

# **1996 Yampi Shelf, Browse Basin Airborne Laser Fluorosensor Survey Interpretation Report [WGC Browse Survey Number 1248.1]**

**Prepared For  
Australian Geological Survey Organisation**

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# Contents

## 1. Introduction

## 2. ALF Survey Analysis

- 2.1 First Pass Fluor Mapping
- 2.2 Refined Fluor Mapping
- 2.3 Adjacent and Near Fluor Detection
- 2.4 Fluorescence Curve Trend Analysis

## 3. Conclusions and Recommendations

## Appendices

- Appendix 1. Acquisition QC
- Appendix 2. Navigation QC
- Appendix 3. CD Contents

## Figures

- Figure 1. The 1996 Yampi (Browse) ALF Survey Location Map
- Figure 2. The 1996 Yampi ALF Survey
- Figure 3. The 1996 Yampi ALF Survey Confident Fluor Map  
(First Pass Interpretation)
- Figure 4. The F/R Area Histogram for the First Pass Fluors.
- Figure 5. The 1996 Yampi ALF Survey Confident Fluor Map, Interpretation 2
- Figure 6. The F/R Histogram for the Picked Fluors, Interpretation 2
- Figure 7. The F/R Histogram Plotted Using the Standard 0 to 1.5 F/R Range
- Figure 8. A Selection of Fluors Plotted with No Normalisation
- Figure 9. A Selection of Fluors Normalised to the Raman Peak
- Figure 10. Selected ALF Spectra
- Figure 11. A Pair of Adjacent Fluors on Line 10220 Plotted with No  
Normalisation
- Figure 12. A Pair of Near Fluors on Line 10210 Plotted with No Normalisation
- Figure 13. The 1996 Yampi ALF Survey Fluor Group Map
- Figure 14. 1996 Yampi ALF Survey Selected Fluor Spectra
- Figure 15. Acquisition QC Curves for Line 10070 Showing Sudden Change in  
Recording Level
- Figure 16. Plot of Raman Peak Amplitude for Line 10070
- Figure 17. Plot of Raman Peak Amplitude for Line 10200
- Figure 18. Plot of Raman Peak Amplitude for Line 10200
- Figure 19. Navigation QC Curves for Line 10060

## Tables

- Table 1. 1996 Yampi ALF Survey Data Acquisition Summary
- Table 2. 1996 Yampi ALF Survey Line Navigation Summary

## 1. Introduction

The 1996 Yampi airborne laser fluorosensor (ALF) survey was flown in two sorties on the 1<sup>st</sup> December 1996. (Only line 20210 was recorded on the second sortie.) Twenty three lines were acquired at 1km spacing in a N-S direction at a flying height of 100m. A map of the survey is shown in Figure 1. Line lengths ranged from 20km to 23.6km, with a total of 488.7km acquired. Line 20210 was a repeat of line 10210. Data collection for the first sortie was completed after 2.4 hours.

A total of 343,563 spectra were collected at a spacing of about 1.4m. In the first pass fluor mapping, 15 were interpreted as showing confident oil fluorescence spectra (about 0.004 percent or 44 fluors per million spectra). The second more detailed interpretation found 57 fluors (about 0.013 percent or 128 fluors per million spectra).

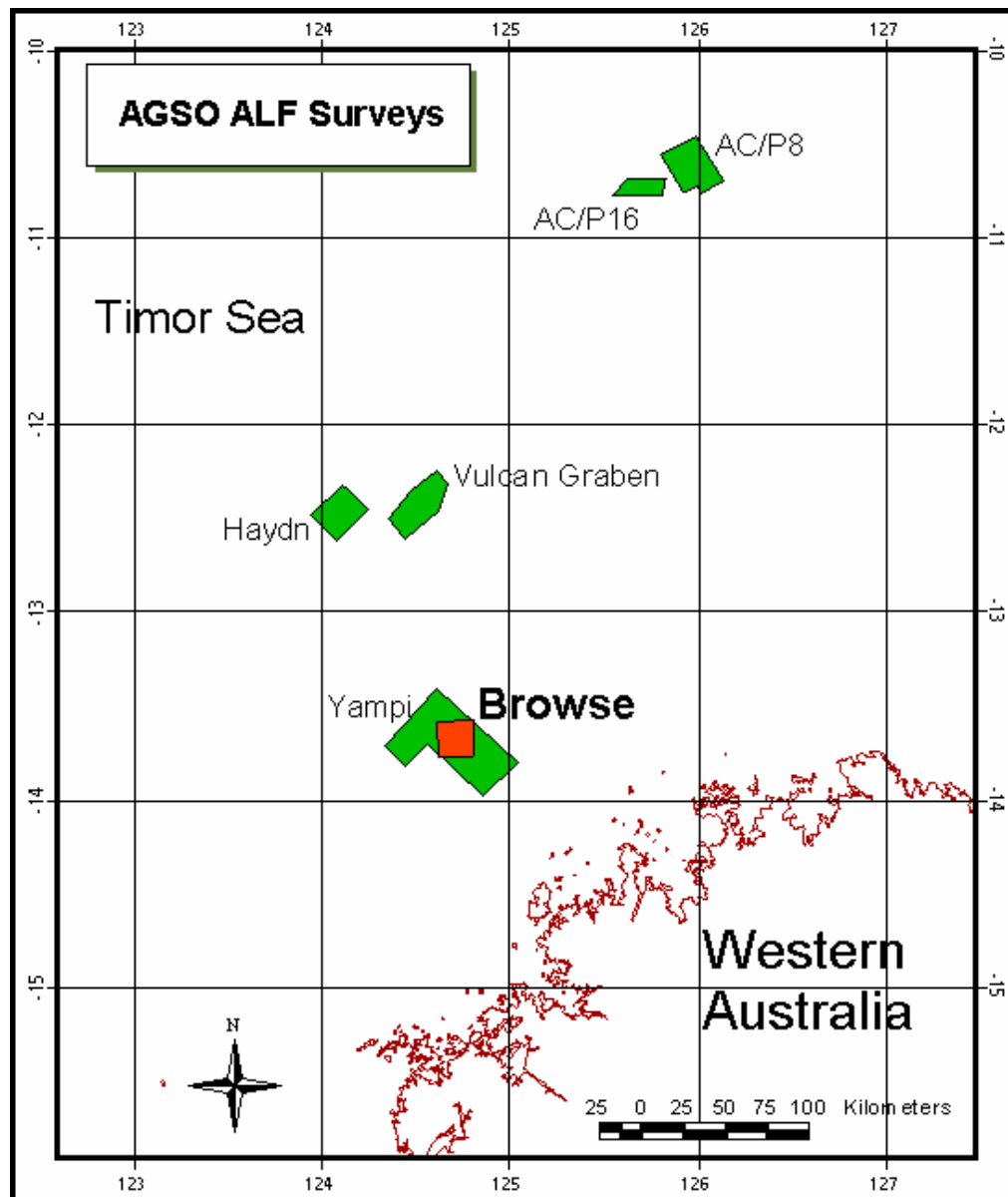
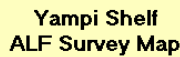


Figure 1. The 1996 Yampi (Browse) ALF Survey Location Map.



**Figure 2. The 1996 Yampi ALF Survey.**

Figure 2 shows a map of the 1996 Yampi ALF survey with point symbols annotated in red at a spacing of 500. The survey is located almost entirely within permit WA-266-P, but with the northern line ends extending into permit WA-265-P.

