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ARIS Summary Report

Regional Geologist, Smithers

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ASSESSMENT REPORT: 25725

Mining Division(s): Atlin

Property Name: Thorn

Location: NAD 27 Latitude: 58 34 00 Longitude: 132 48 00 UTM: 08 6493689 627970
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NTS: 104K10W

Camp:

Claim(s): Check-Mate, Stuart 1-3

Operator(s): Kohima Pacific Gold Corp., Almaden Resources Corp.
Author(s): Poliquin, J. Duane, Poliquin, Morgan

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Searched For: Gold, Copper, Silver

General
Work Categories: GEOL, GEOC

Work Done: Geochemical
SAMP Sampling/assaying (13 sample(s))
Elements Analyzed For : Multielement
Geological
MNGR Mineralographic (84 sample(s);PIMA)

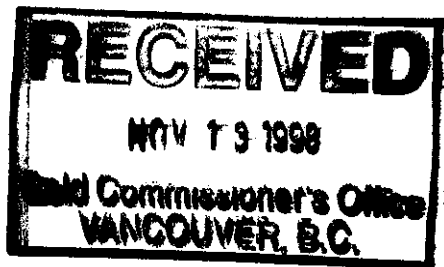
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Geology and Hydrothermal Alteration Mineralogy



of

The Thorn Prospect,

(104 K 10W)

Atlin Mining Division

58° 34' N, 132° 48' W

by

Morgan J. Poliquin, M.Sc.

and

J.D. Poliquin, P.Eng.

for

Kohima Pacific Gold Corp.

November 13, 1998

Check-mate, Stuart 1, Stuart 2, Stuart 3 Claims

**GEOLOGICAL SURVEY BRANCH
ASSESSMENT REPORT**

25,725

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Summary

The Thorn prospect has been recognized as a zone of spectacular alteration for some time. Brightly coloured alteration occurs in rock faces along La Jaune and Camp Creeks, south of the Sutlahine River. The intermittent work initially concentrated on the porphyry potential in the area. The gold potential was only the focus in the most recent campaigns of work. The alteration mineralogy and style of mineralization alerted the author to the potential to find high sulphidation epithermal mineralization. In past campaigns of work, enargite-bearing massive sulphide boulders have been found in La Jaune Creek. The best value obtained from float sampling was 8.45 % Cu, 22 g/t Au and 311 g/t Ag. Hand trenching never found the source of such boulders, however on the east slope of La Jaune Creek, sampling from one 3.7 meter wide trench returned 9 g/t Au, 311.9 g/t Ag and 0.3 % Cu. During 1986 an 8 hole 688 meter NQ diamond drill program tested coincident VLF-EM and gold soil anomalies on a small portion of the alteration zone. Despite limited sampling of altered sections of core, significant gold-copper values were intersected. These included 10.29 meters of 2.7 g/t Au, 35 g/t Ag and 2.58 meters of 3.78 % Cu, 2.0 g/t Au and 152.5 g/t Ag. No studies were ever carried out on the core to determine the alteration mineralogy associated with Cu-Au-Ag mineralization.

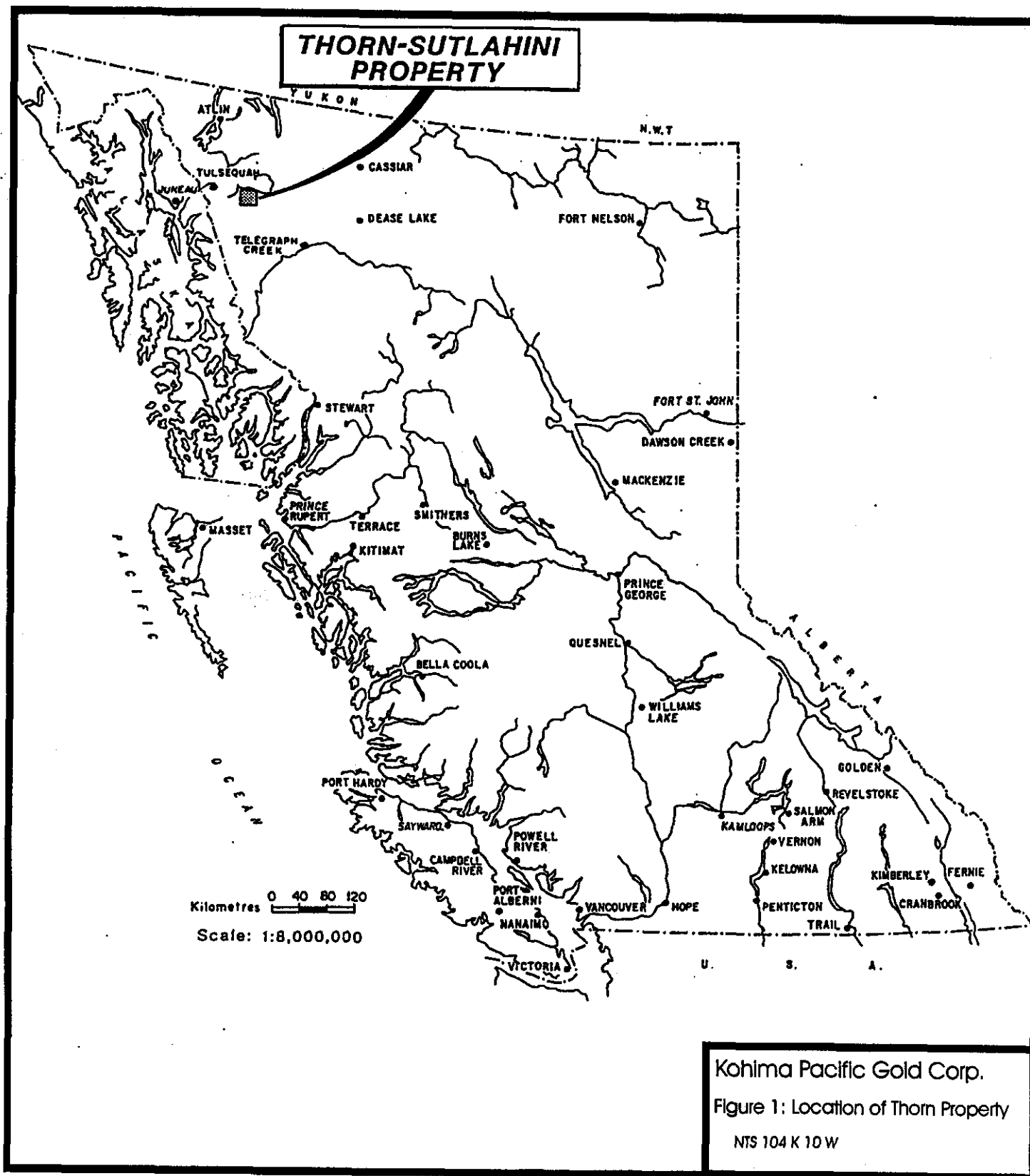
This focus of this study was the core from the 1986 program of drilling. Samples were selected on regular intervals for mineralogic analysis with a PIMA, a portable infrared spectrometer, capable of determining alteration mineralogy. Samples were taken from three holes, 86-1, 86-3 and 86-6. Hole 86-3 returned 10.3 meters of 2.7 g/t Au and 35 g/t Ag in past sampling, however intervals were left unsampled from this campaign of work. These unsplit intervals were sampled to provide a continuous sample interval for the hole. Limited prospecting was also carried out along Camp Creek, interpreted to represent a major structural feature, possibly genetically related to alteration-mineralization. A massive zone of enargite-pyrite was discovered, striking at 060°, parallel to the Creek. Sampling across the exposed 0.5 meters of this zone returned 6.9 % Cu, 0.9 g/t Au and 180 g/t Ag.

Future work should focus on the alteration zone exposed along Camp Creek. The discovery of massive enargite-pyrite along the creek supports the interpretation that the creek may be a reflection of the important controlling structural at the time of alteration-mineralization. Prospecting, detailed rock-chip and soil sampling should be carried out in conjunction with ground geophysics on a grid oriented perpendicular to the flow of Camp Creek, approximately 150°.

Style of Mineralization

The author spent time doing graduate work in the South Pacific at the University of Auckland, a centre for research in epithermal systems. Recently high-sulphidation systems have been distinguished as a distinct style of mineralization and have become far better understood. Generally it is thought that magmatic vapours, namely HCl, HF and SO₂, separate from a melt and ascend along major structural features these gases disassociate in the presence of groundwater, and cool to form a highly acidic fluid (Arribas, 1995). These fluids alter the wall rock adjacent to the controlling structure forming increasingly neutral stable clay-dominated mineralogic assemblages zoned away from the structure. The fluids are generally so acid that they have the ability to leach all cations from the host rock, resulting in a residual silica. The residual or vuggy silica bodies are greatly reduced in volume and as such highly permeable. Subsequent to the ascent of volatiles, metal-bearing brines ascend along the controlling structural features, precipitating highly oxidized sulphides, often characterized by enargite, in zones of permeability, including vuggy silica bodies.

High-sulphidation ore-bodies vary in mineralogy and style. Large gold-rich bodies, generally associated with vuggy silica and quartz-alunite alteration may represent higher levels of such systems. Examples of this style of mineralization include Peirina, Peru, La Coipa, and Nevada, Chile, Nansatsu, Japan and Summitville, Colorado. Massive structurally-controlled enargite-pyrite veins are the source of ore at El Indio, Chile, Lepanto, Philippines and Chelopech, Bulgaria. In the case of El Indio, (23 MT of ore averaging 6.6 g/t Au, 50 g/t Ag and 4 % Cu) massive enargite-pyrite veins, associated with pyrophyllite



altered wall rock, are crosscut by late-stage gold rich quartz veining and quartz-alunite alteration (Jannus, 1995; Sillitoe, 1995).

Recent work on the Lepanto enargite mine in the Philippines (33 MT of ore grading 2.2% Cu, 3.5 g/t Au and 11 g/t Ag) has demonstrated with stable isotope, K-Ar and U-Pb age data and fluid inclusion data a distinct connection with underlying high-grade copper-gold porphyry mineralization in the giant FSE porphyry deposit (Arribas et al., 1995; Hedenquist et al., 1998). Such a connection has always been postulated, however this new data implies that settings such as the Thorn showing, are prospective for high-grade porphyry copper-gold ore as well as the exposed enargite copper-gold-silver mineralization.

Introduction

The Thorn project was acquired by Kohima Pacific Gold Corp. (Kohima) in the winter of 1997 and the spring of 1998. An option to obtain a 100% interest in the Check-mate claim was acquired by Kohima. Three 4-post claims totaling 52 units were staked around the checkmate claim. The project was acquired following the recognition, by M.J. Poliquin that the alteration mineralogy and style of mineralization represented a previously unrecognized high-sulphidation epithermal Cu-Au system. Much recent research has been conducted on such systems worldwide in recent years and this understanding led the author to recognize the potential of the Thorn prospect.

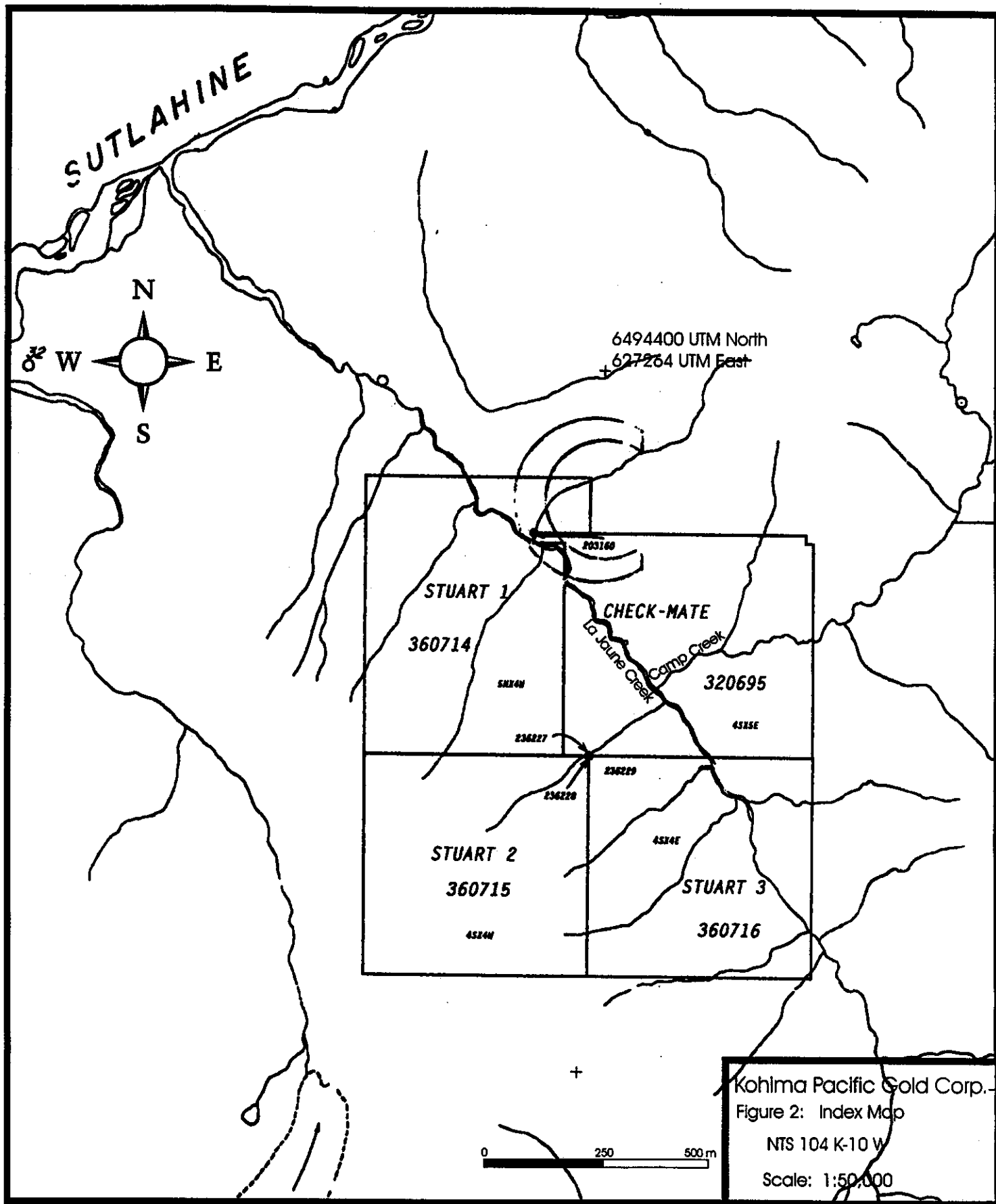
Core existing from the 1986 campaign of drilling, carried out by Inland Recovery Group Ltd., was found to be preserved in good condition although the core racks had collapsed. Considerable time was required to extract the core and restack it to ensure its preservation. In this program the core, and several areas of prominent outcrop, were sampled for the purposes of determining alteration mineralogy. As described above, high-sulphidation settings are characterized by acid-stable phyllosilicate hydrothermal assemblages that are zoned, generally parallel to the source structure for ascending hydrothermal fluids. These alteration patterns, consisting largely of varying compositions of clay that reflect increasingly neutral stable conditions away from the controlling structure. As a result, a spatial mineralogic database can often guide the explorationist towards feeder structures and potentially economic mineralization within the altered area. Unfortunately the alteration minerals are generally very difficult to identify and distinguish in hand specimen due to the fine-grained nature of clay-dominated mineralogy. New instrumentation, capable of identifying mineralogy using an infrared spectrometry, has been made available to the exploration community. The instrument, a portable infrared spectrometer (PIMA), was used in this study to identify clay mineralogy. Samples were selected from three drill holes, 86-1, 86-3 and 86-6 at intervals down the hole and measured with the PIMA. Samples were also taken from outcrops mapped along Camp Creek. Some rock-chip sampling was carried out on mineralized outcrop exposed in Camp Creek. Sections of core were also split to fill in gaps left by the initial sampling of the core.

