1996 Laminaria High, Northern Bonaparte Basin (AC/P8) Airborne Laser Fluorosensor Survey Interpretation Report [WGC AC/P8 Survey Number 1248.2]

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Contents

1. Introduction

The AC/P8 airborne laser fluorosensor (ALF) survey is located in the Northern Bonaparte Basin, Timor Sea (Figure 1). It was flown in three flights between 29th November 1996 and 1st December 1996. Fifty lines were acquired at 500m spacing in a NW-SE direction at a flying height of 100m. Line lengths ranged from about 26km to 32km with a total of 1,490km acquired.

A total of 1,040,856 spectra were collected at an average spacing of 1.34m to 1.49m. Of these, 249 were selected as confident fluorescence spectra in the second pass interpretation (about 0.024 percent or 239 fluors per million spectra).

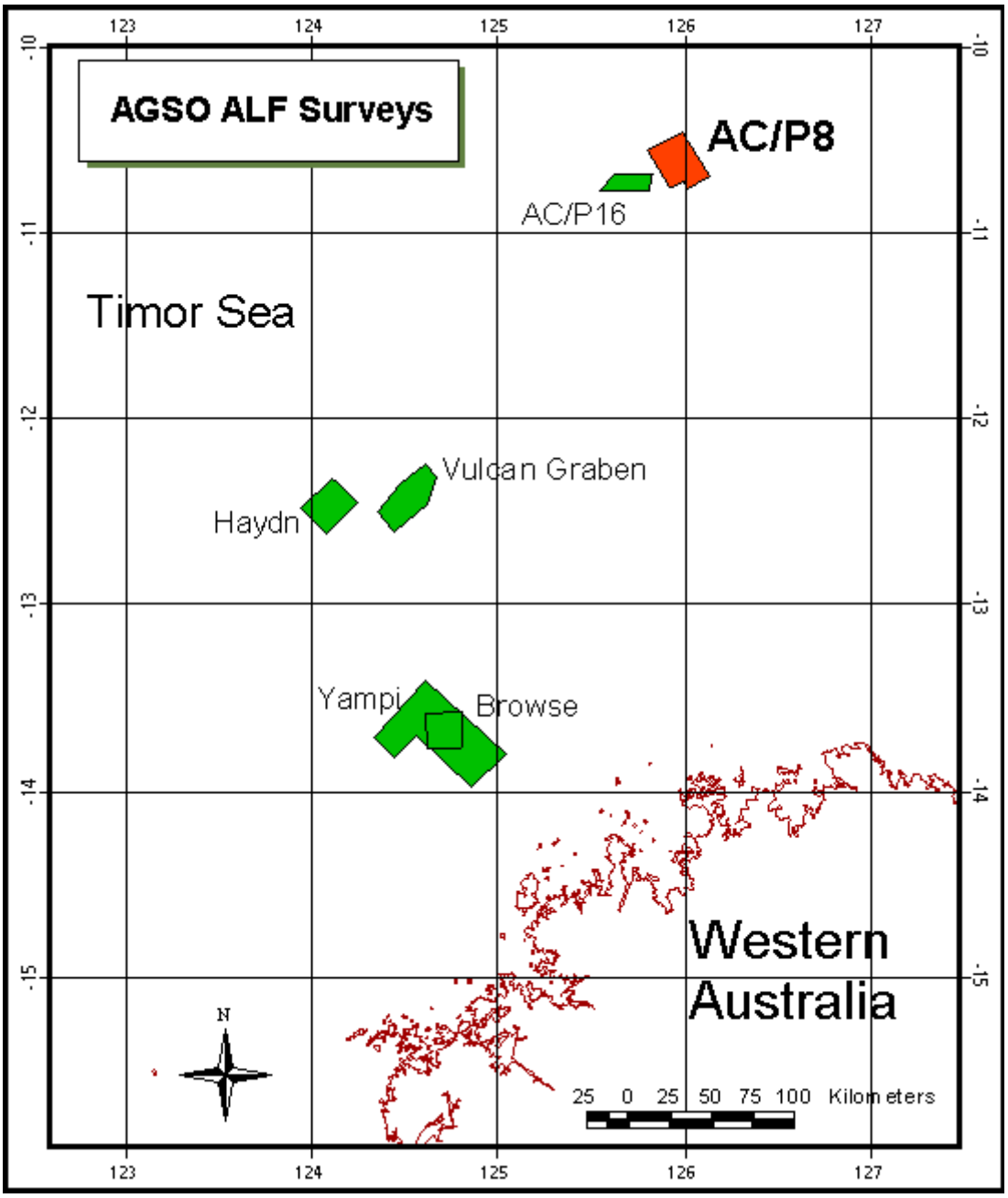


Figure 1 AC/P8 ALF Survey Location Map.

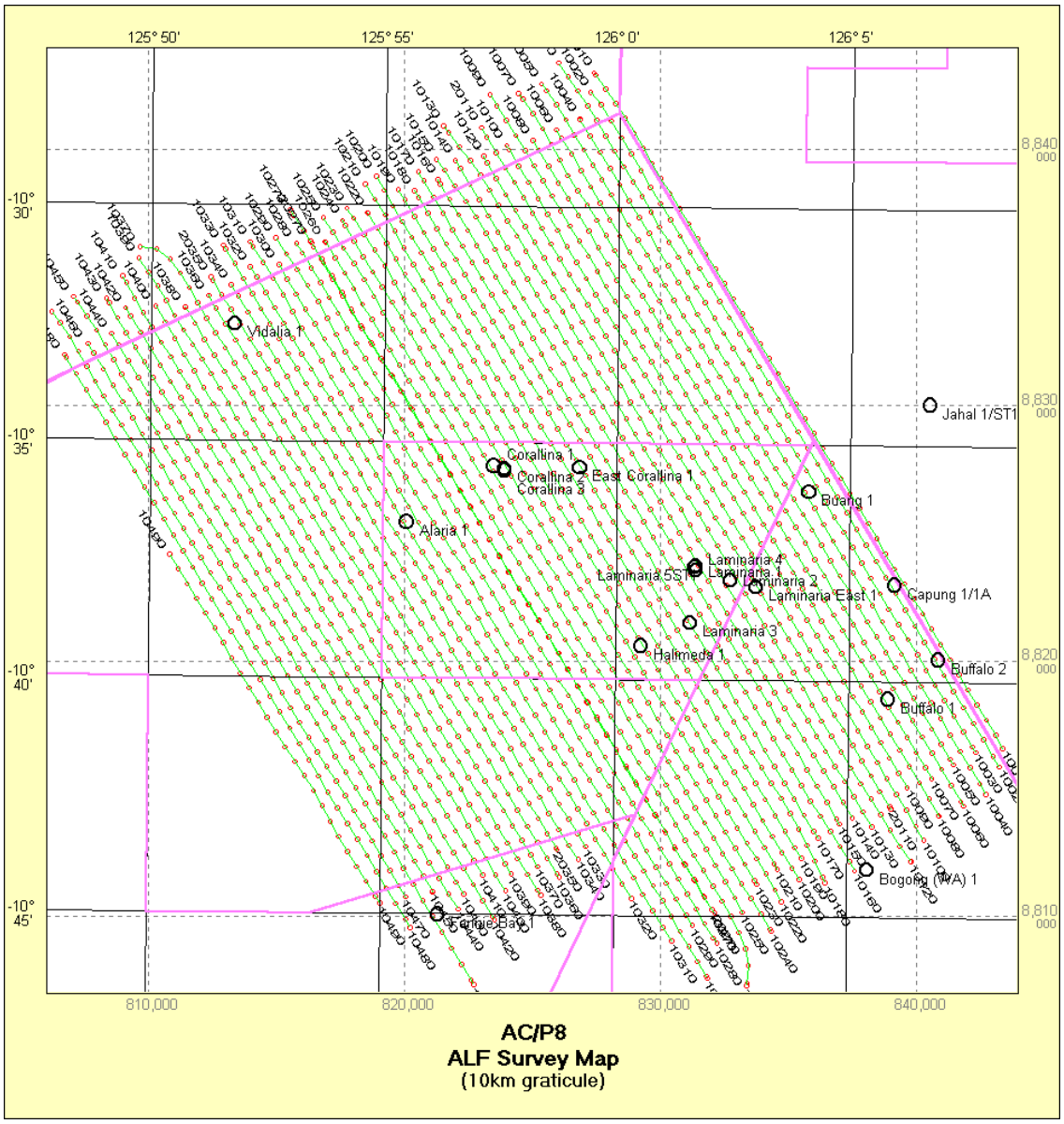


Figure 2. The AC/P8 ALF Survey.