### Mapping Specifications:

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

Min Easting: 660,000

Max Easting: 698,000

Min Northing: 8,469,000

Max Northing: 8,503,000

## 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 343,563 to 159 possible fluors, then manually selecting 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
```

15 confident fluors were picked and are 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.

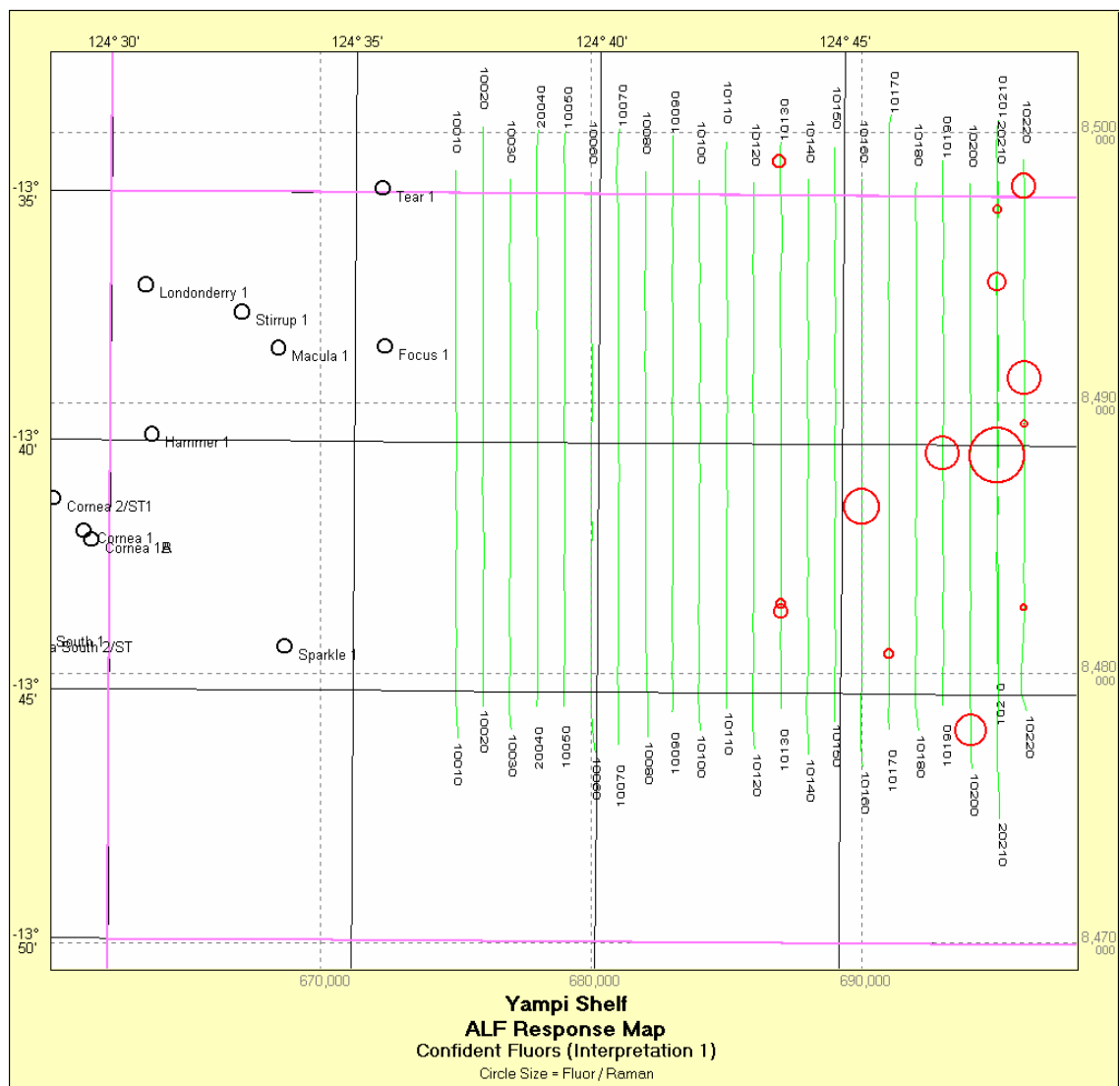
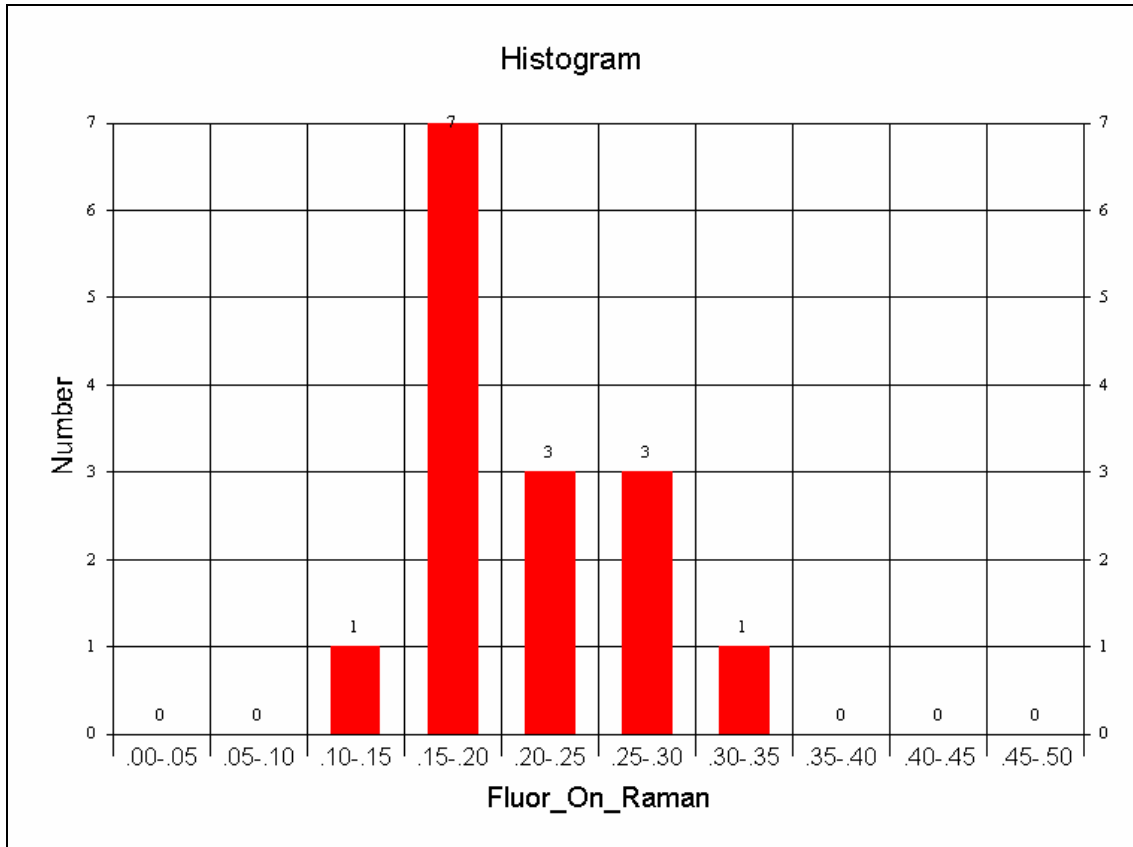


Figure 3. The 1996 Yampi ALF Survey Confident Fluor Map (First Pass Interpretation).



**Figure 4. The F/R Histogram for the First Pass Fluors**

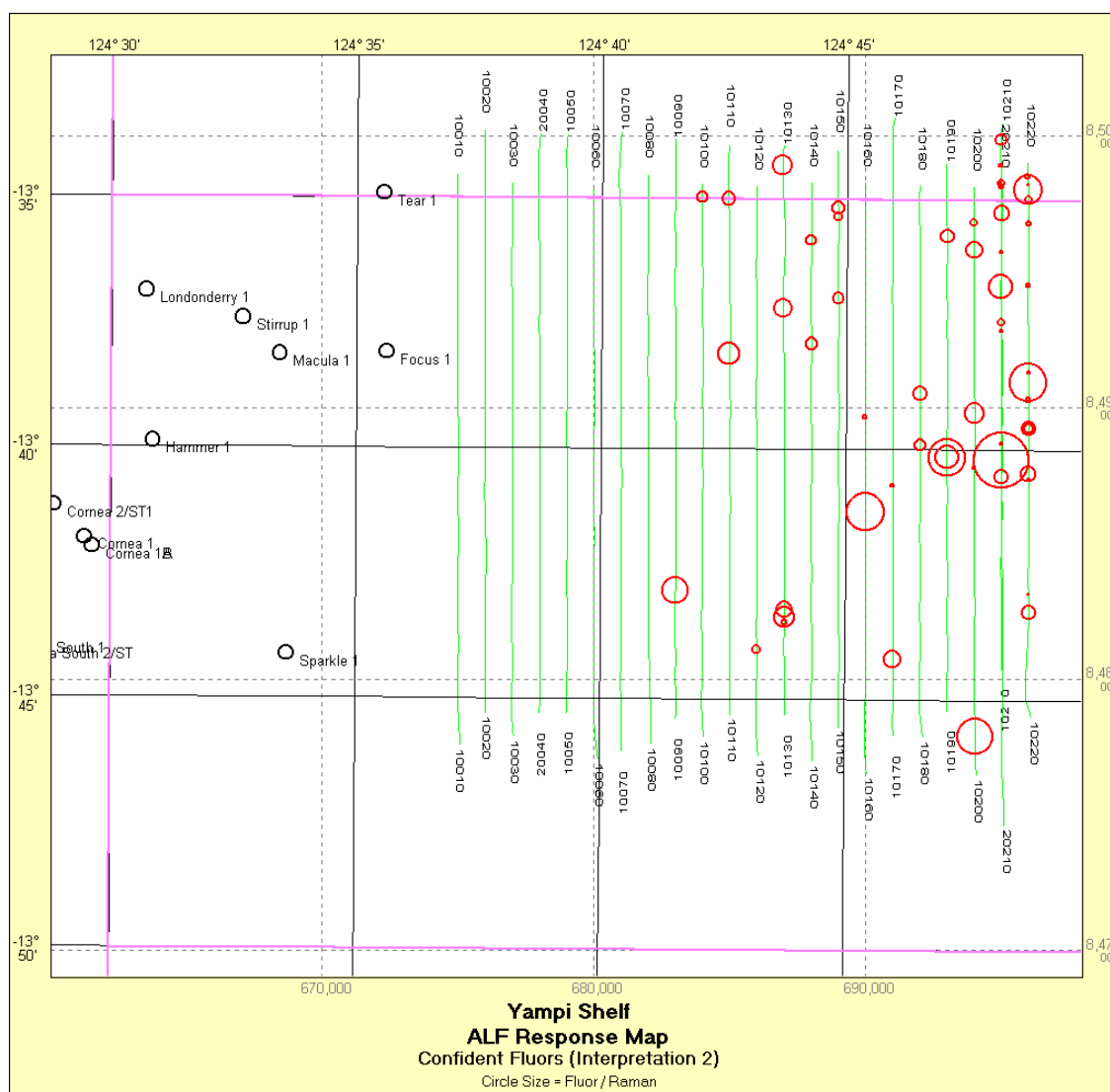
The fluorescence / Raman area histogram for the first pass interpretation is shown in Figure 4. Because relatively few fluors were picked the leakage distribution is poorly defined on the map and the histogram distribution is poorly constrained statistically.

The second pass interpretation aimed to pick more fluors to produce a better fluor map and histogram. This was important in comparing the results of this survey with that of the Yampi survey, which extends over the same area.

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).

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

A more careful interpretation, selecting lower intensity fluors than in the first pass interpretation, resulted in 57 fluors picked. The map of these is shown in Figure 5. Most of the higher intensity fluors are picked in both interpretations but the more detailed interpretation shows a more accurate low intensity fluor distribution.