Location and Access

The Thorn prospect is located at 58°33' N latitude and 132°48' W longitude on map sheet 104K-10W. It lies on a northwestern flowing tributary of the Sutlahine River in northwestern British Columbia (Figure 1). The Sutlahine River flows into the Taku River which drains into the Pacific Ocean near Juneau, Alaska. The nearest centres to the property are Atlin, located 125 kilometers to the northwest and Telegraph Creek, located 125 kilometers to the southeast. The property was accessed by helicopter from Atlin, B.C. for the work described in this report. The property is located 20 kilometers southeast of King Salmon Lake and 11 kilometers northwest of Trapper Lake, both of which are accessible by float-plane.

<i>Claim Name</i>	<i>Number of Units</i>	<i>Record No.</i>	<i>Expiry Date</i>
<i>Check-mate</i>	20	320695	Sept. 2, 2001
<i>Stuart 1</i>	20	360714	Nov. 21, 2000
<i>Stuart 2</i>	16	360715	Nov. 21, 2000
<i>Stuart 3</i>	16	360716	Nov. 21, 2000

Table 1: Claim Information



Claim Information

The claim area consists of the Check-mate claim, held under option by Kohima Pacific Gold Corp. (Kohima) and the wholly owned Stuart 1-3 claims, acquired by staking. Table 1 is a list of the claims and their expiry dates. Figure 2 illustrates the location of the claims.

History

Prominent white-yellow alteration exposed in the Sutlahine and Camp creek area was first recognized in 1959 by Kennco exploration geologists. There is no record of any staking having been carried out at that time.

In 1963 Julian Mining Company staked the Thorn property to cover mineralized outcrops in the drainage area of the creeks. This work culminated in four, short Pack Sack drill holes. Results are unknown to the author. In 1964, the claimed area was increased and prospecting and geologic mapping was carried out. In 1965 several zones of silicification and anomalous gold values were discovered. Geophysical and geochemical anomalies were tested with four holes that totaled 179 meters. Subsequently Julian allowed the property to lapse. Apparently the gold values were not encouraging with the then prevailing gold prices.

In 1968 the property was re-staked as the Ink group, acquired by Montana Mines and optioned to American Uranium Ltd. Work conducted included the sampling of 22 hand trenches, stream sediment sampling and reconnaissance ground magnetics. Best results from this phase of work included the trenches summarized in table 2. Subsequently the property was allowed to lapse in 1970.

<i>Trench No.</i>	<i>Width (m)</i>	<i>Ag (g/tonne)</i>	<i>Au (g/tonne)</i>
<i>Tr M6</i>	4.6	25.4	1.2
<i>Tr 12</i>	3.7	311.9	8.6
<i>Tr 15</i>	12.2	36.0	1.3
<i>Tr 16</i>	6.1	17.8	1.7

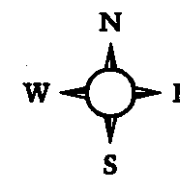
Table 2: Hand Trenching Results from work conducted in 1968 by American Uranium Ltd. (Taken from Sanguinetti, 1969)

In 1981 J.R. Woodcock acquired the Daisy claims which were staked to cover the general area of alteration. In 1982 the claims were optioned to Inland Recovery Group Ltd.. In 1983 a program of geologic mapping, geochemistry and VLF-EM was carried out. Several zones of coincident elevated gold soil geochemistry and VLF conductors were identified from this work and were subsequently tested by diamond drilling in 1986. Eight holes were drilled totaling 688 meters from 3 drill pads. The drilling intersected several zones of high Au-Ag and Cu-Au-Ag mineralization. The intervals sampled for assay are listed in table 3. Locations of the drill holes are illustrated in figures 3,4.

<i>Hole No.</i>	<i>From (m)</i>	<i>To (m)</i>	<i>Length (m)</i>	<i>Cu (%)</i>	<i>Au (g/t)</i>	<i>Ag (g/t)</i>
<i>86-1</i>	14.44	14.87	0.43	0.92	1.7	59.0
<i>86-2</i>	115.98	18.09	2.11	0.16	0.5	21.9
<i>86-3</i>	43.69	53.98	10.29	0.07	2.7	35.3
<i>86-4</i>	30.20	30.74	0.54	0.04	2.2	67.9
<i>86-5</i>	57.30	62.74	5.44	0.04	1.6	19.9
<i>86-6</i>	69.01	71.78	2.58	3.78	2.0	152.5
<i>86-7</i>	11.16	12.37	1.21	3.35	1.4	53.8
<i>86-7</i>	104.33	110.29	5.96	1.34	1.1	42.9
<i>86-8</i>	13.30	15.50	2.20	1.38	1.4	120.0

Table 3: Diamond Drilling Results from work conducted in 1986 by Inland Recovery Group Ltd. (Taken from Woodcock, 1987)

LCP
Check-Mate
Approximate
position



Camp Creek
Camp and
Core Storage

86-6

86-7,8

86-3,4

86-5

86-1,2

La Jaune Creek

0 400 m

Kohima Pacific Gold Corp.

Figure 3: Property Geology

Legend

 Intense hydrothermal
alteration

 Quartz-Feldspar dykes

 Diamond Drill holes
from 1986 work

The claims were allowed to lapse in 1993 and the Check-mate claim was staked by Clive Aspinall of Atlin, B.C. shortly after. Kohima Pacific Gold Corp. acquired the right to obtain a 100% interest in this claim in 1998 and in November of 1997 staked the Stuart 1, Stuart 2 and Stuart 3 claims which surround the Check-mate claim. In July and August of 1998 84 samples were taken for mineralogic study, using a portable infrared spectrometer (PIMA). Eleven samples were assayed of diamond drill core, in order to in fill gaps in previous sampling. Two chip-samples of outcrop, one from a zone of massive enargite-pyrite, were also analyzed.

Geology

Regional Geology

Approximately eight kilometers to the southwest the Coast Range Plutonic Complex Batholith occurs in contact with Lower Triassic clastic sedimentary rocks and volcanics, Upper Triassic intermediate volcanic rocks of the Stuhini Group and Lower to Middle Jurassic sedimentary rocks of the Takwahoni Formation (Souther, 1971). The youngest rocks in the area are the largely flat-lying Sloko group Tertiary rhyolite volcanics.

Property Geology

The project covers an area of hydrothermal alteration developed in andesite tuffs of the Stuhini Group. Altered quartz-feldspar dykes intrude these rocks as do fine-grained mafic dykes. A specimen was selected by Dr. Panteleyev during a visit to the property in 1990 for K-Ar age dating. According to Dr. Panteleyev, a date of 80 Ma was obtained for altered Stuhini volcanics (pers. com. Panteleyev, 1998). This date suggests that alteration and mineralization is not associated with flat-lying Sloko rhyolites as has been previously assumed.

Outcrop is sparse and largely restricted to creek walls and peaks. No mapping was carried out as part of the present work. From an examination of the core it was noted that altered rock included Stuhini volcanic tuffs. Previous work described quartz-feldspar dykes as the only significantly altered units.

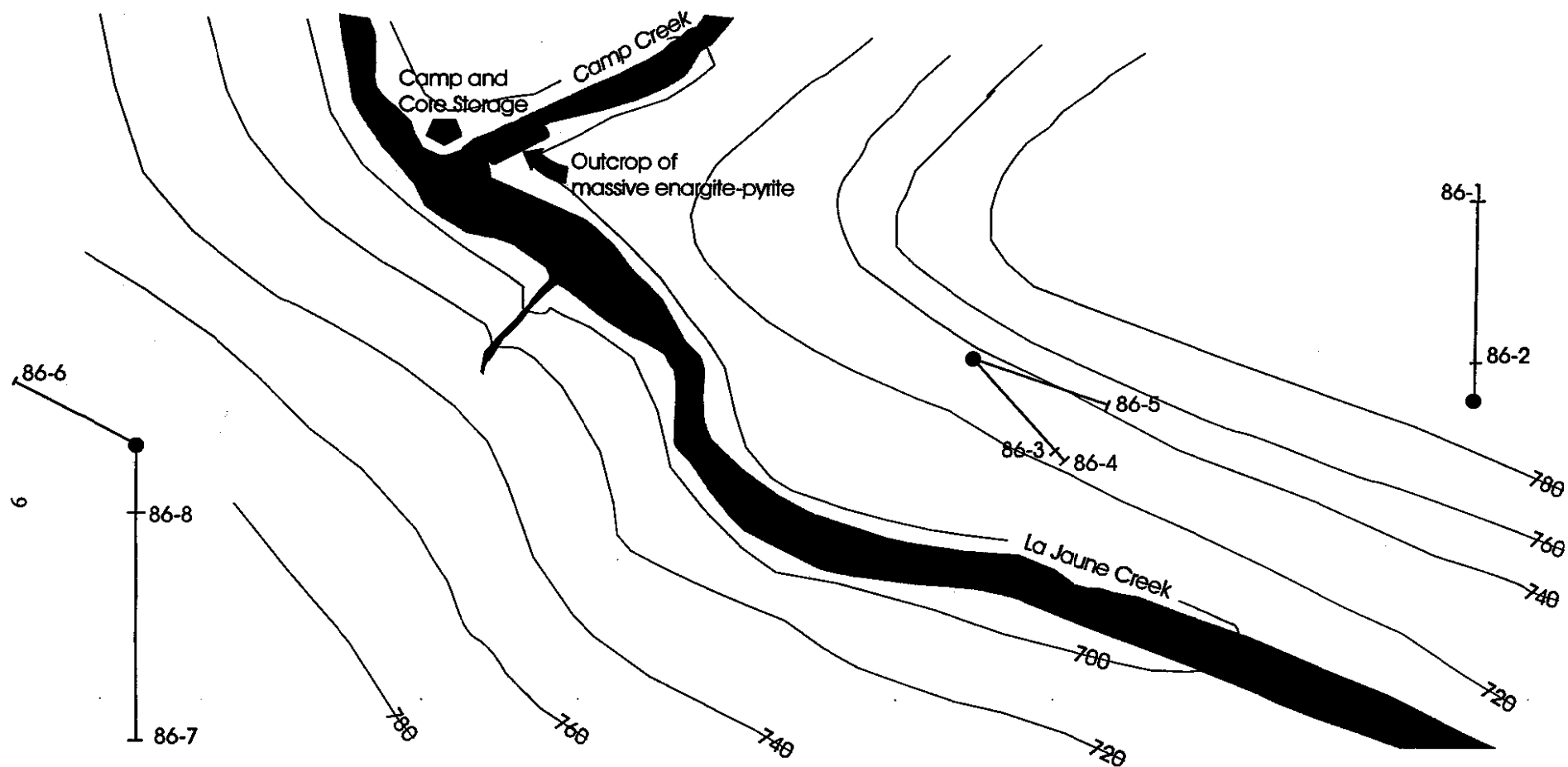
Alteration and Mineralization

Intense phyllosilicate-sulphate-pyrite-quartz alteration occurs over a roughly 2 x 2 kilometer area. Outcrops largely occur in canyons and creek walls. The altered rock forms spectacular white-yellow in colour bluffs on the walls of La Jaune and Camp Creeks, in sharp contrast to the subdued colours of the Coast rainforest. The alteration zones are aligned in a roughly northeast-southwest direction (Figure 3). The most significant zone of alteration is exposed along the walls of Camp Creek. Camp Creek itself is interpreted to reflect a major structure that may have controlled the ascent of hydrothermal fluids. To the south of this major zone other areas of outcropping hydrothermally altered rock occur (Figure 3). These zones were the focus of the 1986 drilling campaign.

To the authors knowledge no significant work has been carried out over the main Camp Creek alteration zone. Minor prospecting along the Creek, in this program of work, resulted in the discovery of outcropping massive enargite-pyrite mineralization associated with a highly clay altered and pyritized volcanic wall rock. The width of the zone is unknown as the sulphides are covered by gravel in the stream, however a width of 0.5 meters is exposed. The structure strikes approximately N 60° E, parallel to Camp Creek (Figure 4).

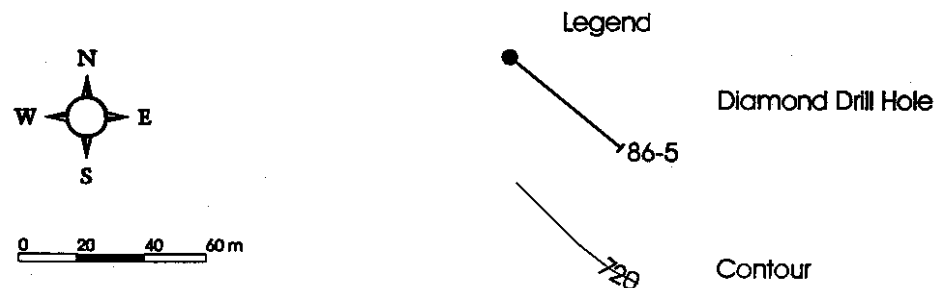
Alteration Mineralogy

The PIMA was used to determine alteration mineralogy. Samples were collected from three diamond drill holes, 86-1, 86-3 and 86-6. These holes were selected because they are spatially farthest apart from one another, and therefore represent the greatest area. Specimens were collected to represent the alteration mineralogy observed in the core, at regular intervals down the hole.



Kohima Pacific Gold Corp.

Figure 4: Location of Drill holes and Discovery Enargite-Pyrite Zone



Methodology

The objective of the analysis was to determine the style of alteration (with particular emphasis on clays and sulfates). The PIMA short-wave infrared spectrometer was chosen as a fast and efficient method of determining the major alteration minerals present. The short-wave infrared (SWIR) technique is extremely sensitive to alteration minerals such as clays, carbonates and selected sulfates, particularly alunite and jarosite. SWIR analysis is also sensitive to elemental substitution and changes in order or crystallinity in minerals.

Short-wave infrared spectroscopy detects the vibrational energy within molecular bonds that have bending and stretching modes within the 1300 to 2500nm region of the electromagnetic spectrum. The observed absorption features are actually first and second overtones and combination tones of fundamental modes which occur in the mid-infrared region. SWIR is particularly sensitive to certain molecules, including, OH, H₂O, NH₄, CO₃, and Al-OH. The positions of the features in the spectrum and their characteristic shapes are a function of the molecules present in the mineral. SWIR spectroscopy therefore, yields some crystallinity information, but is not detecting primary changes in the lattice structure as does X-ray diffraction. Variations in chemical composition may be detected as the positions of features shift consistently with elemental substitution.

The following figure demonstrates the various aspects of an absorption feature, including wavelength position, depth and width (full height, half width maximum).

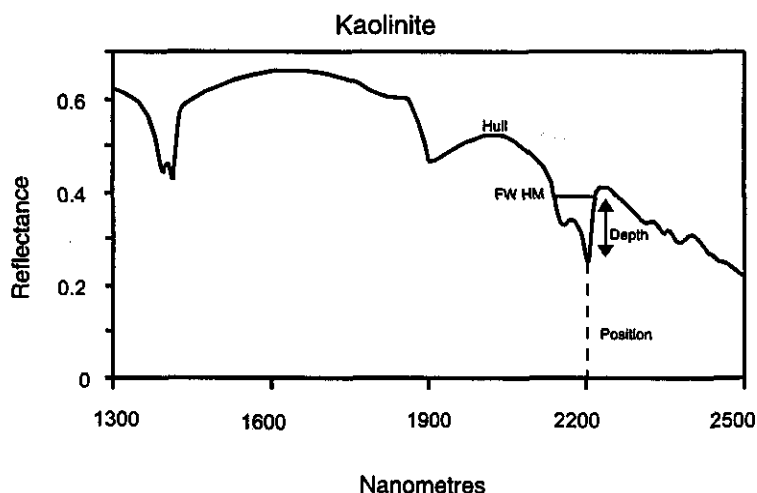


Figure 5: Example of PIMA Spectra

The PIMA-II is a commercial field instrument built by Integrated Spectronics Pty. Ltd. in Australia. The instrument has an internal light source, allowing collection of laboratory quality data in the field. In addition, internal calibration allows for comparison of data from one year to the next. The instrument is capable of measuring a variety of sample types, including rocks, chips, powders and liquids.

