APPENDIX 9.

X-RAY DIFFRACTION ANALYSIS.

PINE LODGE-1

W1034

AMDEL
CORE
SERVICES

PETROLOGY REPORT

PINE LODGE #1

OTWAY BASIN

Report prepared for Gas and Fuel Exploration

by

S E PHILLIPS & A P THOMAS

Amdel Core Services
PO Box 109
Eastwood
SA 5063

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1. INTRODUCTION

Gas and Fuel Exploration requested X-ray diffraction (XRD) analysis of 16 sidewall core samples from Pine Lodge #1 in the Otway Basin. To determine bulk mineralogy by X-ray diffraction, samples were hand ground in acetone and smeared onto glass slides. Continuous scans were run of these smears from 3^{o} to 75^{o} 2 theta, at 1^{o}/minute, using Co K alpha radiation, 50kV and 35mA, on a Philips PW1050 diffractometer. Peaks were identified by comparison with JCPDS files stored in a computer program called XPLOT.

2. X-RAY DIFFRACTION RESULTS

All XRD analyses are summarised in Table 3.1.

2.1 Pine Lodge #1, sample 1, depth 1030.0m

Bulk XRD (Fig. 1) indicates that quartz is dominant, kaolinite and illite/muscovite are minor and that there are traces of feldspar (?microcline) and pyrite. The presence of interstratified clays is inferred by a high background at low 2 theta angles.

2.2 Pine Lodge #1, sample 2, depth 1039.5m

Bulk XRD (Fig. 2) indicates that quartz is dominant, siderite subdominant and that there are minor amounts of kaolinite and/or clinochlore. Kaolinite and clinochlore share the same major peaks and are normally differentiated by heating and minor peaks of each mineral. In this sample, subsidiary peaks for kaolinite (1.49 Angstroms) and clinochlore (7 or 14 Angstroms) are absent, hence precise identification is not possible. Interstratified clays are suggested by a high background at low 2 theta angles.

2.3 Pine Lodge #1, sample 3, depth 1060.0m

The dominance of quartz is indicated from the bulk XRD trace of this sample (Fig. 3). Siderite, calcite and kaolinite/clinochlore are present in minor proportions and pyrite occurs in trace amounts. Clinochlore and kaolinite cannot be precisely identified for the same reasons as given in the previous sample. A small peak at 2.13 Angstroms indicates that there are possible traces of Ca rich feldspar. Interstratified clays are inferred by a high background at low 2 theta angles.

2.4 Pine Lodge #1, sample 4, depth 1068.0m

Bulk XRD (Fig. 4) indicates that quartz is dominant, siderite is minor and that there are trace amounts of kaolinite/clinochlore, barite, pyrite and ankerite/ferroan dolomite. The main siderite peak is a doublet suggesting 2 different compositions for this mineral. Note that the scale of this trace has been expanded to accommodate the siderite peak doublet.

2.5 Pine Lodge #1, sample 5, depth 1077.0m

The dominance of quartz is apparent from bulk XRD (Fig. 5). There are minor proportions of kaolinite/clinochlore and pyrite and trace amounts of feldspar. The absence of unique secondary peaks precludes precise identification of kaolinite or clinochlore and interstratified clays are suggested by a high background at low 2 theta angles.

2.6 Pine Lodge #1, sample 6, depth 1081.5m

Bulk XRD (Fig. 6) indicates that quartz is dominant, pyrite, kaolinite and feldspar (?microcline) are in minor proportions and that there are traces of calcite and ankerite/ferroan dolomite. The presence of interstratified clays is inferred by a high background at low 2 theta angles.

2.7 Pine Lodge #1, sample 7, depth 1300.0m

Bulk XRD (Fig. 7) shows that quartz is dominant, siderite, kaolinite, illite/muscovite and feldspar (potassic) are minor and that there is a trace of pyrite. Interstratified clays are indicated by a high background at low 2 theta angles.

2.8 Pine Lodge #1, sample 8, depth 1400.0m

Bulk XRD (Fig. 8) indicates that quartz is dominant, siderite subdominant and that illite/muscovite, kaolinite and ankerite/ferroan dolomite are in minor proportions. The major siderite peak is a doublet and suggests that some of this mineral is a different chemical phase (?manganese rich). Interstratified clays are indicated by a high background at low 2 theta angles.

2.9 Pine Lodge #1, sample 9, depth 1709.0m

Bulk XRD (Fig. 9) indicates the dominance of quartz, with kaolinite, siderite, illite/muscovite and feldspar (potassic) in minor proportions. High background values at low 2 theta angles suggests that there are interstratified clays.

2.10 Pine Lodge #1, sample 10, depth 1868.0m

The dominance of quartz is established from the bulk XRD trace (Fig. 10). Kaolinite, siderite and ankerite/ferroan dolomite are present in minor amounts and there are traces of sylvite and calcite. Sylvite is probably a drilling additive. Interstratified clays are suggested by a high background at low 2 theta angles.

2.11 Pine Lodge #1, sample 11, depth 1961.5m

Quartz dominates the bulk XRD trace of this sample (Fig. 11). Kaolinite and sylvite are present in minor proportions and there are possibly trace amounts of pyrite and halite. Sylvite and halite are likely to be drilling additives. Interstratified clays are indicated by a high background at low 2 theta angles.

2.12 Pine Lodge #1, sample 12, depth 1969.0m

Bulk XRD (Fig. 12) indicates that quartz is dominant, feldspar (microcline) and kaolinite are in minor amounts and that sylvite and ankerite/ferroan dolomite occur in trace amounts. Sylvite is likely to be a drilling additive. A high background at low 2 theta angles suggests that interstratified clays are present.

2.13 Pine Lodge #1, sample 13, depth 2014.0m

Quartz dominates the bulk XRD trace, kaolinite, feldspar and siderite are in minor proportions and there are traces of illite/muscovite (Fig. 13). Both potassic and sodic feldspars may be present in this sample. Interstratified clays are indicated by a high background at low 2 theta angles and the broad nature of the strongest illite/muscovite peak.

2.14 Pine Lodge #1, sample 14, depth 2064.5m

Bulk XRD (Fig. 14) indicates that quartz is dominant, calcite, kaolinite and sylvite are minor, and that pyrite occurs in trace proportions. Interstratified clays are indicated by a high background at low 2 theta angles. Sylvite is probably a drilling additive.

2.15 Pine Lodge #1, sample 15, depth 2087.0m

Calcite and quartz are codominant in the bulk XRD trace of this sample (Fig. 15). Kaolinite, feldspar (?albite) and possibly clinochlore occur in minor amounts. The presence of clinochlore is suggested by a doublet peak at 3.5 Angstroms and a high background at low 2 theta angles indicates that there are interstratified clays.