**Figure 5. The 1996 Yampi ALF Survey Confident Fluor Map, Interpretation 2**



The fluorescence area / Raman area ratio ranges from 0.11 to 0.32 over the 57 picked fluors. There are many more low ratio (and low intensity) fluors than high ratio fluors. A histogram of the F/R distribution is shown in Figure 6. (The modified fluorescence region between 319.4nm to 479.7nm was used to calculate the fluorescence area.)

The refined interpretation greatly increased the number of low intensity fluors with very little change to the number of larger fluors.

There are very few fluors in the lowest intensity interval because they are very difficult to pick above the noise in the data. It may be possible in the future to improve the interpretation techniques to reliably detect low intensity fluors.

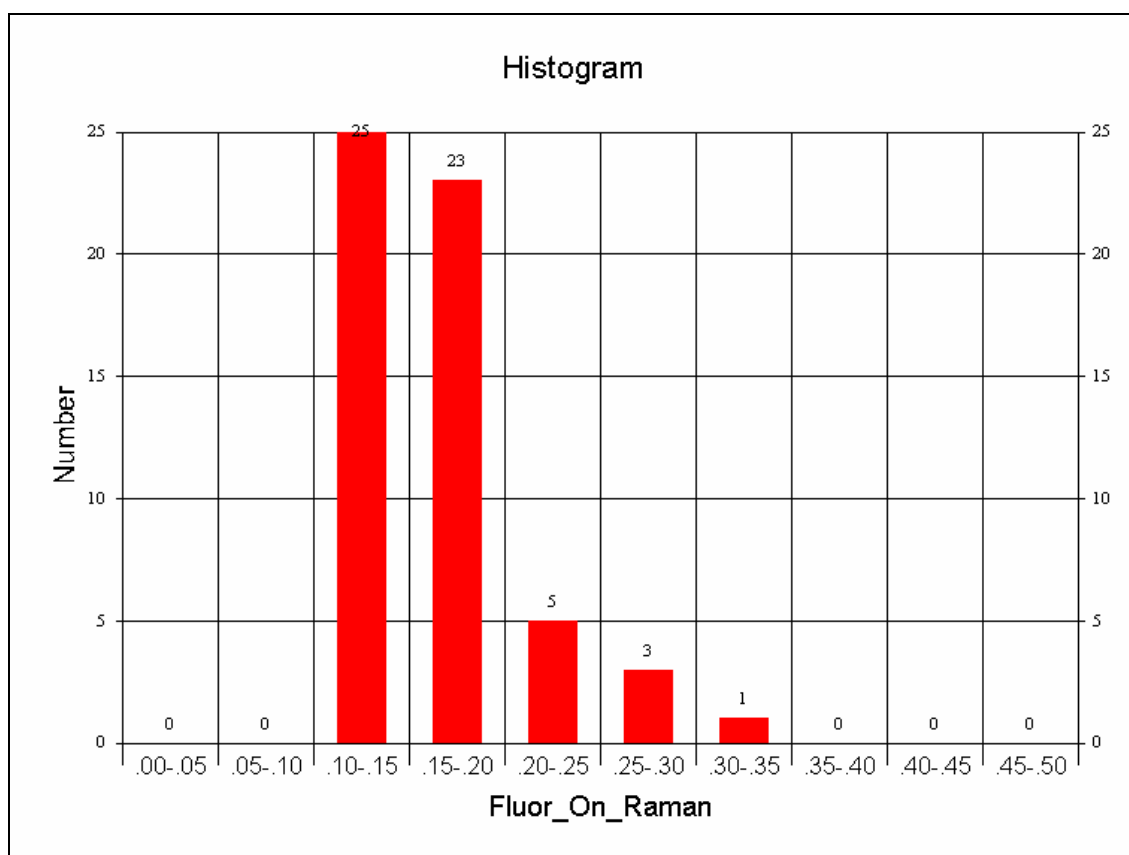


Figure 6. The F/R Ratio Histogram for the Picked Fluors, Interpretation 2.

The histogram is replotted in Figure 7 using the standard 0 to 1.5 F/R range. The standard plot makes comparison of different surveys easier. Only one fluor has a F/R ratio greater than 0.30.

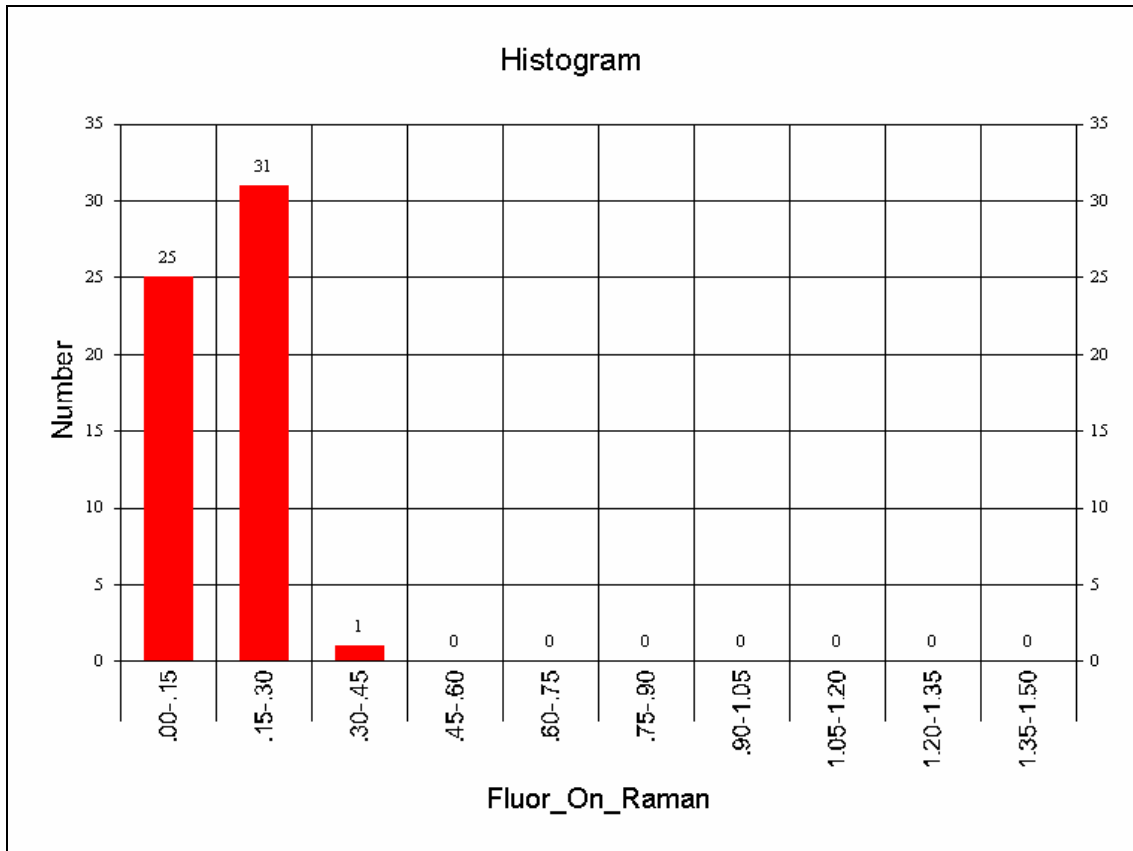


Figure 7. The F/R Histogram Plotted Using the Standard 0 to 1.5 F/R Range.

Figures 8 and 9 show ten of the largest fluors plotted with and without Raman peak normalization.

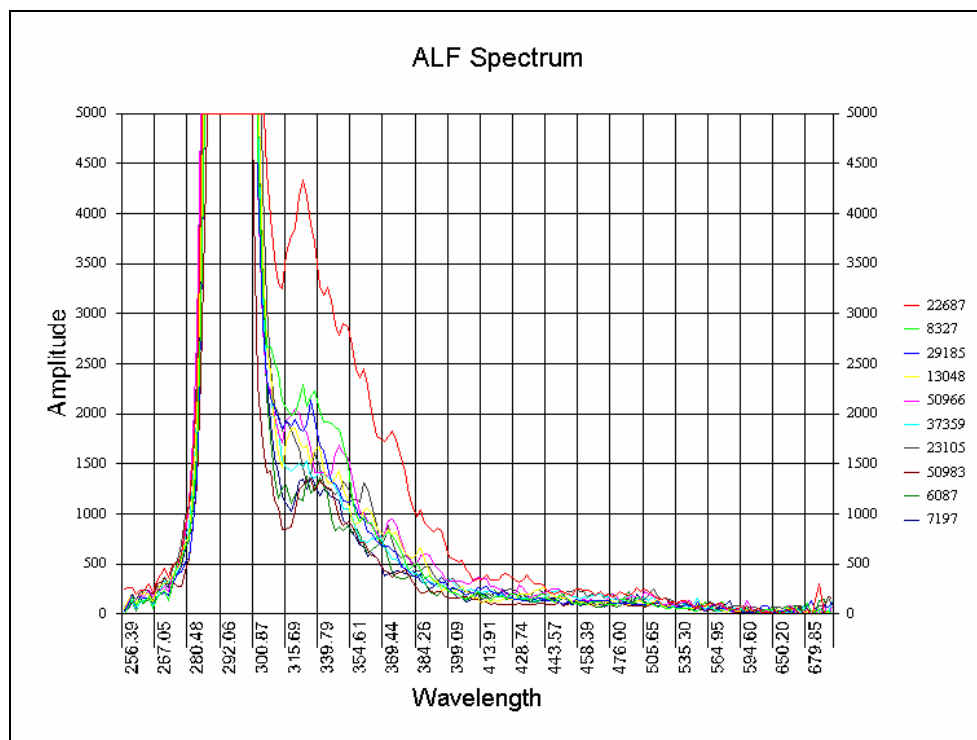