Figure 2 shows a map of the AC/P8 ALF survey with point symbols annotated in red at a spacing of 500.

Line 20270 was a repeat of line 10270.

Mapping Specifications:

Projection: Southern UTM Zone 51 (Central Meridian 123 degrees east)

Min Easting:	806,000
Max Easting:	844,000
Min Northing:	8,807,000
Max Northing:	8,844,000

2. ALF Survey Analysis

2.1. First Pass Fluor Mapping

A first pass fluorescence anomaly mapping was done using a channel 50 cutoff amplitude of 1000 to reduce the number of spectra to review from 1,040,856 to 1,664 possible fluors, then manually selecting the confident fluors.

The following SQL query is used to select the possible fluors:

SELECT * FROM [RawAlfData] WHERE Ch_50 > 1000 ORDER BY Ch_50 DESC

Of the 1,664 possible fluors, 163 were picked as confident fluors and plotted in Figure 3. Each fluor is plotted as a red circle with size proportional to the fluorescence area / Raman area ratio. The most obvious and confident fluors tend to plot with the largest circles.

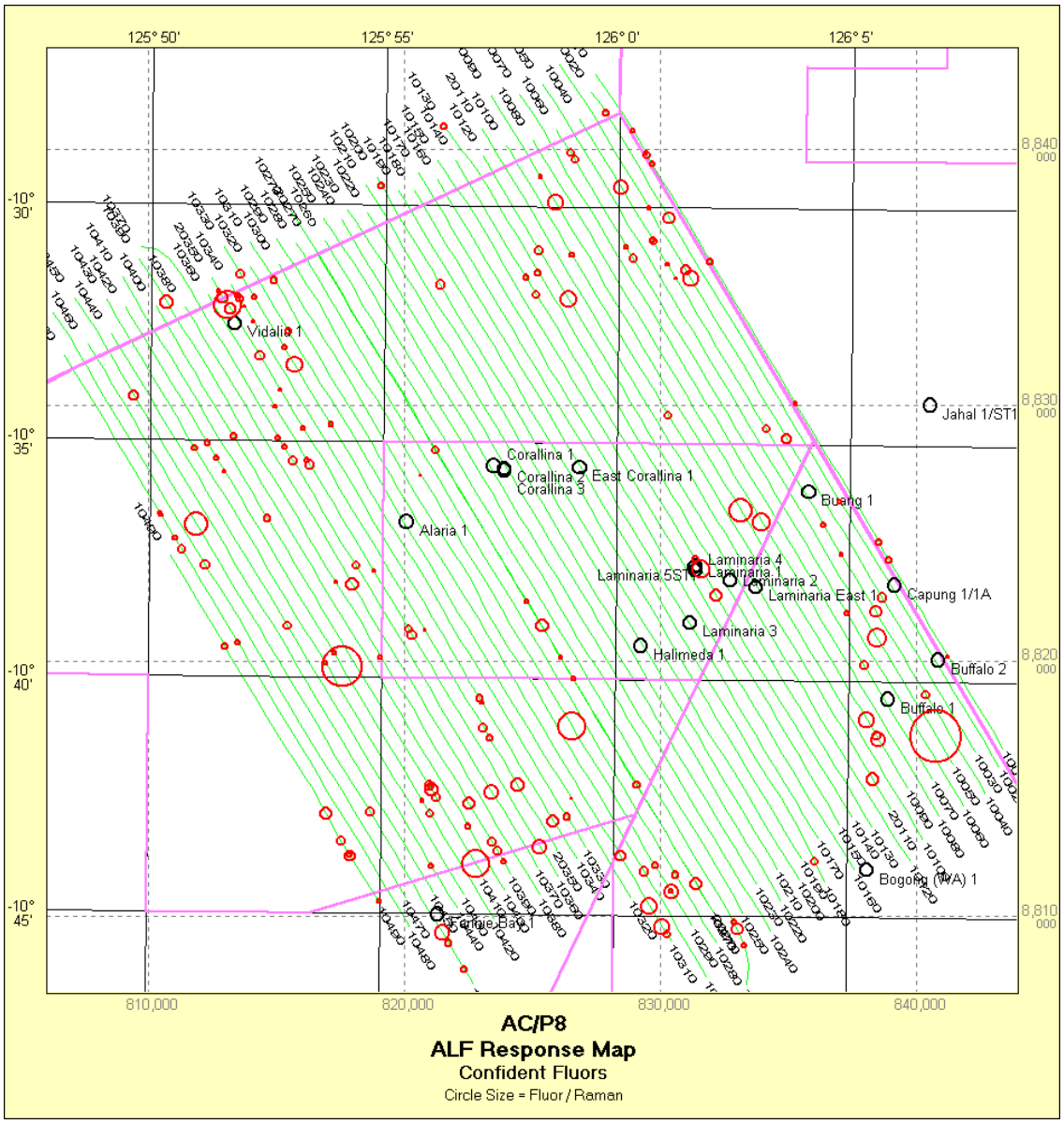


Figure 3. The AC/P8 ALF Survey Confident Fluor Map.

Figure 4 shows the fluorescence area / Raman area ratio histogram for the picked fluors. (The fluorescence area is calculated between 320nm and 480nm to avoid laser glint problems.) Most of the picked fluors have a F/R ratio between 0.15 and 0.30. The number of fluors in the higher ratio intervals declines rapidly. Very few fluors are picked with a F/R ratio less than 0.15 because they cannot be identified with confidence.

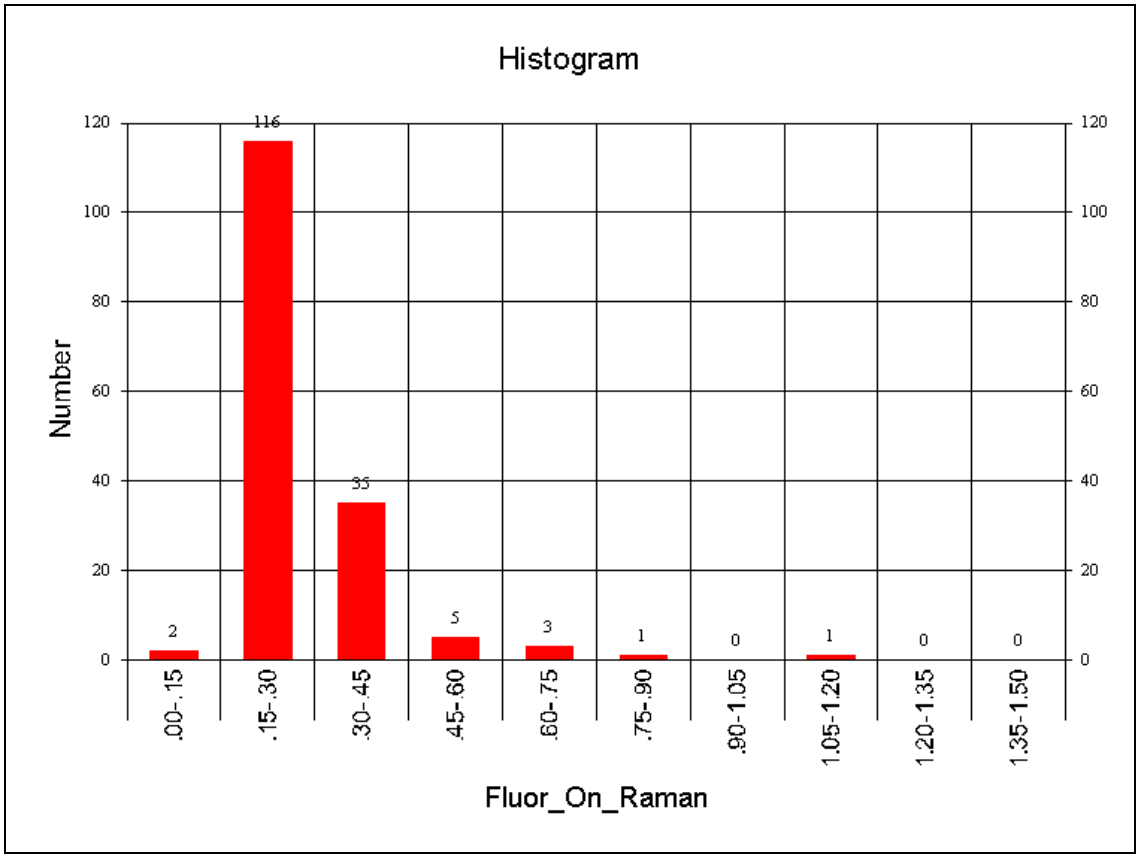


Figure 4. The F/R Ratio Histogram for the Picked Fluors.