2.16 Pine Lodge #1, sample 16, depth 2109.0m

Bulk XRD (Fig. 16) indicates that quartz is dominant and feldspar (?albite), kaolinite, illite/muscovite, calcite and siderite are in minor proportions. There is also a trace of pyrite, and interstratified clays are indicated by a small peak and high background at low 2 theta angles.

3. TABLE

3.1 BULK XRD MINERALOGY PINE LODGE #1

Sample	Depth	Qtz	Kaol	I/M	Cal	Sid	Feld	Others
		Strongest peak height in counts						
1	1030.0m	2097	637	413	-	-	tr	Py
2	1039.5m	6013	277*	-	-	313	-	-
3	1060.0m	7328	248*	-	147	323	98	Py
4	1068.0m	6261	tr	-	-	1440	-	Py, Ba, An
5	1077.0m	2150	223*	-	-	-	tr	Py
6	1081.5m	13955	168	-	tr	-	118	Py, An
7	1300.0m	3196	407	212	-	268	165	Py
8	1400.0m	4812	279	246	-	1063	-	An
9	1709.0m	4551	457	248	-	363	163	-
10	1868.0m	7631	250	-	tr	217	-	An, Sy
11	1961.5m	8320	296	-	-	-	-	Sy, Py, Ha
12	1969.0m	8542	305	-	-	-	249	Sy, An, Py
13	2014.0m	3590	426	238	-	230	156	In
14	2064.5m	6602	193	-	600	-	-	Sy, Py
15	2087.0m	1448	404#	-	1809	-	100	-
16	2109.0m	1826	263	-	171	131	328	In, Py

Qtz = quartz, Kaol = kaolinite, I/M = illite/muscovite, Cal = calcite, Sid = siderite, Feld = feldspar, Py = pyrite, In = interstratified clays, An = ankerite/ferroan dolomite, Ba = barite, Sy = sylvite, Ha = halite. Kaolinite peak heights marked "*" refer to samples where this peak may be due to clinochlore rather than kaolinite, and where marked "#" both kaolinite and clinochlore are suspected.

All the XRD results are summarised in the table above. To facilitate between-sample comparisons of relative abundance for the same mineral, the results in Table 3.1 are given in counts of peak height. These figures are based on the strongest line for each mineral detected. Caution should be used in assessing relative abundance from these figures since peak height is also significantly affected by factors such as crystal size and crystallinity. For these reasons the figures are even more unreliable when comparing different minerals in the same sample. For example, based on peak height alone carbonate minerals will always appear less abundant than similar proportions of quartz because of differences in crystallinity. Clay minerals will also appear to be less abundant than quartz in a bulk XRD trace because of differences in crystal size. Note that XRD will not detect minerals which represent less than approximately 5% of the total rock composition.

5. FIGURES AND CAPTIONS

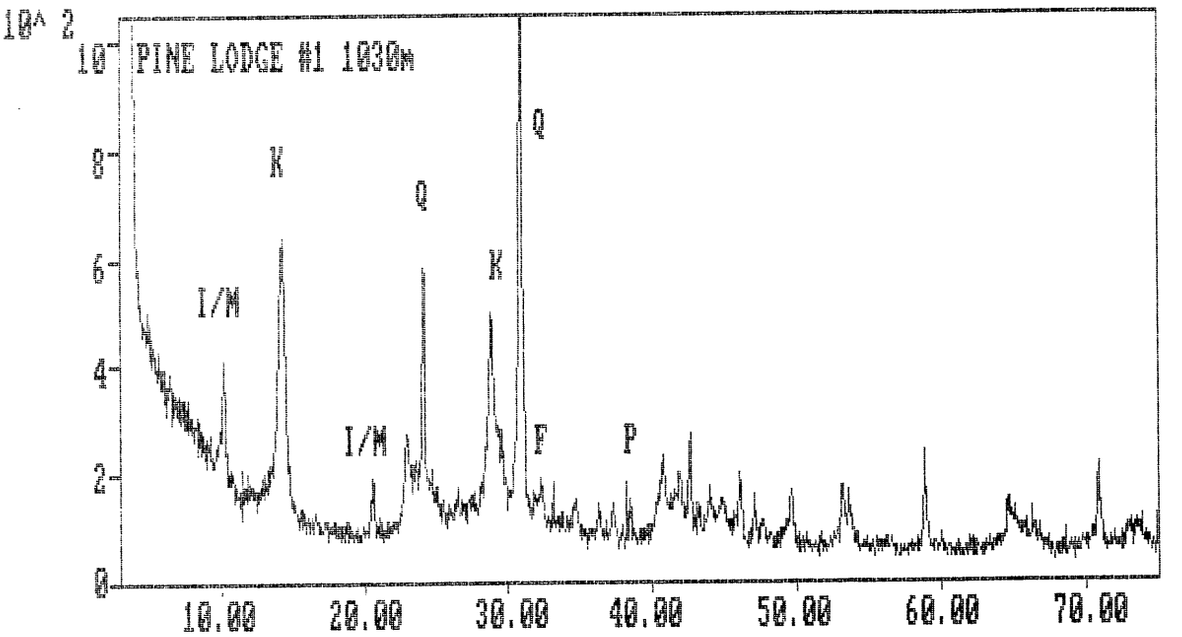

Figure 1. Bulk XRD trace of sample 1, Pine Lodge #1, depth 1030.0m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, I/M=illite/muscovite, F=feldspar, K=kaolinite and P=pyrite.