Figure 8. A Selection of Fluors Plotted with No Normalisation.

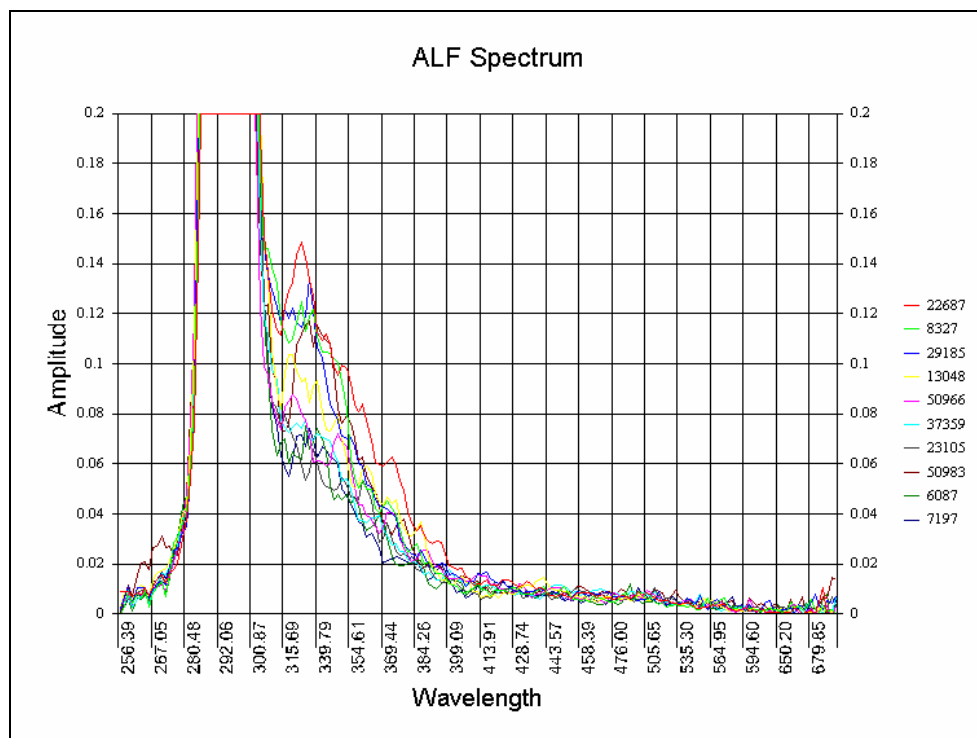
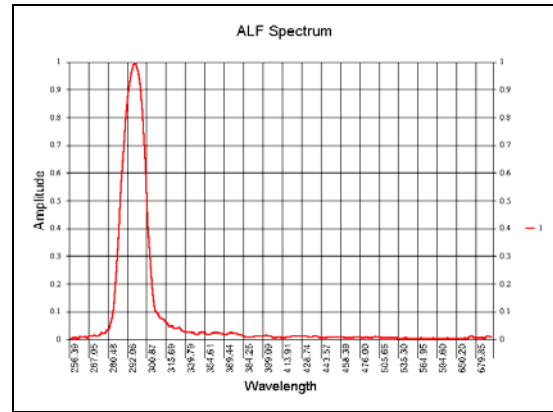
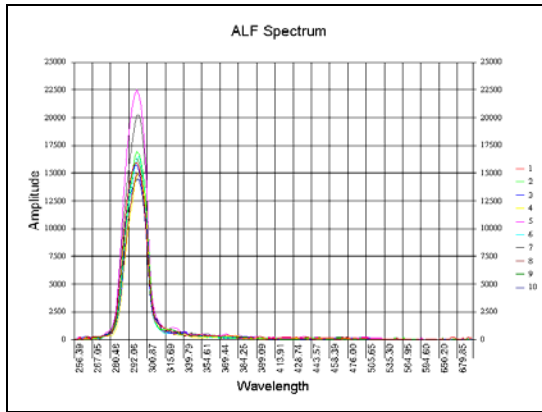
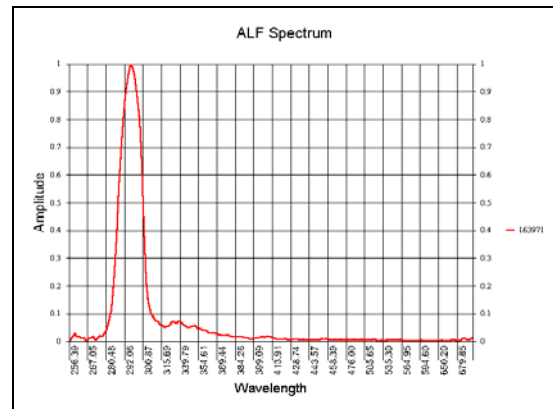
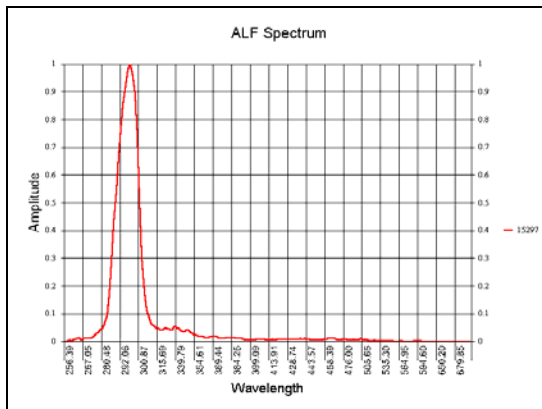


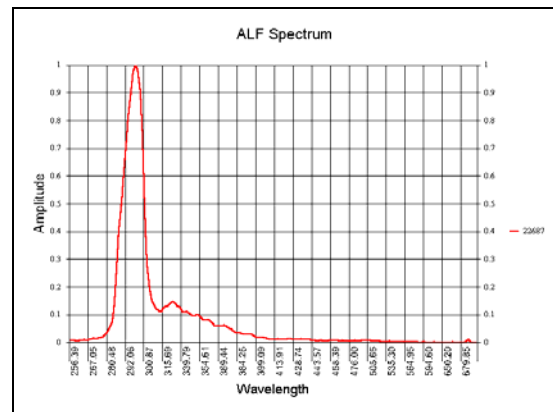
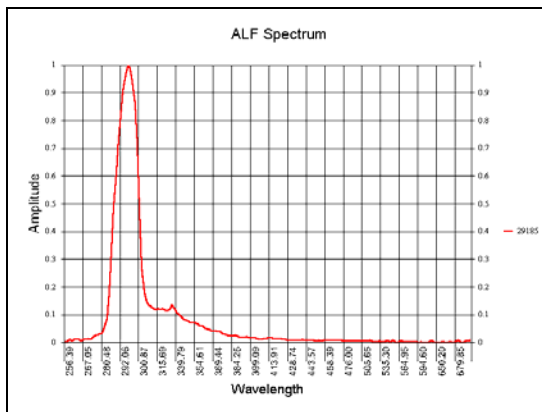
Figure 9. A Selection of Fluors Normalised to the Raman Peak.



10 a) Line 10220 Ten Adjacent ALF Spectra. 10 b) Line 10220 No Fluor.



10 c) Line 10210 Lowest Amplitude Fluor. 10 d) Line 10110 Small Amplitude Fluor.



10 e) Line 10200 Large Amplitude Fluor. 10 f) Line 10210 Largest Amplitude Fluor.

Figure 10. Selected ALF Spectra.

Figure 10 shows a selection of typical spectra and fluors from the survey. The smallest fluor, with a F/R ratio of 0.128 lies on line 10210, point 15297. The largest picked fluor, with a F/R ratio of 0.336 lies on line 10210, point 15297. Line 10110, point 163971 contains a typical small fluor (F/R = 0.177). Line 10200, point 29185 contains a typical large fluor (F/R = 0.261).

### 2.3. Adjacent and Near Fluor Detection

Figure 11 shows two adjacent fluors picked on line 10220, at points 7196 and 7197 (using the refined fluor interpretation). When near spectra are identified up to a maximum gap of 10, two close fluors are found on line 10210 (Figure 12).

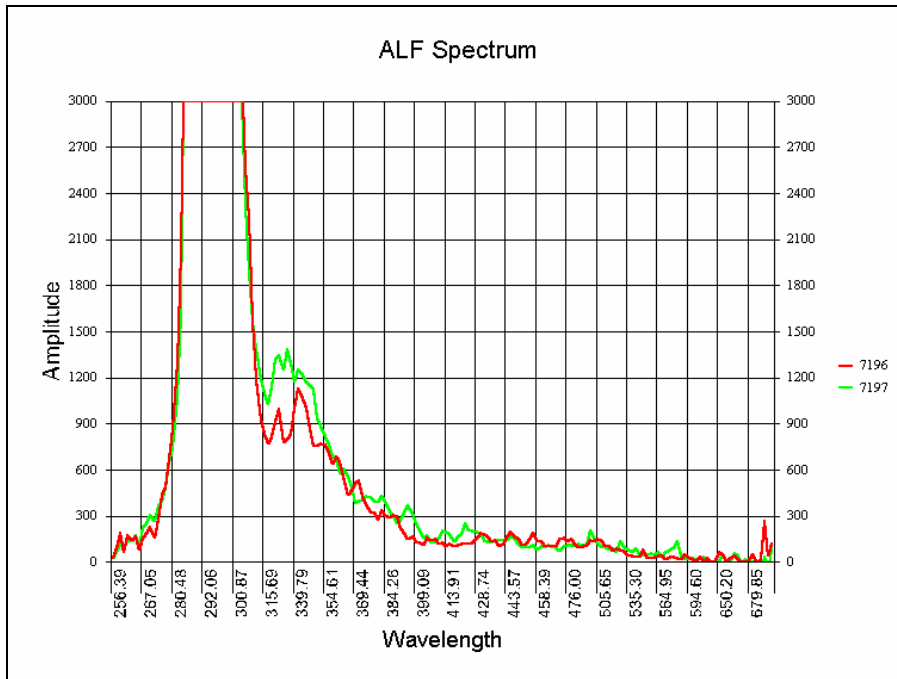


Figure 11. A Pair of Adjacent Fluors on Line 10220 Plotted with No Normalisation.

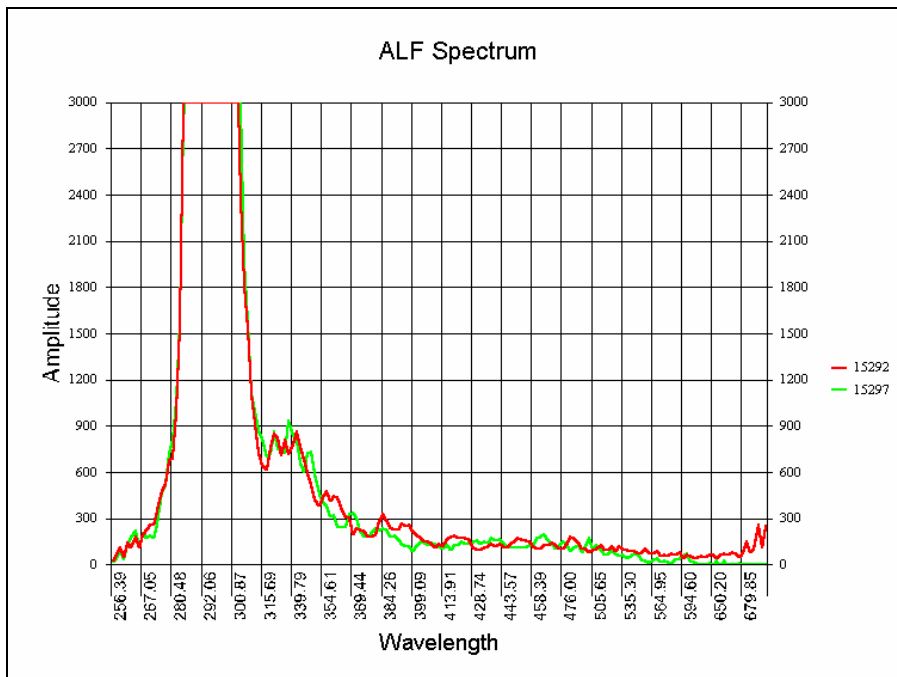
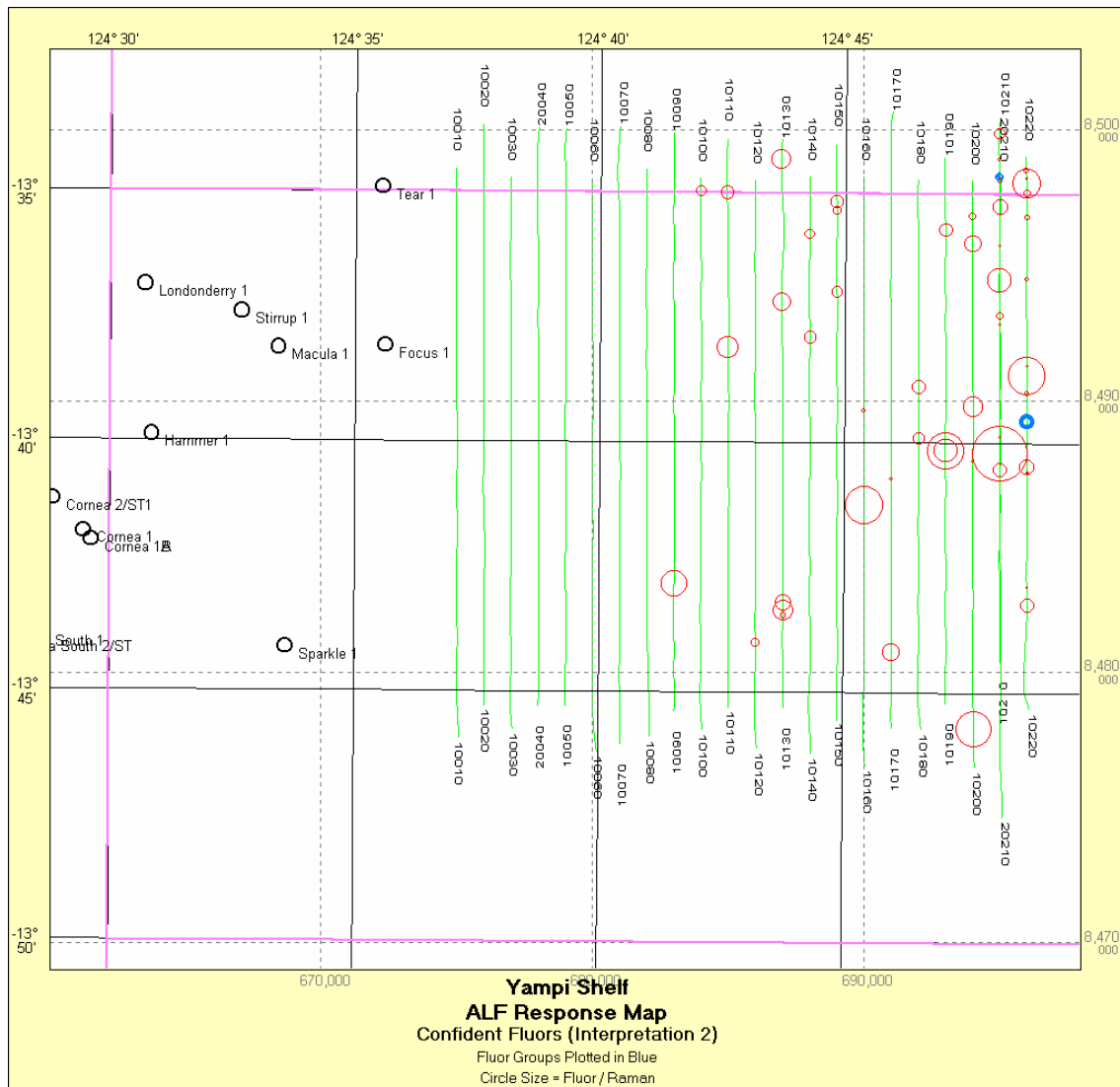