2.2. Refined Fluor Mapping

The fluorescence anomaly mapping was refined in a second interpretation. To reduce the effects of acquisition parameters on the initial automatic selection of possible fluors, they were selected using the ratio of channel 50 amplitudes (in the fluorescence region) to channel 27 amplitudes (near the Raman peak).

The following SQL query was used:

SELECT * FROM [RawAlfData] WHERE Ch_50 > Ch_27 / 20 ORDER BY Ch_50 DESC

This query reduced the number of records to review to 8097. (By sorting on channel 50, the actual fluors tend to be located at the top of the list.) Less than half the data was reviewed before confident fluors became rare and the analysis could be stopped.

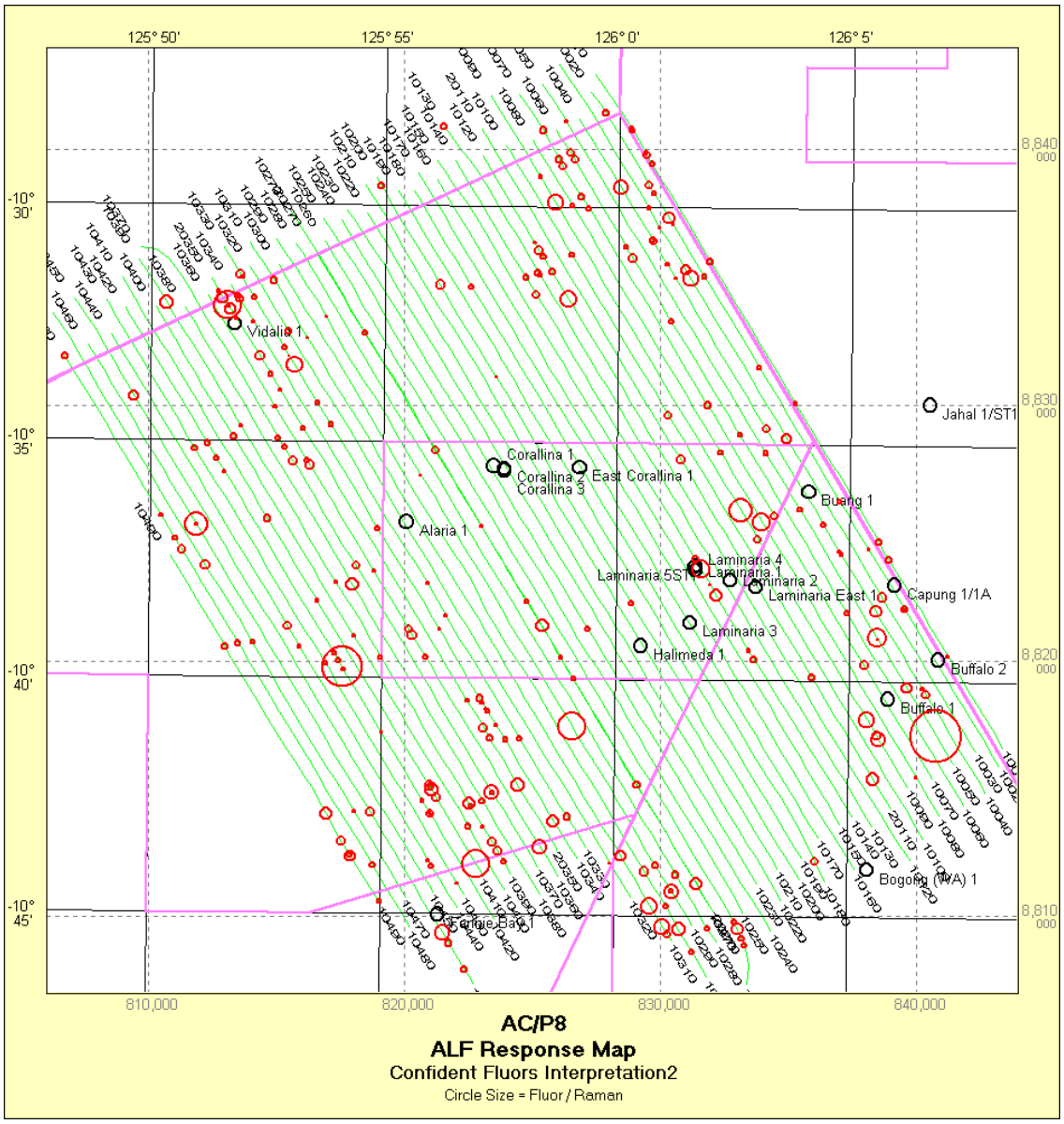


Figure 5. The AC/P8 ALF Survey Confident Fluor Map, Interpretation 2.

A total of 249 fluors were picked in the refined interpretation. A map of these is shown in Figure 5. The first pass and refined interpretations show very similar fluor distributions. The largest fluors are picked in both interpretations but the larger number of small fluors on the refined map defines the leakage regions a little more clearly.

There is a marked lack of fluors near the Corallina accumulation and only a few fluors near the Laminaria Field. This suggests a present day competent seal over these structures. Loss of hydrocarbons through water washing may explain the low degree of fill in the structures. Newell (1999) discusses this model in the Northern Bonaparte Basin.

The F/R histogram plot (Figure 6) shows that nearly all of the extra fluors picked have low amplitude. The lowest amplitude fluors remained difficult to pick with confidence.

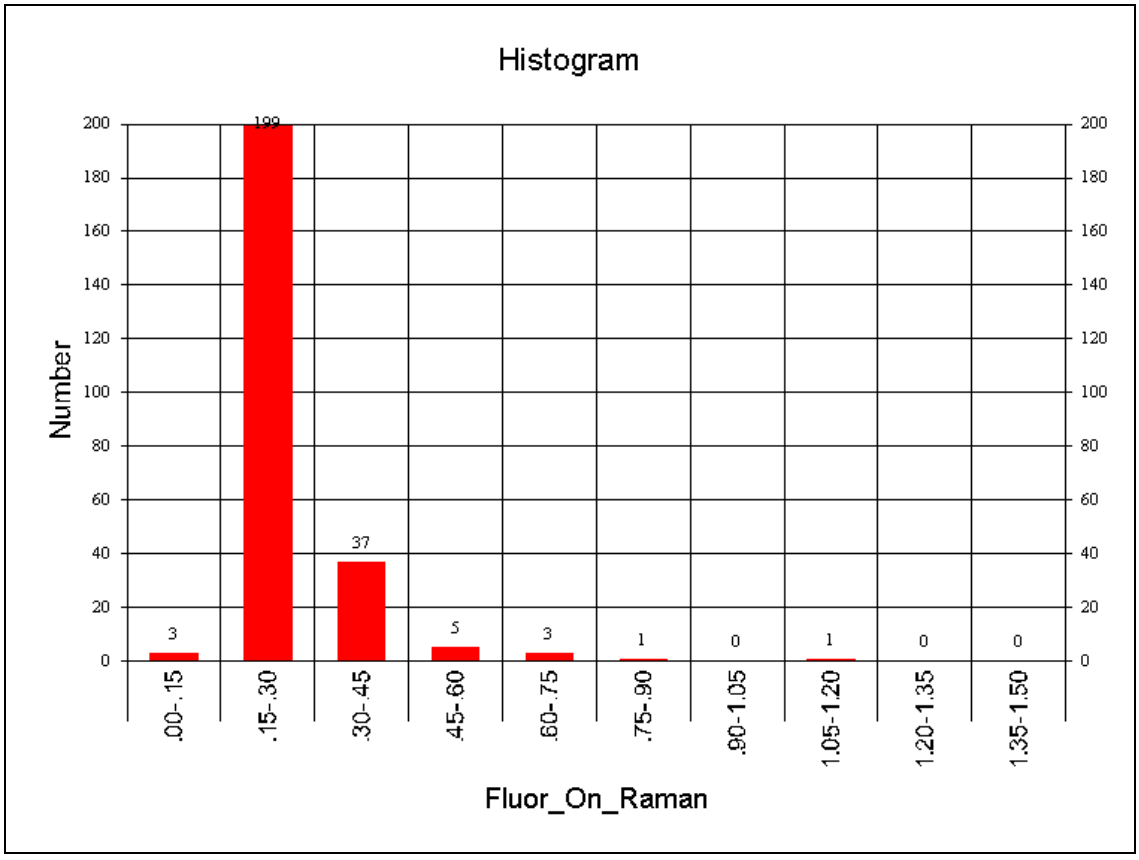
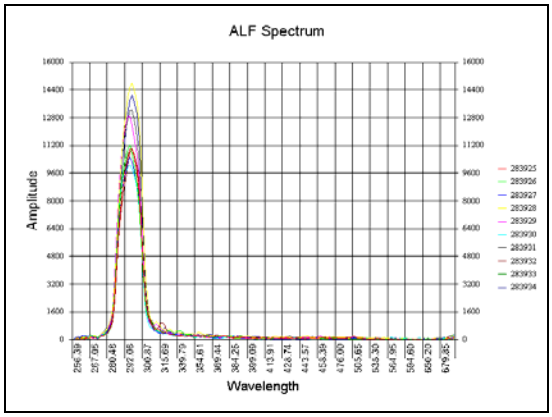
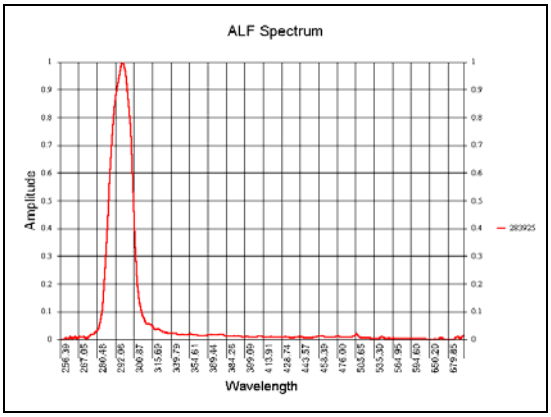


