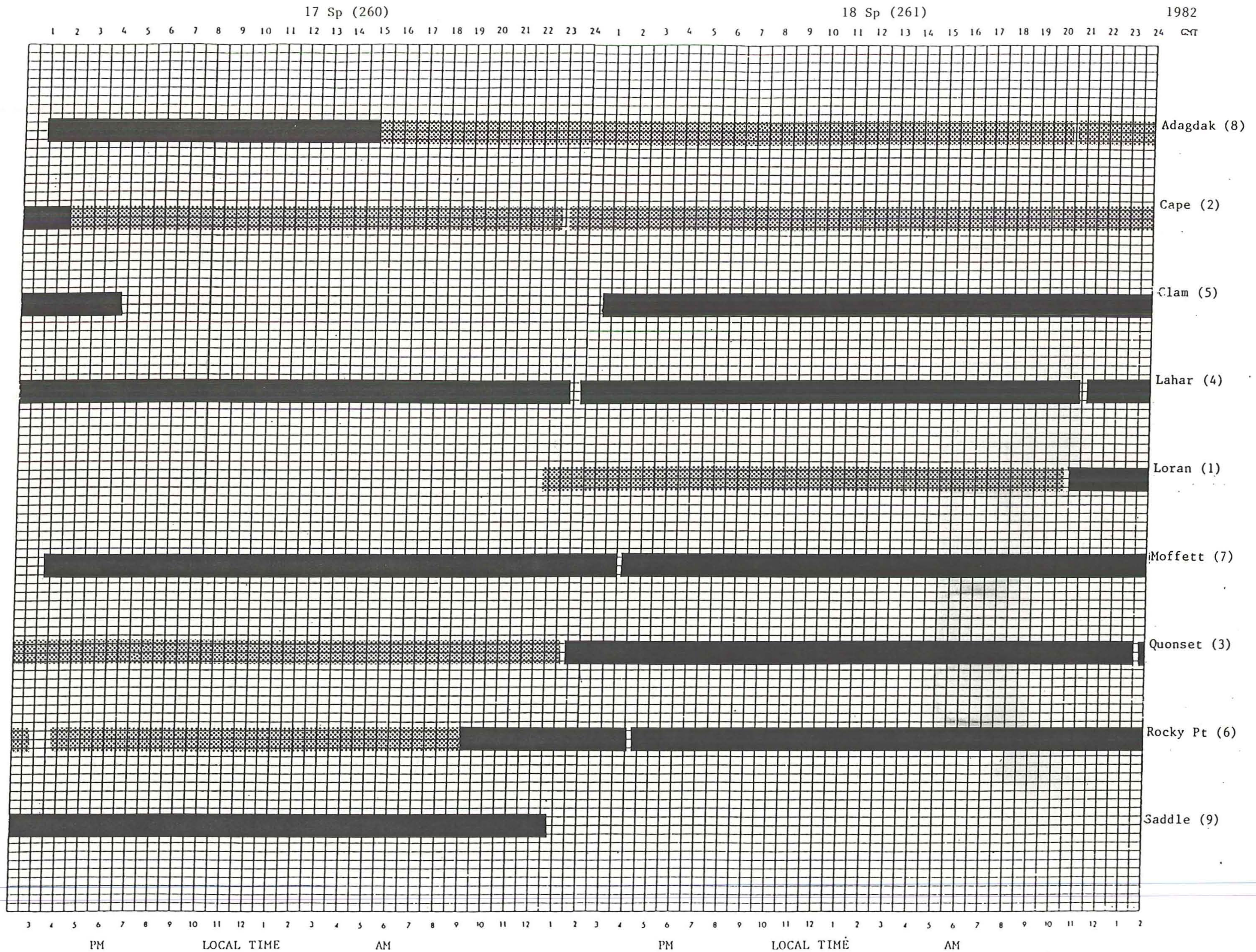
Seismograph Schedule: ADAK IS., ALASKA



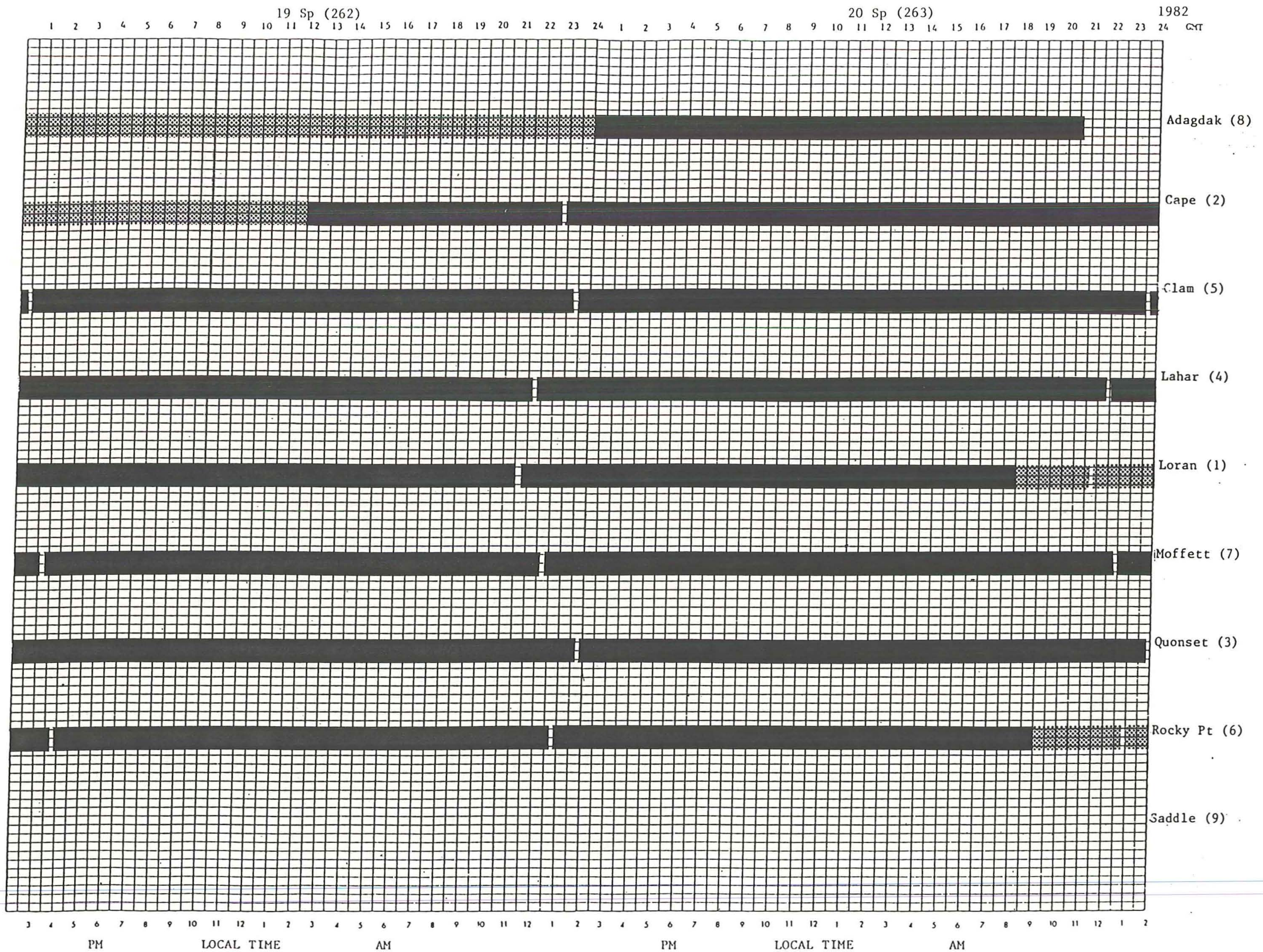