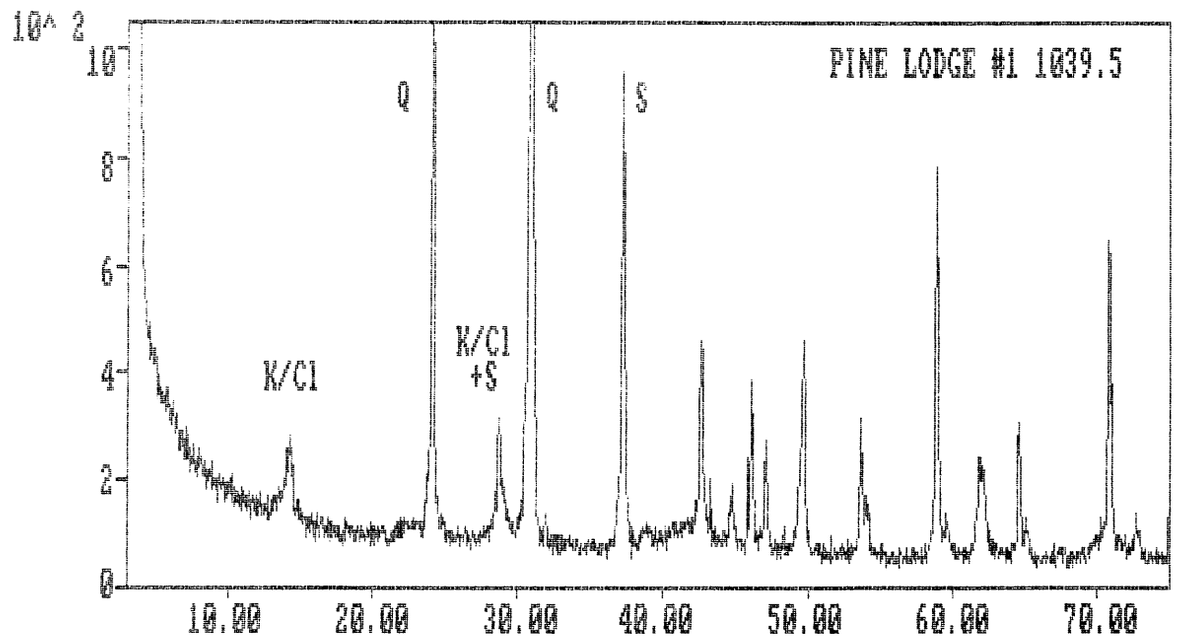

Figure 2. Bulk XRD trace of sample 2, Pine Lodge #1, depth 1039.5m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, K/Cl=kaolinite or clinochlore and S=siderite.

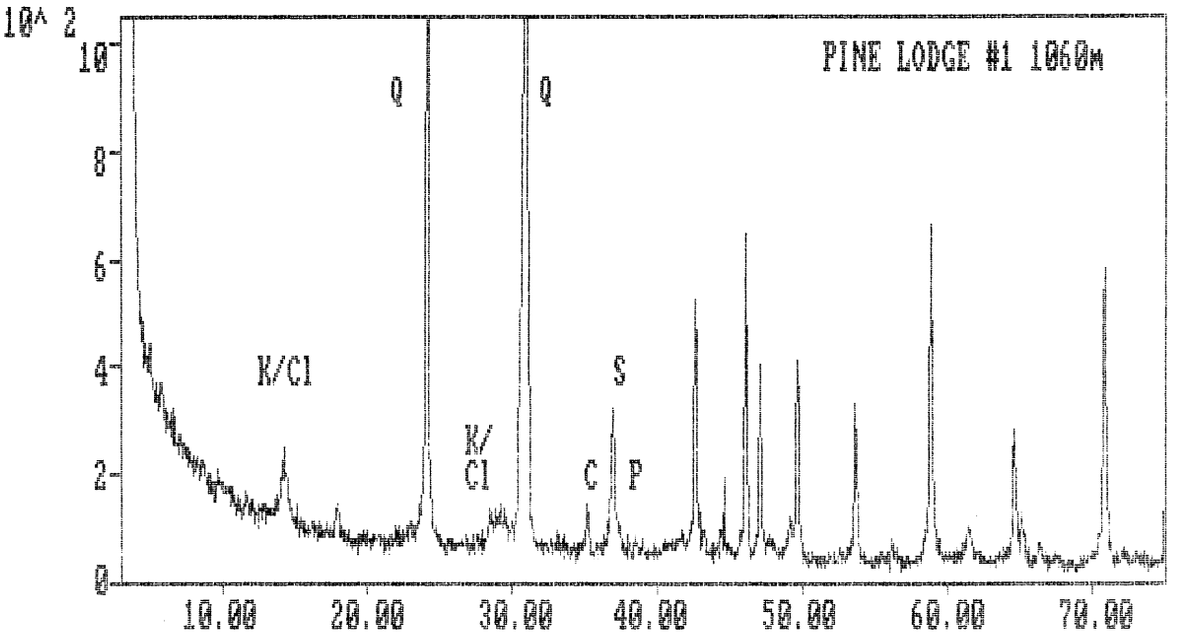

Figure 3. Bulk XRD trace of sample 3, Pine Lodge #1, depth 1060.0m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, S=siderite, C=calcite, K/Cl=kaolinite or clinochlore and P=pyrite.

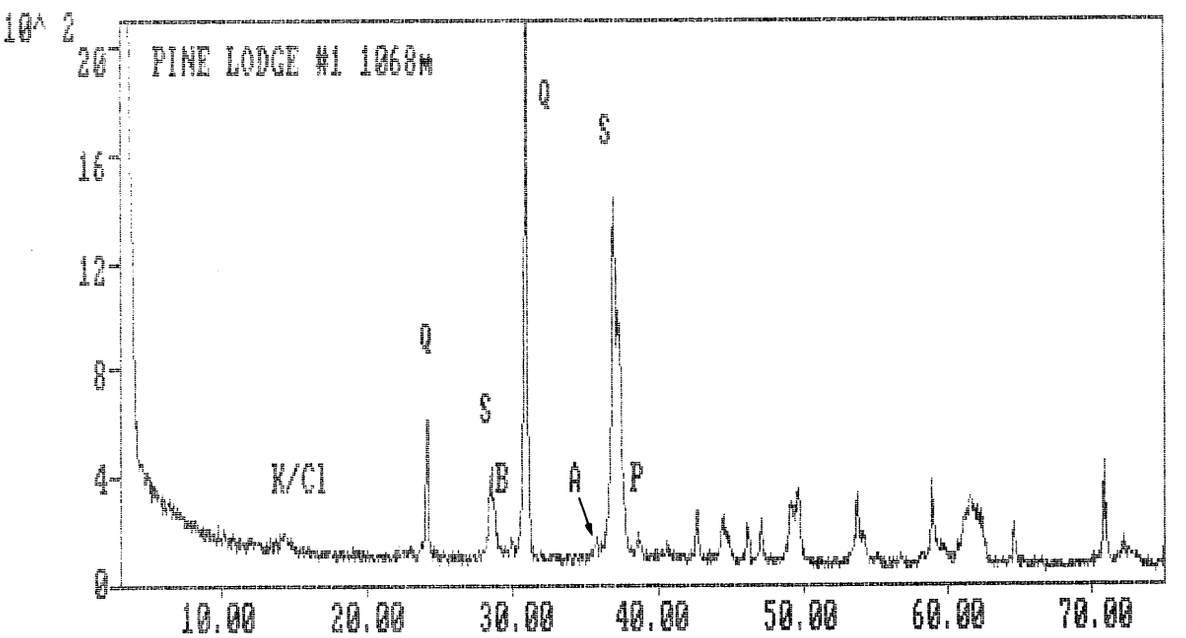

Figure 4. Bulk XRD trace of sample 4, Pine Lodge #1, depth 1068.0m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, S=siderite, K/Cl=kaolinite or clinochlore, B=barite and A=ankerite/ferroan dolomite.