Figure 6. The F/R Ratio Histogram of the Picked Fluors, Interpretation 2.

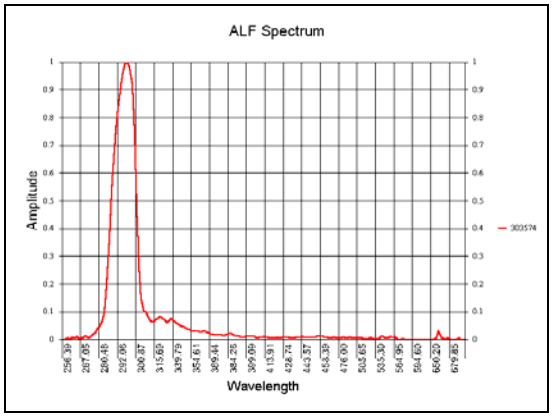
Figure 7 shows a selection of ALF spectra from the AC/P8 survey. Figure 7a is not normalized and shows ten adjacent spectra, having no fluorescence, on line 10010. Figure 7b shows one of these spectra normalized to the Raman peak. Figure 7c to 7f show normalized displays of flours of increasing intensity.



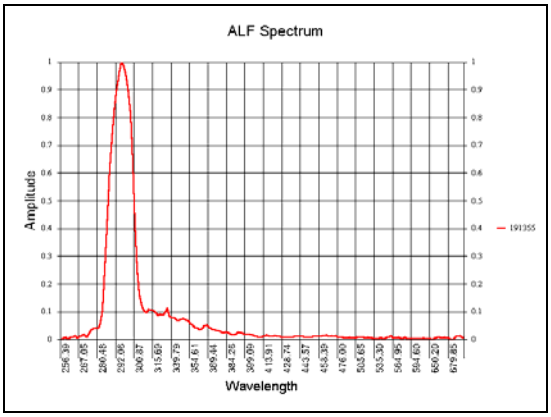
7 a) Line 10010 Ten Adjacent ALF Spectra.



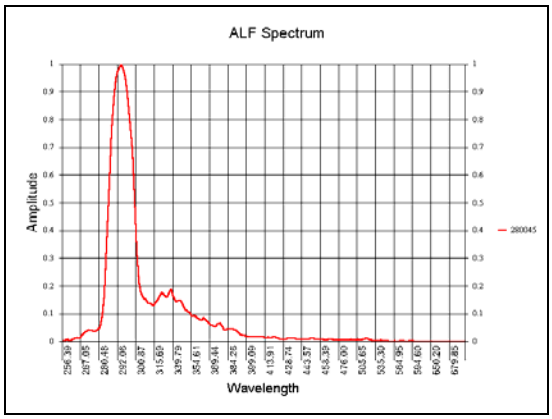
7 b) Line 10010 No Fluor.



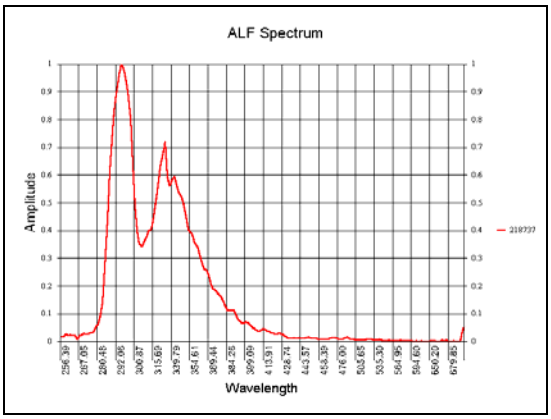
7 c) Line 10330 Low Amplitude Fluor.



7 d) Line 10060 Small to Medium Fluor.



7 e) Line 10020 Medium to Large Fluor.



7 f) Line 10050 Largest Amplitude Fluor.

Figure 7. Selected ALF Spectra.

2.3. Adjacent Fluor Detection

No adjacent fluors were present in the second refined interpretation. One pair of near fluors were found when the data was searched for fluors within 10 samples of each other. These fluors were found on line 10290 and are shown in Figure 8. The curves are normalized to the Raman peak to aid comparison.

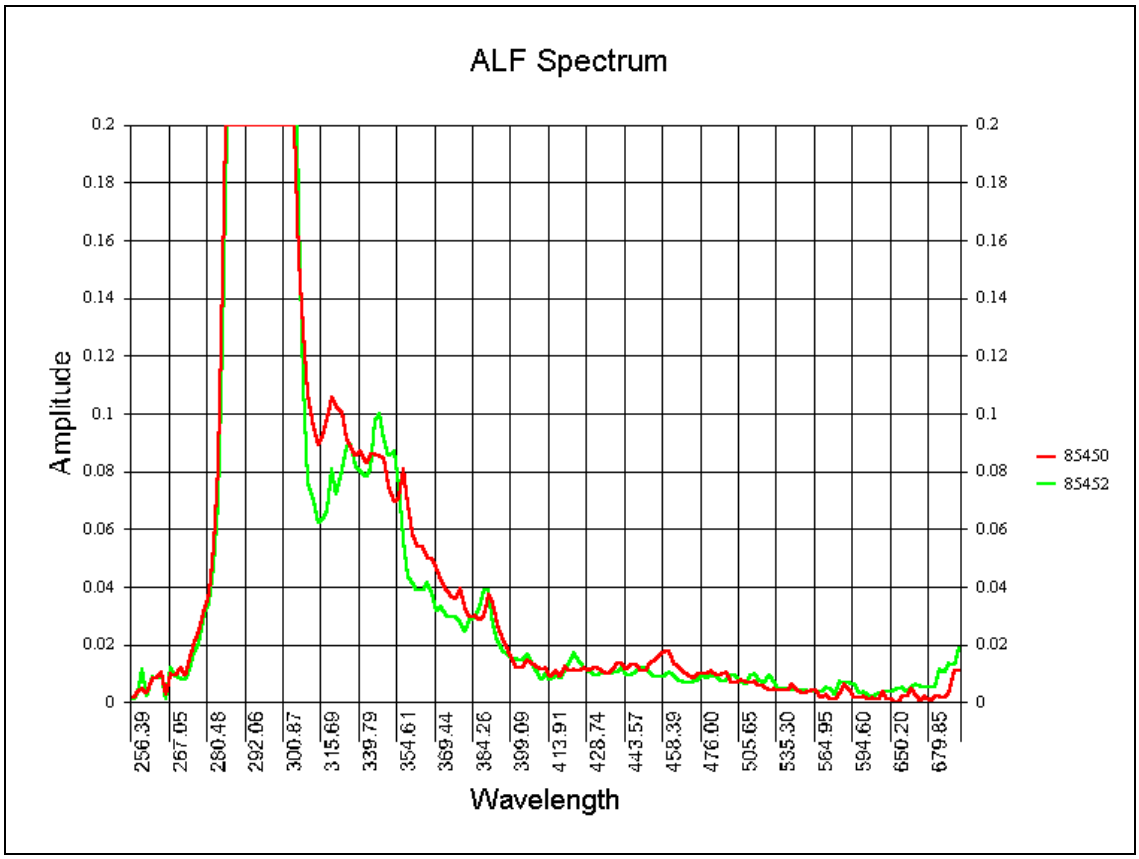


Figure 8. Line 10290 Near Fluors. (With Raman Peak Normalisation.)