Seismograph Schedule: ADAK IS., ALASKA



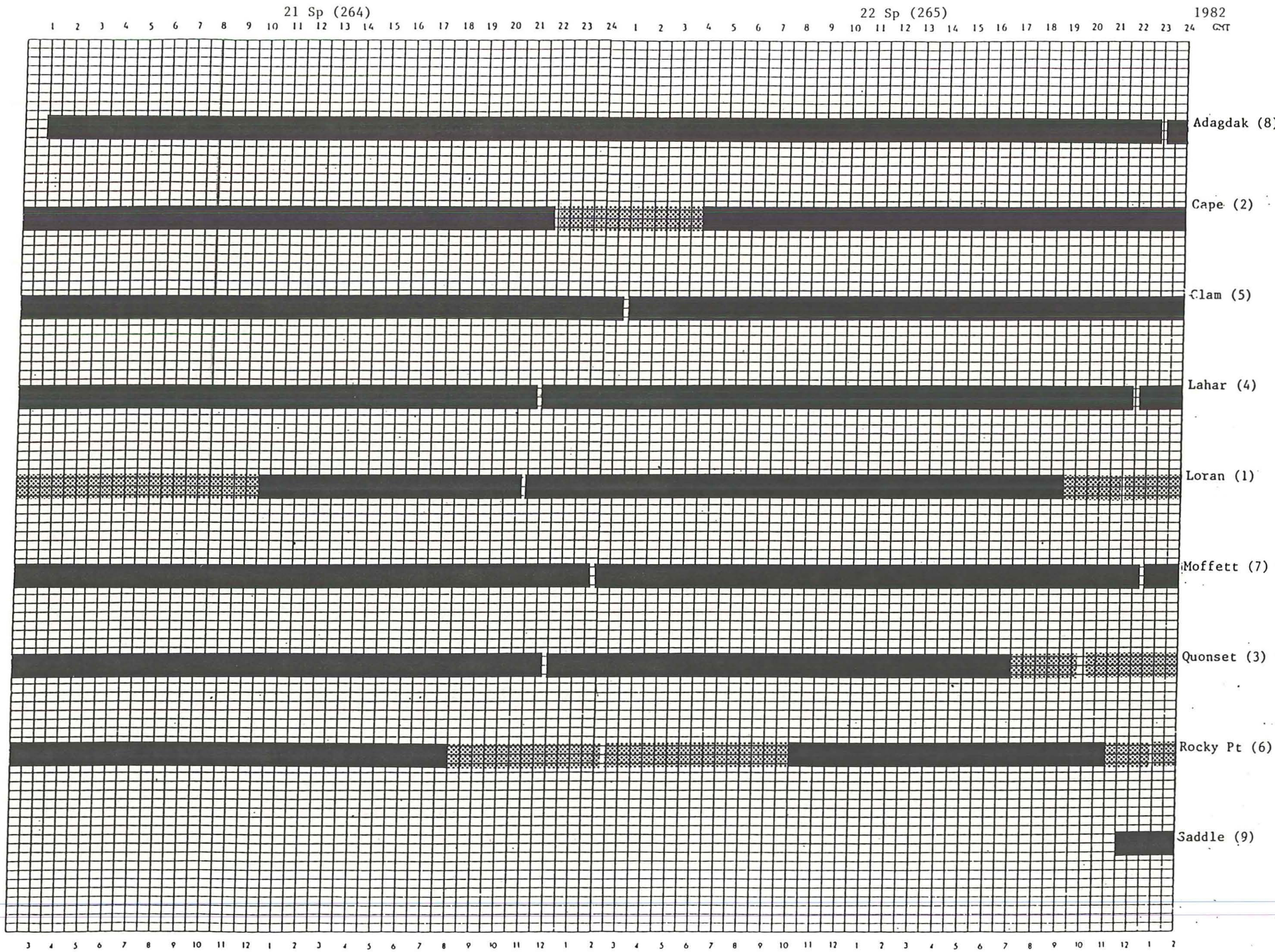
