Airborne Laser Fluorosensor (MkIII) Survey Reprocessing And Interpretation Report: WA-260-P, Timor Sea, Australia

Prepared For
AGSO – Geoscience Australia

May 2001

Record 2001/17

AGSOCAT 35929

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Date:	May 2001

AGSO - Geoscience Australia

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ISSN: 1039-0073
ISBN: 0 642 466963

Bibliographic reference: Cowley, R., 2001. Airborne Laser Fluorosensor (MkIII) Survey Reprocessing And Interpretation Report: WA-260-P, Timor Sea, Australia. AGSO – Geoscience Australia, Record 2001/17 AGSOCAT NO. 35929.

Contents

Summary

The WA-260-P airborne laser fluorosensor (ALF) survey was flown by World Geoscience in the Timor Sea in October 1997 for BHP Petroleum and joint venture partners using the ALF MkIII system. The survey was designed to detect natural oil seepage over the permit in an effort to refine the petroleum prospectivity assessment.

The survey covers a triangular area over the northern two thirds of the permit and extends about 60km north to south and nearly 50km east to west at its widest section in the south.

This report is a re-interpretation of the World Geoscience data by Signalworks Pty Ltd using the *ALF Explorer™* software. A total of 285 fluorescence anomalies (fluors) were picked out of the 1,751,550 recorded spectra in the final interpretation. This is an average fluor density of 0.16 fluors per thousand spectra.

The fluor distribution across permit WA-260-P is relatively uniform, with no strong oil seepage patterns evident. A possible band of more intense fluors lies on an E-W trend to the south of the Buller-1 and Cleia-1 wells.

The scattered distribution of detected fluors may be an indication of a working petroleum system. The known accumulations covered by the survey do not directly correspond with distinct clustering of fluors.

1. Introduction

The WA-260-P airborne laser fluorosensor (ALF) survey was flown by World Geoscience in the Timor Sea in October 1997 for BHP Petroleum and joint venture partners using the ALF MkIII system. This system uses a 266nm laser wavelength, shorter than the 308nm used in the MkII system. The Raman peak wavelength is 293nm (344nm MkII) and the fluorescence region is 320nm to 580nm (370nm to 580nm MkII).

The survey area is shaded in red on the location map (Figure 1). Six MkIII ALF surveys, acquired between 1995 and 1998, are shown with blue shading and are re-interpreted in the reports Cowley (2000a-g* and 2001a*). Other MkII ALF surveys are shaded in light green (Cowley, 2001b-d*). The original BP interpretations are documented in the reports by Williams and Mackintosh (1990*) and Walker (1991a-b*).

N-S oriented lines were acquired at a spacing of 500m in the northern part of the survey and 1000m in the south. E-W trending cross lines were acquired at a 2000m spacing (Figure 2). 1,751,550 spectra were collected at an average spacing of 1.45m to 1.67m. Approximately 2,700km of data were acquired.

During the first pass interpretation 139 fluorescence anomalies (fluors) were selected. This was increased to 285 fluors during the more sensitive refined interpretation stage. This is an average fluor density of 0.16 fluors per thousand spectra.

* Bibliographic references:

Williams, A.K. and Mackintosh, J.M., 1990. ALF Survey of the western margin of Australia. 1. Bonaparte and West Timor Sea Basins. Volume 1, A – Basic Data Report; Volume 2, B – Interpretive Data Report; Volume 3, C – BP In-house Report. Remote Sensing Group, BP Exploration (unpubl. report).
Walker, N.S., 1991a. 1991 Timor Sea Airborne Laser Fluorosensor Survey for BP Developments Australia Ltd. Basic Data Report. (Timor Gap Survey.) (unpubl. report).
Walker, N.S., 1991b. 1991 Timor Sea Airborne Laser Fluorosensor Survey for BP Developments Australia Ltd. Interpreted Data Report. (Timor Gap Survey.) (unpubl. report).
Cowley, R., 2000a. Comparison of AGSO – Geoscience Australia North-West Shelf Airborne Laser Fluorosensor Survey Interpretations. Record 2000/27.
Cowley, R., 2000b. 1996 Nancar Trough, Northern Bonaparte Basin (AC/P16) Airborne Laser Fluorosensor Survey Interpretation Report. Record 2000/28.
Cowley, R., 2000c. 1996 Laminaria High, Northern Bonaparte Basin (AC/P8) Airborne Laser Fluorosensor Interpretation Report. Record 2000/29.
Cowley. R., 2000d. 1998 Yampi Shelf, Browse Basin Airborne Laser Fluorosensor Survey Interpretation Report. Record 2000/30.
Cowley. R., 2000e. 1996 Yampi Shelf, Browse Basin Airborne Laser Fluorosensor Survey Interpretation Report. Record 2000/31.
Cowley. R., 2000f. 1996 Vulcan Sub-basin / Browse Basin Transition Airborne Laser Fluorosensor Survey Interpretation Report. Record 2000/32.
Cowley. R., 2000g. 1996 Vulcan Sub-basin Airborne Laser Fluorosensor Survey Interpretation Report. Record 2000/33.

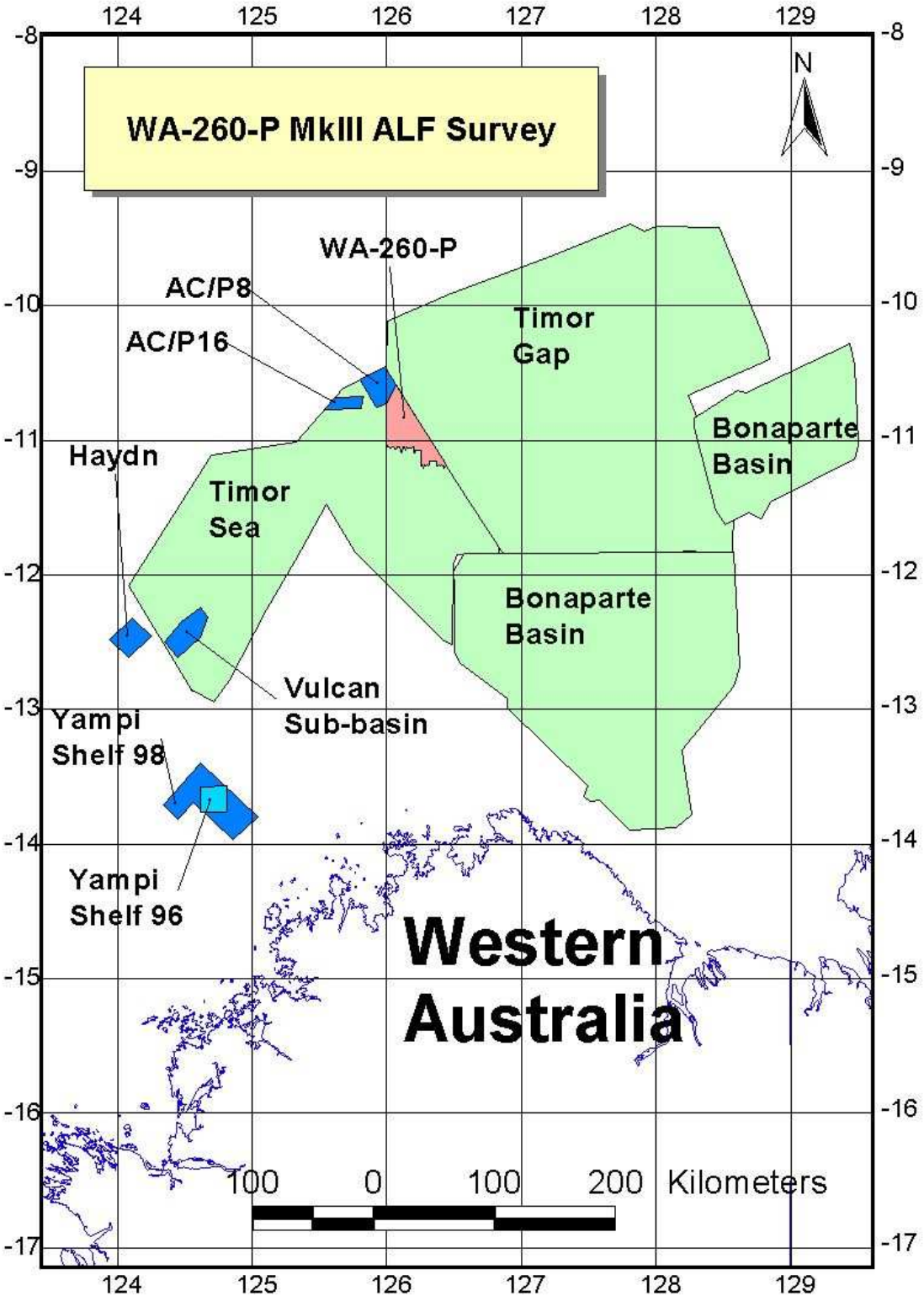


Figure 1. WA-260-P MkIII ALF Survey Location Map.
(The WA-260-P survey is shaded in red.)
(Blue areas are other MkIII ALF surveys.)
(Light green areas are MkII ALF surveys.)

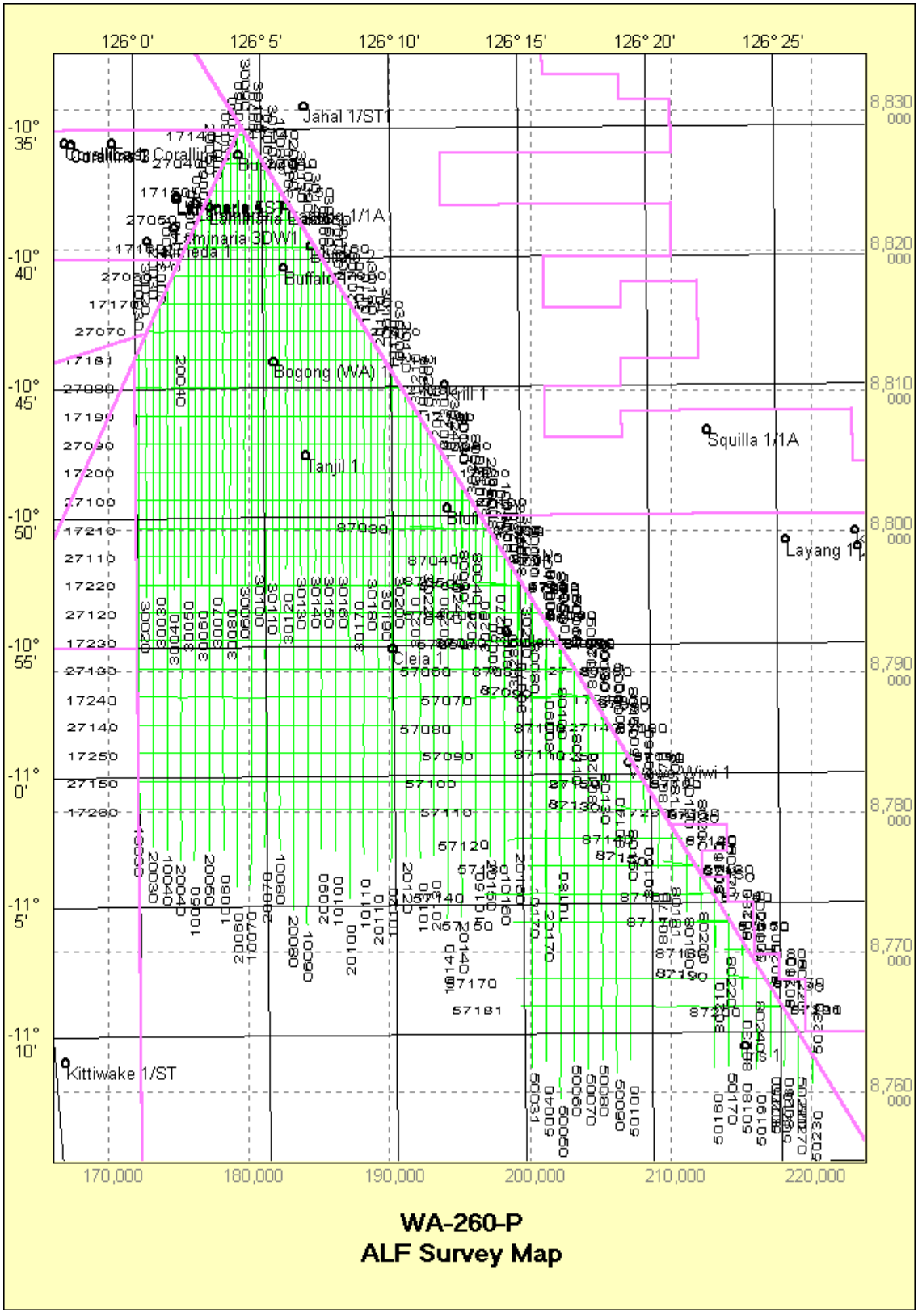


Figure 2. WA-260-P MkIII ALF Survey Map.