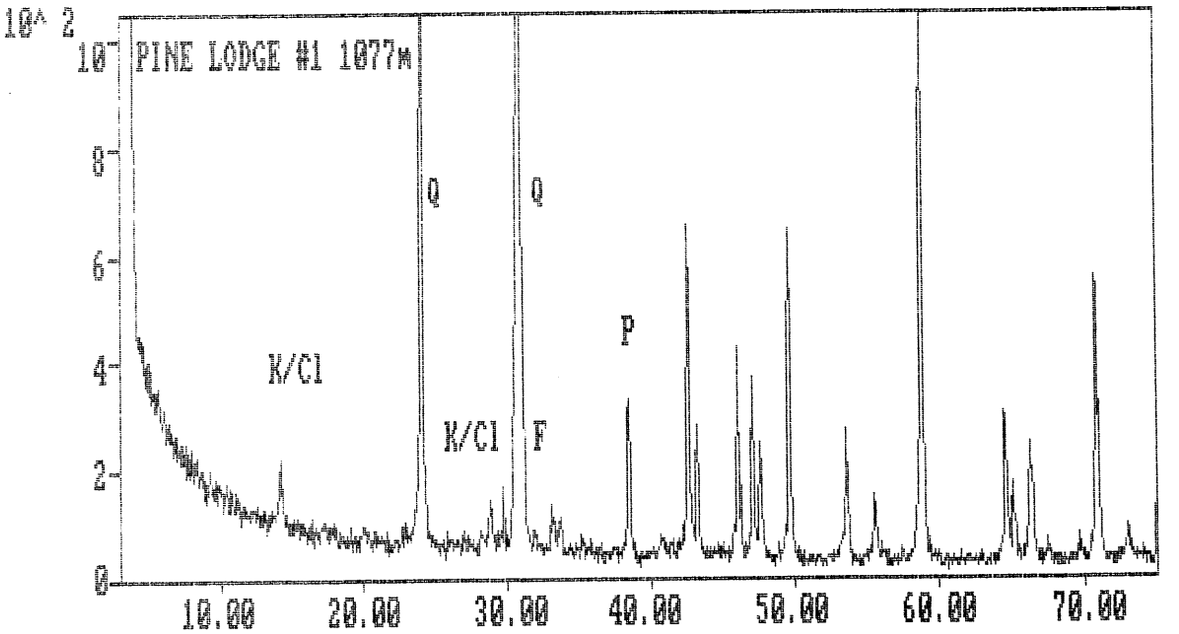

Figure 5. Bulk XRD trace of sample 5, Pine Lodge #1, depth 1077.0m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, K/Cl=kaolinite or clinochlore, P=pyrite and F=feldspar.

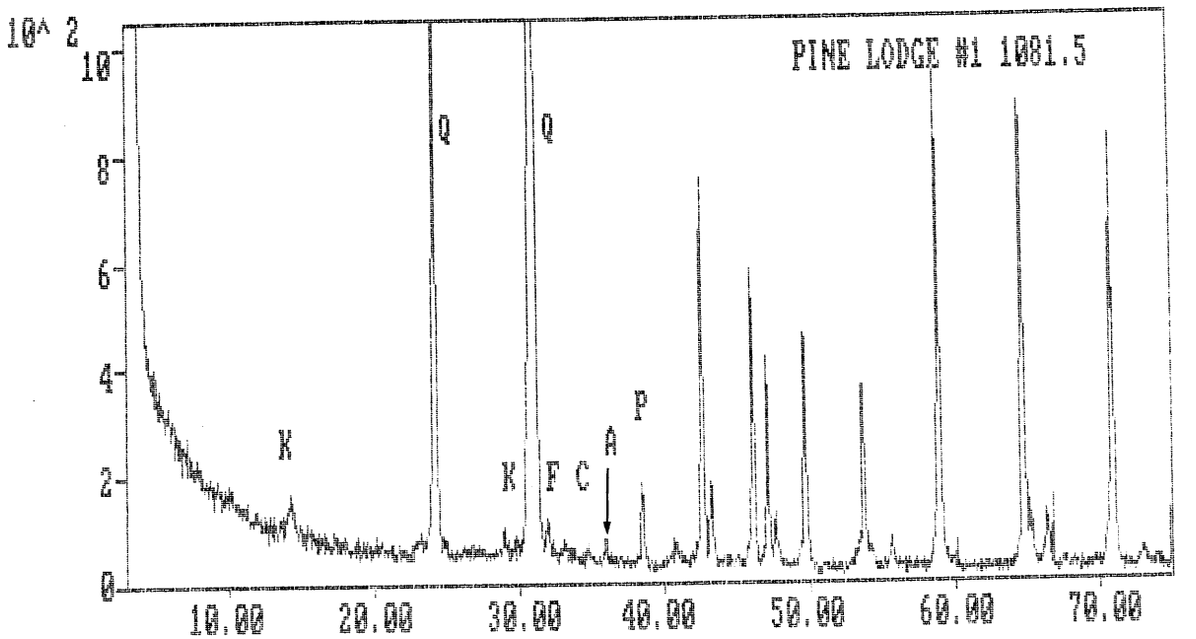

Figure 6. Bulk XRD trace of sample 6, Pine Lodge #1, depth 1081.5m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, K=kaolinite, F=feldspar, P=pyrite, C=calcite and A=ankerite/ferroan dolomite.