Figure 12. A Pair of Near Fluors on Line 10210 Plotted with No Normalisation.



**Figure 13. The 1996 Yampi ALF Survey Fluor Group Map.**

The adjacent and near fluor groups are plotted in blue in Figure 13. The adjacent fluors are the larger ones located in the middle right of the survey. The near fluors are smaller and located in the upper right (NE) of the survey.

## 2.4. Fluorescence Curve Trend Analysis

Figure 14 shows a selection of fluors from the 1996 Yampi survey. No fluor curve trends were observed. The low intensity of the fluors increases the relative noise levels, which distorts the curve shape. Curve trends are also likely to be less significant over a small survey area.

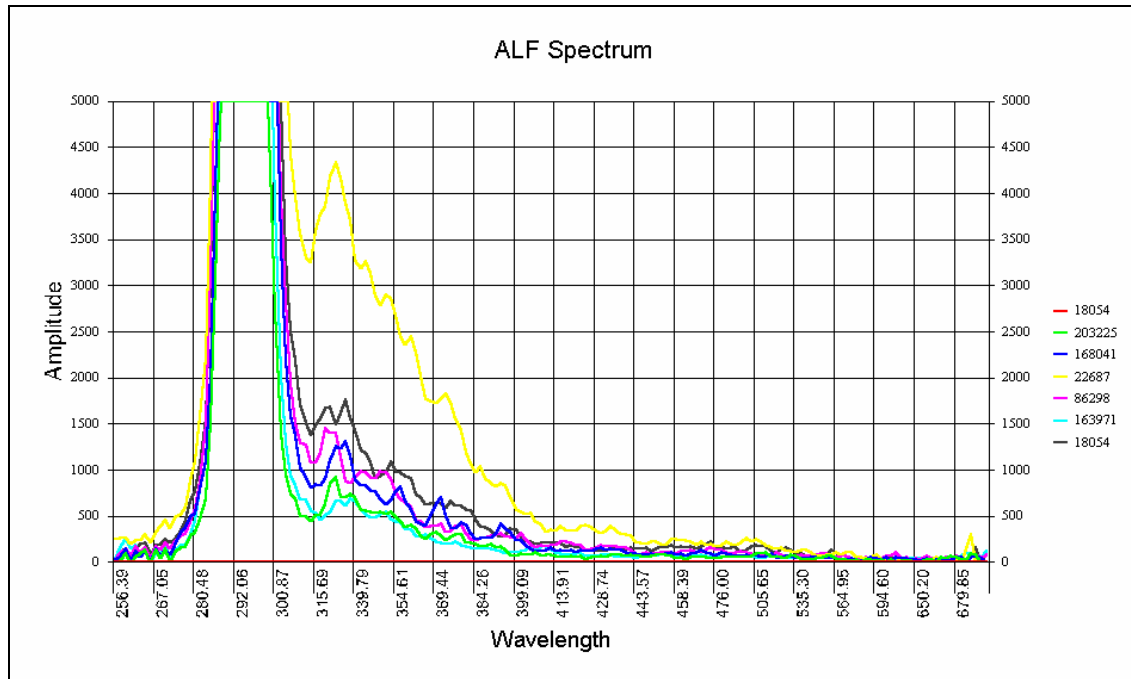


Figure 14. 1996 Yampi ALF Survey Selected Fluor Spectra.

### **3. Conclusions and Recommendations**

The 1996 Yampi ALF survey covered about 480 square kilometers with 1000m spaced lines. No serious acquisition or navigation problems were found with the survey.

Of the 343,563 spectra recorded, 57 were interpreted as having confident fluors (165 fluors per million spectra). These were mostly low intensity fluors with only one having a F/R ratio above 0.30.

The fluors were found mostly in the eastern half of the survey in broad clusters.



## Appendix 1. Data Acquisition QC

Line	Sections	Clipped	Avg Raman Peak	Avg Raman Variance
10010	144	0	13,236	7,810,631
10020	154	0	12,817	7,573,389
10030	139	0	13,485	8,503,250
10050	154	0	13,532	8,094,588
10060	144	0	14,551	9,260,478