Results

Tables 4,5 and 6 list the minerals identified with the PIMA for samples from holes 86-3, 86-1 and 86-6 respectively.

Discussion

The drill holes intersected Stuhini volcanoclastics that are pervasively altered. Generally primary textures are obliterated by intense white-grey friable clay-pyrite alteration, often associated with quartz veining. Quartz-feldspar dykes crosscut the volcanics and are also altered. The primary textures are recognizable in the dykes, however. Late stage, prominent green mafic dykes also occur, crosscutting the altered rock. These mafic dykes are chloritized and contain pyrite.

The ubiquitous presence of pyrite in the samples affected the spectra slightly, by adding "noise" to the output. However some very clear distinctions and conclusions can be drawn from the work. The bleached, high intensity clay alteration that is noticeably associated with veining, abundant sulphides and mineralization is characterized by pyrophyllite and generally lesser dickite. Hole 86-6 passed out of this alteration and into more neutral stable clay assemblages, from illite-pyrophyllite to illite and finally chlorite-illite down the hole. This type of gradation in clay mineralogy is classic in high-sulphidation systems, where acid fluid have been progressively neutralized by wall rock to the structure along which they have ascended.

Dickite appears to increase in zones of higher gold grades, and occurs in quartz-sulphide veins. An association between elevated gold grades and the presence of dickite has been recognized in other high-sulphidation deposits (Sillitoe, 1995; Thompson, A. J. B., pers. comm.). It is interesting to note that the pyrophyllite-dickite alteration occurring from 47 to 75 meters depth in hole 86-6, and surrounding a massive enargite-pyrite vein, has never been split for geochemical analysis.

Illite±smectite alteration is associated with quartz-feldspar dykes that cross-cut Stuhini volcanics. Primary textures are largely preserved in these dykes, and illite occurs in the groundmass associated with pyrite and minor chalcopyrite.

Sample #	Depth (m)	Mineralogy		Notes
		Major	Minor	
3-1	17.3	kaolinite		
3-2	20.5	pyrophyllite	diaspore	
3-3	23.2	pyrophyllite		
3-4	26.0	pyrophyllite		
3-5	28.6	pyrophyllite		
3-6	31.6	pyrophyllite		
3-7	34.5	pyrophyllite		
3-8	38.7	pyrophyllite		
3-9	39.6	pyrophyllite		
3-10	43.0	illite	smectite?	Quartz-Feldspar dyke
3-11	46.2	pyrophyllite	dickite	
3-12	49.3	dickite	pyrophyllite	
3-13	53.8	dickite	pyrophyllite	
3-14	56.5	pyrophyllite	dickite	
3-15	59.0	dickite	pyrophyllite	
3-16	61.4	illite	smectite?	Quartz-Feldspar dyke
3-17	65.1	pyrophyllite		
3-18	67.5	illite	smectite?	Quartz-Feldspar dyke
3-19	70.4	pyrophyllite		

Table 4:

PIMA Results for Hole 86-3

Sample #	Depth (m)	Mineralogy	
		Major	Minor
1-1	8.0	illite	smectite?
1-2	10.1	illite	smectite?
1-3	13.5	illite	
1-4	16.1	illite	smectite?
1-5	19.0	illite	smectite
1-6	21.9	illite	smectite
1-7	24.6	illite	smectite?
1-8	26.5	illite	smectite?
1-9	29.3	illite	smectite?
1-10	33.8	illite	smectite?
1-11	38.4	illite	smectite?
1-12	43.5	illite	smectite?
1-13	46.8	illite	smectite?
1-14	49.9	illite	smectite?
1-15	52.7	pyrophyllite	
1-16	53.4	pyrophyllite	
1-17	57.0	pyrophyllite-dickite	
1-18	58.7	pyrophyllite	
1-19	62.4	pyrophyllite	
1-20	65.3	pyrophyllite	
1-21	66.0	pyrophyllite	
1-22	71.2	pyrophyllite	dickite
1-23	74.1	illite	smectite?
1-24	77.6	illite	smectite?
1-25	80.6	illite	smectite?
1-26	85.7	illite	smectite?
1-27	88.7	illite	smectite?
1-28	91.7	illite	smectite?
1-29	96.8	illite	smectite?
1-30	103.2	pyrophyllite	
1-31	108.8	pyrophyllite	
1-32	110.2	pyrophyllite	
1-33	107.4	illite	smectite?
1-34	110.0	illite	smectite?

Table 5:

PIMA Results from Hole 86-1

Sample #	Depth (m)	Mineralogy	
		Major	Minor
6-1	45.0	illite	smectite
6-2	46.5	illite	smectite
6-3	47.8	pyrophyllite	dickite
6-4	49.8	pyrophyllite	
6-5	51.3	pyrophyllite	
6-6	54.0	pyrophyllite	dickite
6-7	55.5	pyrophyllite	dickite
6-8	57.0	pyrophyllite	dickite
6-9	59.6	pyrophyllite	dickite
6-10	61.6	pyrophyllite	dickite
6-11	63.2	dickite-pyrophyllite	
6-12	65.2	pyrophyllite	
6-13	66.1	pyrophyllite	
6-14	66.9	pyrophyllite	dickite
6-15	67.3	illite	smectite
6-16	68.4	illite	smectite
6-17	70.4	pyrophyllite-dickite	
6-18	70.7	pyrophyllite	dickite
6-19	72.2	illite	pyrophyllite
6-20	73.4	illite	pyrophyllite
6-21	76.2	illite	
6-22	78.5	illite	
6-23	80.2	illite	
6-24	81.6	illite	
6-25	82.7	chlorite	illite
6-26	85.7	chlorite	illite

Table 6: PIMA Results of Hole 86-6

Samples taken from adjacent to the outcropping massive enargite-pyrite zone (OC-1, OC-2, OC-3; see Appendix A) contain pyrophyllite±diaspore. Dickite was not observed in these samples. The pyrophyllite-diaspore assemblage and enargite mineralization in Camp Creek probably represents higher temperatures and greater proximity to the central part of the system from the area of past drilling.

Sampling Results

Samples were taken for analysis from several outcrops along Camp Creek as well as from diamond drill core from the 1986 program of drilling.

Outcrop Sampling Results

An outcrop of massive enargite-pyrite was found, exposed along the southern bank of Camp Creek (Figure 3). The exposed portion of the structure is 0.5 meters wide. This zone was chip-sampled as was an adjacent zone of silicification and pyrophyllite alteration. The results of this sampling are shown in table 4.

Sample #	Width (m)	Au (g/t)	Cu (%)	Ag (g/t)
0862	0.5	0.96	6.88	179.0
0863	1.3	0.03	2.7	0.03

Table 7: Outcrop Chip-Sampling Results

Diamond Drill Core Splitting Results

Sampling carried out at the time of drilling was very selective. Holes 86-3 and 86-6 were recognized as poorly sampled holes. In the case of 86-3 a zone of intense clay alteration and silicification had been sampled returning values listed in Table 3, however significant gaps were left in the sampling. These gaps were sampled to provide a continuous database for the hole. Hole 86-6 was very sparsely sampled. A considerable zone of alteration and veining was left unsampled. Only a short section of massive enargite-pyrite was sampled in this hole. Unfortunately owing to time constraints, hole 86-6 could not be sampled as part of this program.

The sampling results, when combined with past sampling data for hole provide an interesting database when considering the alteration mineralogic data gathered.

Sample #	From (m)	To (m)	Width (m)	Au (g/t)	Ag (g/t)
0851	19.0	21.0	2.0	0.140	10.8
0852	21.0	23.0	2.0	0.135	5.4
0853	27.0	27.7	0.7	0.140	6.2
0854	28.9	30.2	0.3	0.210	10.8
0855	30.7	32.4	0.7	0.080	1.8
0856	33.8	35.0	1.2	0.220	6.2
0857	38.4	38.6	0.2	0.370	16.8
0858	39.4	39.7	0.3	0.160	1.4
0859	39.9	42.0	2.1	0.210	6.2
0860	42.0	43.8	1.8	0.285	7.8
0861	44.3	44.9	0.6	0.250	4.0

Table 8: Sampling from hole 86-3

By combining these data with the assay work done previously a more continuous section of sampling is provided. Table 9 summarizes the results.

From (m)	To (m)	Width (m)	Au (g/t)	Ag (g/t)	Cu %
19.0	56.5	37.50	0.92	21.1	0.09
23.0	27.14	4.14	0.93	73.5	0.50
38.67	56.5	17.83	1.52	18.9	0.05
43.5	52.5	9.00	2.58	30.4	0.06

Table 9: Complete Intervals, Hole 86-3

Conclusions and Recommendations

The identification of acid-stable clays with the PIMA confirmed that the Thorn prospect is a high-sulphidation epithermal system. Pyrophyllite and dickite are associated with quartz-gold veining and massive enargite zones. This assemblage is indicative of deeper levels of exposure within the hydrothermal system as pyrophyllite is observed to occur at temperatures >200°C in geothermal systems (Reyes, 1990). Economic mineralization, in the form of massive enargite and quartz-gold veins, occur at this level of exposure associated with pyrophyllite-bearing wall-rock alteration in many high-sulphidation systems. High-grade massive-enargite veins, occurring at the Thorn prospect, are typical of economic mineralization exploited as ore in the world-class El Indio and Lepanto deposits. Late-stage quartz veining and high-gold grades also occur at the Thorn project. Such veining is important gold-ore at the El Indio deposit. High-sulphidation zones of massive-enargite and gold-quartz veining are strongly structurally controlled. Ore-forming magmatic fluids are focused away from a source intrusive body and into zones of major permeability that are characterized by major faults and structural features and which control economic mineralization.

Camp Creek is interpreted to be the geographic reflection of such a structure. Pyrophyllite-bearing acid-sulphate alteration appears to be controlled in this direction and a massive enargite vein has been located, striking parallel to the creek. This area of the property has never been thoroughly explored. No extensive geochemical, geophysical work has been extended across the creek, and no drilling has been directed along or across the creek. The drilling carried out in 1986 was tested altered areas to the south of Camp Creek. The PIMA study on core from this program indicated that several zones of pyrophyllite-dickite alteration occur and are associated with quartz-gold veining. These zones probably represent narrow structures that parallel Camp Creek, which is the main zone of alteration.

Work on this zone should be conducted in two phases. An extensive first phase of grid-construction, rock-chip and soil sampling should focus on Camp Creek. Rock-chip samples should be taken across the grid, with representative specimens for determining alteration mineralogy for each site. Soil samples should be taken on a 100 x 50 meter grid spacing. The massive enargite-pyrite veins should have a significant EM signature. VLF-EM work reported by past workers on the property was not conclusive. However a ground hoop-EM survey on lines that cross Camp Creek should be able to penetrate overburden and differentiate between massive enargite zones and the high pyrite content associated with argillic alteration. Targets generated from this work, including the known outcropping massive enargite vein should be targeted with deep diamond drill holes. Exciting and significant gold-copper grades have been intersected with past drilling to the south of this area with several short holes. Hole CB-3 contained 37.5 meters of around 1 g/t gold and included 9 meters of 2.58 g/t Au. Further drilling is warranted to test some of the deeper and lateral potential of the zone of quartz veining intersected in hole CB-3. Veins at El Indio proved elusive at the drill stage and many high grade structures were found subsequent to drill testing in underground exploration development work. Table 10 is a preliminary cost schedule for a proposed phase I work program.

Type of work	days	units	cost/day (unit)	Total
Grid Cutting				
2 cutters	15		400.00	6,000.00
1 geologist	5		400.00	2,000.00
Soil / Rock Sampling				
2 samplers	15		400.00	6,000.00
1 geologist	15		400.00	6,000.00
rock samples	500		30.00	15,000.00
soil samples	1000		30.00	30,000.00
PIMA time	10		700.00	7,000.00
EM Geophysics	10		600.00	6,000.00
Helicopter time	20 hours		800.00	16,000.00
Float Plane time	10 hours		300.00	3,000.00
Supplies				10,000.00
Total				\$107,000.00

Table 10:

Cost Proposal for Phase I Work

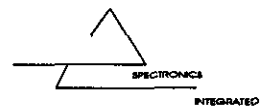
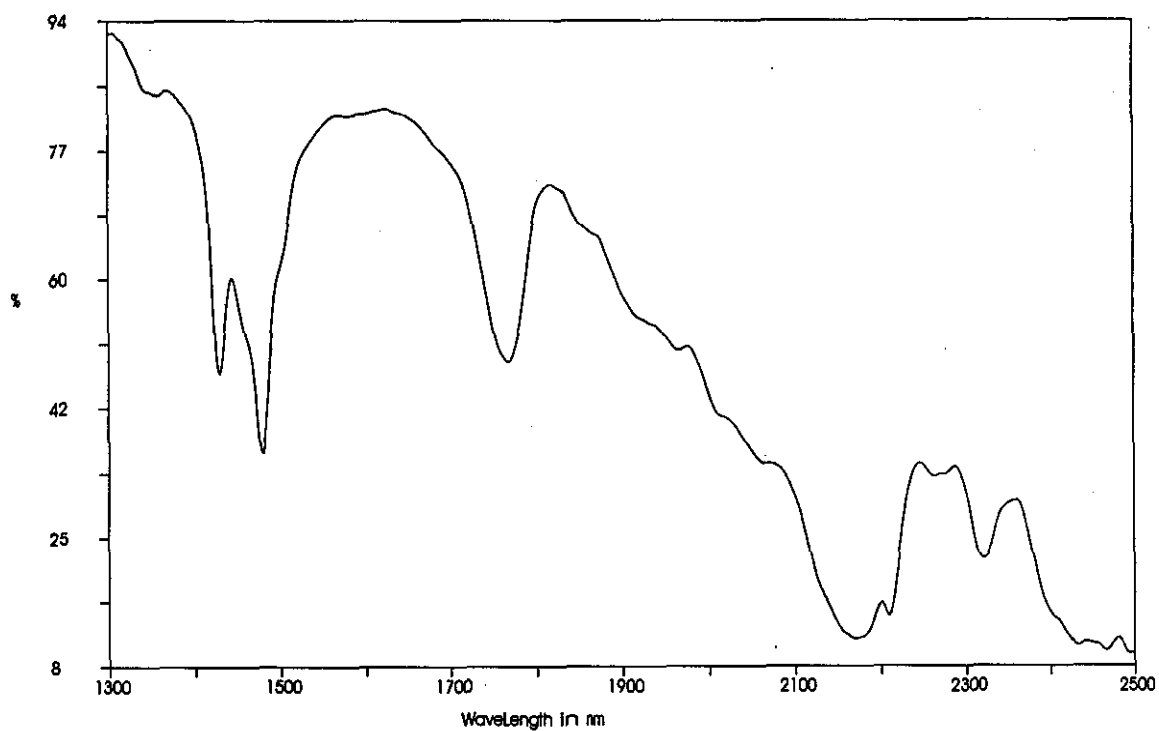
References