Seismograph Schedule: ADAK IS., ALASKA



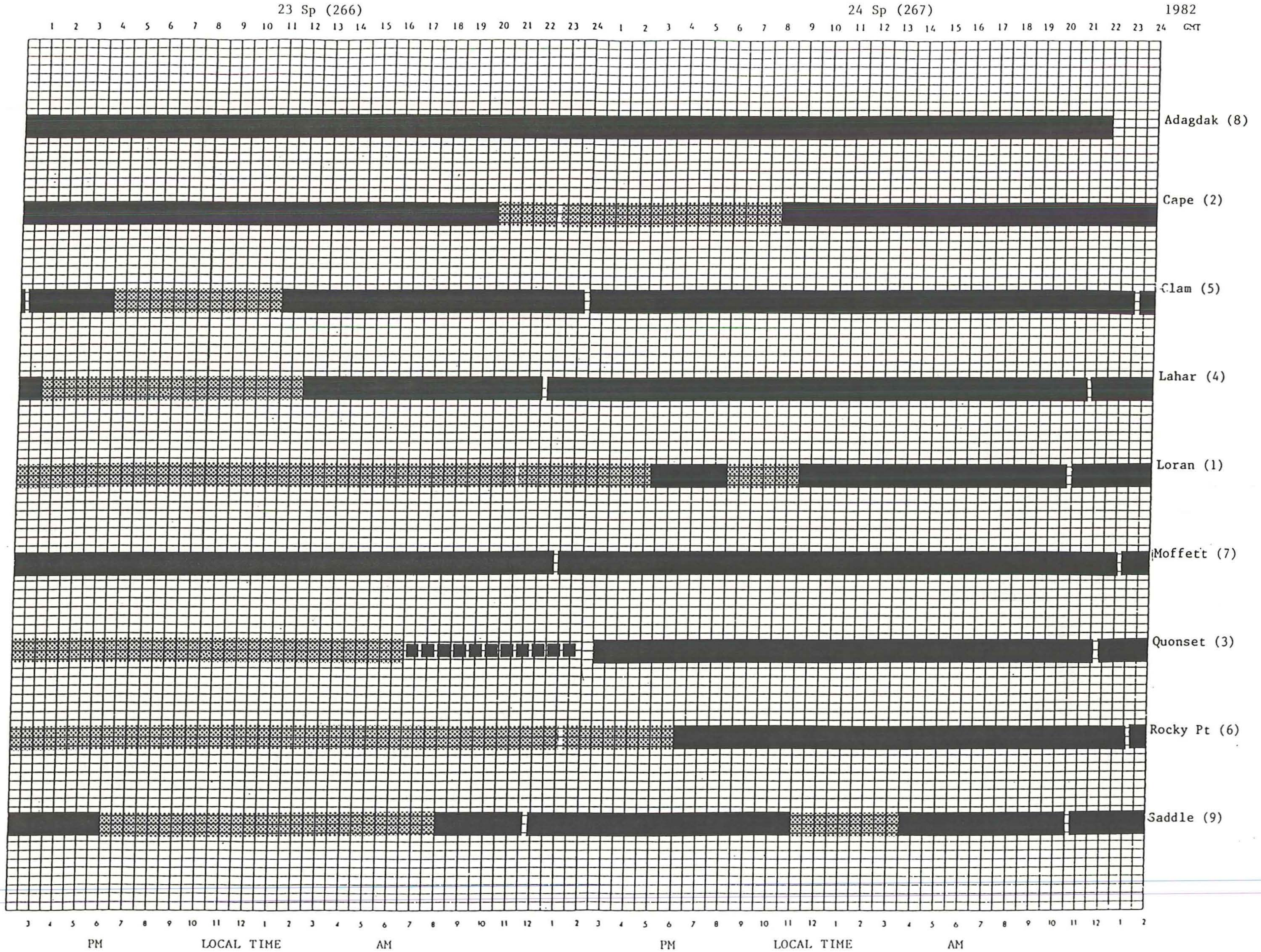
Seismograph Schedule: ADAK IS., ALASKA