10070	165	0	13,459	8,183,180
10080	140	0	11,919	6,973,847
10090	152	0	10,894	6,132,389
10100	137	0	13,717	8,940,729
10110	149	0	13,701	8,658,790
10120	142	0	12,939	7,065,619
10130	149	0	13,315	7,067,395
10140	144	0	13,937	7,461,678
10150	154	0	14,064	7,172,078
10160	148	0	14,539	7,245,805
10170	165	0	14,485	7,408,530
10180	139	0	14,645	7,250,861
10190	146	0	14,358	7,705,765
10200	148	0	12,850	7,523,311
10210	144	0	18,592	14,926,410
10220	135	0	16,920	12,283,050
20040	154	0	13,336	8,194,227
20210	166	0	13,372	11,246,490

**Table 1. Data Acquisition Summary.**

Table 1 summarises the data acquisition performance for the 1996 Yampi ALF survey. The average Raman peak and variance values are within acceptable ranges for each line. None of the lines have clipped data. A review of the acquisition QC curves using the ALF Tools software shows the variation of the parameters along each line.

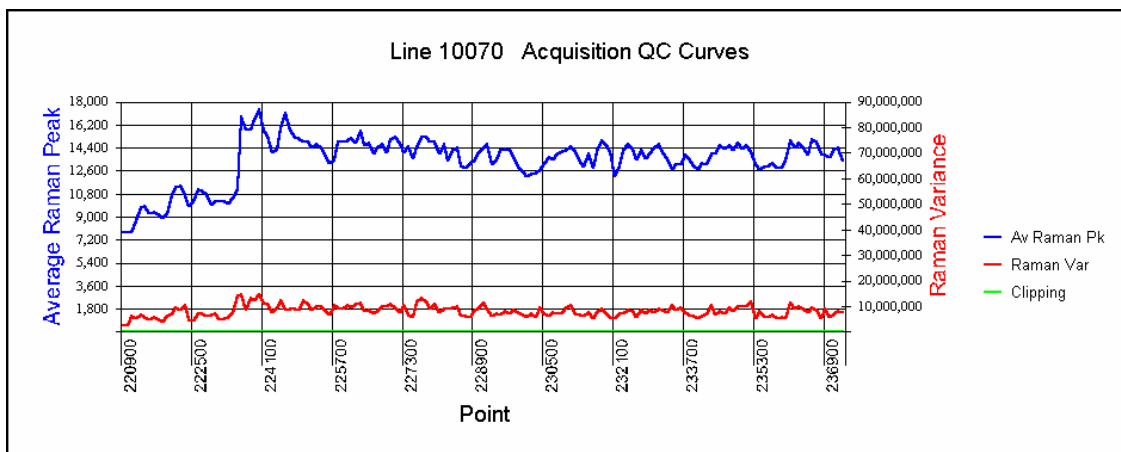


Figure 15. Acquisition QC Curves for Line 10070 Showing Sudden Change in Recording Level.

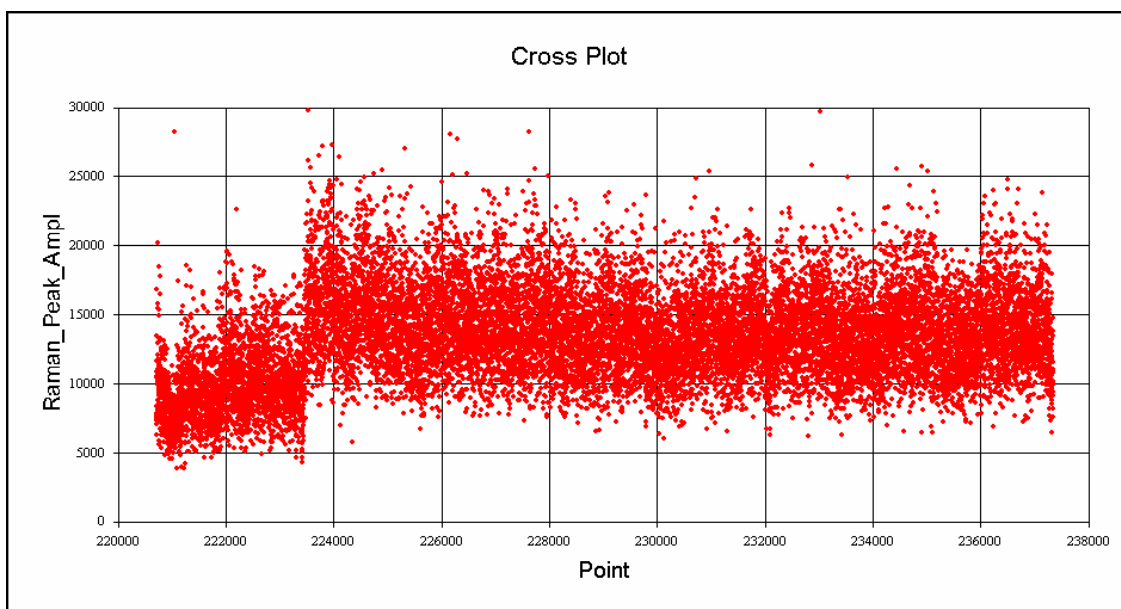


Figure 16. Plot of Raman Peak Amplitude for Line 10070.

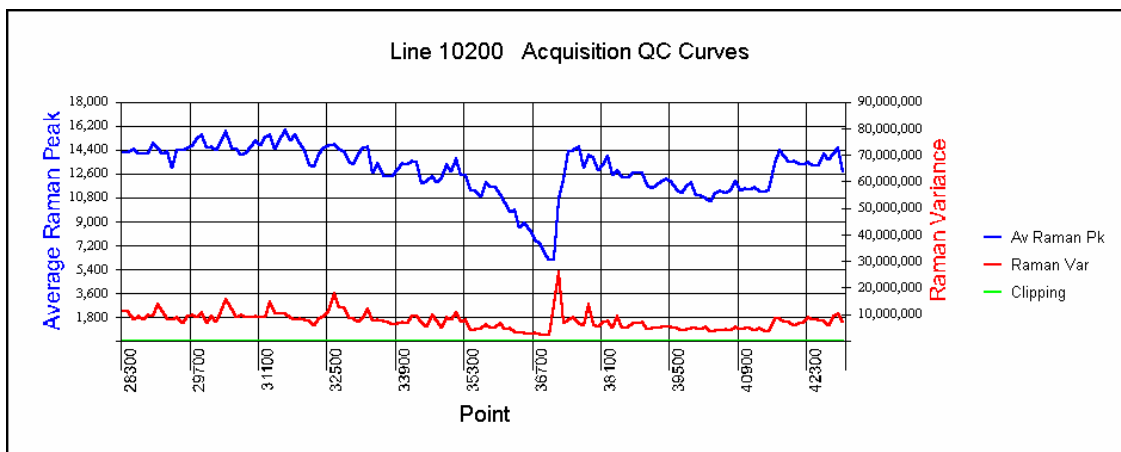


Figure 17. Plot of Raman Peak Amplitude for Line 10200.

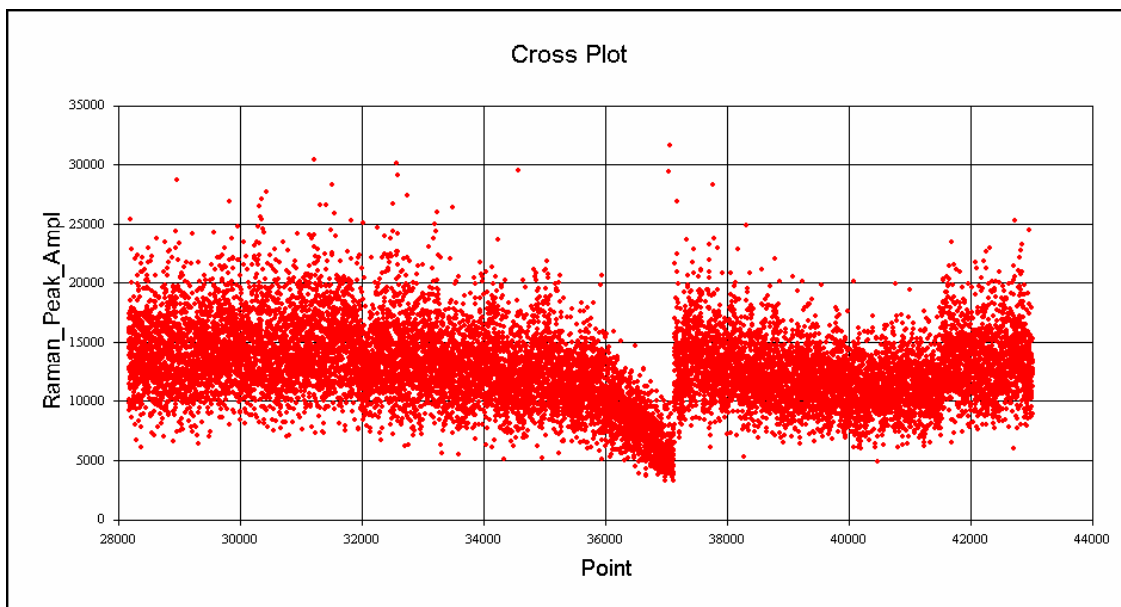


Figure 18. Plot of Raman Peak Amplitude for Line 10200.

## 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)
10010	359.86	21,059.08	286.97	264.18	14,467	21,063.91	264.24	1.46
10020	179.95	21,461.62	308.49	250.45	15,551	21,467.97	250.53	1.38