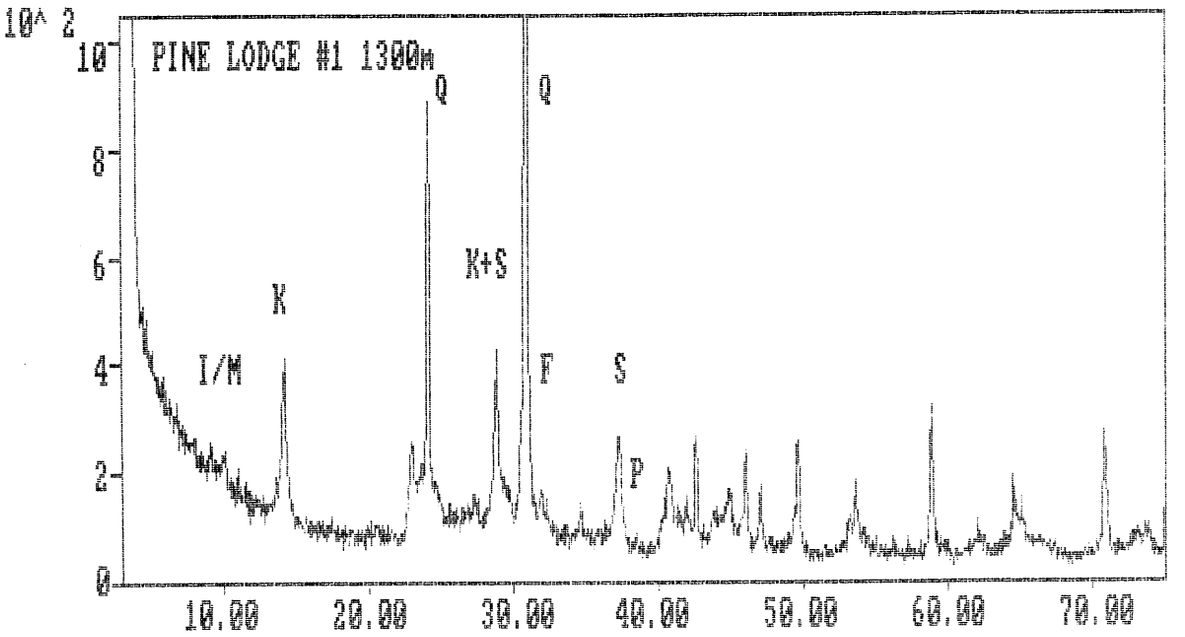

Figure 7. Bulk XRD trace of sample 7, Pine Lodge #1, depth 1300.0m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, S=siderite, F=feldspar, I/M=illite/muscovite, P=pyrite and K=kaolinite.

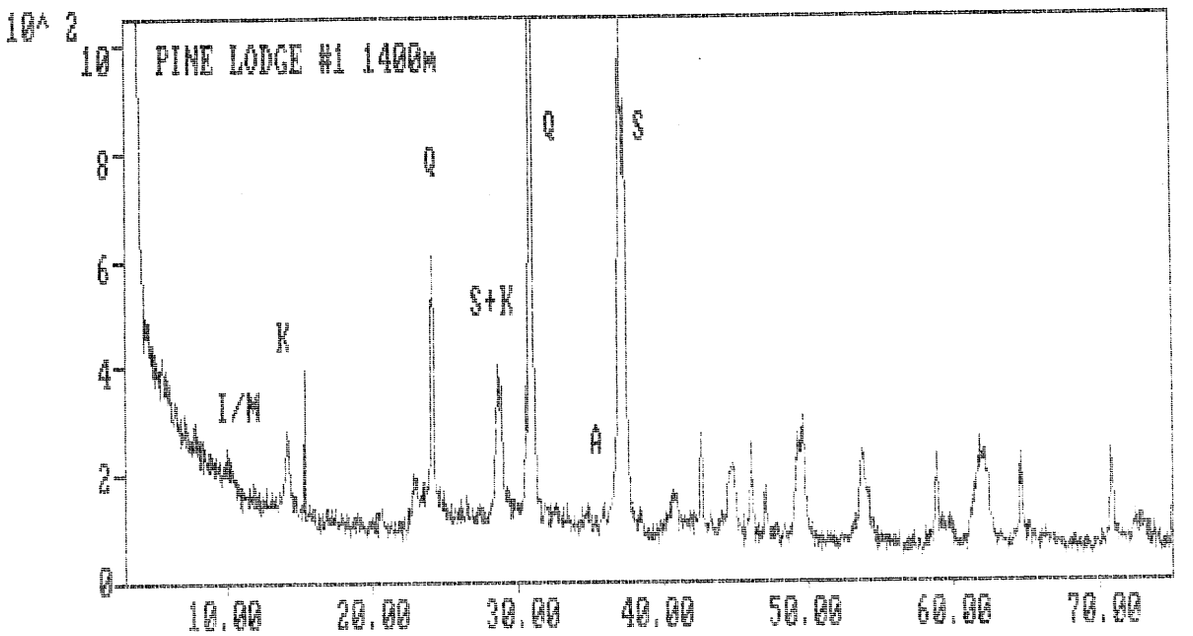

Figure 8. Bulk XRD trace of sample 8, Pine Lodge #1, depth 1400.0m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, S=siderite, I/M=illite/muscovite, A=ankerite/ferroan dolomite and K=kaolinite.

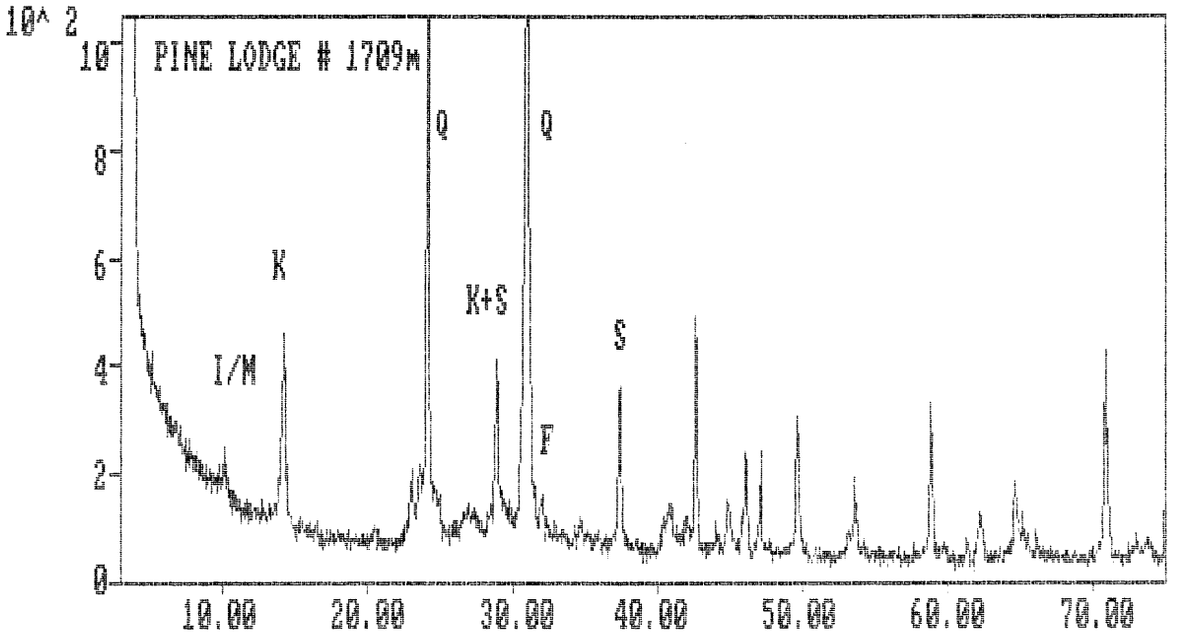

Figure 9. Bulk XRD trace of sample 9, Pine Lodge #1, depth 1709.0m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, S=siderite, I/M=illite/muscovite, F=feldspar and K=kaolinite.