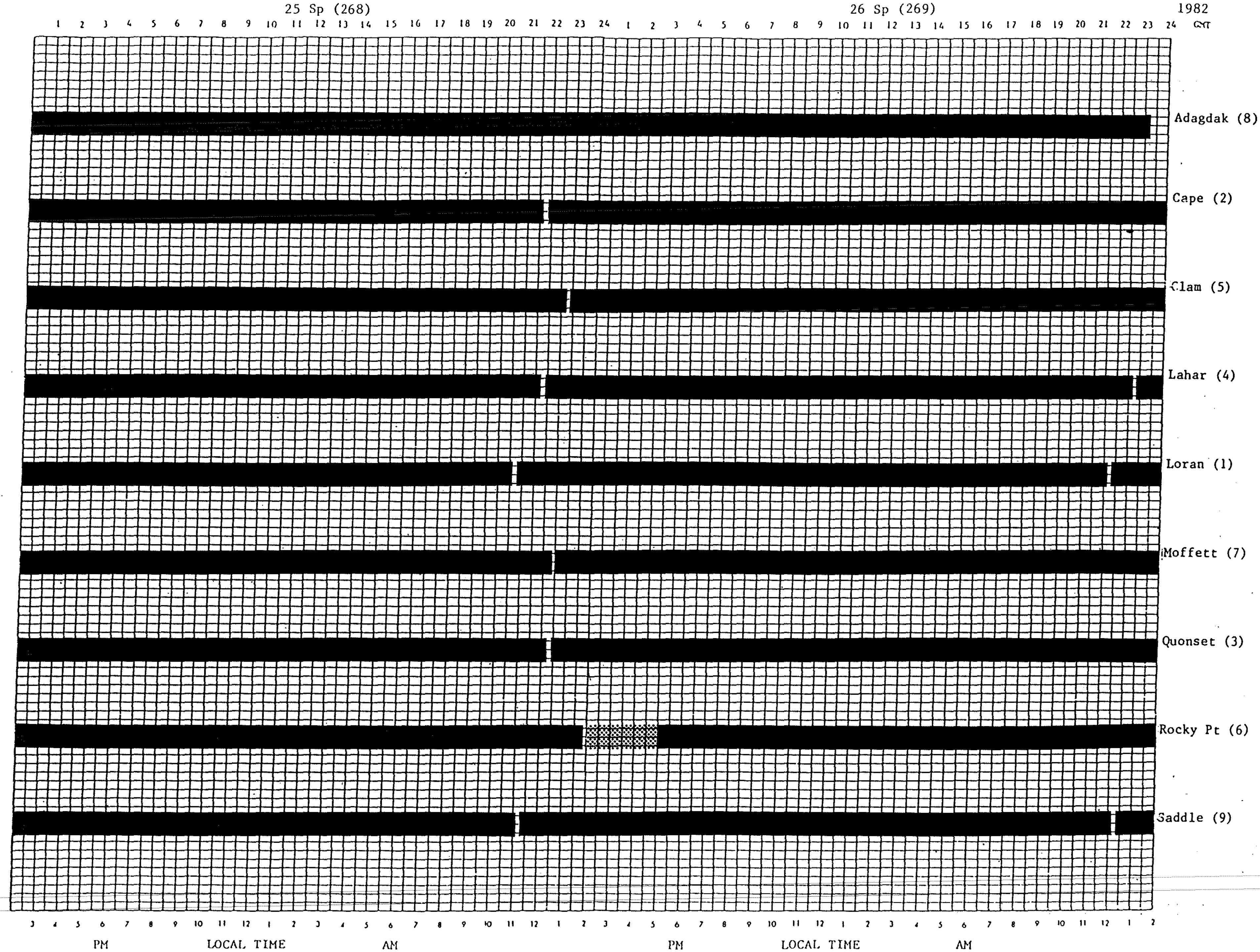
Seismograph Schedule: ADAK IS., ALASKA