Mapping Specifications
Projection: Southern UTM Zone 52 (Central Meridian 129 degrees east)
Projection Datum: AGD84.

The following boundaries were used for mapping:

Min easting:	171,000
Max easting:	221,000
Min northing:	8,758,000
Max northing:	8,829,000

2. ALF Survey Analysis

2.1. First Pass Fluor Mapping

A first pass fluor interpretation produced the initial map of oil seepage shown in Figure 3. Fluors were picked in a two-stage process where an SQL query was used to select a number of possible fluors from which the confident fluors were selected manually.

The following query was used in the first pass interpretation:
SELECT * FROM [RawAlfData] WHERE Ch_50 > Ch_27 / 10 ORDER BY Ch_50 DESC

The number of possible fluors selected were small enough for manual picking. 139 fluors were picked out of the total of 1,751,432 spectra (79 fluors per million spectra).

The map of first pass fluors (Figure 3) shows a relatively even distribution of small fluorescence anomalies across the permit.

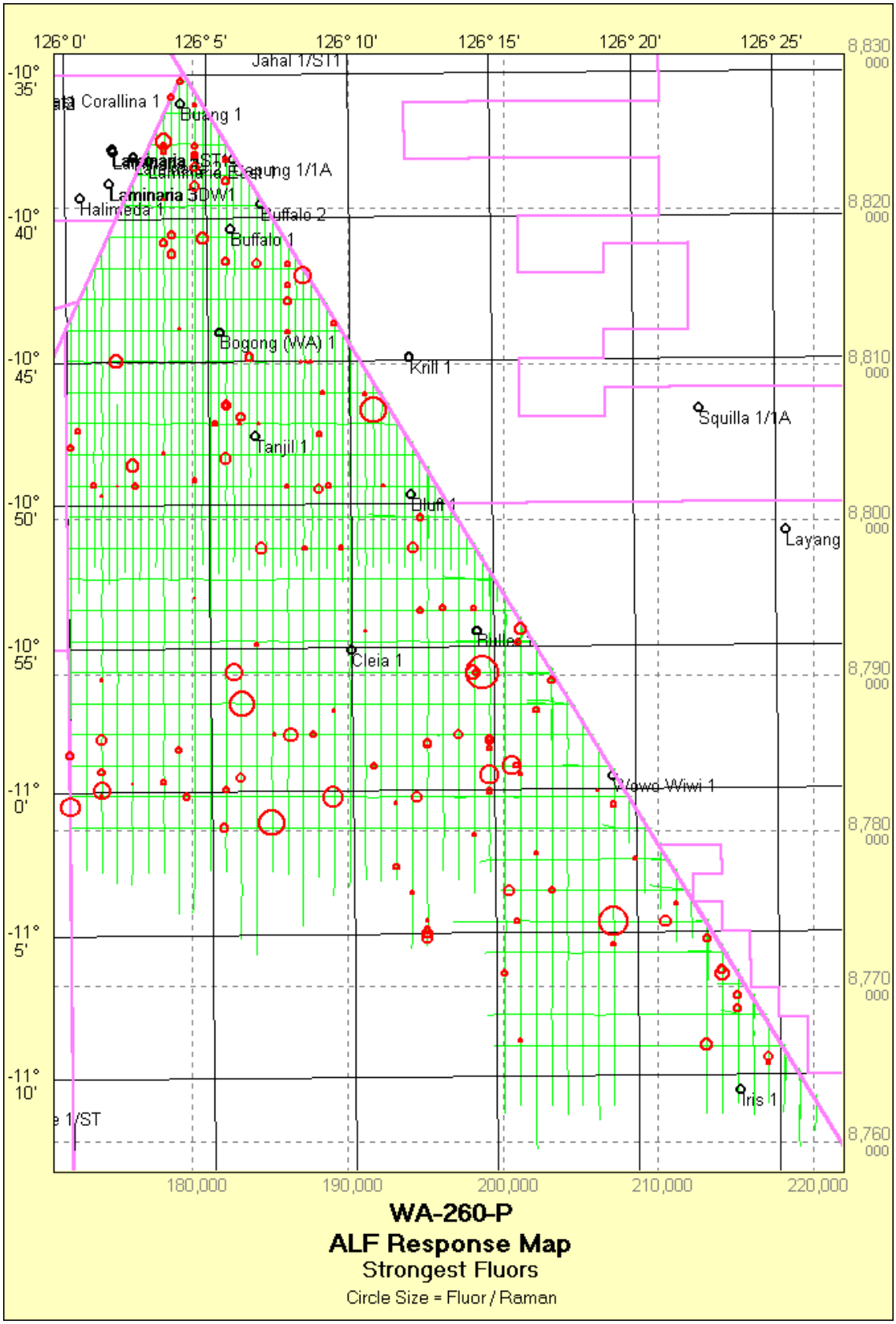


Figure 3. WA-260-P First Pass Fluor Map.

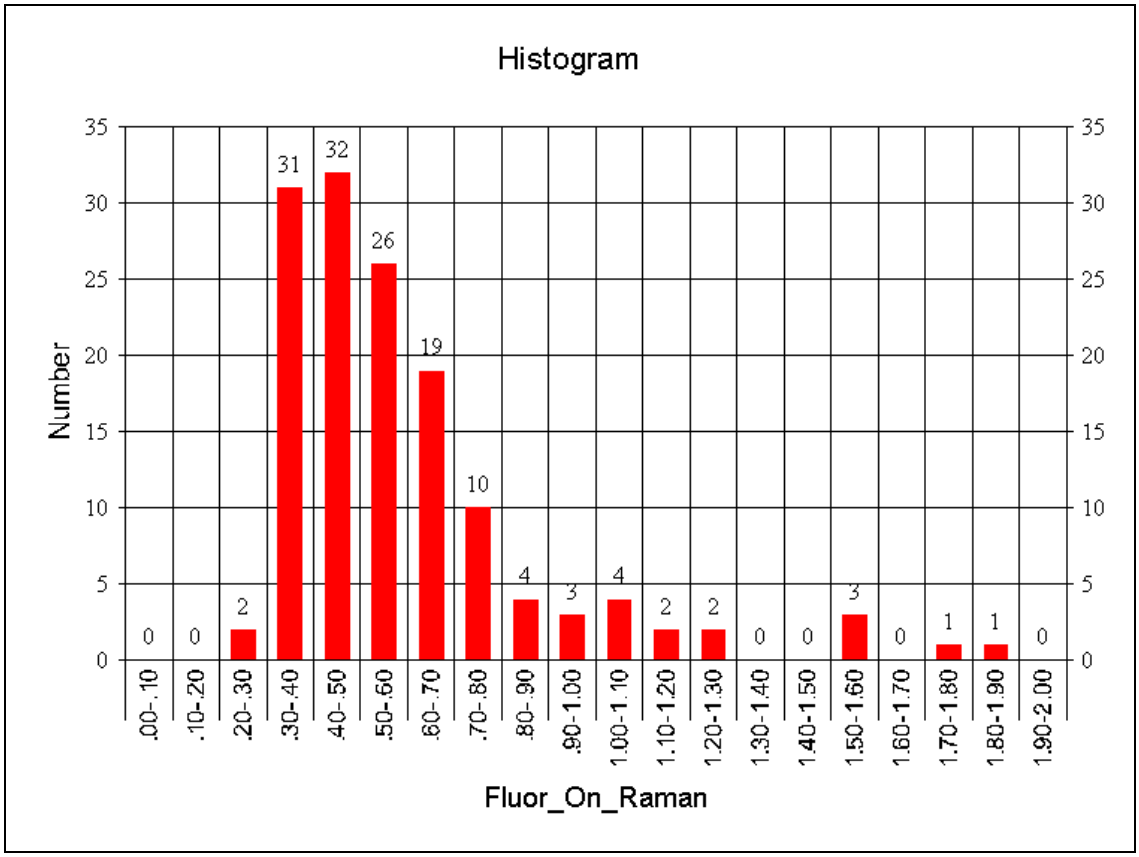


Figure 4. F / R Histogram for the First Pass Fluor Picks.

The fluorescence on Raman (F/R) histogram for the first pass fluors (Figure 4) shows a relatively high number of small fluors. There are few very low intensity fluors because of the difficulty in picking them above the background noise. The high intensity fluors are easy to pick but few in numbers.

2.2 Refined Fluor Mapping

A refined interpretation method was used to select more of the subtle, low intensity fluors that can provide an improved map of the hydrocarbon seepage patterns. The refined interpretation used two queries to select possible fluors. The following query was used to select most of the possible fluors:
SELECT * FROM [RawAlfData] WHERE Ch_50 > Ch_27 / 20 ORDER BY Ch_50 DESC
This query selected 206,214 possible fluors from the 1,751,432 total spectra.

Line 30290 was noisy and was excluded from the analysis using this query:
SELECT * FROM [RawAlfData] WHERE Ch_50 > Ch_27 / 20 and Line <> 30290 ORDER BY Ch_50 DESC
Lines 17140, 80220 and 20040 also affected by noise to a lesser extent. 197 fluors were manually selected before picking was stopped at record number 4200.

This second query was then used to select possible fluors on data recorded with lower gain levels:
SELECT * FROM [RawAlfData] where Ch_50 > Ch_27 / 10 order by Ch_50 desc
This query selected 1,570 possible fluors.

285 fluors were picked in total during the refined fluor interpretation. The refined fluor map is shown in Figure 5. Moderate amounts of hydrocarbon seepage were detected over most of the survey area, though with no well defined patterns. A possible band of more intense fluors lies on an E-W trend to the south of the Buller-1 and Cleia-1 wells. Some fluors clusters lie near the Buffalo Oil Field, though the density is not anomalously high.