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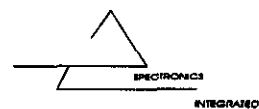
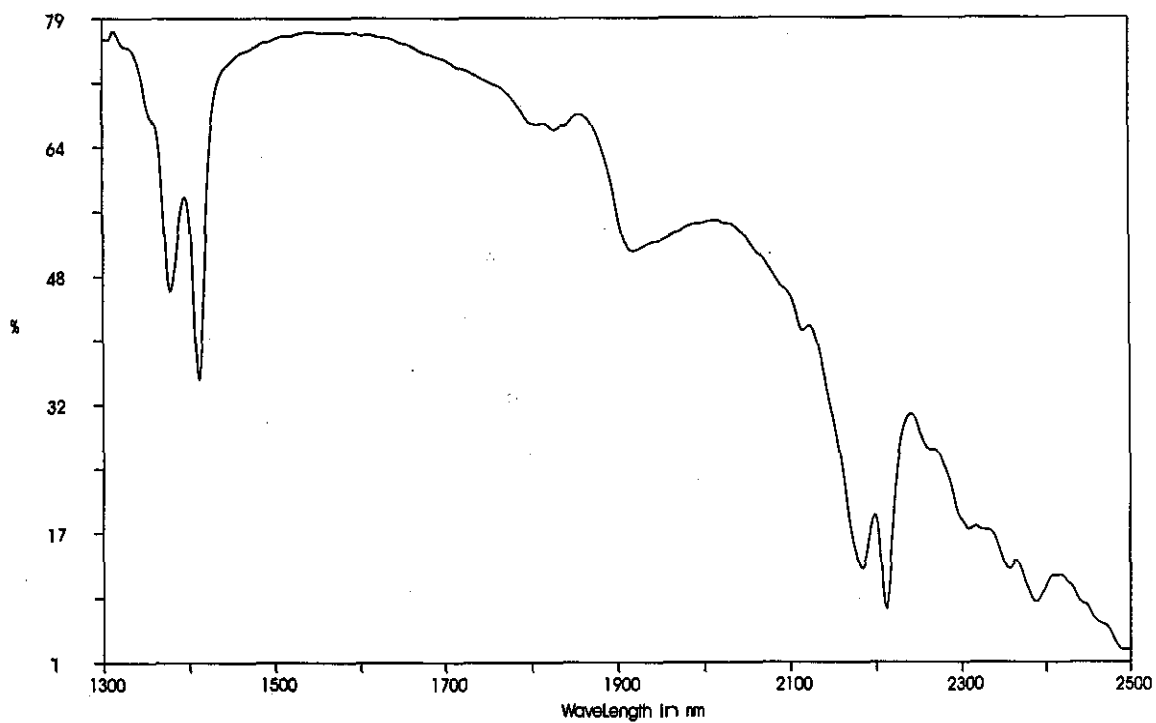
Appendix A:

PIMA Spectra

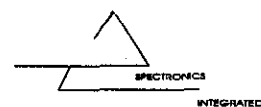
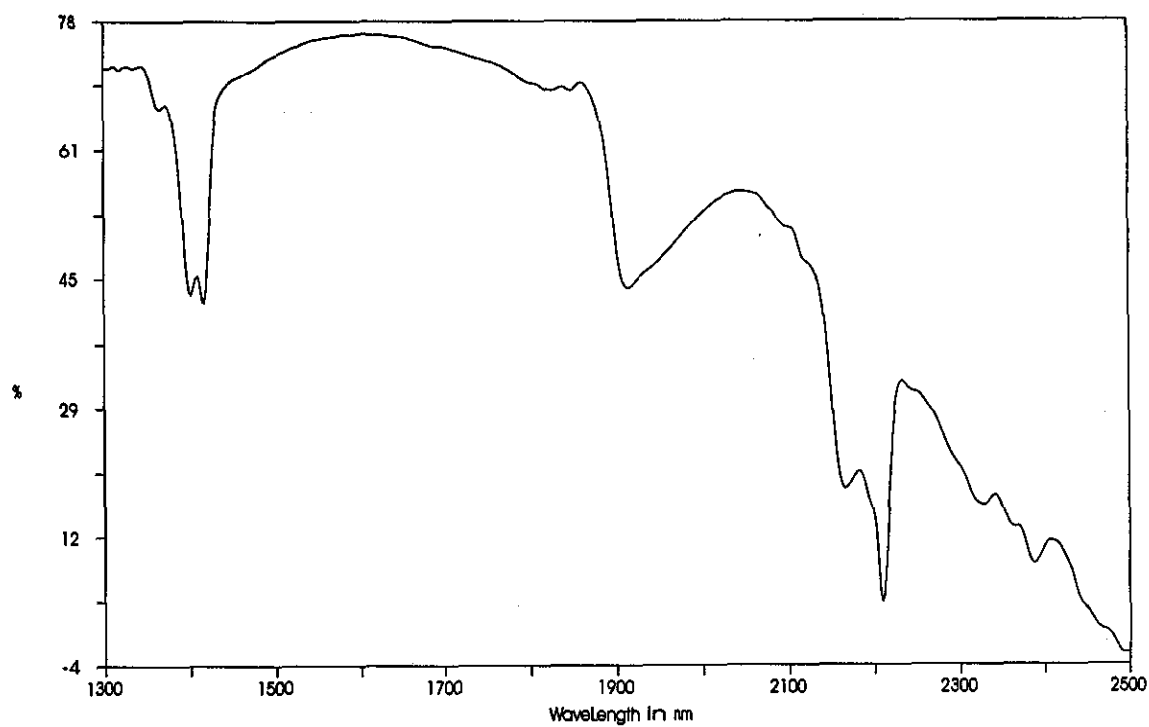
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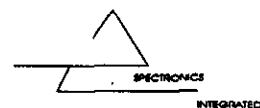
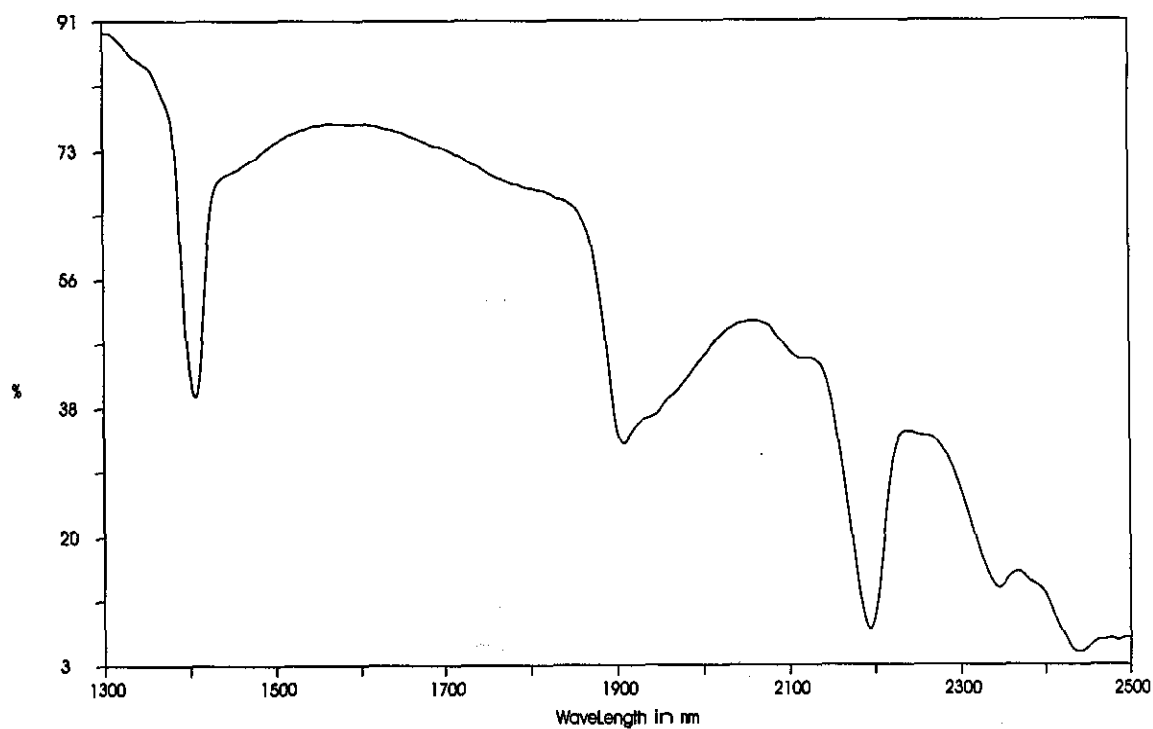
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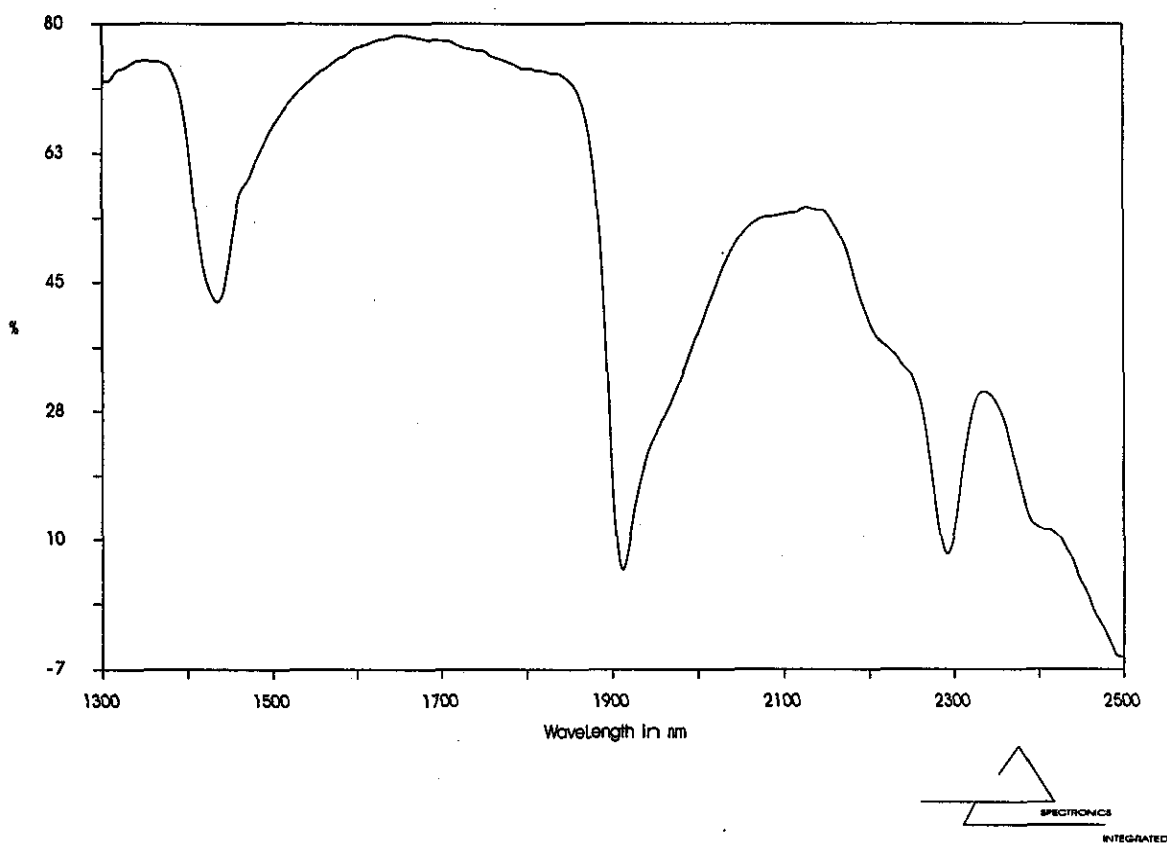
EXAMPLE OF KAOLINITE SPECTRA