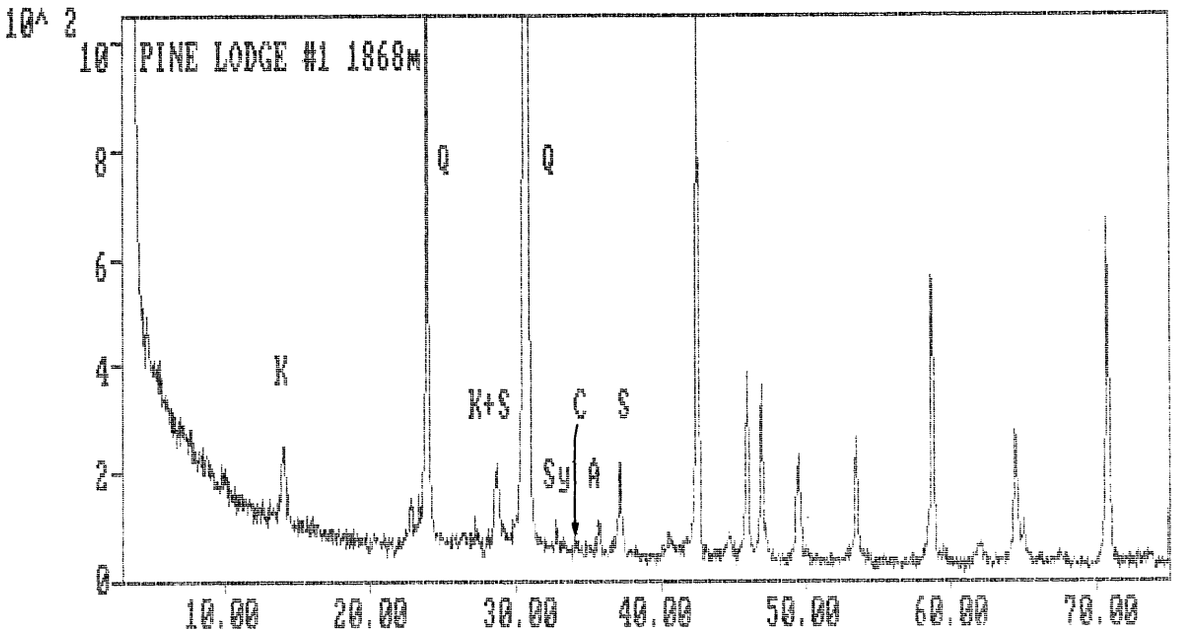

Figure 10. Bulk XRD trace of sample 10, Pine Lodge #1, depth 1868.0m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, S=siderite, A=ankerite/ferroan dolomite, C=calcite, Sy=sylvite and K=kaolinite.

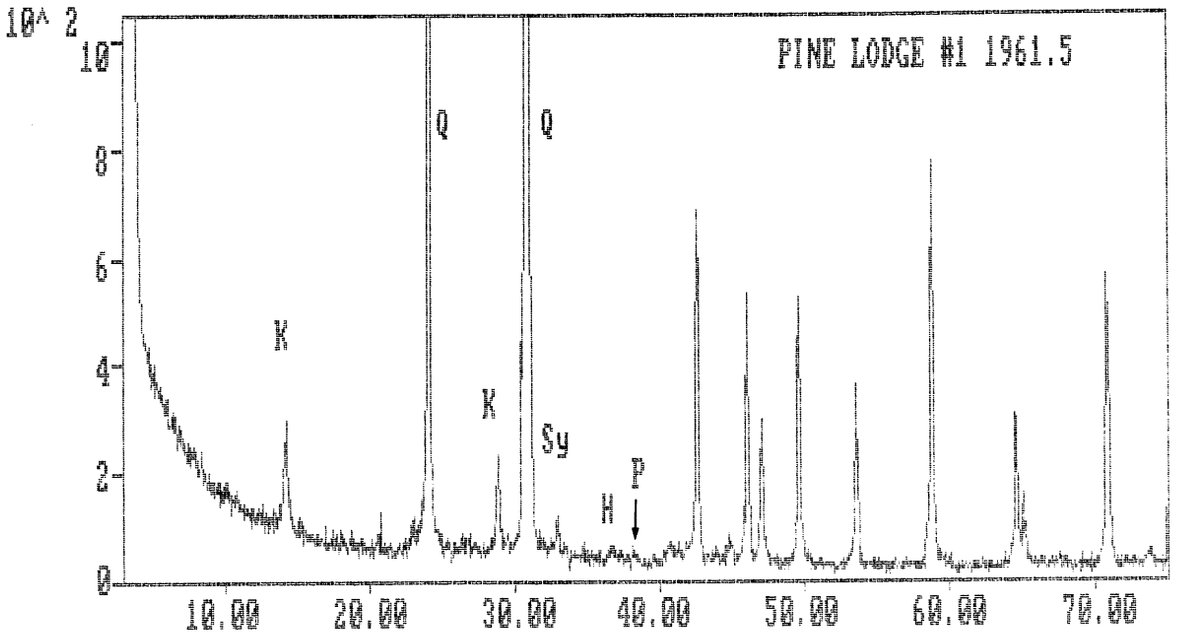

Figure 11. Bulk XRD trace of sample 11, Pine Lodge #1, depth 1961.5m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, Sy=sylvite, H=halite, P=pyrite and K=kaolinite.