10030	359.92	20,375.02	277.48	264.34	13,988	20,381.55	264.43	1.46
10050	180.24	21,300.66	307.48	249.39	15,497	21,310.62	249.51	1.38
10060	359.62	21,171.61	287.50	265.11	14,489	21,182.47	265.24	1.46
10070	180.12	22,806.78	329.97	248.82	16,629	22,817.49	248.94	1.37
10080	359.73	20,973.33	279.97	269.69	14,109	20,976.43	269.73	1.49
10090	180.01	21,380.45	303.48	253.62	15,293	21,383.41	253.66	1.40
10100	359.92	20,384.22	272.98	268.82	13,756	20,388.80	268.88	1.48
10110	179.94	20,989.98	297.98	253.59	15,015	20,997.46	253.68	1.40
10120	359.89	20,985.95	282.98	266.98	14,258	20,993.82	267.08	1.47
10130	180.05	20,975.06	297.48	253.83	14,989	20,984.81	253.95	1.40
10140	359.92	21,282.67	289.48	264.67	14,585	21,287.41	264.73	1.46
10150	179.97	21,256.13	307.48	248.87	15,491	21,261.48	248.93	1.37
10160	359.91	21,728.25	295.47	264.74	14,885	21,732.16	264.78	1.46
10170	180.19	22,739.92	330.00	248.07	16,623	22,747.02	248.15	1.37
10180	359.77	20,286.03	276.50	264.12	13,927	20,294.02	264.23	1.46
10190	180.00	20,164.99	292.99	247.77	14,755	20,167.60	247.80	1.37
10200	359.84	21,667.05	294.98	264.43	14,852	21,670.52	264.47	1.46
10210	180.20	20,133.04	288.00	251.66	14,496	20,140.33	251.75	1.39
10220	359.75	20,404.18	271.97	270.08	13,681	20,435.51	270.50	1.49
20040	180.14	21,353.75	307.97	249.61	15,524	21,361.92	249.71	1.38
20210	359.85	23,626.53	331.99	256.20	16,703	23,631.15	256.25	1.41
<b>Total</b>		<b>488,506.30</b>	<b>6,819.59</b>		<b>343,563</b>	<b>488,677.86</b>		