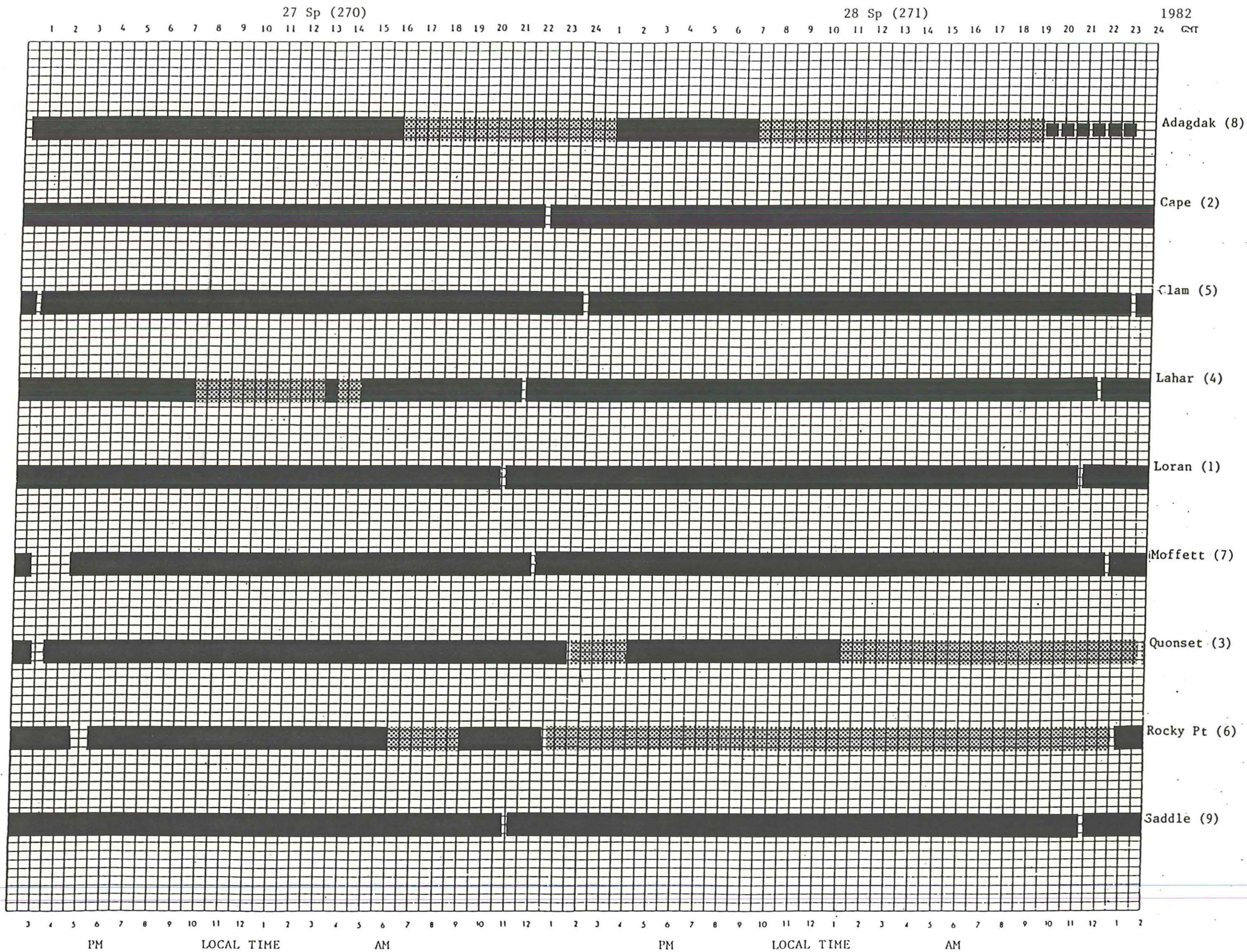
Seismograph Schedule: ADAK IS., ALASKA



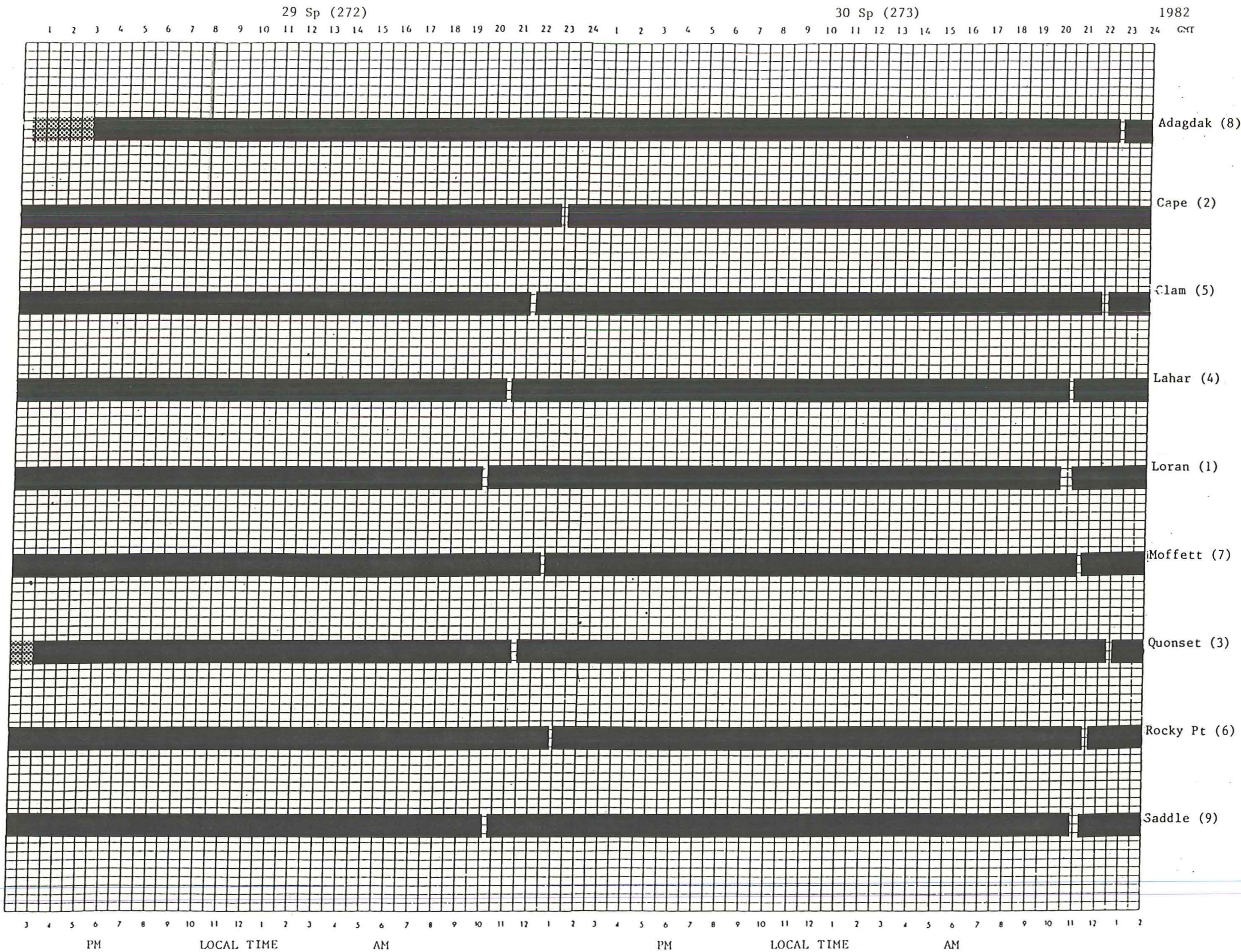