The near fluors are plotted in blue on the map shown in Figure 9. They lie about 8km west of the Bogong-1 well.

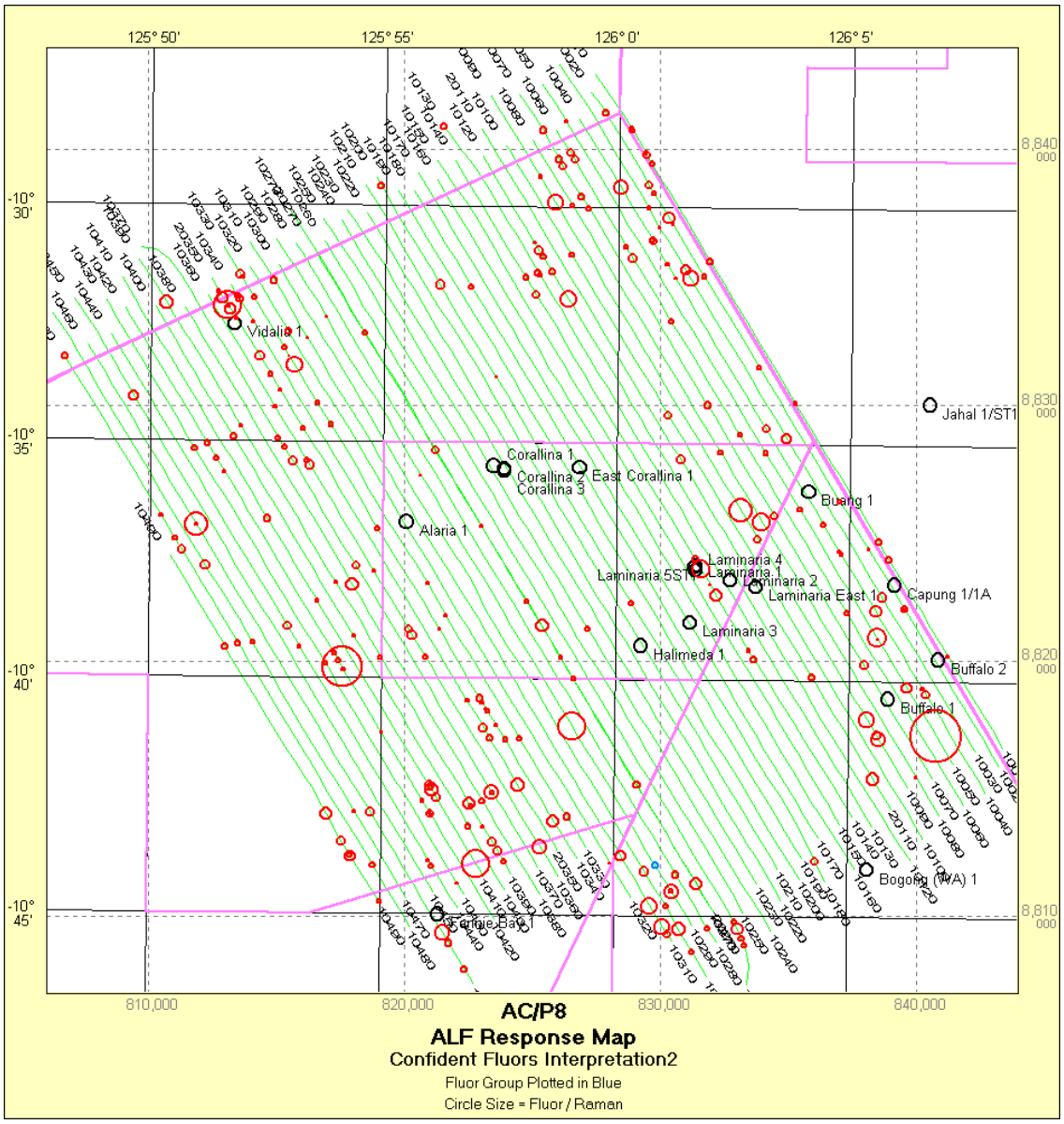


Figure 9. The AC/P8 ALF Survey Near Fluor Map.

2.4. Fluorescence Curve Trend Analysis

No significant fluorescence response trends were found in the AC/P8 ALF survey data.

Three sets of fluorescence curve plots (Figures 10, 11 and 12) were produced from different fluor clusters over the survey. Each group was selected from a different part of the survey (see Figure 13) and some attempt was made to select similar shaped fluors in each group. Despite this, the fluorescence curves showed significant shape variations within each group.

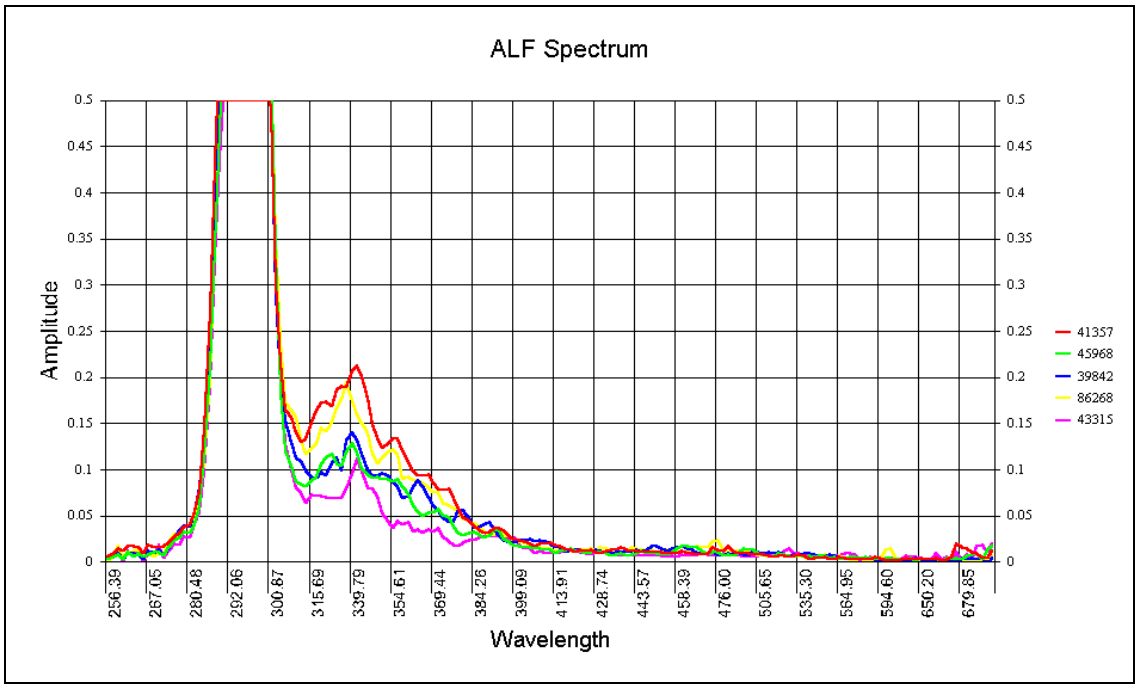


Figure 10. Fluor Group 1 ALF Spectra.

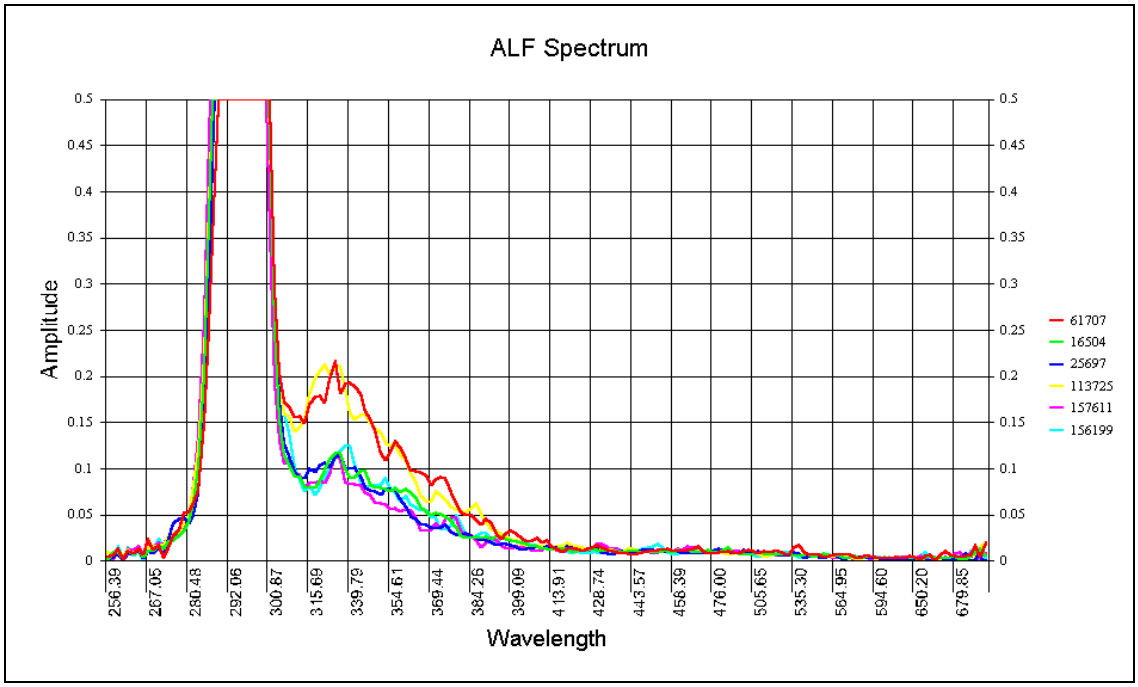


Figure 11. Fluor Group 2 ALF Spectra.