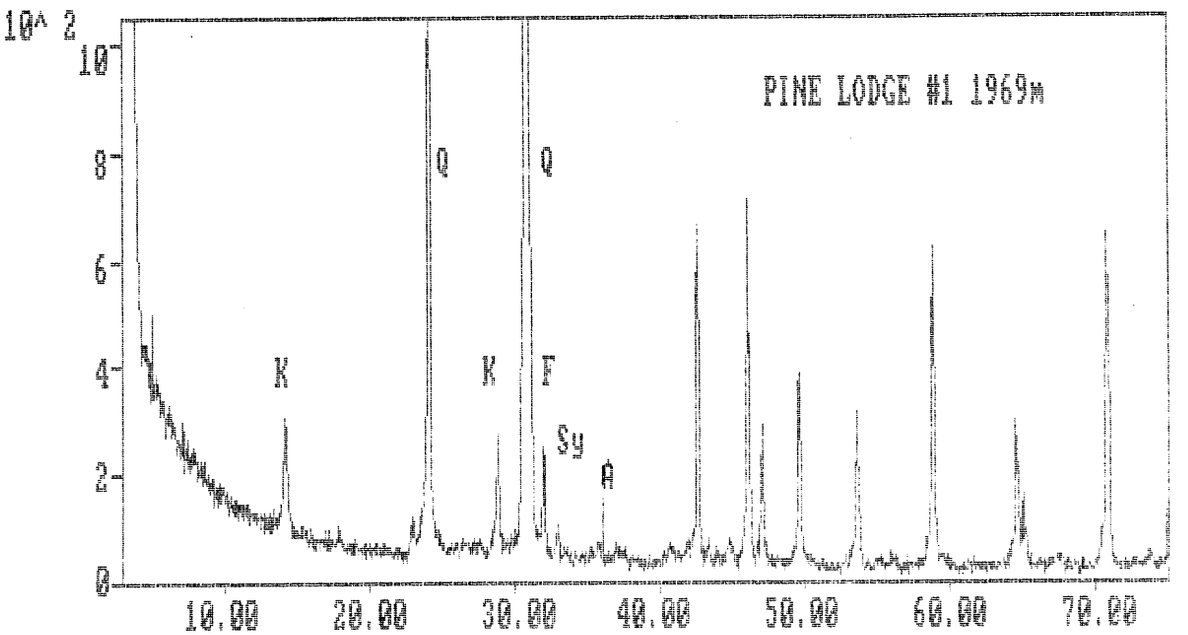

Figure 12. Bulk XRD trace of sample 12, Pine Lodge #1, depth 1969.0m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, A=ankerite/ferroan dolomite, Sy=sylvite, F=feldspar and K=kaolinite.

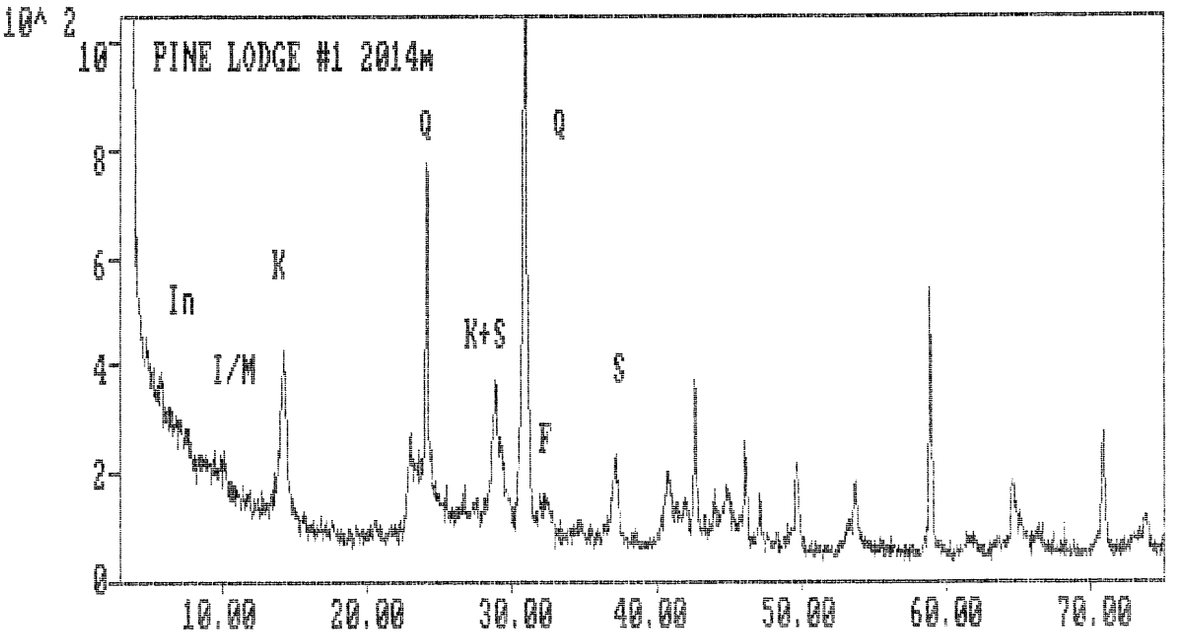

Figure 13. Bulk XRD trace of sample 13, Pine Lodge #1, depth 2014.0m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, In=interstratified clays, S=siderite, I/M=illite/muscovite, F=feldspar and K=kaolinite.