Seismograph Schedule: ADAK IS., ALASKA



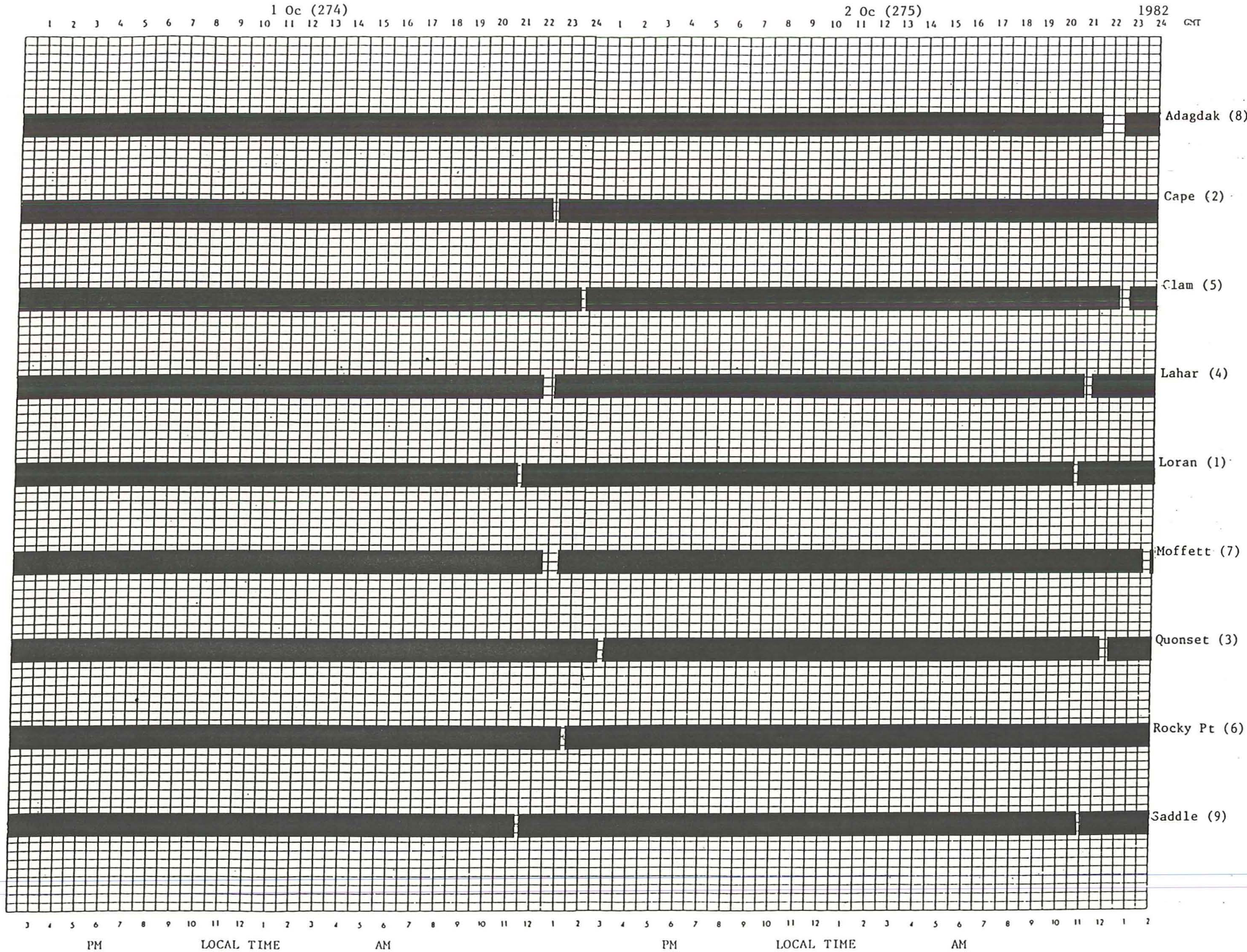
Seismograph Schedule: ADAK IS., ALASKA