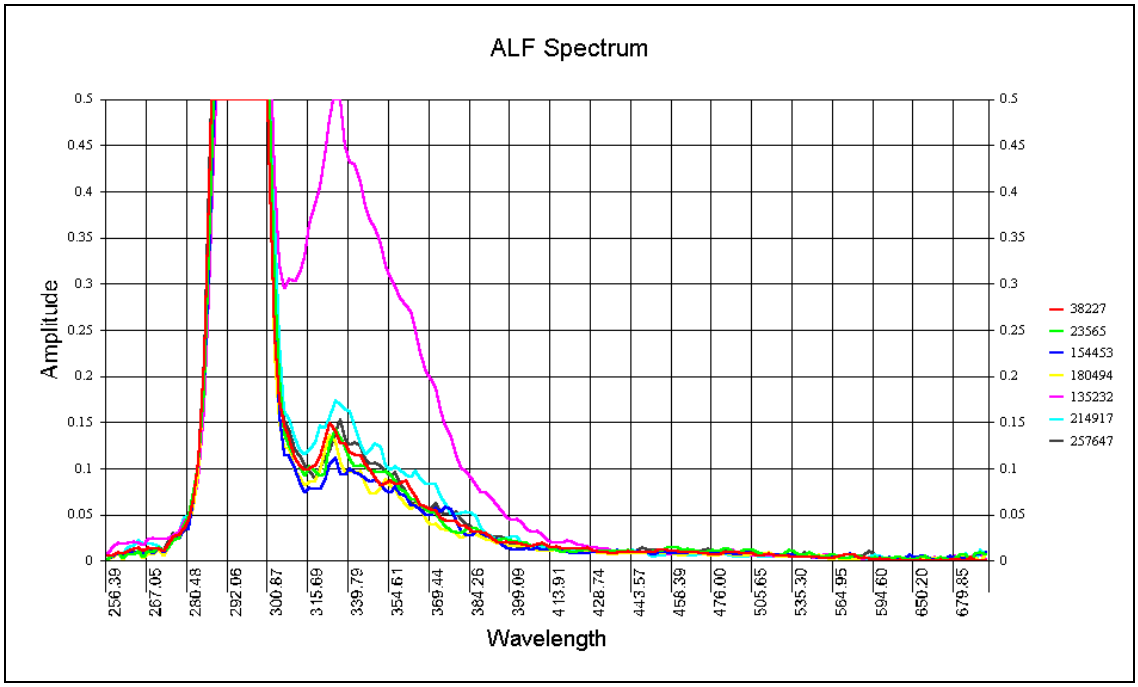


Figure 12. Fluor Group 3 ALF Spectra.

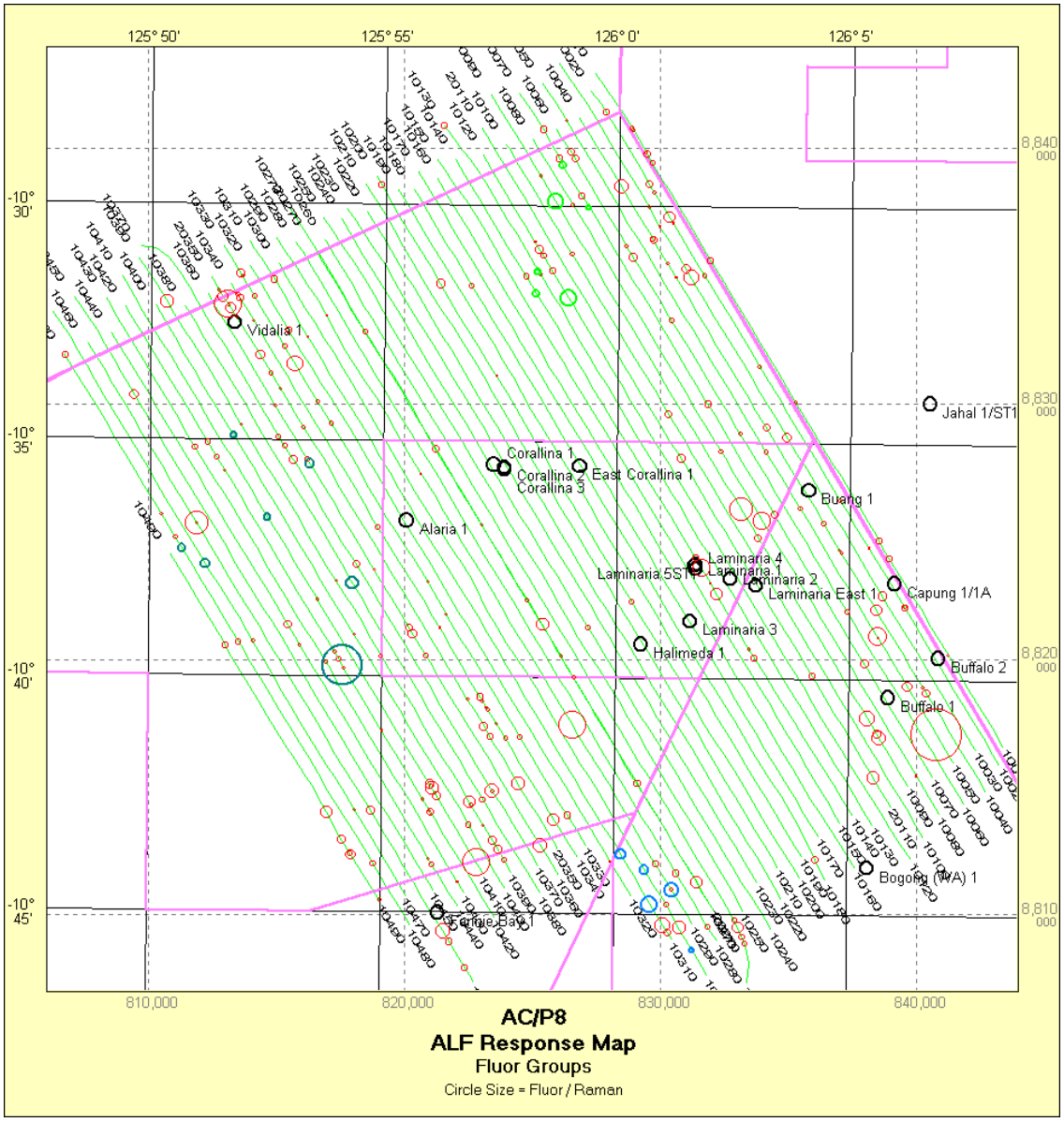


Figure 13. AC/P8 Fluor Group Map.

Figure 13 shows the locations of the fluor groups plotted above. Fluor group 1 lies to the south and is displayed in blue, group 2 lies to the west of Alaria-1 and is light green and group 3, north of Corallina-1, is dark green.

3. Conclusions and Recommendations

The AC/P8 ALF survey was of medium size with 1,490 km flown. 249 confident fluors were picked from 1,040,856 spectra, corresponding to an average density of 239 fluors per million spectra.

The data was relatively noise free with no serious navigation problems.

The majority of fluors were small but there were also a significant number having medium intensity. Fluor clusters were notably absent from the Corallina Field and only a few fluors were located over the Laminaria Field. The relatively high density of fluors ranging up to medium size over the survey may indicate a working source and migration system.