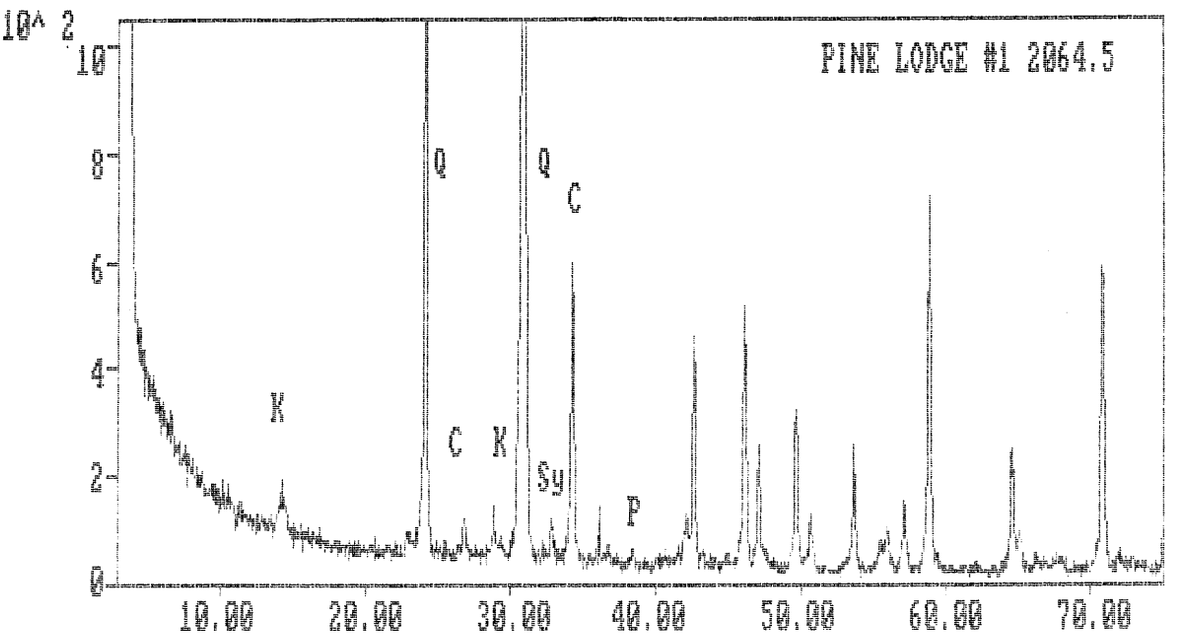

Figure 14. Bulk XRD trace of sample 14, Pine Lodge #1, depth 2064.5m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, C=calcite, Sy=sylvite, P=pyrite and K=kaolinite.

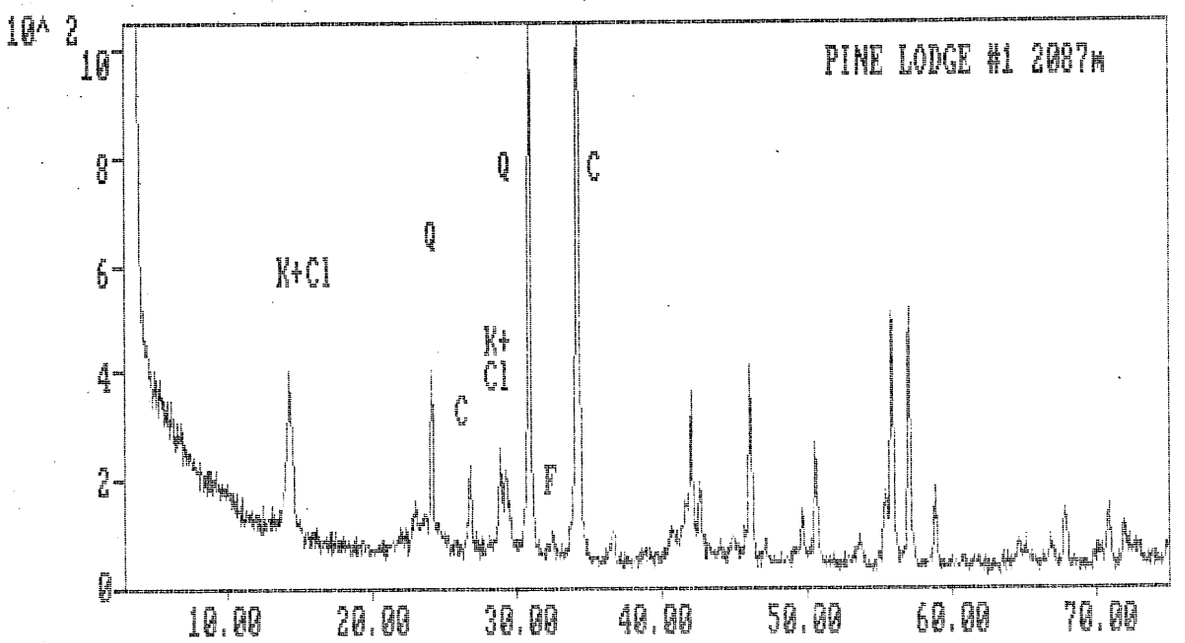

Figure 15. Bulk XRD trace of sample 15, Pine Lodge #1, depth 2087.0m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, C=calcite, F=feldspar, K=kaolinite and Cl=clinochlore.

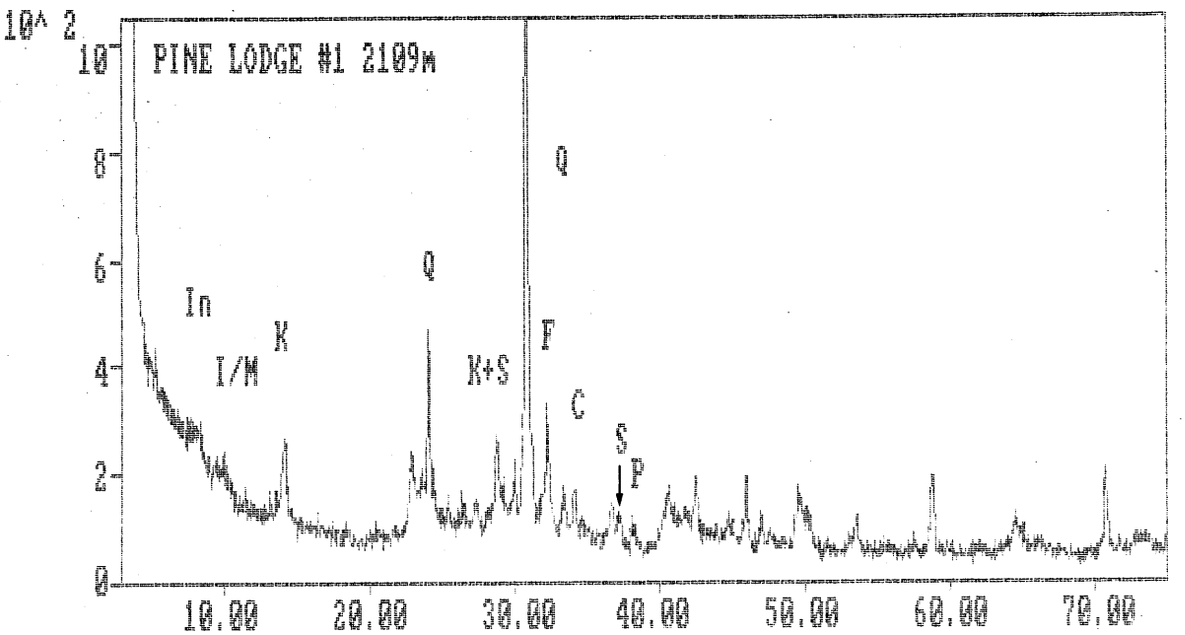

Figure 16. Bulk XRD trace of sample 16, Pine Lodge #1, depth 2109.0m. Only the strongest peaks for each mineral identified have been labelled. Q=quartz, C=calcite, F=feldspar, K=kaolinite, In=interstratified clays, I/M=illite/muscovite, S=siderite and P=pyrite.