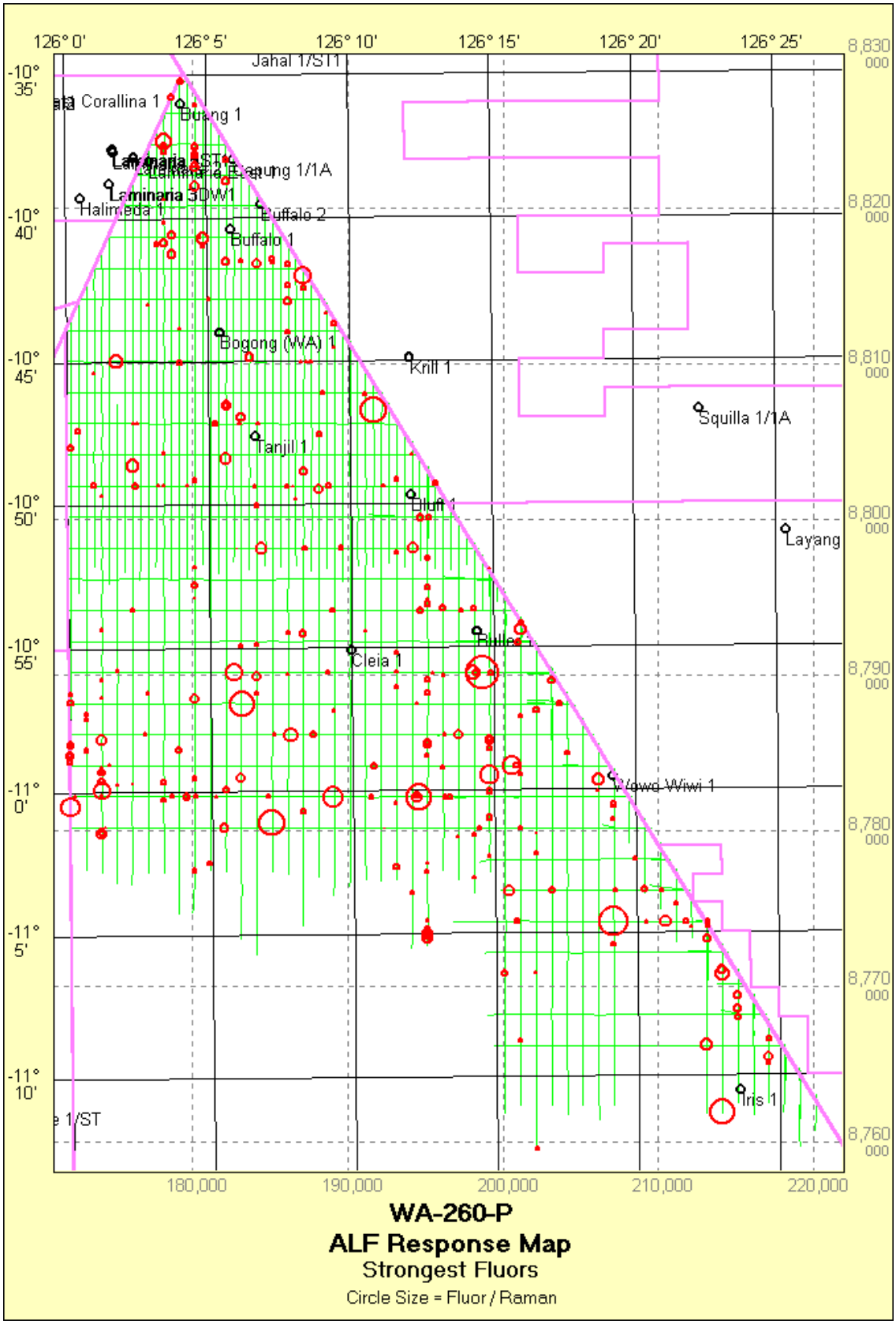


Figure 5. WA-260-P Refined Fluor Map.

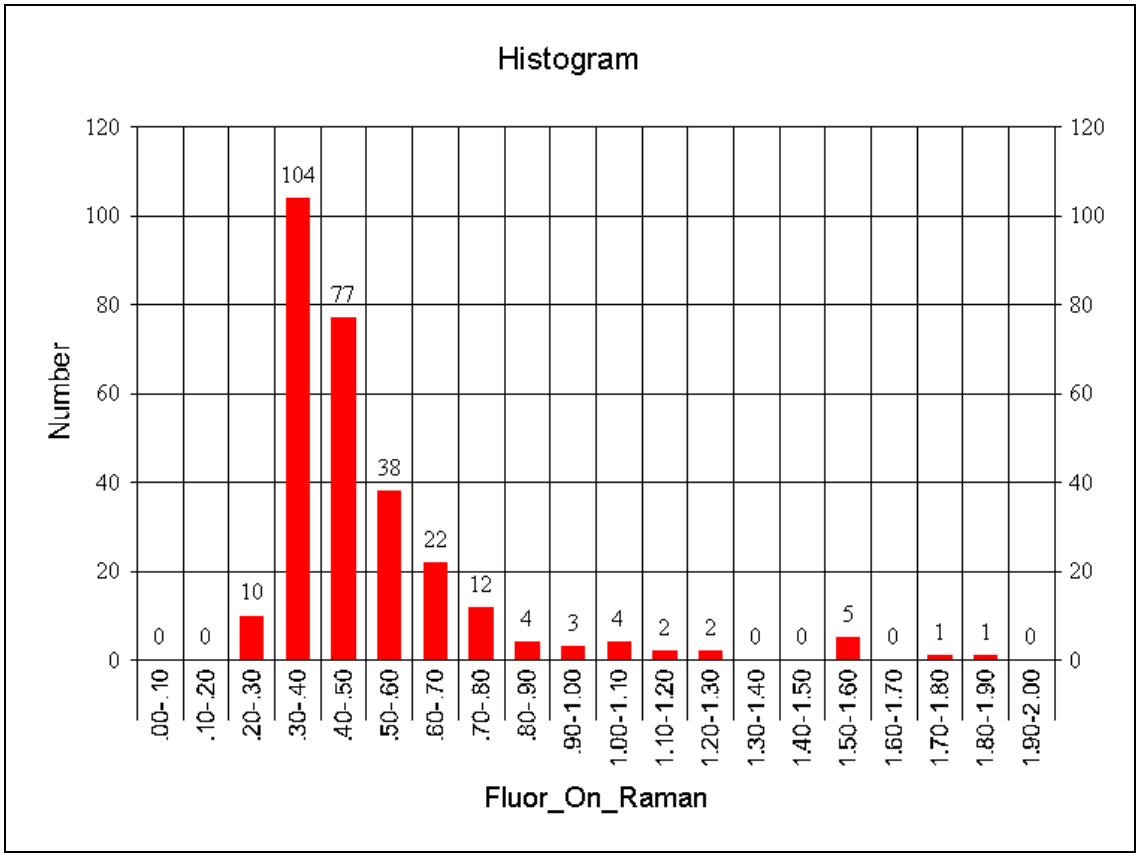
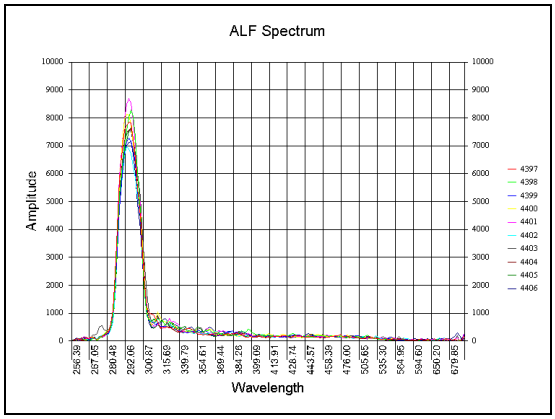
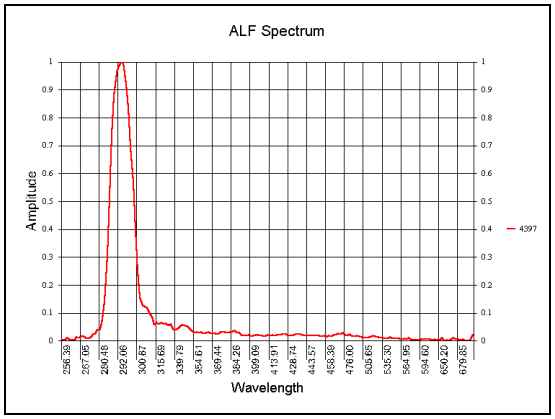


Figure 6. F / R Histogram for the Refined Fluor Picks.

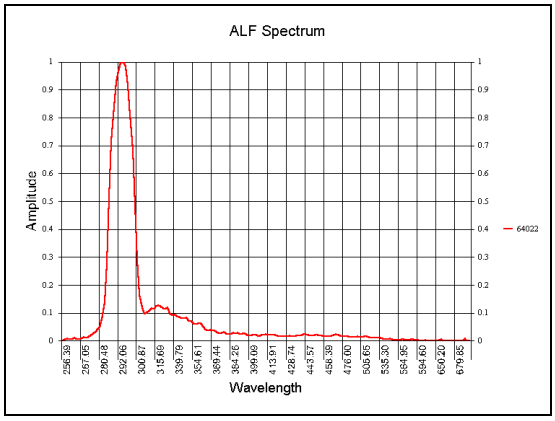
The F/R histogram for the refined fluor picks is shown in Figure 6. There are more low intensity fluors than were picked in the first pass interpretation. There is little difference between the two histograms over the high fluor intensity range (F/R > 0.80).



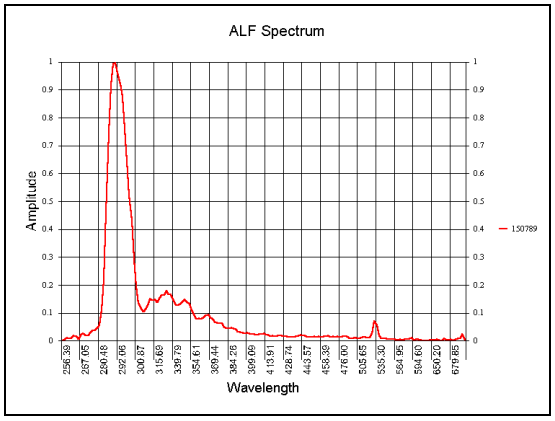
7 a) Line 10030 First Ten Spectra



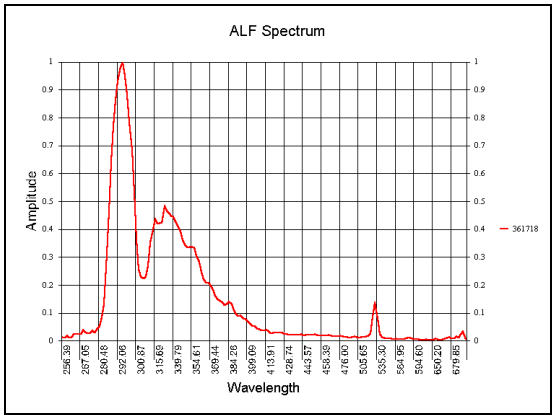
7 b) Line 10030 No Fluor



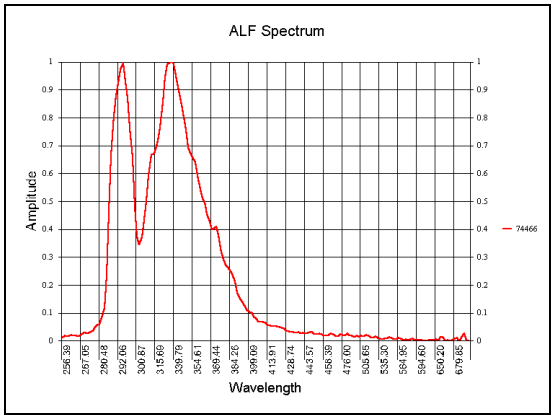
7 c) Line 20160 Small Fluor



7 d) Line 17210 Small to Medium Fluor



7 e) Line 10060 Medium to Large Fluor



7 f) Line 57060 Largest Fluor

Figure 7. WA-260-P ALF Survey Selected Spectra.