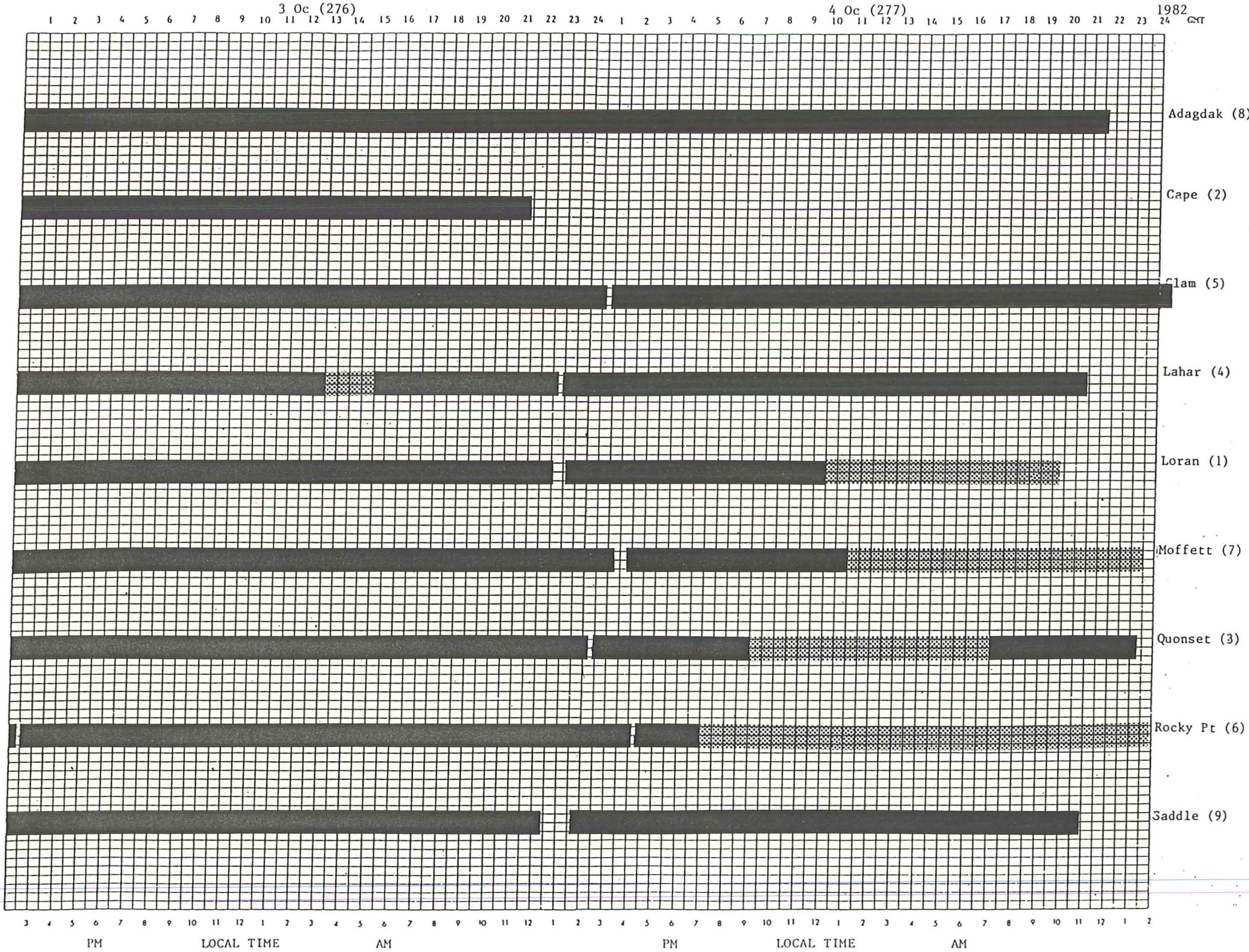
Seismograph Schedule: ADAK IS., ALASKA



Seismograph Schedule: ADAK IS., ALASKA



Seismograph Schedule: ADAK IS. ALASKA



Seismograph Schedule: ADAK IS., ALASKA