**Table 2. Line Navigation Summary.**

Table 2 summarises the data navigation for the 1996 Yampi ALF survey. A detailed assessment can be made by using the ALF Tools software to review the navigation QC curves.

Navigation parameters were acceptable. All lines were flown at an altitude within 10m of the nominal 100m. Average flight speed for each line ranged from 248 to 270 km/hr. Many of the lines started at a slower speed before accelerating to a steady speed.

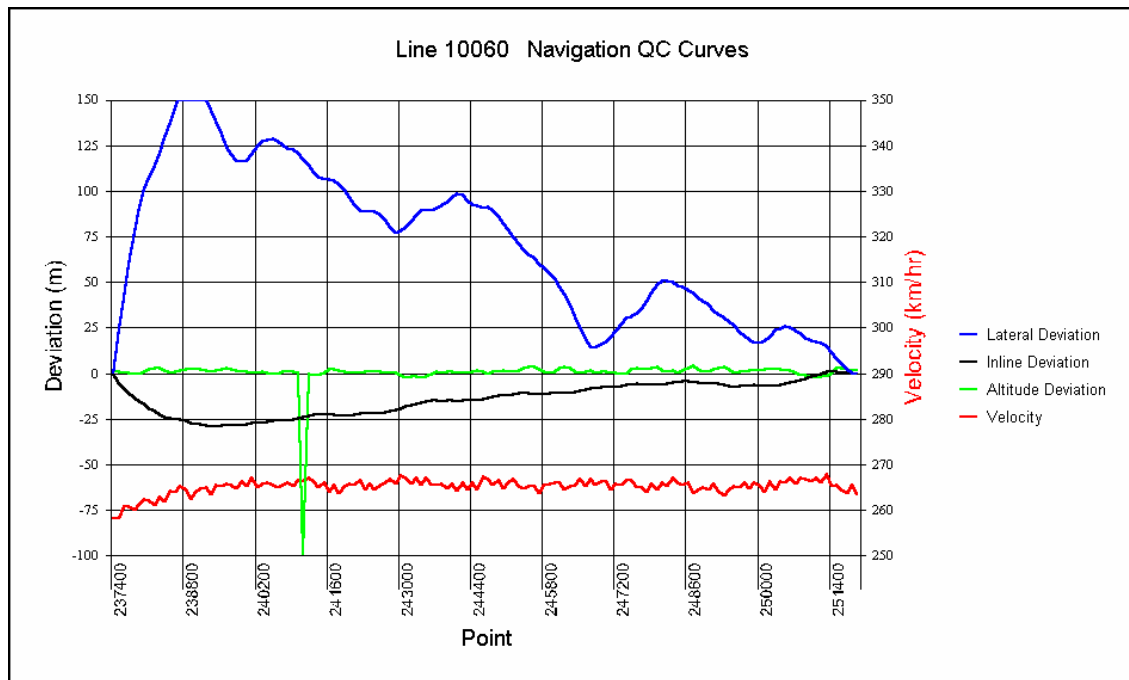


Figure 19. Navigation QC Curves for Line 10060.

## **Appendix 3. CD Contents**

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

### **ALF Analysis.dat**

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

### **Yampi 1996 ALF Survey Interp Report.doc**

The Browse (Yampi 1996) ALF survey interpretation report.

### **Browse Survey Summary.xls**

Survey summary spreadsheet.

### **Browse.mdb**

ALF Explorer project database containing interpretation results.

### **Confident Fluors.dat**

ASCII data file of the confident fluors picked during the interpretation.

### **First Pass Fluors.map**

ALF Explorer map definition file for the first pass ALF fluor map.

### **Fluors.map**

ALF Explorer map definition file for the refined ALF fluor map.

### **Line 10210 Near Fluors.dat**

ASCII data file of the group of fluors on line 10210 separated by 10 samples or less.

### **Line 10220 Near Fluors.dat**

ASCII data file of the group of fluors on line 10220 separated by 10 samples or less.

### **Figures**

Directory containing figures used in the interpretation report