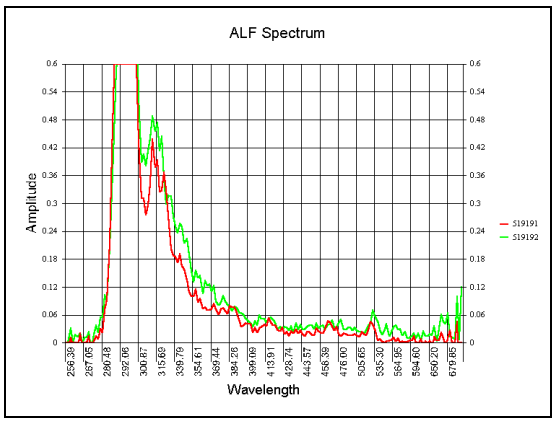
Figure 7 shows a selection of spectra and fluors picked on the WA-260-P ALF survey. The spectra have relatively low noise and the fluors can usually be picked with high confidence.

2.3. Adjacent Fluor Detection

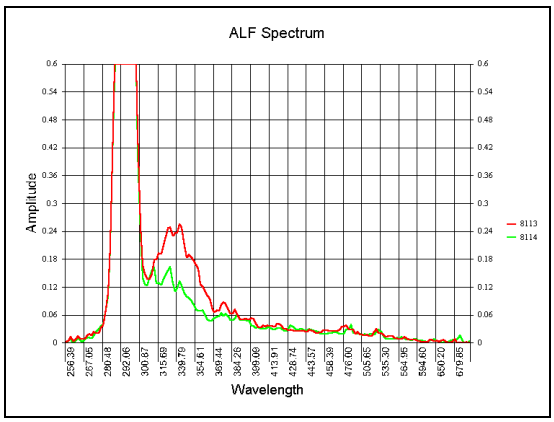
Most fluors detected are isolated anomalies and indicate the presence of individual oil films. The sampling resolution of ALF is one sample, which covers an area of 200mm, every 1.5m. However, the detection of adjacent fluors may indicate areas of more significant hydrocarbon seepage. Therefore, the refined fluor data set was processed to identify adjacent fluors.

Four pairs of adjacent fluors were detected in the refined fluor picks. Plots of their spectra are shown in Figure 8 below.

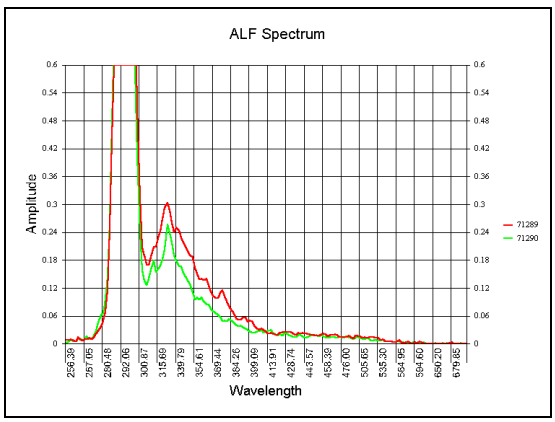
The map of the adjacent fluors (Figure 9) shows that they all lie in the southern half of the survey, to the south of the Cleia-1 well.



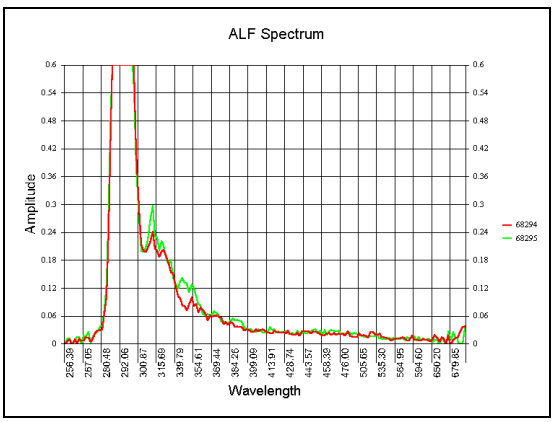
8 a) Line 10040 Adjacent Fluor Group 1



8 b) Line 20140 Adjacent Fluor Group 2



8 c) Line 20160 Adjacent Group 3



8 d) Line 57070 Adjacent Group 4

Figure 8. Adjacent Fluors Detected in the Refined Fluor Picks.

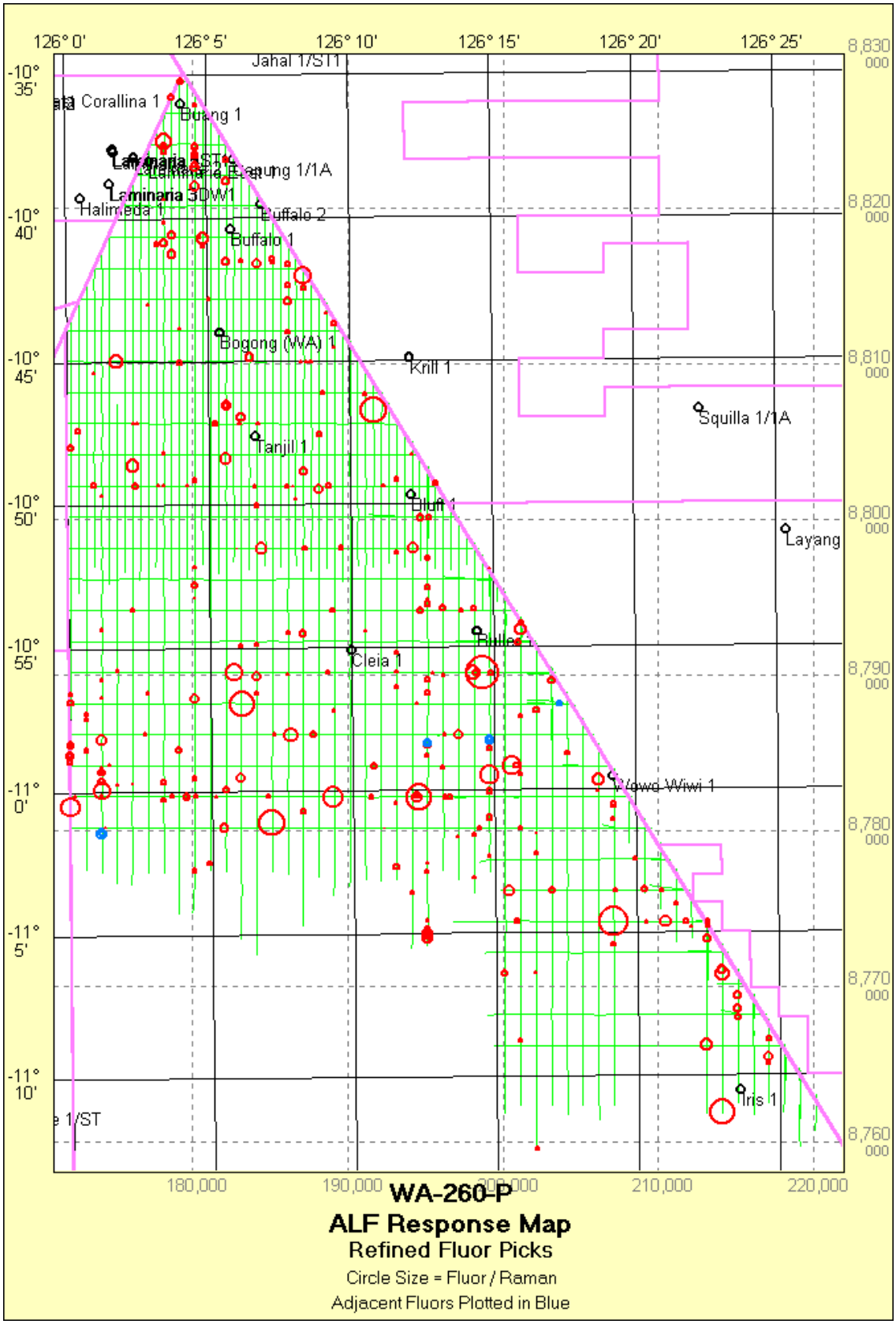


Figure 9. Fluor Map with Adjacent Fluors Plotted in Blue.

2.4. Near Fluor Detection

Groups of near fluors from the refined fluor picks were also looked for to determine whetther these would enhance the areas of more significant hydrocarbon seepage identified by the adjacent fluors. A gap distance of 10 fluors or about 15m was selected so that any fluors separated by less than this distance were grouped together.

Thirteen pairs of near fluors were detected. These fluor groups are plotted in blue on the map in Figure 10.

Many of the near fluors also lie in the southern half of the survey, to the south of the Cleia-1 well.

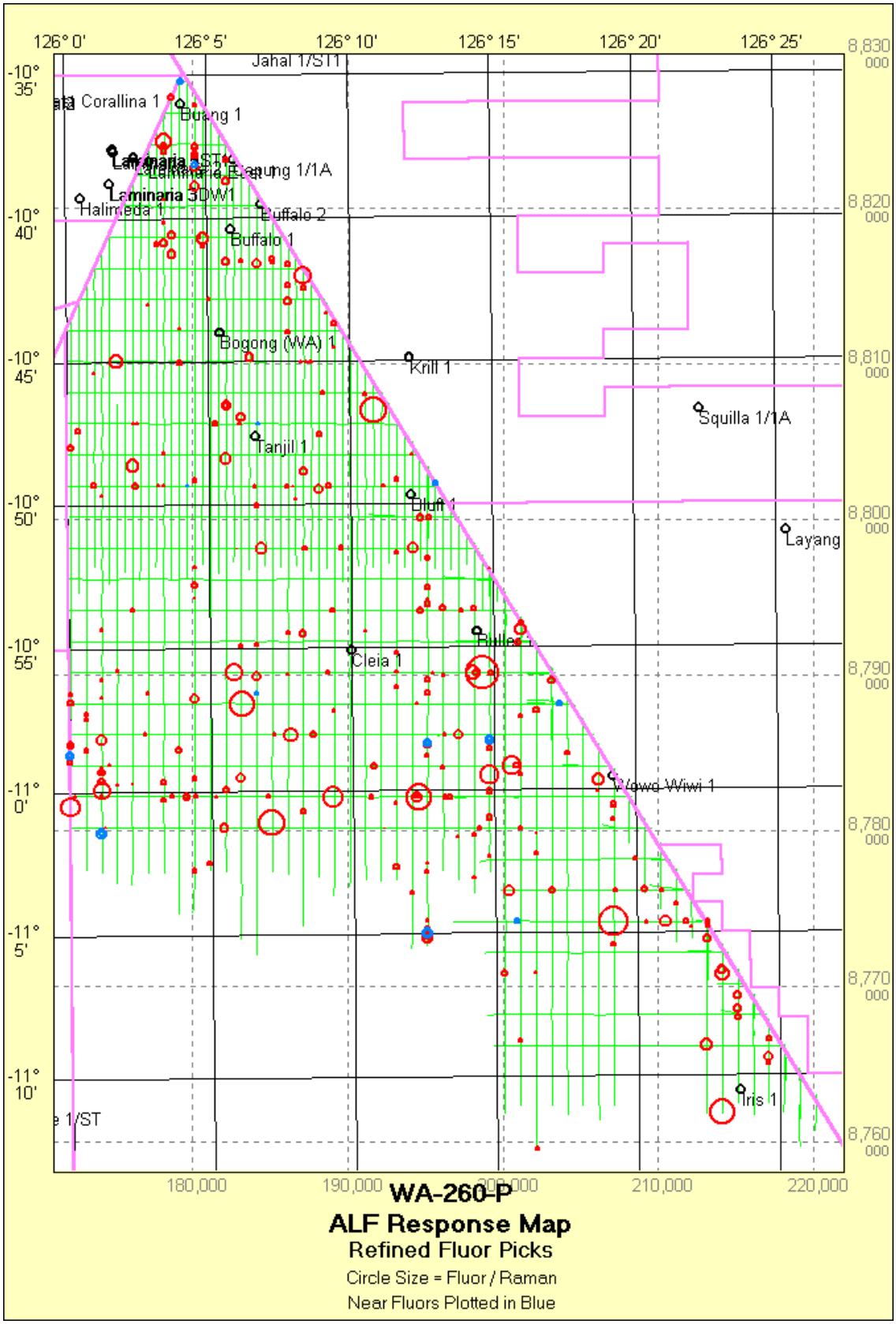


Figure 10. Fluor Map with Near Fluors Plotted in Blue.