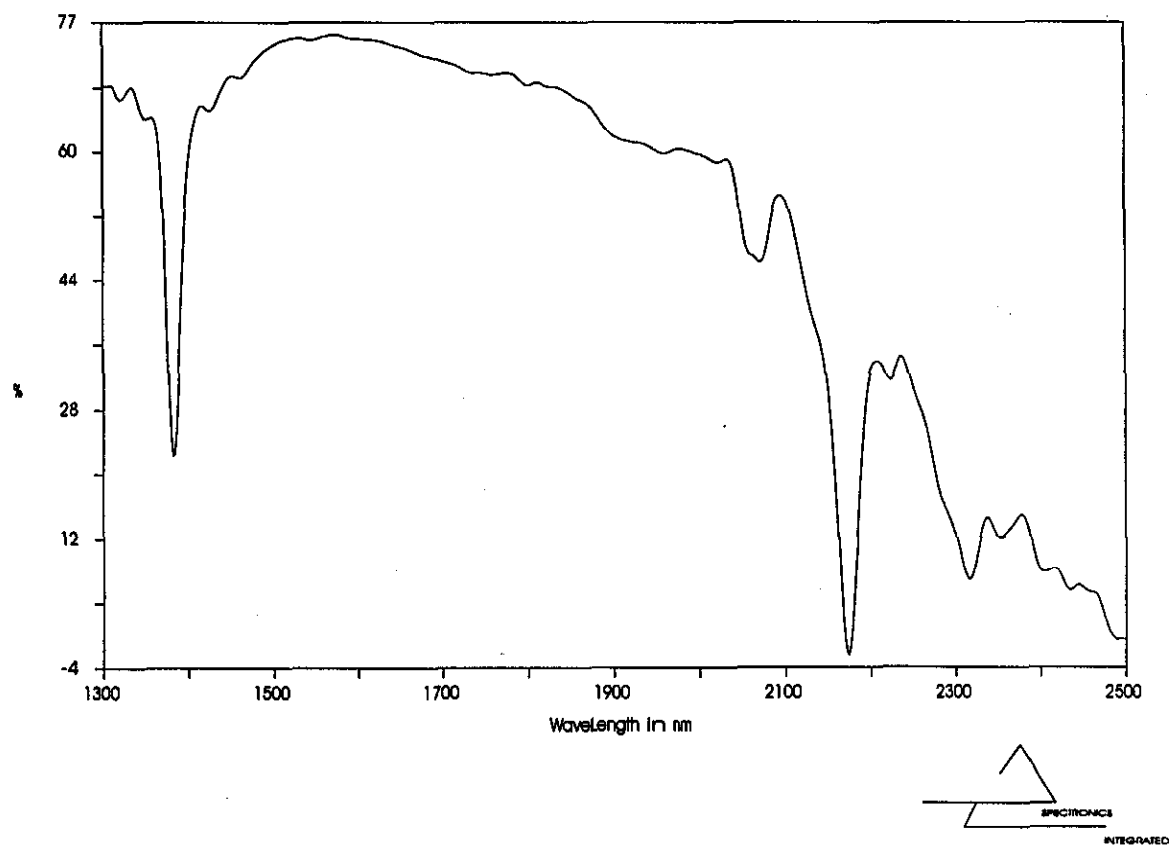
EXAMPLE OF ILLITE SPECTRA



EXAMPLE OF SMECTITE SPECTRA



EXAMPLE OF PYROPHYLLITE SPECTRA



Sample # Spectra for Hole 86-1 Specimens

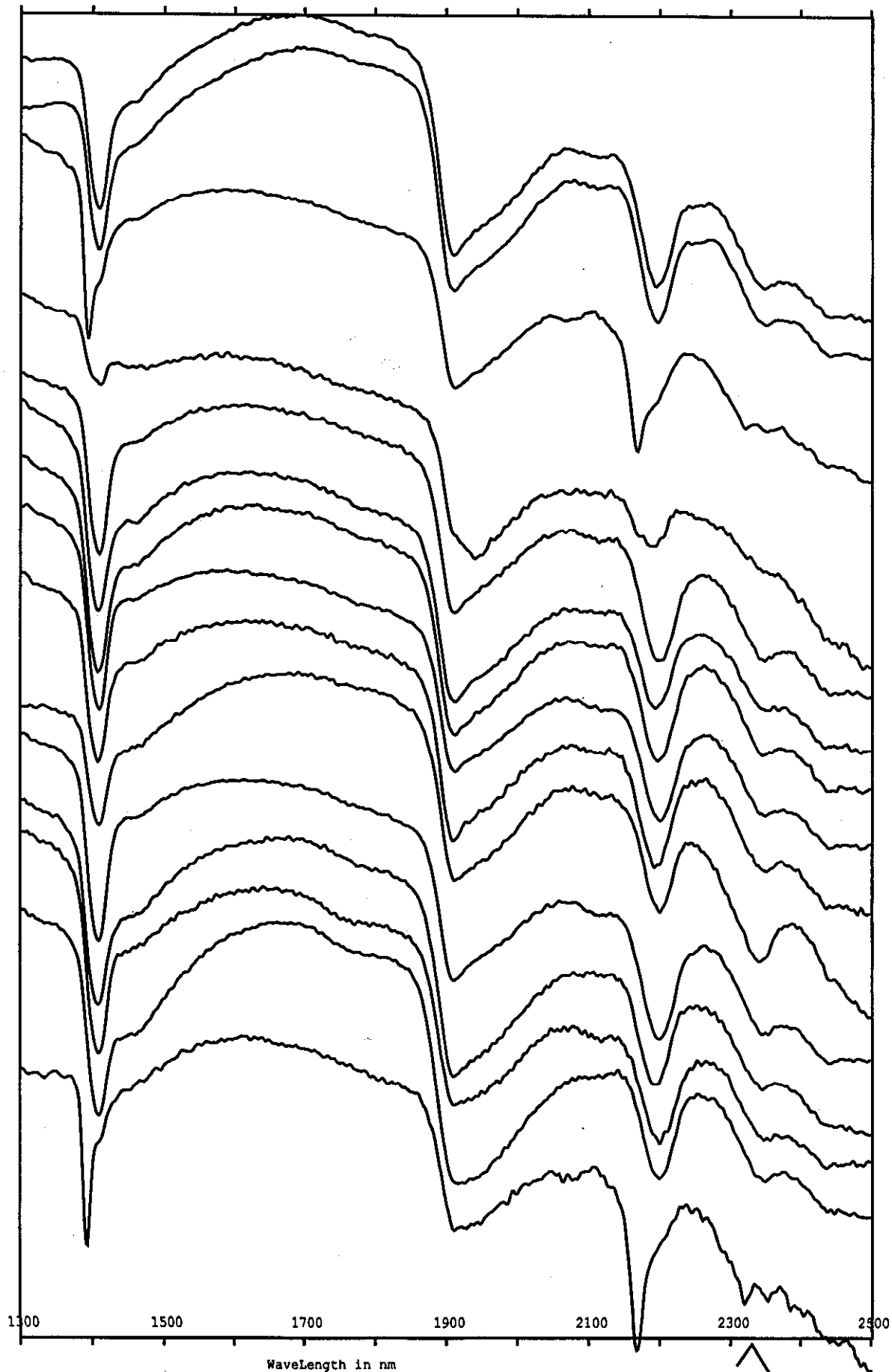
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1-3

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1-12
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1-14

1-15



SPECTRONICS
INTEGRATED

1-11

1-12

1-13

1-14

1-15

1-16

1-17

1-18

1-19

1-20

1-21

1-22

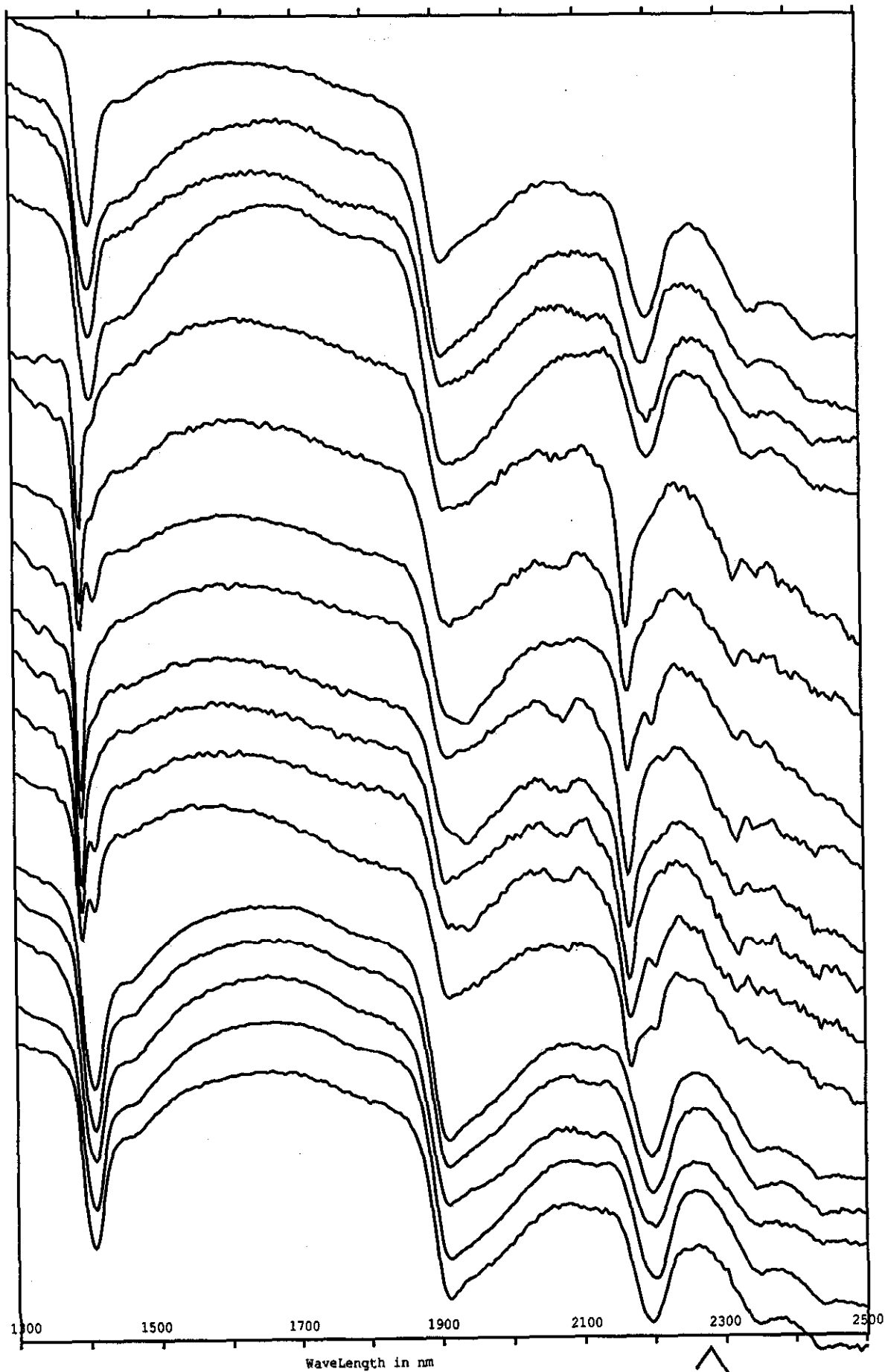
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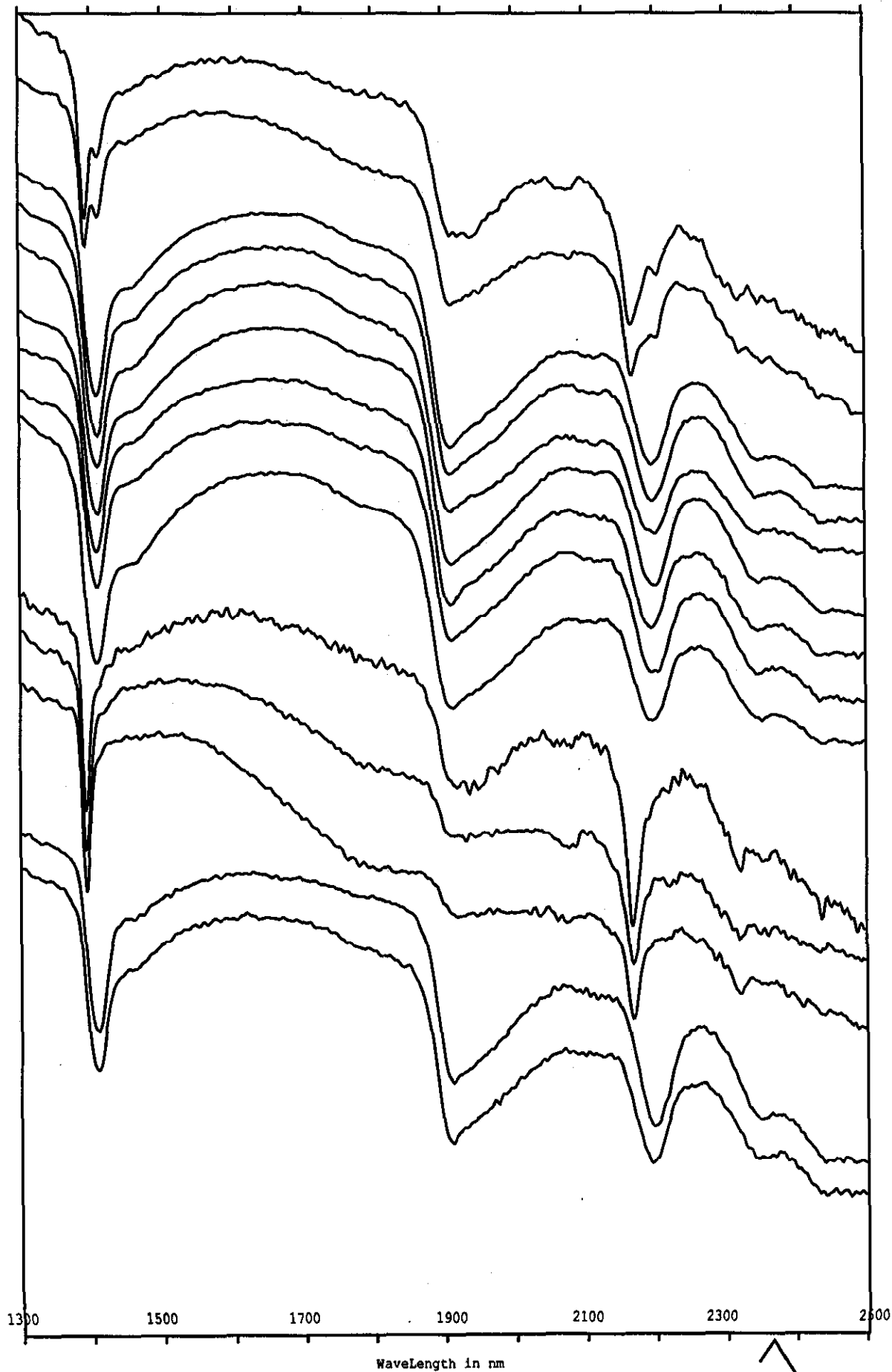
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1-36



Spectra for Hole 86-3

Sample #

3-1

3-2

3-3

3-4

3-5

3-6

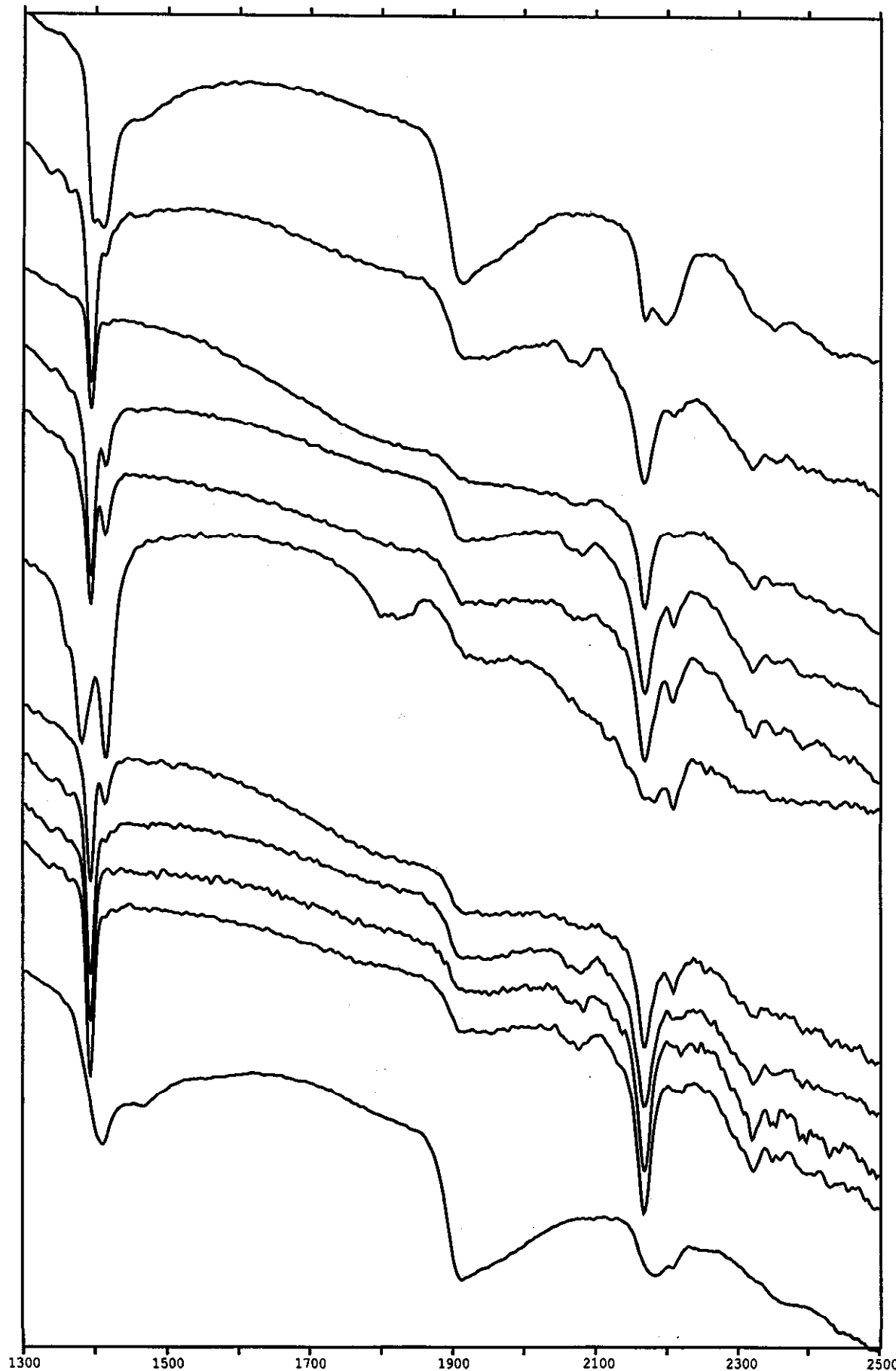
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3-8