Appendix 1. Data Acquisition QC

Line	Sections	Clipped	Avg Raman Peak	Avg Raman Variance
10010	224	0	13,134	9,978,213
10020	207	0	12,791	8,780,080
10030	225	0	14,161	10,566,450
10040	208	0	14,016	10,519,960
10050	223	0	12,762	9,406,592
10060	208	0	12,595	9,202,903
10070	225	0	11,067	8,429,459
10080	207	0	11,785	8,139,137
10090	227	0	13,371	10,313,680
10100	215	0	11,802	7,178,518
10120	221	0	11,226	9,660,284
10130	231	0	9,877	6,892,924
10140	206	0	12,430	6,355,283
10150	204	0	13,557	10,810,740
10160	223	0	14,070	11,292,730
10170	204	0	14,797	12,269,040
10180	223	0	13,947	11,424,770
10190	206	0	12,417	9,181,881
10200	222	0	14,587	10,384,710
10210	210	0	12,566	9,834,978
10220	223	0	11,410	9,844,407
10230	209	0	12,091	11,206,670
10240	231	0	13,883	13,213,770
10250	213	0	12,038	9,625,964

Table 1a. AC/P8 ALF Survey Data Acquisition Summary.

Line	Sections	Clipped	Avg Raman Peak	Avg Raman Variance
10260	240	0	13,145	11,347,720
10270	215	0	13,108	15,081,540
10280	229	0	15,078	16,263,140
10290	213	0	15,621	17,914,950
10300	234	0	11,772	11,772,030
10310	215	0	16,277	17,897,040
10320	207	0	14,306	13,104,950
10330	200	0	13,563	10,840,190
10340	177	0	14,002	10,751,010
10360	179	0	15,265	11,162,760
10370	212	0	13,437	9,512,439
10380	181	0	14,109	10,024,330
10390	208	0	16,231	13,441,330
10400	179	0	15,433	11,894,420
10410	201	0	11,833	8,907,557
10420	187	0	14,023	10,121,740
10430	200	0	16,596	14,708,980
10440	177	0	13,499	9,427,737
10450	202	0	15,184	12,070,320
10460	198	0	15,448	13,042,020
10470	197	0	17,814	21,526,820
10480	177	0	17,135	17,381,950
10490	116	0	16,085	18,097,880
20110	223	0	12,959	9,068,139
20270	204	0	15,983	10,464,310
20350	191	0	15,468	12,758,350

Table 1b. AC/P8 ALF Survey Data Acquisition Summary (cont).

Line 20270 was a repeat of line 10270 which may have had some data acquisition problems.

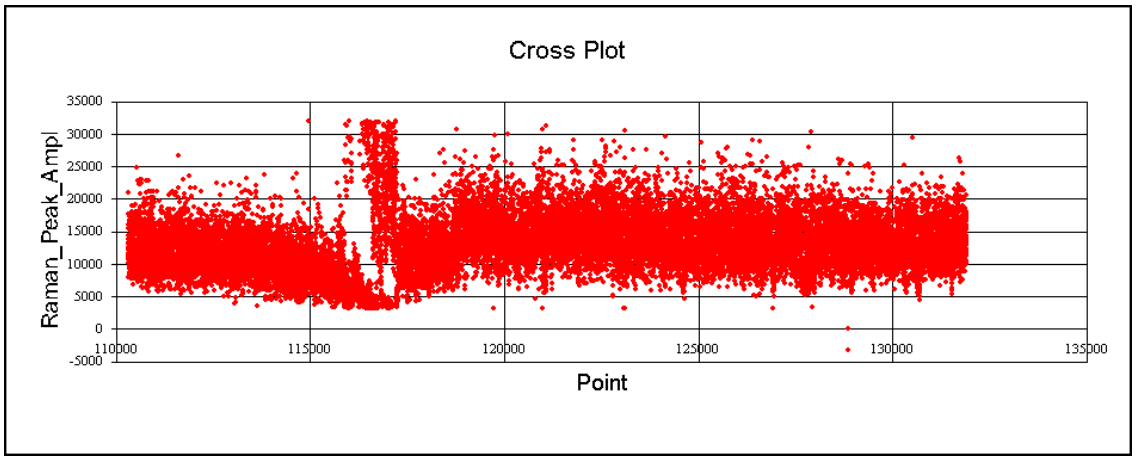


Figure 14. Line 10270 Raman Peak.

Figure 14 shows the Raman peak plot for line 10270. There is evidence of an acquisition problem between points 116,000 and 118,000. The Raman peak plot of the repeated line 20270 is shown in Figure 15 below.

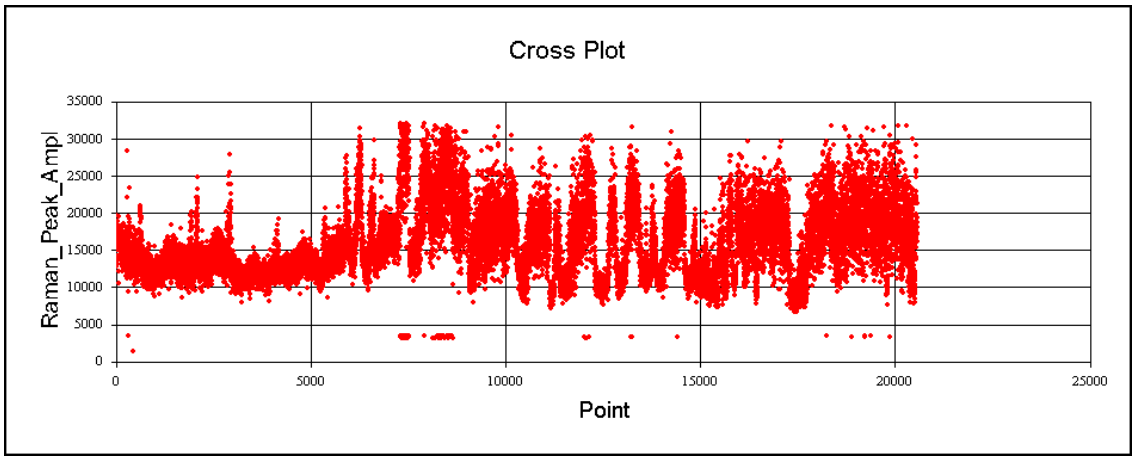


Figure 15. Line 20270 Raman Peak.

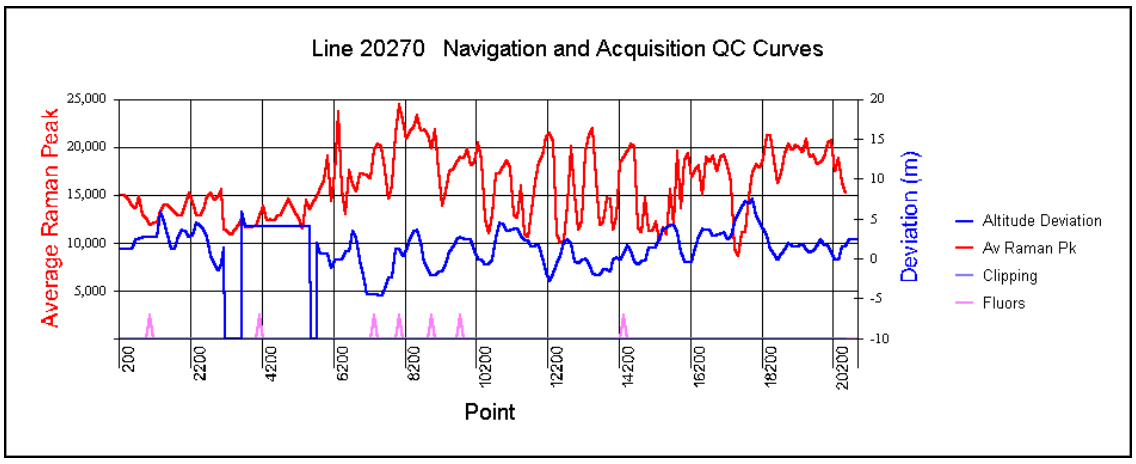


Figure 16. Line 20270 Altitude Deviation and Raman Peak Plot.