3. Conclusions and Recommendations

The fluor distribution across permit WA-260-P is relatively uniform, with no strong oil seepage patterns evident. A possible band of more intense fluors lies on an E-W trend to the south of the Buller-1 and Cleia-1 wells.

Data acquisition variations caused changes in the levels of the recorded spectra between lines. Careful fluor picking was required to prevent this affecting the mapped fluor distribution.

No other obvious seepage indicators like hydrocarbon related diagenetic zones (HRDZs) or shallow amplitude anomalies have been observed on seismic data in the permit.

The scattered distribution of detected fluors may be an indication of a working petroleum system. The known accumulations covered by the survey do not directly correspond with any distinct clustering of fluors.

Appendix 1. Data Acquisition QC

Line	Sections	Clipped	Avg Raman Peak	Avg Raman Variance
10030	218	0	8,869	926,350
10040	258	7	11,010	11,244,860
10050	284	11	11,093	10,757,650
10060	317	2	10,062	9,527,070
10070	337	17	10,909	12,258,800
10080	305	2	9,680	9,939,894
10090	315	129	13,890	18,951,780
10100	266	61	12,724	15,989,980
10110	233	6	10,122	9,826,167
10120	228	32	9,873	12,139,530
10130	194	14	11,501	11,964,930
10140	213	66	12,772	18,139,230
10150	150	93	14,310	21,829,780
10160	148	26	12,169	16,355,840
10170	130	19	11,488	10,803,250
10180	90	36	13,193	18,623,940
17140	4	3	13,639	25,722,400
17150	30	7	13,367	16,694,650
17160	58	10	12,459	14,564,920
17170	84	5	11,342	11,789,850
17181	114	5	11,248	10,700,680
17190	133	1	11,405	10,705,100
17200	144	1	10,223	8,642,076
17210	164	1	10,239	7,711,903
17220	176	4	11,369	8,381,511
17230	189	1	10,391	6,668,895
17240	195	4	11,244	9,078,779
17250	188	15	13,379	12,401,450
17260	216	20	13,345	12,195,450
20030	242	0	9,684	496,220
20040	199	1	9,407	593,291
20050	300	1	9,668	3,043,011
20060	346	0	9,945	5,143,741
20070	312	2	8,964	5,400,423
20080	320	5	9,982	6,668,545
20090	269	6	9,270	4,885,770
20100	267	97	9,963	20,579,450
20110	241	49	12,088	10,410,740
20120	205	26	12,079	10,143,410
20130	190	23	11,147	10,036,640
20140	189	19	11,324	14,897,670
20150	150	51	14,428	16,623,630

Table 1a. WA-260-P Data Acquisition QC Table.

Line	Sections	Clipped	Avg Raman Peak	Avg Raman Variance
20160	128	11	11,716	14,742,880
20170	125	13	11,585	13,755,900
27040	18	1	12,027	12,237,530
27050	44	2	10,788	9,520,192
27060	75	0	10,795	8,013,440
27070	98	16	12,575	13,856,960
27080	120	33	15,194	14,250,450
27090	140	32	15,004	13,937,460
27100	151	50	15,239	15,491,800
27110	172	49	15,006	14,870,230
27120	192	3	10,230	9,660,718
27130	180	1	10,625	10,180,680
27140	205	7	11,066	11,277,450
27150	180	11	11,479	12,100,370
30020	114	0	12,207	6,092,583
30030	129	0	12,294	6,436,317
30040	137	0	12,436	6,759,975
30050	160	0	12,381	7,352,508
30060	165	2	12,111	6,895,177
30070	185	2	11,920	6,793,112
30080	185	5	15,337	8,421,679
30090	221	2	14,039	7,914,338
30100	179	0	13,408	7,371,493
30110	195	1	11,994	6,941,974
30120	159	6	13,711	8,819,437
30130	170	0	10,523	5,286,993
30140	140	4	13,399	8,139,063
30150	147	1	12,180	6,581,398
30160	121	3	13,108	8,324,337
30170	127	1	12,600	7,298,288
30180	102	1	12,837	7,134,198
30190	109	1	13,781	7,696,175
30200	81	1	14,340	8,192,819
30210	81	9	16,039	9,977,109
30220	62	2	16,050	9,293,436
30230	59	5	15,927	10,089,510
30240	41	10	16,295	10,630,890
30251	37	14	4,793	7,134,527
30260	29	8	6,649	6,745,834
30270	13	3	7,137	5,121,711
30280	24	3	8,026	8,823,563
30290	8	2	10,116	13,407,610

Table 1b. WA-260-P Data Acquisition QC Table.

Line	Sections	Clipped	Avg Raman Peak	Avg Raman Variance
50031	212	25	11,031	14,737,550
50040	206	0	11,529	7,860,121
50050	204	10	12,624	9,436,584
50060	184	0	12,074	8,704,948
50070	171	1	11,499	8,090,821
50080	162	1	11,521	8,570,050
50090	152	1	11,396	8,951,892
50100	140	0	11,385	9,181,377
50160	79	8	12,220	11,903,060
50170	69	1	12,156	11,987,600
50180	53	3	11,963	11,843,590
50190	49	5	12,480	13,218,340
50200	32	1	11,917	12,143,100
50210	28	1	11,964	12,651,520
50220	18	0	11,775	11,895,460
50230	15	1	11,824	12,636,660
57030	16	5	12,726	19,618,590
57040	31	8	12,072	19,636,500
57050	33	16	13,309	22,655,310
57060	50	26	14,003	21,225,440
57070	47	12	13,048	17,354,830
57080	66	22	13,172	19,405,370
57090	62	13	12,526	17,234,150
57100	79	20	12,677	17,410,190
57110	79	9	11,884	15,506,120
57120	81	21	12,633	17,744,720
57130	78	4	11,800	14,620,240
57140	107	6	10,733	12,942,310
57150	97	2	11,951	12,439,530
57170	111	7	12,309	12,943,410
57181	121	3	11,900	11,690,320
80030	28	0	8,676	1,259,436
80040	19	0	8,567	363,193
80050	31	0	8,639	375,332
80060	19	0	8,369	354,589
80070	28	0	8,641	518,214
80080	19	0	8,751	451,765
80090	25	0	8,493	534,964
80100	18	0	8,606	396,048
80110	29	0	9,003	1,445,140
80120	18	0	9,140	957,943
80130	26	0	7,593	853,686
80140	17	0	7,748	493,247
80150	30	0	8,580	2,527,142

Table 1c. WA-260-P Data Acquisition QC Table.

Line	Sections	Clipped	Avg Raman Peak	Avg Raman Variance
80160	20	0	10,242	4,608,389
80170	30	1	9,398	3,081,108
80181	25	2	10,170	11,917,650
80190	29	2	11,814	11,171,060
80200	17	0	10,387	7,645,096
80210	28	0	8,966	3,798,244
80220	17	1	9,766	6,096,289
80230	25	0	7,928	733,978
80240	16	0	7,805	615,874
80250	30	0	9,947	1,399,774
80260	21	0	9,859	2,109,169
80270	31	0	8,675	940,822
87030	36	0	8,531	520,184
87040	12	0	8,839	971,173
87050	23	0	8,412	1,076,198
87060	15	0	12,876	13,128,920
87070	24	3	14,292	18,031,250
87080	15	2	11,950	12,234,760
87090	20	0	12,244	12,417,280
87100	12	0	10,688	10,644,270
87110	20	1	11,934	13,042,210
87120	12	0	10,519	9,466,589
87130	20	3	10,912	10,757,040
87140	13	0	10,047	7,257,777
87150	15	0	10,387	7,657,950
87160	11	0	10,973	9,409,471
87170	16	0	10,004	8,339,871
87180	11	0	9,811	7,328,566
87190	18	0	10,637	6,573,394
87200	12	0	10,368	6,623,768

Table 1d. WA-260-P Data Acquisition QC Table.

Average Raman peak levels typically ranged between 8,000 and 14,000 (Figure 11). Average Raman variance levels typically ranged between $5x10^6$ and $20x10^6$ (Figure 12). A Raman peak level greater than 29,000 is used to indicate data clipping.

A map of the Raman peak averaged over 100 adjacent spectra is shown in Figure 13. There is some change in the Raman level between lines, probably reflecting changes in the recording parameters. A map of the Raman variance is shown in Figure 14.

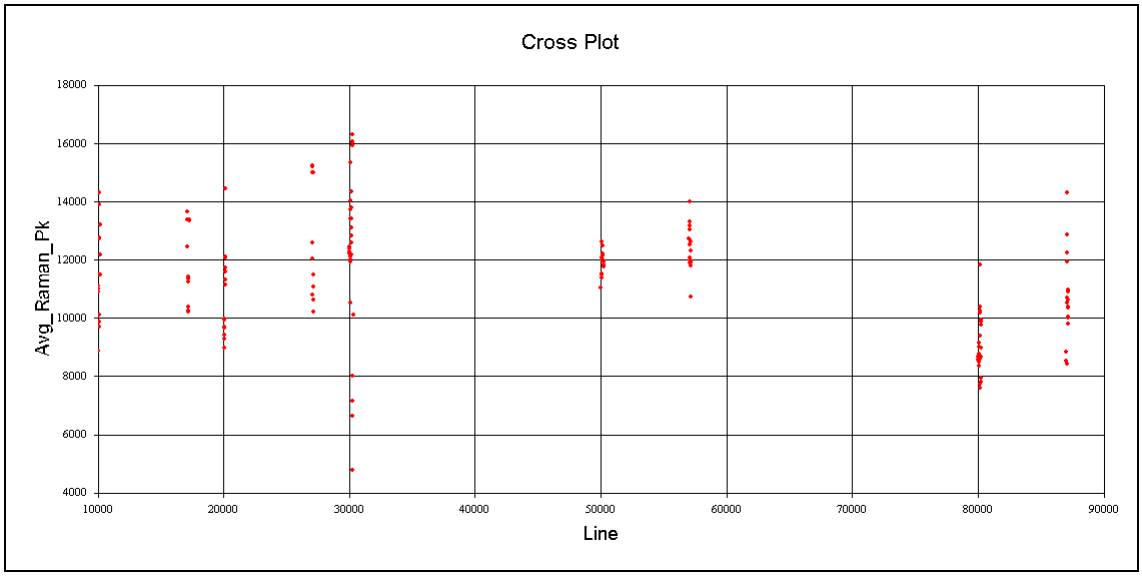


Figure 11. The Average Raman Peak Plotted for Each Line.