3-9

3-10

3-11



WaveLength in nm

3-10

3-11

3-12

3-13

3-14

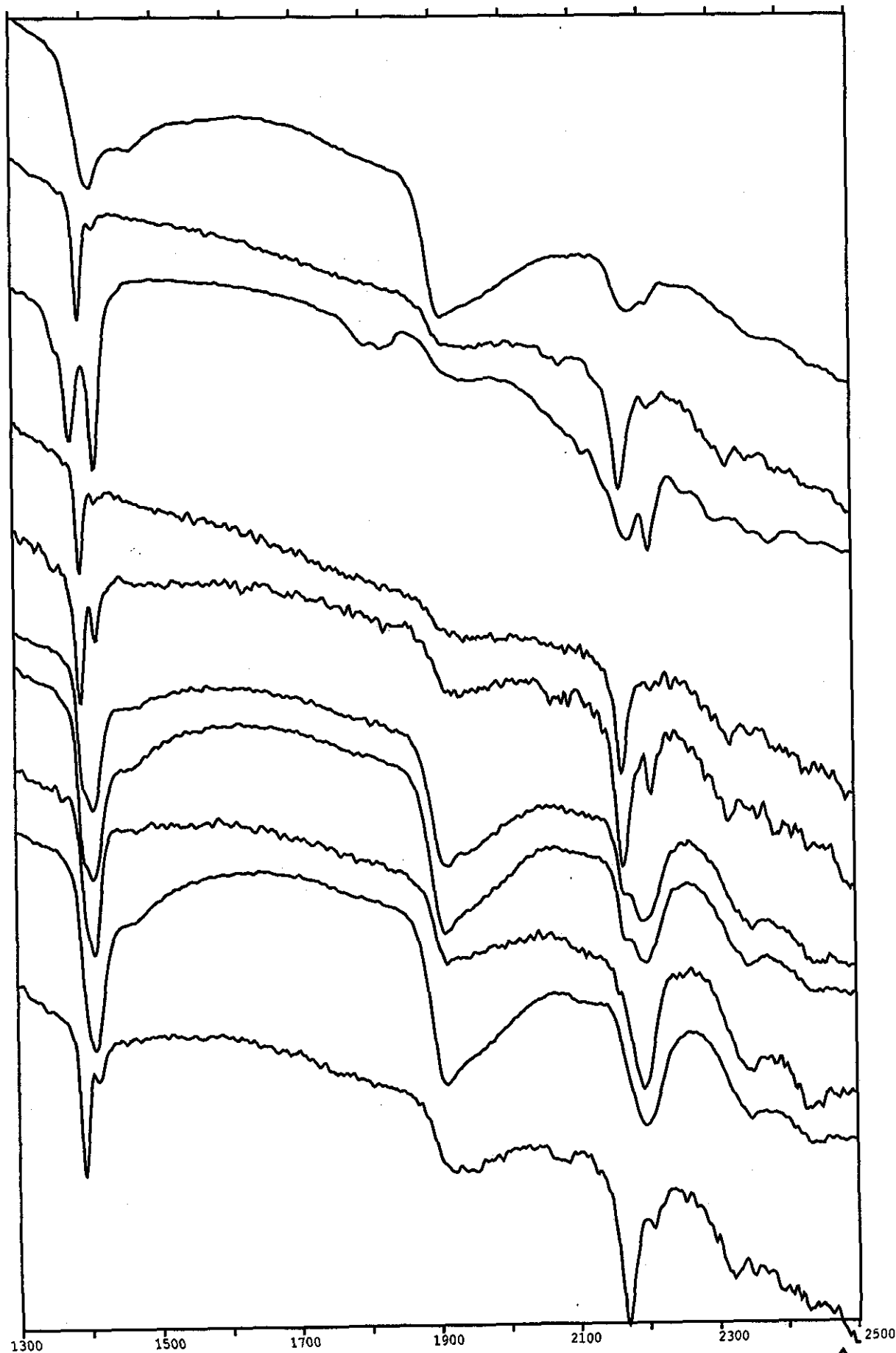
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3-16

3-17

3-18

3-19

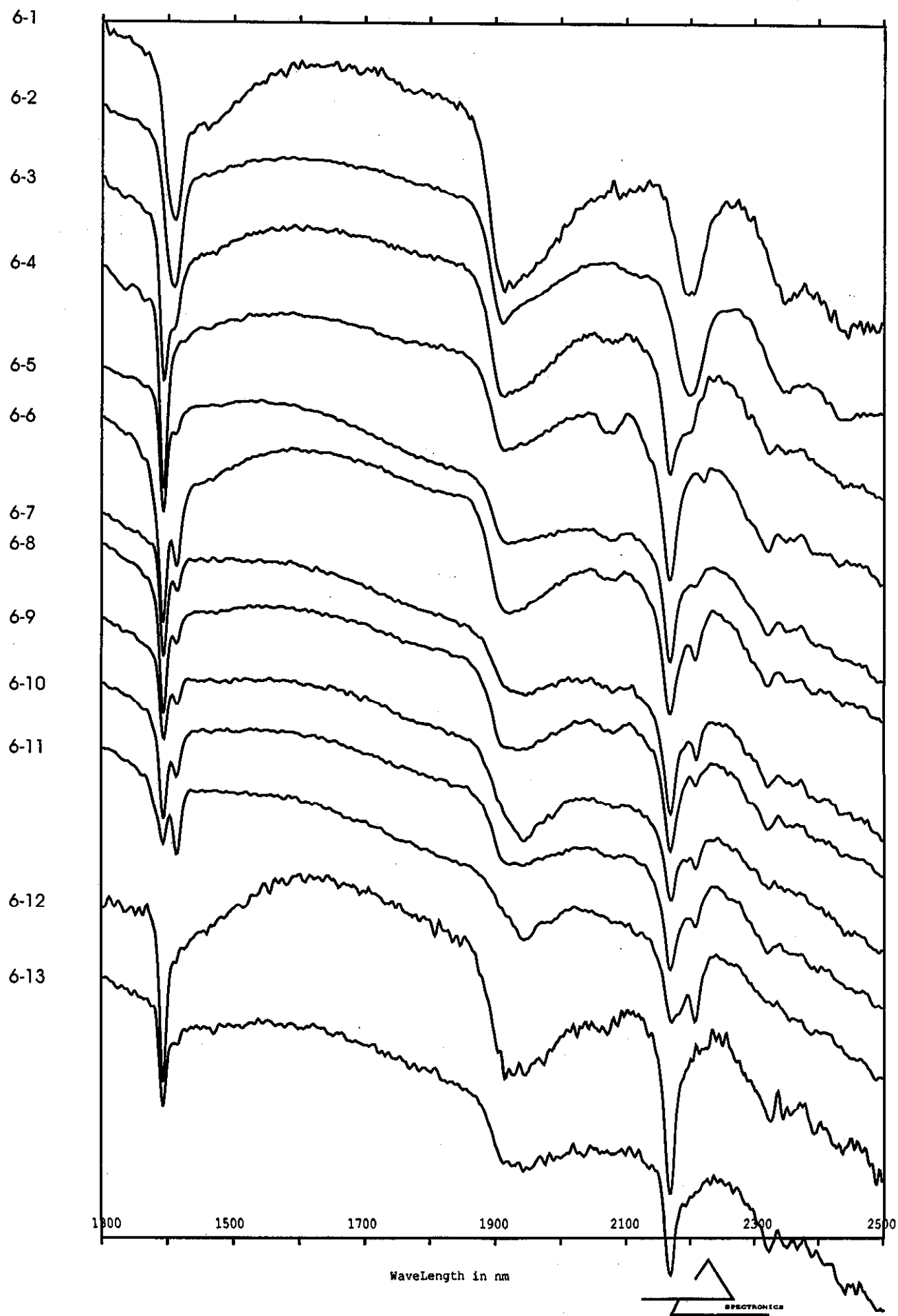


WaveLength in nm



Sample #

Spectra for Hole 86-6 Spectra



6-11

6-12

6-13

6-14

6-15

6-16

6-17

6-18

6-19

6-20

6-21

6-22

6-23

6-24

1300

1500

1700

1900

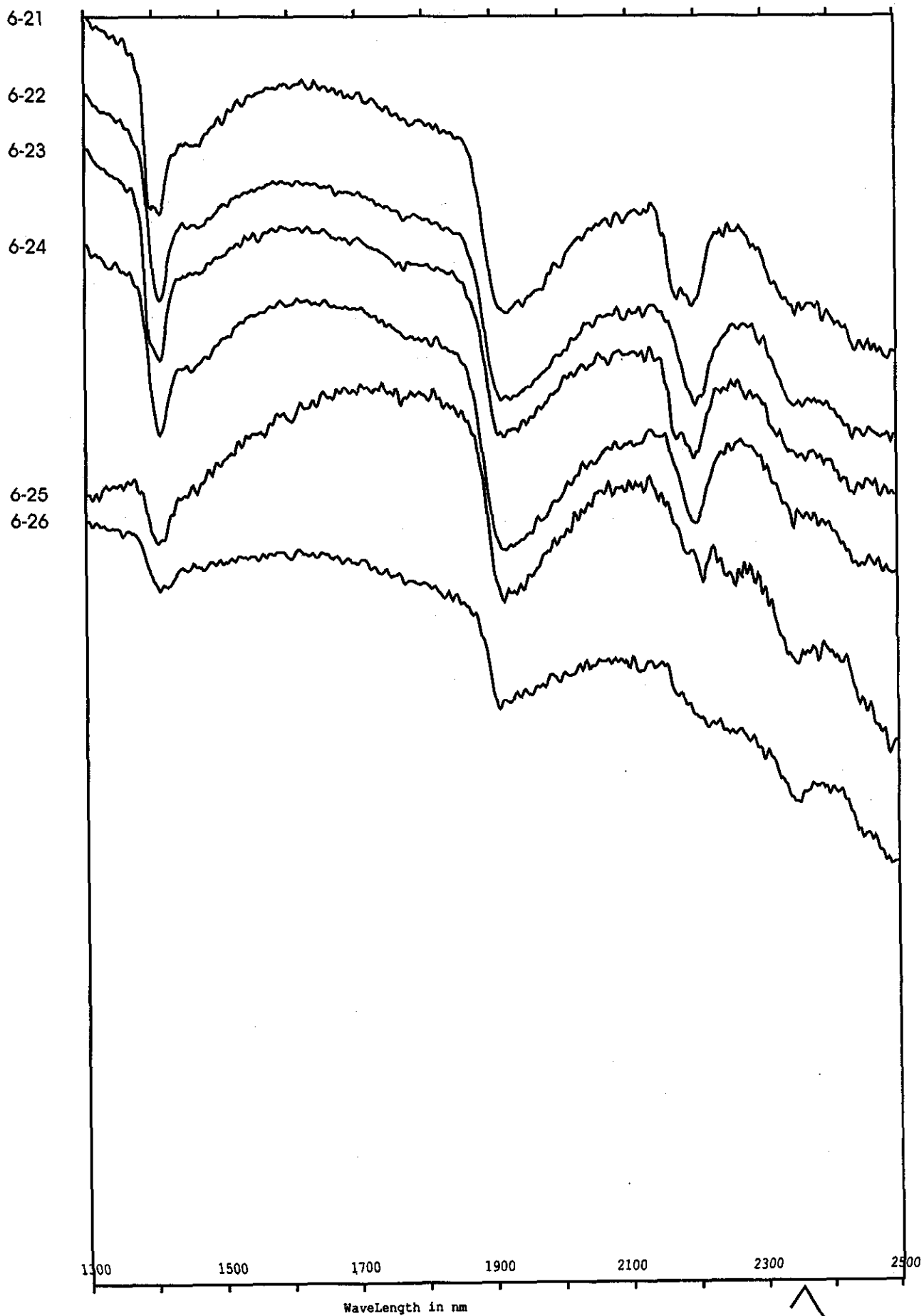
2100

2300

2500

WaveLength in nm





SPECTRA FROM OUTCROP SAMPLES

SAMPLE #

OC-1

OC-2

OC-3

1300 1500 1700 1900 2100 2300 2500

WaveLength in nm





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Analytical Chemists * Geochemists * Registered Assayers

212 Brooksbank Ave., North Vancouver
British Columbia, Canada V7J 2C1
PHONE: 604-984-0221 FAX: 604-984-0218

To: KORIMA PACIFIC GOLD CORPORATION

423 - 5735 HAMPTON PLACE
VANCOUVER, BC
V6T 2G8

Project: THOIN
Comments: ATTN:M.POLQUIN

Page Number : 1
Total Pages : 1
Certificate Date: 13-SEP-1998
Invoice No. : 19830392
P.O. Number :
Account : QLT

CERTIFICATE OF ANALYSIS

A9830392

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CERTIFICATION: 



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Analytical Chemists * Geochemists * Registered Assayers

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British Columbia, Canada V7J 2C1
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P.O. Number :
Account : QLT

CERTIFICATE OF ANALYSIS

A9830393

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CERTIFICATION Hank Rickles



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British Columbia, Canada V7J 2C1
PHONE: 604-984-0221 FAX: 604-984-0218

To: KOHIMA PACIFIC GOLD CORPORATION

423 - 5735 HAMPTON PLACE
VANCOUVER, BC
V6T 2G8

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P.O. Number :
Account :QLT

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A9830393

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M580855	258 295	1	< 0.01	4	10	60	2	< 1	25	< 0.01	< 10	< 10	2	< 10	98
M580856	258 295	1	0.01	5	30	240	14	< 1	21	< 0.01	< 10	< 10	3	< 10	514
M580857	258 295	1	< 0.01	6	80	900	36	< 1	47	< 0.01	< 10	< 10	1	< 10	742
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M580859	258 295	1	< 0.01	7	40	140	14	< 1	19	< 0.01	< 10	< 10	2	< 10	56
M580860	258 295	1	< 0.01	6	10	186	22	< 1	17	< 0.01	< 10	< 10	2	< 10	56
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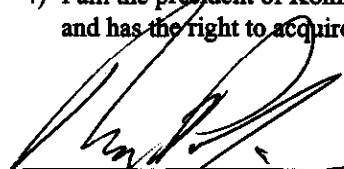
CERTIFICATION: Hartfield

Appendix C:

Certificate

I, Morgan J. Poliquin certify that:

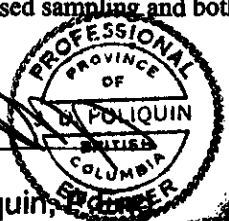
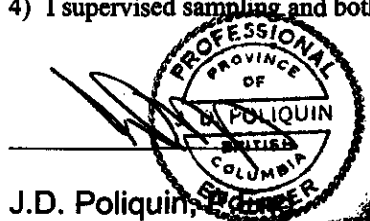
- 1) I received a B.A.Sc. degree in Geological Engineering from U.B.C. in 1994 and a M.Sc. degree in Geology from the University of Auckland in New Zealand in 1997.
- 2) I have worked in mineral exploration in Canada, Mexico, Eastern Europe, the South Pacific and the U.S.A. since graduating.
- 3) I am a member of the Society of Economic Geologists and the Canadian Institute of Mining, Metallurgy and Petroleum.
- 4) I am the president of Kohima Pacific Gold Corp., which owns the Stuart 1, Stuart 2 and Stuart 3 claims and has the right to acquire a 100% interest in the Check-mate claim.



M.J. Poliquin, M.Sc.

I, J.D. Poliquin certify that:

- 1) I received a Bachelors degree in Geological Engineering from the University of Saskatchewan in 1962, and have been practicing my profession since that time.
- 2) I am registered as a Professional Engineer in the Province of British Columbia.
- 3) I am a member of the Canadian Institute of Mining, Metallurgy and Petroleum and the Society of mining Engineers.
- 4) I supervised sampling and both field and analytical work described in this report.



J.D. Poliquin, P.Eng.

Appendix D:

Cost Statements

COST STATEMENTS

The work was carried out in two separate periods of work. Costs for each period are broken down separately

Work Period 1

Item	Days/Units	Cost/Unit	Total
Morgan J. Poliquin, M.Sc.	4	\$300.00	\$1,200.00
J.D. Poliquin, P.Eng.	2	\$600.00	\$1,200.00
G. Peatfield, Ph.D., P.Eng.	1	\$750.00	\$750.00
Pima Rental	2	\$300.00	\$600.00
Room and Board	7 man days	\$100.00	\$700.00
Helicopter			\$1,153.89
Fuel			\$247.17
Truck Rental	5	\$100.00	\$500.00
Supplies			\$284.31
Total			\$6,635.37

Work Period 2

Item	Days/Units	Cost/Unit	Total
Morgan J. Poliquin, M.Sc.: 4 field days, 4 PIMA days, 5 report days	13	\$300.00	\$3,900.00
J.D. Poliquin, P.Eng.: 4 field days, 0.5 days report	4.5	\$600.00	\$2,700.00
PIMA Rental	4	\$300.00	\$1,200.00
Room and Board	4 man days	\$100.00	\$400.00
Helicopter			\$1,609.17
Apex Air, Beaver			\$385.20
Assays			\$372.04
Truck Rental	5	\$100.00	\$500.00
Supplies			\$618.18
Photocopies			\$328.31
Total			\$12,012.90

Total Costs

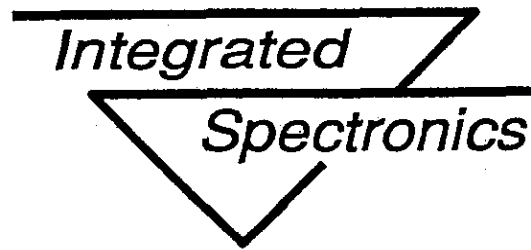
Work Period 1	\$ 6,635.37
Work Period 2	\$ 12,012.90
Total	\$ 18,648.27

Two assessment filings were made for this work period

Filing 1 (Event # 3123282)	\$ 4,050.00
Filing 2 was calculated by subtracting Filing 1 (\$4050.00) from the Total work.	\$ 14,598.27
PAC account withdrawals were made, totalling 30% of	\$ 4,379.48
Filing 2 (Event #) 3127941	\$ 18,977.75

APPENDIX E:

PIMA MANUAL



PIMA II

Operations Manual (6th Edition)

Incorporating PIMASPEC Ver. 3.4

©Integrated Spectronics Pty Ltd 1993

October 1994

Document Ref. No.
ISPL-P2OM-6

Integrated Spectronics Pty Ltd
22 Delhi Road, North Ryde, NSW 2113
PO Box 437, Baulkham Hills, NSW 2153
Australia

PLEASE NOTE

This PIMA II spectrometer has been shipped with Version 2.4 of the PIMASPEC operational software. This software also makes use of a new wavelength calibration target incorporated in the spectrometer.