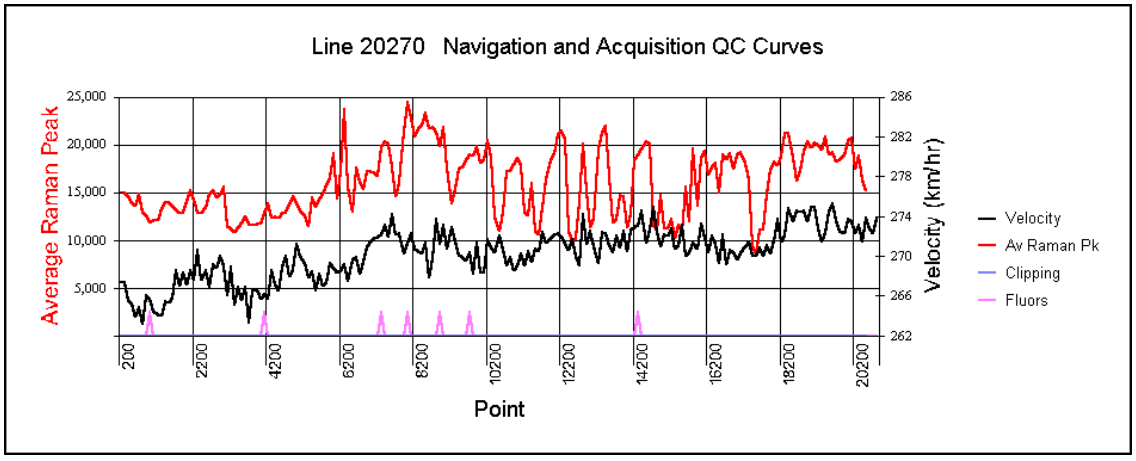


Figure 17. Line 20270 Aircraft Speed and Raman Peak Plot.

The Raman peak fluctuates along much of line 20270. Figures 16 and 17 show the altitude variation and aircraft velocity plotted against the Raman peak. There is some correlation between both these curves and the Raman peak. Note that the aircraft speed and altitude will also correlate to some degree. The aircraft will slow down as altitude increases and speed up on descent.

The Raman variation may be related to the attitude of the aircraft and the angle of the laser beam. Recording the attitude using a digital gyroscope during acquisition may help resolve this. The Raman variation may also be related to the focus distance of the telescope used for data acquisition, and the defocusing caused by altitude variations.

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 (km/hr)	Avg Point Spacing (m)
10010	148.84	30,867.00	445.98	249.16	22,495	30,877.54	249.25	1.37
10020	328.79	30,831.71	411.50	269.73	20,754	30,851.13	269.90	1.49
10030	148.86	31,500.51	448.99	252.57	22,644	31,509.42	252.64	1.39
10040	328.98	30,816.40	413.49	268.30	20,854	30,820.46	268.34	1.48
10050	148.82	31,110.97	444.50	251.97	22,415	31,118.20	252.03	1.39
10060	328.97	30,861.51	414.47	268.06	20,900	30,864.51	268.08	1.48
10070	148.94	31,286.03	447.47	251.70	22,565	31,296.73	251.79	1.39
10080	329.03	30,817.43	412.97	268.65	20,824	30,820.50	268.67	1.48
10090	148.97	31,622.14	452.98	251.31	22,839	31,627.05	251.35	1.38
10100	329.02	31,672.73	427.49	266.73	21,552	31,674.48	266.74	1.47
10120	328.83	32,241.53	440.49	263.50	22,202	32,249.38	263.57	1.45
10130	148.60	32,123.67	461.00	250.86	23,233	32,141.18	250.99	1.38
10140	328.91	30,035.92	411.98	262.46	20,760	30,039.72	262.50	1.45
10150	148.78	30,409.49	407.46	268.67	20,536	30,419.42	268.76	1.48
10160	328.93	31,546.57	444.97	255.23	22,425	31,550.37	255.26	1.41
10170	149.04	30,362.42	406.49	268.90	20,484	30,365.38	268.93	1.48
10180	329.35	31,470.17	444.50	254.88	22,396	31,483.01	254.98	1.41
10190	148.93	30,526.07	409.98	268.05	20,656	30,530.71	268.09	1.48
10200	149.02	32,069.62	442.47	260.92	22,283	32,076.53	260.98	1.44
10210	148.99	31,263.24	420.00	267.97	21,157	31,269.30	268.02	1.48
10220	329.03	31,418.38	444.49	254.46	22,388	31,422.20	254.49	1.40
10230	148.77	30,920.72	415.99	267.59	20,950	30,925.79	267.63	1.48
10240	328.91	32,471.64	461.48	253.31	23,243	32,477.55	253.36	1.40
10250	148.92	31,713.88	424.96	268.66	21,400	31,726.60	268.77	1.48

Table 2a. AC/P8 ALF Survey Line Navigation Summary.

The navigation parameters for the survey were acceptable. Some lines veered off a straight path at the end of the line, probably as the aircraft was turning into the next line, but this did not affect the main area of the survey.

Variations in average flight speed for each line resulted in the average point spacing ranging from 1.34m to 1.49m. There was also some significant speed variation and related altitude variation within some lines. Several lines showed an acceleration phase at the start before steadying at a relatively constant acquisition speed. This may have been caused by a speed loss during turning.

Line	Heading (deg)	Straight Line Distance (m)	Acquisition Time (seconds)	Avg Straight Line Velocity (km/hr)	Points	Flight Distance (m)	Avg Flying Velocity (km/hr)	Avg Point Spacing (m)
10260	330.51	33,438.33	478.98	251.32	24,116	33,647.96	252.90	1.40
10270	148.96	31,930.49	428.97	267.97	21,597	31,934.49	268.00	1.48
10280	329.01	31,926.52	456.98	251.51	23,003	31,930.62	251.54	1.39
10290	148.81	31,445.28	424.00	266.99	21,337	31,457.39	267.09	1.47
10300	329.05	32,549.34	467.97	250.40	23,542	32,563.46	250.50	1.38
10310	148.94	31,933.40	429.49	267.67	21,593	31,941.40	267.73	1.48
10320	328.89	28,844.13	414.98	250.23	20,843	28,848.12	250.26	1.38
10330	148.96	27,449.77	397.98	248.30	20,071	27,455.54	248.36	1.37
10340	328.89	26,240.91	352.97	267.64	17,801	26,245.91	267.69	1.47
10360	328.97	26,570.60	356.99	267.95	18,000	26,572.55	267.97	1.48
10370	147.37	28,776.66	423.99	244.34	21,378	29,087.54	246.98	1.36
10380	328.88	26,883.90	360.48	268.48	18,173	26,888.03	268.52	1.48
10390	148.84	28,137.96	413.48	244.99	20,846	28,149.41	245.09	1.35
10400	329.12	26,640.75	356.96	268.68	17,996	26,644.89	268.72	1.48
10410	149.05	27,330.88	401.49	245.07	20,238	27,334.57	245.10	1.35
10420	328.93	27,933.61	373.99	268.89	18,851	27,936.02	268.91	1.48
10430	149.07	27,157.70	397.99	245.65	20,058	27,162.49	245.70	1.35
10440	328.95	26,270.03	353.99	267.16	17,838	26,273.20	267.19	1.47
10450	148.89	27,169.44	401.49	243.62	20,226	27,177.81	243.69	1.34
10460	328.97	29,239.64	395.48	266.16	19,913	29,242.31	266.19	1.47
10470	148.87	26,729.74	392.99	244.86	19,790	26,737.92	244.93	1.35
10480	328.90	26,158.21	354.49	265.65	17,841	26,160.95	265.68	1.47
10490	148.94	15,927.68	233.48	245.59	11,742	15,935.09	245.70	1.36
20110	149.02	31,070.95	443.99	251.93	22,383	31,076.01	251.97	1.39
20270	328.97	30,658.27	408.49	270.19	20,563	30,662.01	270.22	1.49
20350	148.89	26,166.18	379.98	247.91	19,162	26,170.05	247.94	1.37
Total		**1,484,540.12**	**20,658.17**		**1,040,856**	**1,485,372.90**		

Table 2b. AC/P8 ALF Survey Line Navigation Summary (cont).

Appendix 3. References

Newell, N.A., 1999—Water Washing in the Northern Bonaparte Basin. APPEA Journal 1999 227-247.

Appendix 4. CD Contents

A CD containing ALF analysis data is included in the back of this report. The CD contains the following files:

ACP8 ALF Survey Interp Report.doc
The AC/P8 ALF survey interpretation report.

ACP8 Survey Summary.xls
Survey summary spreadsheet.

Acp8.dbf
ALF Explorer project database containing interpretation results.

ALF Power.map
ALF Explorer map definition file for the ALF power map.

ALF Response 1st pass interp.map
ALF Explorer map definition file for the first pass fluor picks map.

ALF Response and Power.map
ALF Explorer map definition file for the ALF power and final fluor picks map.

ALF Response.map
ALF Explorer map definition file for the final fluor picks map.

ALF Survey.map
ALF Explorer map definition file for the ALF survey map.

ALFAnalysis.dat
ALF Explorer project data file. (This file together with the Acp16.mdb file forms the ALF Explorer project data.)

Confident Fluors.dat
ASCII data file of the confident fluors picked during the interpretation.

Line 10290 Near Fluors.dat
ASCII data file of the group of fluors on line 10290 separated by 10 samples or less.

Figures
Directory containing figures used in the interpretation report.