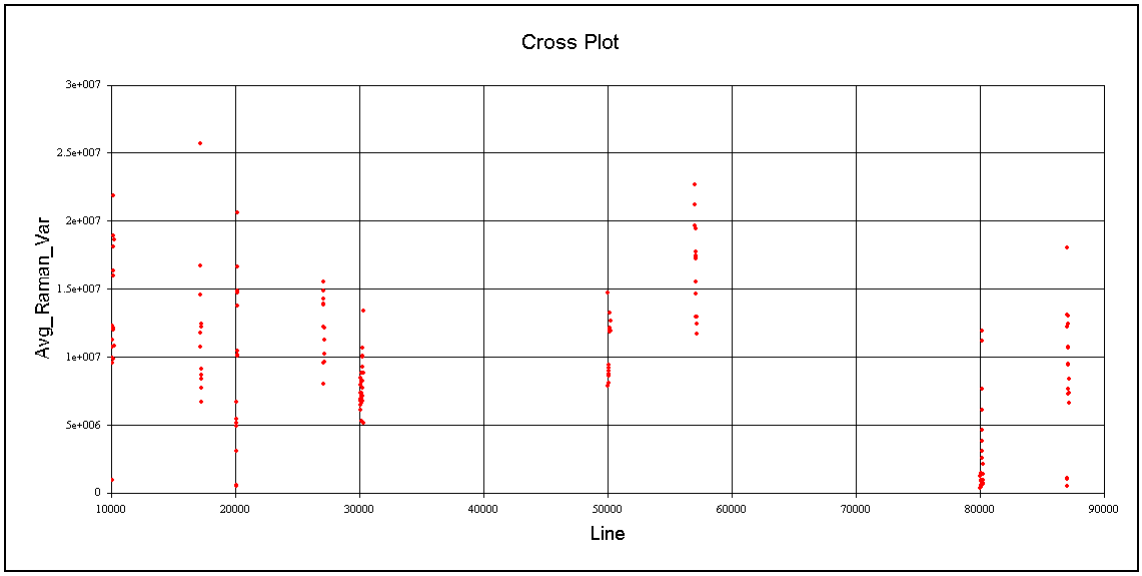


Figure 12. The Average Raman Variance Plotted for Each Line.

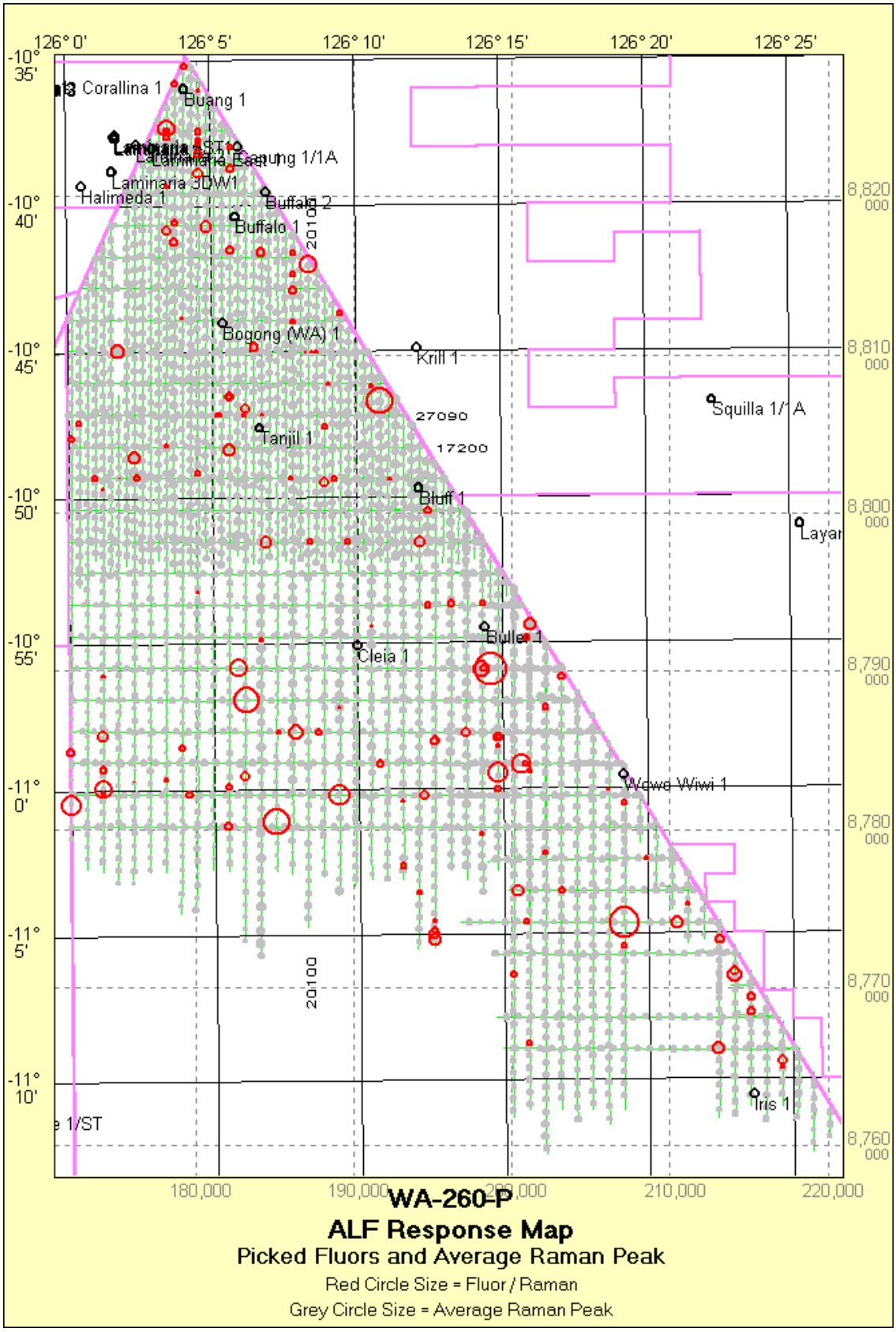


Figure 13. Map of Picked Fluors and Average Raman Peak.

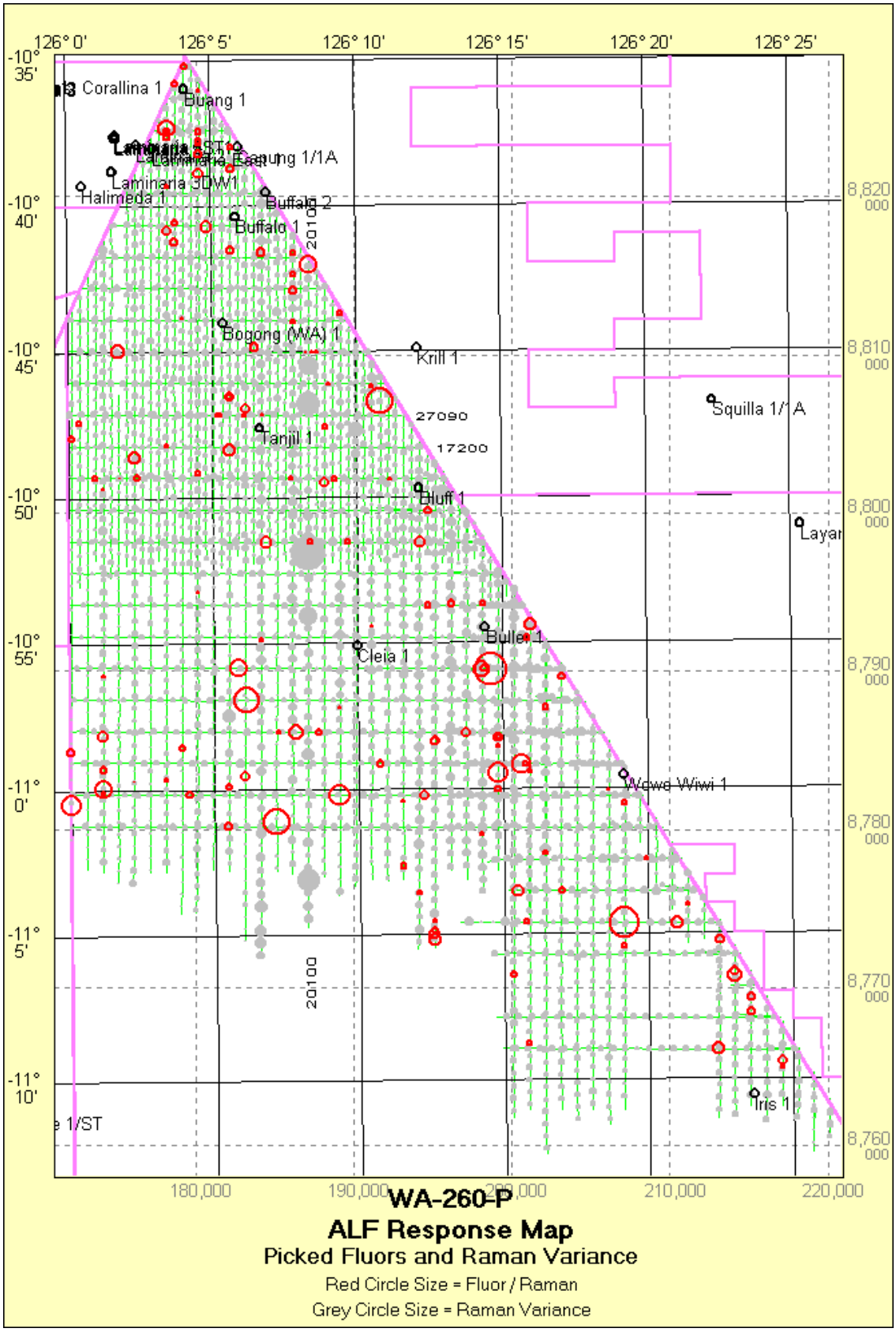


Figure 14. Map of Picked Fluors and Raman Variance.

Figures 15 and 16 show detailed acquisition QC plots for lines 27090 and 17200. Line 27090 has higher Raman peak and variance levels and also more data clipping. Although the lines are adjacent, they were flown on different sorties with different recording parameters. Careful fluor picking is required to prevent the acquisition variations from affecting the fluor patterns.

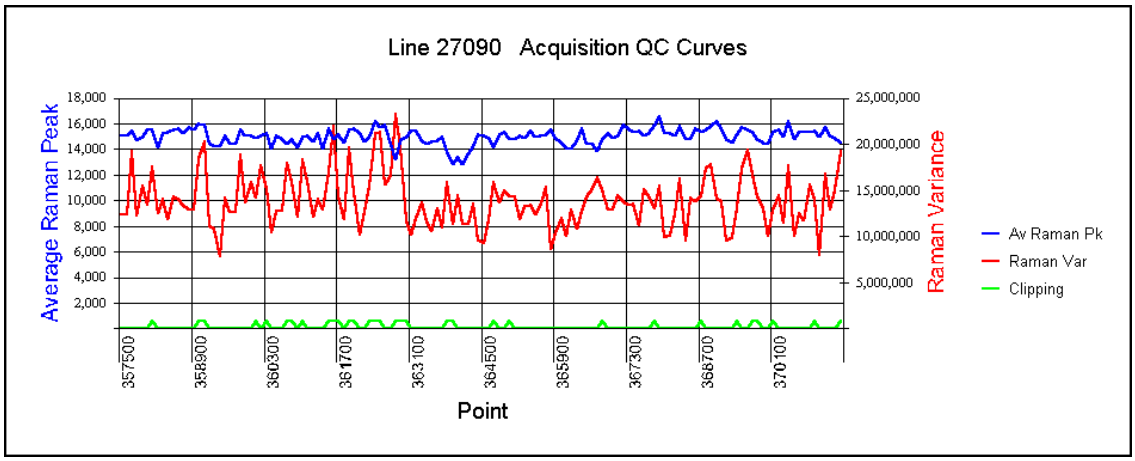


Figure 15. Line 27090 Acquisition QC Curves.