For the correct operation of the spectrometer, three (3) calibration files must be present in the operating directory of your computer. These files are used for wavelength calibration, correction for light scattered from the sapphire sampling window and for normalisation of measured reflectance to that of a diffuse gold reflector.

These files are factory set and are included on your software discs and on the SRAM card in the HP200LX computer.

More detail can be found in Appendix A of this manual.

Throughout this manual, references are made to a trigger on the pistol grip and the use of this trigger to initiate a measurement. As of January 1996, this feature is not available and all measurements must be started from the keyboard.

Once a measurement sequence has started, several seconds are available to position the sample against the sapphire window.

Integrated Spectronics Pty Ltd

January 1996

PLEASE NOTE:

THE PIMA SHOULD NOT BE RUN OUT OF "Windows 95"

The PIMA operation file "PS34.EXE" CANNOT be run out of "Windows 95".

If you wish to run the PIMA from a computer that has "Windows 95" installed you must do so in the "MSDOS Mode".

This can be achieved in two ways:

1. Hit "F8" before the computer enters "Windows 95" when you first start it up.
This should bring up the "Microsoft Windows 95 Start up Menu".
Select "6. Command Prompt Only"
From here the PIMA can be run in the usual manner.

or

2. Start up "Windows 95" in the usual way.
Shutdown "Windows 95" selecting "Restart the computer in MS-DOS mode ?".
From here the PIMA can be run in the usual manner.

PIMA Operation Note
Feb 1997

Spectral Measurements using Petri dishes

Petri dishes and calibration files supplied by Integrated Spectronics are to be used in accordance with the following procedures.

When a Petri dish is being used, the PIMA operational software is initiated by selecting the batch file, AAPET**.BAT where ** is the serial number of the instrument.

This batch file loads calibration files that are used with Petri dishes ONLY.

If no Petri dish is to be used, then the operational software is initiated with the batch file, AA**.BAT.

NB: If you change from using a Petri to no Petri dish and vice versa, then you have to exit the PIMA operations program and start it again using the appropriate batch file. Failure to observe this requirement will result in spectral distortions.

Warranty

Integrated Spectronics Pty Ltd. (ISPL) warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from date of shipment. If any product proves to be defective during this warranty period, ISPL will repair the defective product without charge for parts or labour. ISPL does not warrant that the operation of the software, firmware or hardware shall be uninterrupted or error free.

In order to obtain warranty service on this product, the customer must notify ISPL before expiration of the warranty period. Customers must also contact ISPL to make suitable arrangements for the performance of the service.

The customer shall be responsible for packing the product for return to an ISPL service centre.

If the warranty service is required within the first three (3) months after the date of shipment, ISPL will pay airfreight charges associated with the return of the product to an ISPL service centre. Such shipment must be from a major center serviced by Federal Express, UPS or DHL and the customer must contact ISPL to arrange shipping details. Failure on behalf of the customer to contact ISPL for shipping instructions will result in the customer being responsible for shipping charges.

If the warranty service is required after the first three (3) months, then the customer shall ship the product to an ISPL service center with all shipping charges prepaid.

The customer shall be responsible under all circumstances for duties, taxes, insurance and any other charges associated with returning product to an ISPL service centre for warranty service.

This warranty shall not apply to any defect, failure or damage caused by improper use, improper or inadequate maintenance and care, unauthorised repair or attempt to modify the software, firmware or hardware of the product.

No other warranty is expressed or implied. ISPL specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

The remedies provided herein are the customer's sole and exclusive remedies. ISPL shall not be liable for any direct, indirect, special, incidental or consequential damages irrespective of whether ISPL has advance notice of the possibility of such damages.

Integrated Spectronics Pty Ltd
Feb. 1996

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1 Introduction to PIMA

PIMA II is a highly sophisticated optical instrument which has been designed specifically to meet the needs of geologists in obtaining quality spectra of minerals and materials in the field.

The instrument is enclosed in a small compact container with a top section containing the controlling computer. At the rear of the instrument is the "Back Panel". Here, various connections are made to power supplies, batteries, and computers. Towards the front of the instrument, there is located an optical port where the samples are placed for measurements. Infrared light passes through the port and onto the sample where it is then reflected back into the instrument.

The top section of the instrument locates the housing for the computer, which is a small portable Hewlett Packard PC (HP200LX) running under MS-DOS version 5.0. Lift the front cover to unclip the latch. The lid of the computer housing can then be opened to reveal the HP200 PC.

Located on the bottom of the instrument, a mounting plate secures the supplied pistol grip. This option allows for true one hand operation of the instrument. A trigger mounted on the pistol grip permits measurements to be taken without the need for keystrokes on the HP200 PC. Therefore, a sample can be held in the right hand, with the instrument in the left hand, making measurements easier.

During the design of the PIMA II, the aims were to make the instrument light, portable, and easy to use. The instrument's power requirements are high during a measurement (due to the internal light source), and heavy duty batteries are required. PIMA II is supplied with a waist-mounted battery pack. The batteries are then located behind the user which provides good weight distribution and allows for ease of operation. Just one cable provides power to the PIMA from the battery and this will plug into the rear of the instrument.

Users should find PIMA II easy to travel with, as a dust and water proof case is provided with the instrument. Check further instructions on how to make the case waterproof.

2 Spectrometer Care

Care should be taken when handling the PIMA and it should be treated as though it was your favourite camera. PIMA II has many lenses and other optical components, so like a camera, any extreme physical jolts could produce gross mis-alignment and even damage.

Always transport the PIMA in the provided case which is dustproof and waterproof.

Always carry the PIMA during field trips with the provided shoulder strap.

When travelling between measurement sites by vehicle, ensure that PIMA is safely stored.

Inform inexperienced users of the necessary care required to be taken, and ensure that they read this manual.

The batteries supplied with the PIMA are fully charged lead acid gel type. These batteries require ventilation to reduce any build up of gas, especially during the recharging of the batteries.

During transport, always check that the terminals are protected and cannot short out with any metal objects. If the batteries are ever shorted, there is an extremely high chance of fire occurring and this could be very dangerous during transport. Always use the plastic cover provided with the batteries to ensure complete protection.

It is not recommended that mineral samples are ever transported in the same case as the PIMA.

Integrated Spectronics does not give warranty to the instrument if damaged during transport, or during field trips. Warranty only covers faulty components from manufacturers and quality production of the unit.

3 Unpacking the Spectrometer

3.1 Unpacking

On receiving your brand new PIMA, you should first check the contents against the packing list shown below. It is not advisable to assemble the unit together yet. This manual is designed to step the user through the correct procedures to avoid any misunderstanding of the PIMA.

Remove the case from the packing box. Near the main front handle of the case is a black knob which must be turned to release the pressure in the case. Turn anti-clockwise to release. The case has four locking clips - two to the front and one each side. Lift these to open the lid.

PIMA II Packing List (Field Version)

6 Volt Yuasa Battery Pack	2
PIMA II Spectrometer	1
PIMA Power supply	1
Battery waist pack	1
Shoulder Strap	1
4 Pin Female to 4 Pin Female Power cable	1
4 Pin to Car Lighter socket Power cable	1
9 Pin Female to 9 Pin Male RS232 cable	1
HP200 PC (mounted on spectrometer)	1
SRAM card (mounted in HP200 PC)	1
HP200 User Manual	1
PIMA II Operations Manual (this manual)	1
Operations disk (1.44 mbyte)	1
PimaView User Reference Manual	1
PimaView disk (1.44 mbyte)	1
HP200 Connectivity Kit	1

If any of the above is missing please contact Integrated Spectronics.

Always place the components back in the same sections of the case as these positions are optimised for easy carrying and weight distribution.

3.2 Set Up Power Supply

Remove the spectrometer, power supply, and batteries and place them on a bench with plenty of space. Now remove the cables from the front compartment. The power supply will require a mains cable. Before plugging in the mains cable, check that the AC voltage selection is set for the correct voltage of your country. This is located at the back of the power supply near the ON/OFF switch. If it requires changing, then use a screw driver to unclip the plastic cover and slide out the fuse. Next, remove the switch block and select the correct voltage. Place the fuse back and plug in the mains cable (**Do not power up yet**).

3.3 Power Up PIMA

There are three sets of cables - two power cables and one RS/232 cable.

One power cable provides connections between the 12 Volt output of the power supply and the 12 Volt input socket on the back panel of the spectrometer. This cable is 1 metre long and has two 4 pin female connectors either end. Locate the cable and plug it into the spectrometer first, then the power supply. Turn on the power supply via the switch located at the back of the power supply. Switch the PIMA on with the 'POWER ON' button located at the back of the PIMA. Note that the power supply has a red light which indicates that power is on. The PIMA will sound a beep when powered up.

The other power cable is used to supply 12v from a vehicle's cigarette lighter.

4 Cables and Interconnections

4.1 Introduction PIMA has been designed and packaged for use in many locations. It can be used as a laboratory unit, portable vehicle-bound unit, and a portable personal unit. PIMA comes complete with all accessories to carry out any of the mentioned situations.

4.2 Power Sources There are three main power sources that the PIMA can be powered from and these are: the city mains outlet, 12 volt battery packs, and 12 volt vehicle outlets. There are cables supplied for each situation and these are described below.

Location 1: Laboratory
Power: 110 - 240 Volts AC
Cables: 2 required.
AC Mains cable (Not supplied with unit).
4 Pin female to 4 Pin female JM socket.
(1 metre long)

Procedure: Connect the JM 4 pin cable between the power supply (12V out) outlet socket and the PIMA back panel (POWER 12V) inlet socket. Switch on the Power supply and the PIMA.

Location 2: Vehicle
Power: 12 Volts DC from vehicle
Cables: 1 required.
Cigarette Lighter connector to 4 Pin female JM socket. (1 metre long)

Procedure: Connect the JM 4 pin cable between the PIMA back panel (POWER 12V) inlet socket and the cigarette lighter outlet in the vehicle.

WARNING

Pima will only operate from a 12 volt outlet. Check that the cigarette lighter is 12 volts and no other voltage. If voltages greater than 13.8 volts is applied to the PIMA, serious damage could be caused and warranty will be void.

Do not leave the PIMA powered on when starting the vehicle motor.

Location 3:

Portable

Power:

12 Volts DC from one Yuasa Battery pack.

Cables:

1 required.

Battery with 4 Pin JM female socket. (1 metre long)

Accessories:

1 Battery Pack

1 Battery Waist Pack

1 Shoulder Strap

1 Pistol Grip assembly

Procedure:

For portable use, the PIMA is supplied with accessories as shown above. Place one 12 volt battery assembly in the Battery Waist Pack. There are two clips which lock the battery in its compartment. Place the Waist pack around the waist so that the batteries are mounted at the rear of the user. Tighten all straps to make it comfortable to wear.

Clip the shoulder straps onto the PIMA handle. This item is not necessary, but recommended for securing the PIMA during excursions.

Mount the pistol grip assembly to the bottom of the PIMA. This assembly locks into the metal plate with a centre screw located at the bottom of the handle.

Finally, connect the battery cable to the PIMA 12V inlet socket mounted on the back panel.

4.3 RS232 Cables

PIMA comes supplied with one RS-232 cable as described in the Packing List in section 3.1:

A 9 Pin male to 9 Pin female connects the PIMA with a host IBM compatible PC. This option allows the user to operate a faster PC whether in the laboratory or in the back of the vehicle. Use the supplied operations disk to load any PC's that are required to run the PIMA.

NOTE: When operating an external PC, check that the PIMASPEC program running on the HP200 PC has been terminated. Otherwise the external PC will not communicate with the PIMA.

5 Measuring a Sample

5.1 Introduction This section will take the user through basic operations of the PIMA. The aim is to make a calibration measurement, make a sample measurement, and save the sample spectra to a file. Further information on software and calibration files can be found in Appendix A.

5.2 The HP 200LX Computer PIMA is operated via a small personal computer, the HP 200LX. The PC runs under MS-DOS operating system or HP's specialised Application Manager. This computer is mounted in the top compartment of the PIMA and is accessible by lifting the lid of this compartment.

Communications are wired directly to the PIMA thus reducing the number of external cables required.

To remove the HP200 PC, just lift it out of the compartment. To the right of the unit is the RS/232 cable. Simply disconnect the cable, then lift the PC further upwards. To the left of the PC is a socket which contains the SRAM card. This holds all the PIMA control programs and the spectral data.

To find out more about the HP200 PC please read the supplied manual.

NOTE: The RS/232 cable has a white dot painted on the HP plug side. The white dot should be facing upward.

5.3 Invoking the PIMA Software

The PIMA operating software, PIMASPEC, is present as a compiled file named PS34.EXE. The number 34 denotes the software version - in this release it is version 3.4.

There are two ways of operating the PIMA control software and this is via the MS-DOS operating system or the HP200 Application manager.

*** APPLICATION MANAGER**

When the computer boots from reset (Press <CTL-ALT-DEL>) it will then continue to run the Application manager. Press the (&...) button and then press the 'F' key. This will enable the FILER program which allows the user to view various program and data files on the SRAM drives.

Check that the PIMA is powered up.

Select [-A-] drive (SRAM card) as displayed and then select AAxxx.bat by moving the arrow keys up and down to the appropriate highlighted selection.

Press the <ENTER> key to invoke the batch file.

NOTE: AAxxx.bat where xxx is the serial number of the PIMA spectrometer

*** MS-DOS**

To run under the MS-DOS operating system simply press the keystroke combination <MENU> <'A'> <'T'> <ENTER> when in the Application Manager main menu.

This procedure will terminate the Application Manager and run MS-DOS. Next, type AAxxx.bat <ENTER> which will invoke the PIMA controller program PS34.EXE. Note that xxx is the serial number of the supplied PIMA.

COMMAND LINE

If PIMASPEC is invoked by itself (e.g. no batch file) then two parameters must be passed. This is the serial number of the spectrometer and the COM port selection. Examples are:

PS34 1234 COM1 Select serial number 1234 and run on COM1 RS/232 port.

PS34 23 COM2 Run PIMA with serial number 23 on COM2.

If running under windows, it is possible to run two PIMA spectrometers from the same PC, via COM1 and COM2 ports

OR alternatively,

Run the spectrometer on COM2 and the mouse driver on COM1, thus allowing PimaView operation.

5.4 Down Loading Data Files

The HP 200LX computer is supplied with a 'Connectivity kit' which enables the user to transfer files from the HP PC to another IBM MS-DOS machine.

The connectivity kit is supplied with the appropriate cables, software and a user manual.

For further information on the HP 200LX computer consult the User Manual supplied with the PIMA.