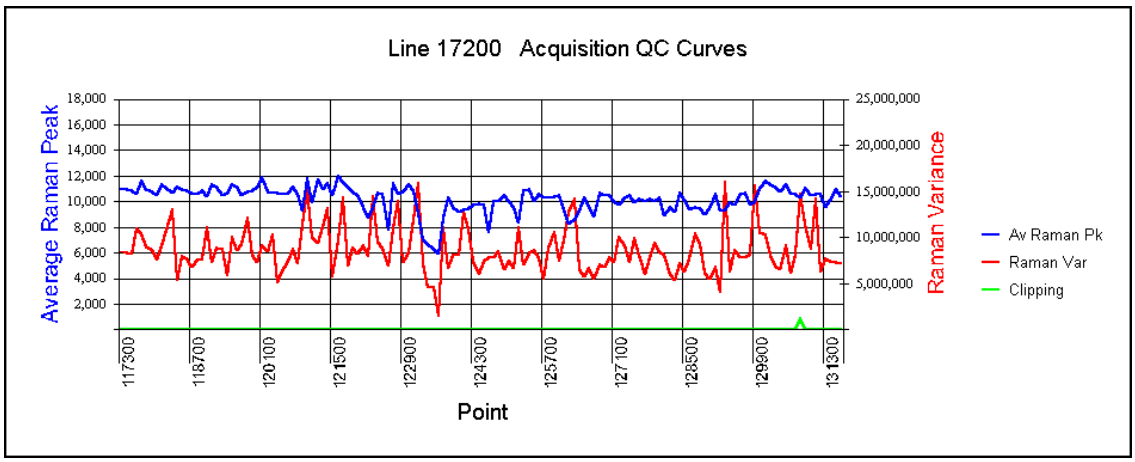


Figure 16. Line 17200 Acquisition QC Curves.

Figure 17 shows the acquisition QC plot for line 20100. There are large Raman peak and variance changes along this line. The amount of clipping tends to increase with the peak and variance increases.

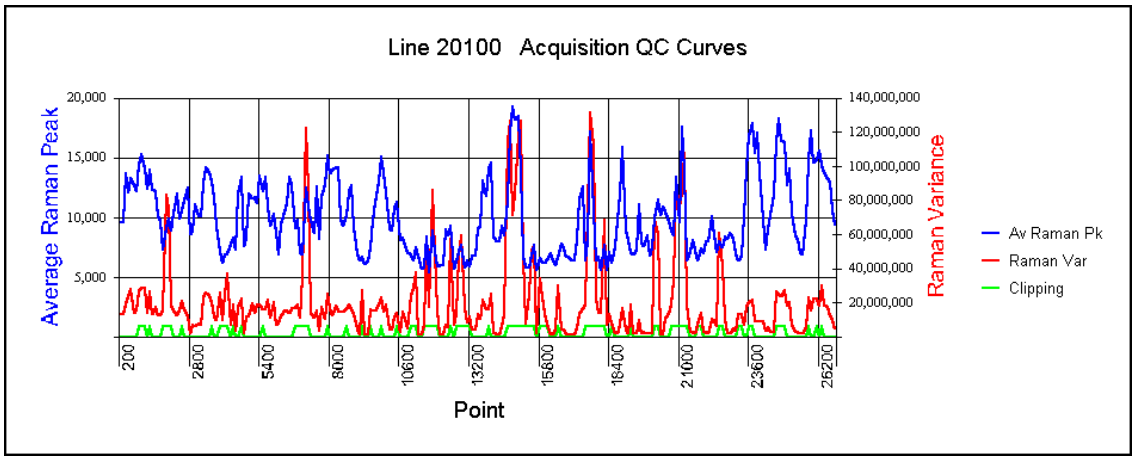


Figure 17. Line 20100 Acquisition QC Curves.

Appendix 2. Data Navigation QC

Line	Heading (Deg)	Straight Line Distance (m)	Acquisition Time (seconds)	Avg Straight Line Velocity (km/hr)	Points	Flight Distance (m)	Avg Flying Velocity	Avg Point Spacing (m)
10030	359.92	33,453.25	431.57	279.05	21,857	33,458.84	279.10	1.53
10040	179.99	40,006.14	510.97	281.86	25,929	40,010.09	281.89	1.54
10050	0.11	45,205.30	564.08	288.50	28,569	45,212.08	288.55	1.58
10060	180.00	48,864.65	627.19	280.48	31,764	48,871.57	280.52	1.54
10070	0.15	52,922.89	667.17	285.57	33,789	52,932.27	285.62	1.57
10080	179.97	47,053.06	604.71	280.12	30,627	47,058.07	280.15	1.54
10090	360.00	49,244.03	624.62	283.82	31,635	49,247.60	283.84	1.56
10100	180.02	40,697.96	526.66	278.19	26,674	40,702.61	278.22	1.53
10110	180.01	37,661.98	461.25	293.95	23,361	37,666.32	293.98	1.61
10120	0.14	35,142.90	453.37	279.05	22,962	35,151.18	279.12	1.53
10130	180.07	31,428.23	385.47	293.52	19,522	31,430.41	293.54	1.61
10140	0.09	32,637.06	422.41	278.15	21,394	32,643.78	278.21	1.53
10150	180.02	24,325.34	297.84	294.02	15,085	24,328.59	294.06	1.61
10160	359.96	22,643.33	294.80	276.51	14,931	22,644.69	276.53	1.52
10170	359.99	20,352.39	259.32	282.54	13,133	20,354.41	282.57	1.55
10180	180.14	14,568.90	179.82	291.67	9,107	14,570.62	291.70	1.60
17140	89.86	667.48	8.44	284.71	479	667.48	284.71	1.40
17150	269.90	5,009.81	61.50	293.26	3,116	5,009.93	293.26	1.61
17160	90.06	9,280.75	117.02	285.51	5,927	9,281.28	285.53	1.57
17170	270.04	13,587.88	167.56	291.93	8,487	13,588.80	291.95	1.60
17181	270.00	17,870.40	226.70	283.78	11,482	17,871.92	283.81	1.56
17190	90.00	20,308.73	264.64	276.27	13,404	20,311.02	276.30	1.52
17200	270.01	22,755.00	287.93	284.51	14,583	22,756.07	284.52	1.56
17210	89.96	25,191.84	326.41	277.84	16,532	25,193.51	277.86	1.52
17220	270.01	27,631.64	348.91	285.10	17,672	27,632.82	285.11	1.56
17230	89.99	28,966.93	375.58	277.65	19,022	28,967.92	277.66	1.52
17240	269.89	30,640.10	387.01	285.02	19,599	30,647.90	285.09	1.56
17250	90.02	28,871.41	373.68	278.14	18,926	28,872.81	278.16	1.53
17260	269.99	33,891.43	428.11	284.99	21,683	33,894.04	285.02	1.56
20030	179.98	37,585.47	480.08	281.84	24,314	37,588.49	281.87	1.55
20040	359.99	30,939.93	395.52	281.61	20,031	30,948.45	281.69	1.55
20050	179.99	46,651.03	593.79	282.83	30,074	46,657.66	282.87	1.55
20060	0.04	53,732.62	685.16	282.32	34,701	53,737.30	282.35	1.55
20070	180.01	48,521.16	617.10	283.06	31,253	48,527.74	283.10	1.55
20080	360.00	49,881.76	634.62	282.96	32,141	49,888.98	283.00	1.55
20090	180.03	42,146.26	533.08	284.62	26,999	42,151.52	284.66	1.56
20100	0.02	42,541.17	530.05	288.93	26,846	42,546.34	288.97	1.58
20110	180.06	37,270.44	475.85	281.97	24,151	37,363.14	282.67	1.55
20120	359.85	33,159.87	406.75	293.49	20,601	33,164.70	293.53	1.61

Table 2a. WA-260-P Data Navigation QC Table.

Line	Heading (Deg)	Straight Line Distance (m)	Acquisition Time (seconds)	Avg Straight Line Velocity (km/hr)	Points	Flight Distance (m)	Avg Flying Velocity	Avg Point Spacing (m)
20130	180.02	29,743.10	377.88	283.36	19,139	29,746.26	283.39	1.55
20140	359.99	30,933.96	376.72	295.61	19,080	30,935.86	295.63	1.62
20150	179.93	23,326.64	299.68	280.22	15,176	23,329.74	280.26	1.54
20160	179.94	19,554.73	254.67	276.42	12,899	19,556.20	276.45	1.52
20170	359.92	20,465.86	247.98	297.11	12,559	20,467.72	297.14	1.63
27040	269.63	2,864.37	37.43	275.49	1,897	2,864.80	275.54	1.51
27050	89.92	7,153.87	87.81	293.29	4,447	7,154.54	293.32	1.61
27060	269.97	11,446.59	149.54	275.56	7,575	11,447.71	275.59	1.51
27070	90.01	15,696.65	193.91	291.41	9,872	15,698.88	291.45	1.59
27080	270.08	19,096.86	237.61	289.33	12,033	19,098.51	289.36	1.59
27090	90.01	21,529.29	278.78	278.02	14,120	21,530.84	278.04	1.53
27100	269.99	23,975.13	299.79	287.90	15,183	23,976.56	287.92	1.58
27110	90.00	26,406.56	341.53	278.35	17,298	26,407.89	278.36	1.53
27120	270.02	28,857.68	382.09	271.89	19,352	28,861.30	271.93	1.49
27130	89.99	28,928.85	357.30	291.47	18,096	28,930.10	291.49	1.60
27140	270.03	30,319.51	403.99	270.18	20,512	30,448.79	271.33	1.48
27150	90.01	28,871.72	357.82	290.48	18,123	28,873.39	290.49	1.59
30020	359.98	18,750.13	227.03	297.32	11,499	18,751.78	297.35	1.63
30030	180.03	19,231.80	255.54	270.93	12,943	19,233.15	270.95	1.49
30040	0.07	22,578.55	273.43	297.27	13,849	22,582.87	297.33	1.63
30050	180.02	23,928.88	316.81	271.91	16,046	23,932.10	271.95	1.49
30060	0.13	26,731.90	326.99	294.31	16,561	26,735.74	294.35	1.61
30070	180.02	28,006.26	367.73	274.18	18,625	28,009.33	274.21	1.50
30080	0.01	31,063.05	367.89	303.97	18,632	31,066.36	304.00	1.67
30090	179.95	32,243.16	438.04	264.99	22,185	32,246.10	265.01	1.45
30100	359.91	29,712.76	354.68	301.58	17,964	29,717.11	301.63	1.65
30110	179.98	28,678.31	387.48	266.44	19,624	28,682.06	266.48	1.46
30120	0.01	26,347.22	314.68	301.42	15,937	26,350.66	301.46	1.65
30130	179.99	25,110.77	337.80	267.61	17,109	25,112.19	267.63	1.47
30140	359.96	23,363.18	278.27	302.25	14,094	23,367.27	302.30	1.66
30150	179.97	21,811.61	292.65	268.31	14,872	21,813.45	268.34	1.47
30160	359.96	20,181.34	240.20	302.47	12,165	20,182.54	302.49	1.66
30170	180.00	18,826.00	252.82	268.07	12,805	18,829.14	268.12	1.47
30180	359.83	17,142.00	204.22	302.18	10,344	17,144.98	302.23	1.66
30190	179.99	16,197.22	218.05	267.42	11,043	16,198.63	267.44	1.47
30200	359.92	13,717.98	163.02	302.94	8,256	13,718.83	302.96	1.66
30210	180.02	12,079.27	162.45	267.68	8,228	12,079.90	267.70	1.47
30220	359.78	10,326.68	123.29	301.53	6,245	10,327.60	301.56	1.65
30230	180.01	8,828.67	118.32	268.62	6,019	8,829.15	268.64	1.47

Table 2b. WA-260-P Data Navigation QC Table.

Line	Heading (Deg)	Straight Line Distance (m)	Acquisition Time (seconds)	Avg Straight Line Velocity (km/hr)	Points	Flight Distance (m)	Avg Flying Velocity	Avg Point Spacing (m)
30240	359.41	6,974.12	83.50	300.68	4,230	6,974.78	300.71	1.65
30251	0.38	5,813.51	74.85	279.61	3,792	5,817.45	279.80	1.53
30260	0.44	4,315.61	57.64	269.54	2,920	4,316.44	269.59	1.48
30270	180.40	2,199.46	27.18	291.32	1,403	2,199.85	291.37	1.57
30280	0.13	3,691.85	48.99	271.29	2,481	3,692.06	271.31	1.49
30290	179.84	1,371.53	16.92	291.82	858	1,371.55	291.82	1.60
50031	179.99	33,537.19	421.54	286.41	21,350	33,542.92	286.46	1.57
50040	180.16	31,251.63	408.07	275.70	20,668	31,257.31	275.75	1.51
50050	359.90	32,591.06	406.02	288.97	20,564	32,596.36	289.02	1.59
50060	179.96	28,172.56	366.22	276.94	18,548	28,174.46	276.96	1.52
50070	359.85	27,232.19	338.98	289.21	17,169	27,236.01	289.25	1.59
50080	179.97	24,941.94	321.78	279.04	16,298	24,944.00	279.07	1.53
50090	359.80	24,278.98	303.15	288.32	15,354	24,282.85	288.37	1.58
50100	180.02	21,646.36	277.63	280.69	14,062	21,647.63	280.70	1.54
50160	180.14	12,543.19	158.23	285.38	8,014	12,548.45	285.50	1.57
50170	359.79	10,953.67	138.73	284.24	7,027	10,955.24	284.29	1.56
50180	180.18	8,527.20	106.94	287.06	5,417	8,527.63	287.07	1.57
50190	0.25	7,816.25	99.40	283.08	5,034	7,819.27	283.19	1.55
50200	180.03	5,316.10	66.62	287.27	3,375	5,316.46	287.29	1.58
50210	1.52	4,396.72	57.00	277.69	2,888	4,403.42	278.11	1.53
50220	179.84	3,109.41	38.68	289.40	1,960	3,109.46	289.40	1.59
50230	0.87	2,377.60	30.95	276.55	1,568	2,378.18	276.62	1.52
57030	269.95	2,540.93	32.70	279.74	1,657	2,541.30	279.78	1.54
57040	90.32	4,828.67	63.46	273.92	3,215	4,829.21	273.95	1.50
57050	269.91	5,204.04	66.78	280.54	3,383	5,204.77	280.58	1.54
57060	90.22	7,667.66	99.85	276.45	5,058	7,669.71	276.52	1.52
57070	269.85	7,334.40	94.72	278.76	4,798	7,335.10	278.78	1.53
57080	89.77	10,074.78	131.01	276.84	6,635	10,076.36	276.89	1.52
57090	269.99	9,789.15	125.96	279.78	6,380	9,790.48	279.82	1.54
57100	90.00	12,184.19	158.60	276.56	8,033	12,185.63	276.60	1.52
57110	269.97	12,313.54	158.08	280.42	8,007	12,314.70	280.45	1.54
57120	89.06	12,394.77	161.59	276.14	8,185	12,415.40	276.60	1.52
57130	270.06	12,159.28	157.01	278.79	7,953	12,160.22	278.82	1.53
57140	89.89	16,552.05	213.30	279.36	10,804	16,557.28	279.45	1.53
57150	89.85	15,759.62	194.32	291.96	9,843	15,763.13	292.03	1.60
57170	89.86	18,021.72	221.23	293.26	11,203	18,024.66	293.31	1.61
57181	270.04	18,760.73	240.77	280.51	12,195	18,761.59	280.52	1.54
80030	359.89	4,605.68	57.81	286.81	2,929	4,606.69	286.87	1.57
80040	179.48	3,171.57	40.56	281.50	2,055	3,172.14	281.55	1.55
80050	0.07	5,083.32	63.56	287.92	3,220	5,085.36	288.03	1.58

Table 2c. WA-260-P Data Navigation QC Table.

Line	Heading (Deg)	Straight Line Distance (m)	Acquisition Time (seconds)	Avg Straight Line Velocity (km/hr)	Points	Flight Distance (m)	Avg Flying Velocity	Avg Point Spacing (m)
80060	180.19	3,094.74	39.06	285.23	1,979	3,095.00	285.25	1.57
80070	0.33	4,589.87	57.38	287.97	2,907	4,590.41	288.00	1.58
80080	179.62	3,032.86	38.46	283.89	1,949	3,033.24	283.92	1.56
80090	0.37	4,087.54	51.32	286.73	2,599	4,087.90	286.76	1.57
80100	179.42	3,003.76	37.91	285.24	1,921	3,003.82	285.25	1.57
80110	359.95	4,716.01	59.55	285.10	3,017	4,716.55	285.13	1.56
80120	180.05	2,934.28	37.28	283.35	1,889	2,934.42	283.37	1.56
80130	359.89	4,243.26	53.35	286.33	2,703	4,243.56	286.35	1.57
80140	180.17	2,878.50	36.67	282.59	1,858	2,878.60	282.60	1.55
80150	359.88	4,953.40	62.07	287.29	3,145	4,955.18	287.40	1.58
80160	180.05	3,180.53	40.55	282.36	2,055	3,181.16	282.42	1.55
80170	0.16	4,827.21	60.95	285.12	3,088	4,828.04	285.17	1.56
80181	359.52	4,269.37	50.64	303.51	2,566	4,270.28	303.57	1.67
80190	359.96	4,746.19	59.28	288.23	3,003	4,746.77	288.27	1.58
80200	179.32	2,840.37	36.43	280.68	1,846	2,840.73	280.72	1.54
80210	0.44	4,585.53	57.93	284.96	2,935	4,587.26	285.07	1.56
80220	179.65	2,703.32	34.71	280.38	1,759	2,703.37	280.38	1.54
80230	0.28	4,144.92	52.37	284.93	2,653	4,146.05	285.01	1.56
80240	179.92	2,591.62	33.05	282.29	1,675	2,591.82	282.32	1.55
80250	0.01	4,857.92	61.01	286.65	3,091	4,858.33	286.67	1.57
80260	180.19	3,381.73	42.81	284.38	2,169	3,381.87	284.39	1.56
80270	359.67	5,057.23	63.87	285.05	3,236	5,058.92	285.14	1.56
87030	91.50	5,828.81	71.24	294.55	3,609	5,832.80	294.75	1.62
87040	269.04	2,133.96	26.95	285.06	1,366	2,134.66	285.15	1.56
87050	93.01	3,599.07	45.99	281.73	2,381	3,601.49	281.92	1.51
87060	270.18	2,568.64	32.28	286.46	1,636	2,568.71	286.47	1.57
87070	90.35	3,830.42	49.54	278.35	2,510	3,831.77	278.45	1.53
87080	270.21	2,564.01	32.30	285.77	1,637	2,564.47	285.82	1.57
87090	96.22	3,189.16	40.38	284.32	2,046	3,194.82	284.83	1.56
87100	270.06	2,030.56	25.51	286.55	1,293	2,030.60	286.56	1.57
87110	90.85	3,290.49	41.64	284.48	2,110	3,292.42	284.65	1.56
87120	269.91	1,978.97	24.86	286.58	1,260	1,979.00	286.58	1.57
87130	94.70	3,219.10	40.96	282.93	2,075	3,247.33	285.41	1.57
87140	270.59	2,133.86	26.89	285.68	1,363	2,133.95	285.69	1.57
87150	98.21	2,613.06	33.19	283.43	1,682	2,619.07	284.08	1.56
87160	269.67	1,865.20	23.68	283.56	1,200	1,865.22	283.56	1.56
87170	92.17	2,630.19	32.91	287.71	1,668	2,630.40	287.74	1.58
87180	269.94	1,866.05	23.40	287.08	1,186	1,866.06	287.09	1.58
87190	94.67	2,998.91	38.04	283.81	1,928	3,005.31	284.41	1.56
87200	269.44	1,970.34	24.80	286.02	1,256	1,970.40	286.03	1.57
Total		**2,723,873.82**	**34,574.20**		**1,751,550**	**2,724,500.25**		

Table 2d. WA-260-P Data Navigation QC Table.

A total of 1,751,550 ALF spectra were collected over 158 lines in the WA-260-P survey. 2,724km of lines were flown. The average point spacing for each line ranged from 1.45m to 1.67m (Figure 18).

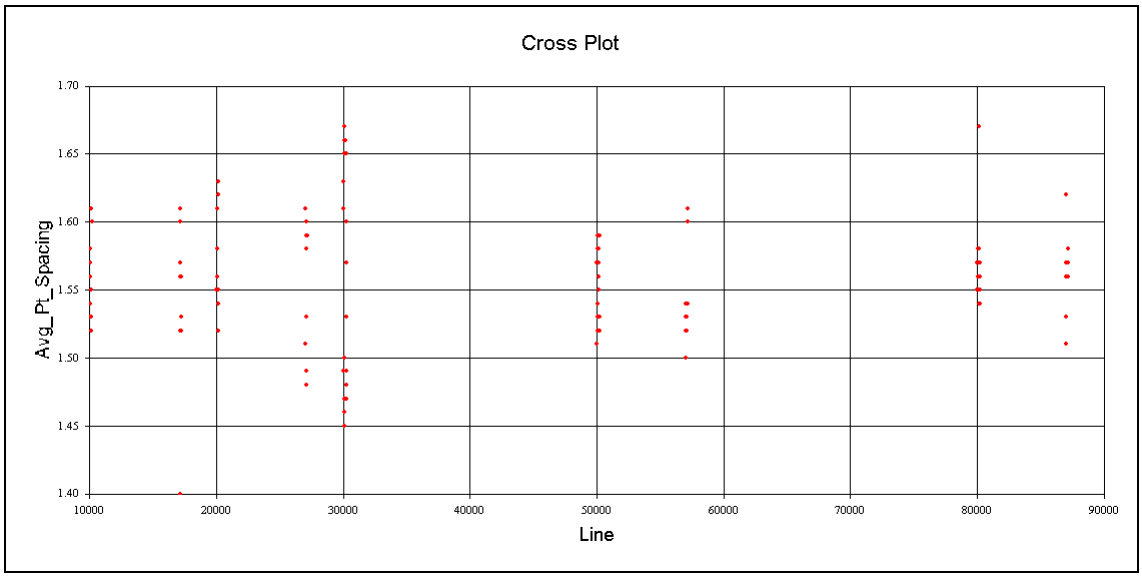


Figure 18. The Average Point Spacing Plotted for Each Line.

Appendix 3. CD Contents

The CD contains the following files:

WA260P ALF Project.zip
: the *ALF Explorer™* project

WA260P ALF Survey Interpretation Report.doc
: the interpretation report document file

Picked Fluors.txt
: an ASCII data file of the fluors selected during the interpretation

WA260P Survey Summary.xls
: Excel spreadsheet containing the survey acquisition and navigation QC summaries

Figures
: Directory containing figures used in the interpretation report.