5.5 Initialisation

On initialisation, the program will display a menu at the top of the screen, a logo, version numbers, and Integrated Spectronics' address. To activate a menu selection, simply type the letter shown in uppercase. For example, typing the letter 'F' will call the 'FILE' menu window to open and a list of submenus will be displayed. Always press the 'ESC' key to return back to the main menu.

5.6 Calibration

To produce reliable results, a calibration measurement must be performed. Calibrations should be performed before any major batch measurements, when changing from the HP200PC to a compatible IBM PC, and during long periods of measurements.

The calibration measurement uses a plastic target which is located in the shutter leaving the user with no responsibility for providing a target.

Simply press 'T' for sysTem and then 'C' for Calib. Note that the PIMA powers up and the software displays various parameter on the screen. These show battery voltage, system temperature, TE cooler (detector) temperature, and other scanning parameters. Now press 'M' for Measure. The PIMA will start a measurement

of the plastic sample located in the shutter, while the raw data is displayed simultaneously on the screen. After the plastic scan is complete, the software instructs PIMA to proceed with a second scan, this being the reference scan. Finally, the HP200 PC calculates a ratio and resamples the data, which is then displayed on the screen as the spectrum of the plastic sample.

5.7 Measurement Of Samples

Obtain a quantity of your favourite sample of kaolinite and place it in a glass (don't use plastic!) container if in powder form.

Located to the front of the PIMA is the optical port where your sample will be placed. Press 'M' for Measure on the PC; PIMA will power up and display the system parameters then request a second keystroke to confirm the measurement; press 'M' again. The PIMA will now take a raw measurement of the sample placed at the optical port. Prevent any movements of the sample as this could produce incorrect results by introducing distortion into the data.

Notice that the raw data is displayed in real time during the sampling process.

When the measurement is complete, the PIMA will sound a beep indicating that the sample is not required any more. Remove the sample from the optical port. PIMA will now carry out the measurement on the internal reference sample. When the reference measurement is completed the results are displayed on the HP200PC screen as the sample spectrum.

5.8 Saving A Measurement

To save the currently displayed measurement press the key sequence 'F' for FILE, 'S' for SAVE. On the display, a window will open showing various options that can be entered.

The first option is the filename, and this can now be typed in. The next option is a code option used for database sorting. Simply press the 'TAB' key to step to this option. The final option is the comment option. Once again, press the 'TAB' key to access this option. Type the required comment and then press the <ENTER> key. This procedure will save the measurement to the SRAM card as a file. Each file saved will have an extension called '.DSP'

and this identifies the data file as a binary file with header information.

If the last digit of the filename is a number, then the program automatically increments this number for each successive measurement. This can be changed by the user by pressing <BACKSPACE> to delete unwanted alphanumerics in a file name.

The header information contains the comments, database codes, time and date of saving, GPS co-ordinates (if fitted) and many other parameters. This information can then later be extracted using other software tools provided by Integrated Spectronics.

5.9 Viewing And Zooming

It may be required to check the wavelengths or intensities of the sampled spectrum during a measurement session. This can be achieved by pressing the key 'V' for VIEW. A cursor will appear on the screen and located to the bottom right of the screen, the wavelength and intensity are displayed. Press the left and right arrows to move the cursor up and down the spectrum with an increment of two nanometres. To step the cursor, hold down the 'CTRL' key and press the left and right arrows.

Zooming is performed by pressing the 'Z' key for ZOOM. This function will zoom by a factor of two with the cursor located at the centre. Moving the cursor up and down the spectrum will also scroll the spectrum at the boundaries. Press the 'ESC' key to exit the viewing mode.

After any measurement, except a Calibration, the default display will be the "VIEW" mode. To save the spectrum just measured, press "ESC" to exit to main menu screen and then select "F" for File.

Menus and Operations

Introduction

This section of the manual assumes that the user is now familiar with connecting the PIMA to a power source, the HP200 PC, and can carry out a sample measurement. This section will explain in more detail the menus provided by the software and their operations.

Main Menu And Control

The top section of the screen displays the main menu for the PIMASPEC program. Each menu is selected by typing the appropriate letter which is displayed as a capital letter in the text. Type 'F' for File and 'T' for sysTem.

The 'ESC' key is always used when returning from sub-menus and generally escaping from various routines. This key is almost standardised in MS-DOS software.

To quit the program, press the 'ESC' key when the program is in the main menu. The user will be prompted for confirmation: type 'y' or 'n' for the appropriate direction of program flow.

File Menu

Pressing 'F' from the main menu will open the file menu. The file menu has a sub-list of menus which are 'Save', 'Open', 'List', and 'Delete'.

SAVE - *Save a spectrum to disk.*

When this menu is active, a window is displayed showing various options. Use the 'TAB' key to select the various options displayed. The first option is the filename, the second is an optional three letter database code, and the final option is the message. When the message description of the file is complete, press the <ENTER> key to invoke saving of the spectrum to disk. The file will be saved with an extension of '.DSP'.

6.7 Options

Pressing the 'O' key will activate this menu. There are four sub-menus relating to this option.

HULL - *Remove the baseline of the spectrum.*

We think of the hull as wrapping a string over the spectrum from the starting to the ending wavelengths.

Hull provides an enhanced visual picture of the spectrum in that it removes the general slope found in majority of spectra. In mathematical terms, the hull is a spectrum with the baseline removed.

Pressing the <SPACE> key, will cause a '*' figure to appear in the menu indicating that the option is now selected. Pressing 'ESC' will quit from the menu. All spectra displayed will include the hull. Note that the hull takes longer to compute so it may sometimes be necessary to select the hull option off to save computing time.

ZOOM - *Zoom spectra display by a factor of 2.*

Selecting this option will enable zooming of the spectra by a factor of 2 about the cursor. This is equivalent to pressing the 'Z' key during the view mode.

COARSE - *Scan the spectrum double speed.*

This option provides for fast scanning with the spectrum being sampled approximately every 4 nm. This option is recognised when the raw data being displayed will not reach the end of the screen. This mode is used when large numbers of samples are required or as a first quick look mode.

ENHANCE - *Increase integration time by factor displayed.*

Various samples reflect light by different amounts. Or, some mineral samples are darker than others. When a dark mineral is being sampled, it may be useful to

increase the integration time by two, three or four times. This is easily achieved by typing the 'E' key when in the Options menu. Note that when the 'E' key is pressed a number displayed in the menu increments from 0 to 3. Where

0	=	Normal mode
1	=	Integrate factor 2
2	=	Integrate factor 3
3	=	Integrate factor 4

If too high an increase is selected, signal saturation can occur. From a technical point of view, this procedure improves the signal to noise ratio. Note that the enhance option must be off for calibration.

6.8 Utility

Pressing the 'U' key will activate this menu with three sub-menus. For this version of software only the Overlay function is operational.

GPS - *Save GPS data with the spectrum.*
 [Not implemented in current software]

There are two types of GPS units which can interface to the PIMA spectrometer and these are the Magellan and Trimble GPSs. An RS/232 cable connects between the GPS and the back panel of the PIMA. The RS/232 port is labelled "GPS" and is a DB9 type female connector. "PimaTap" test software provided by Integrated Spectronics has the capability of testing the GPS interface.

Future versions of PIMASPEC will save GPS data in the header along with the spectrum data when this option is toggled.

OVERLAY - *Overlay multiple spectra.*

When the overlay function is selected, the directory window is opened with a list of spectrum files displayed. Press the 'TAB' key to the directory window and select a spectrum to be overlayed with the existing spectrum on

the screen. This simple function allows for comparing multiple spectra with ease.

PROCESS - This function not active.

6.9 System

Type the letter 'T' and the system menu will open. There are three submenus displayed where two are required for successful operation.

ZONE - Reconfigure the Integration, Gains and Zones.

This option must be used very carefully as the parameters displayed are critical in the operation of the PIMA. Note that when the zone window opens a list of parameters are displayed. There are 32 numbers in all and these are grouped as 4 rows by 8 columns. There are eight zones where each zone represents a segment of the spectrum. For example, zone0 may cover 1300 nm to 1450 nm, zone1 may cover 1450 nm to 1600nm and so on. The step range is determined by two numbers and these are the *STEPS* and *MEASURES* which are shown as the last two rows of the list. *STEPS* should always equal 6 and never be changed. *MEASURE* can be changed and usually varies from 45 to 80. So, when *MEASURE* = 45 and *STEP* = 6 the result is 270 steps of the grating (optical component).

The sum of the *MEASURES* should not be greater than 440 (e.g. 55 Measures X 8 zones).

To vary the integration time, change the *CHOP* value to a number that is a multiple of 6. The value 6 means 6 chops for every sample. Therefore, 12 chops will be twice the integration time of 6 chops, thus each sample will take twice as long. The advantage of increasing the number of chops is to improve the signal to noise ratio, especially when dark objects are sampled. Once the zones are set up correctly, it is rare that they will need changing. To increase the integration time, simply use the *OPTION ENHANCE* mode which will automatically increase each zone's chop by the enhancement factor.

The last parameter row displayed is the *GAIN* control. This is usually set to 0, and can be varied from 0 to 3. This has the effect of switching amplifier gain stages for each zone and is required in reaching the optimum dynamic range in the signal. This procedure does not improve the signal to noise ratio.

To edit the zone parameters, use the <ARROW> keys to move about the array of numbers, use the <BACKSPACE> key to delete numbers and finally use the <ENTER> key to enter the number changed. Press the <ESC> key to return back to the main menu.

NOTE: The zone files are factory set to optimise the performance of each PIMA.

CALIBRATE - *Calibrate the PIMA.*

Calibration data is required by the resampling algorithms which are generated by this menu function. The calibration data aligns the resampled data to a reference sample which is a piece of plastic located in the front of the shutter. For further details, read section 5.5 on *Calibration*.

STATUS - *Check the PIMA status.*

This function will read the temperature of the system, the battery voltage and display a few other parameters such as time and date.

7 Accessory Software

7.1 Introduction Integrated Spectronics believes in total support of its hardware products with good quality user-friendly software. Section 6 described the operations of the PIMASPEC program which is the main controlling program for the PIMA. This section will describe the support software.

7.2 PIMAEDIT PimaEdit is a program for converting the spectrum data files acquired by the PIMA to another format. This new format could be used for other software packages such as databases, plotting packages etc. PimaEdit will also allow the user to modify the data with various functions. The functions vary from smoothing to hull differences. There are a number of options for output. The outputs can be the original format (.dsp binary files), ASCII text outputs, or PCS text output (CSIRO format).

NOTE: The original spectrum data files have a .dsp extension, therefore the output format can not have the same extension. This prevents any accidental overwriting of the original data. Always make a backup of the original data.

PimaEdit operates simply by typing 'PIMAEDIT' <ENTER>. The program will initialise with a window displaying various parameters. Press the 'LEFT' and 'RIGHT' arrow keys to change the parameter. Press the 'UP' and 'DOWN' key to move to the next parameter. Press the <ENTER> key to initialise a batch conversion as per modified parameters. Press the <ESC> key to quit the program.

KEY	FUNCTION
<i>ENTER</i>	<i>Start conversion</i>
<i>ESC</i>	<i>Quit Program</i>
<i>LEFT & RIGHT ARROW</i>	<i>Change option parameter</i>
<i>UP & DOWN ARROW</i>	<i>Move to next parameter</i>

The following section describes each option as displayed by PimaEdit.

REFLECTANCE SCALE - *Change the Y component for ASCII*

There are three selections which modify the reflectance scale when the output selected is ASCII. The ranges are 0-1, 0-100, 0-10000. The range 0-100 is probably the most commonly used as it represents a percentage value.

WAVELENGTH SCALE - *Change the X component for ASCII*

There are three selections which modify the wavelength scale when the output selected is ASCII. The selections are *channel, nanometre, micrometre*.

HULL FUNCTION - *Remove the baseline from spectrum*

The hull function has three selections which are *disable, quotient, difference*. The function of the hull is to calculate the slope found in most spectra and then ratio or subtract this slope from the data. Using the hull will remove all offsets and normalise the absorption features. This function works for all output types. Note that during a batch process, the hull function requires many

calculations so a co-processor is recommended to increase processing speed.

DIFFERENTIAL ORDER - *Calculate the 1st, 2nd differential*

This function has three selections and these are *disable, 1st diff, 2nd diff*. The *1st diff* calculates the 1st differential which is mathematically equivalent to difference between each data point divided by one. The *2nd diff* calculates the difference between each data point of the 1st differential. This function is useful in analysing the slopes of the absorption features, such that the greater the peaks in the 1st differential, the steeper the slopes in the original data.

This function works for all output types.

SMOOTH ORDER - *Smooth the data with n points*

If certain data is 'noisy' due to it being a dark specimen, then this function will reduce the noise component in the data. There are six settings which are *disable, 5 points, 7 points, 9 points, 11 points, 13 points*. Selecting a 5 point smooth will have least smoothing effect than a 13 point smooth so check that the points selected are not over smoothing the data. Over smoothed data will reduce the resolution content and it may become useless when finer details are being analysed.

OUTPUT FILE TYPE - *Select output file*

This option will select the output file type which are *ASCII, binary, PCS*.

ASCII

This option will output the data as text with two columns and 601 rows. The first column is the wavelength, the second column being the reflectance. The output values are determined by the scale option settings. For the wavelength, *channel* and *nanometre* are output as integers

where *micrometre* output are real numbers. For reflectance, 0-1 and 0-100 are output as real numbers and 0-10000 are output as integers.

BINARY

This option will output the data back into the PIMA data format (.dsp format). The output extension can not be a '.dsp' as this will cause overwriting of the original data. PimaEdit usually configures the output of binary files with an extension of '.bin'.

PCS

This option will output the data as text with a format that was originated by CSIRO (Australia).

The format for each text line is as follows:

1. The filename.
2. The word "LINEAR"
3. No. points, starting wavelength, ending wavelength. These numbers for PIMA are 601 1300 2500.
4. The next (n points divided by five) lines are the reflectance values.
5. The last line is again 601 1300 2500.

SOURCE PATH NAME -

The raw data files directory location.

If no text is entered here then PimaEdit assumes the current directory is to be used. Always use the correct MS-DOS syntax when writing directory paths. For example *C:\PIMA\PIMAFILES*.

SOURCE FILE SPEC - *Specify the batch wildcards*

This text is used for selecting what files are to be converted to the new format. It uses the MS-DOS wildcard syntax which allows for a variety of options in filtering letters and extensions for file selection. For examples the user wants to select all (.dsp) files for conversion; then type *.DSP. For only one file to be converted, type; PIMAFILE.DSP, or a selection of files, type; PI??????.*

For further information on wildcards, consult a MS-DOS reference book.

DEST. PATH NAME - *The converted data files directory*

If no text is entered here then PimaEdit assumes the current directory is to be used.

DEST. ASCII FILE EXT. - *The extension for ASCII output*

DEST. BINARY FILE EXT. - *The extension for binary output*

These two text options specify the output extensions for the ASCII and BINARY files. Usually PimaEdit uses (.TXT) for ASCII files and (.BIN) for binary files.

REFERENCE FILENAME - *Filename for references*

Each time PimaEdit makes a conversion of a data files, a reference is made. The filename which defaults to 'PIMA.REF' may be modified for a different batch process, or the references will be appended to that file.

The following is a list of the output generated for a reference file.

HEADER

LOGO - *Integrated Spectronics logo.*

DATE - *Date and Time of the conversion by PimaEdit.*

FILENAME - Name of the Reference file.

PATH - Path name of the source file.

DATA

FILENAME - Name of the spectrum converted.

DATE - Date the spectrum was sampled.

TIME - Time the spectrum was sampled.

GPS TIME - Location where the data was sampled.

GPS LAT

GPS LONG

GPS ALT

COMMENT - Message about the spectrum made.

RUN PIMAVIEW - *Run the PIMA viewing program*

PimaView is a data viewing and analysis program written by Integrated Spectronics specifically for the PIMA and is supplied with every spectrometer. Consult the PimaView manual for operations.