BRITISH COLUMBIA
PROSPECTORS ASSISTANCE PROGRAM
MINISTRY OF ENERGY AND MINES
GEOLOGICAL SURVEY BRANCH

PROGRAM YEAR:	2001/2002
REPORT #:	PAP 01-39
NAME:	NEIL CHURCH

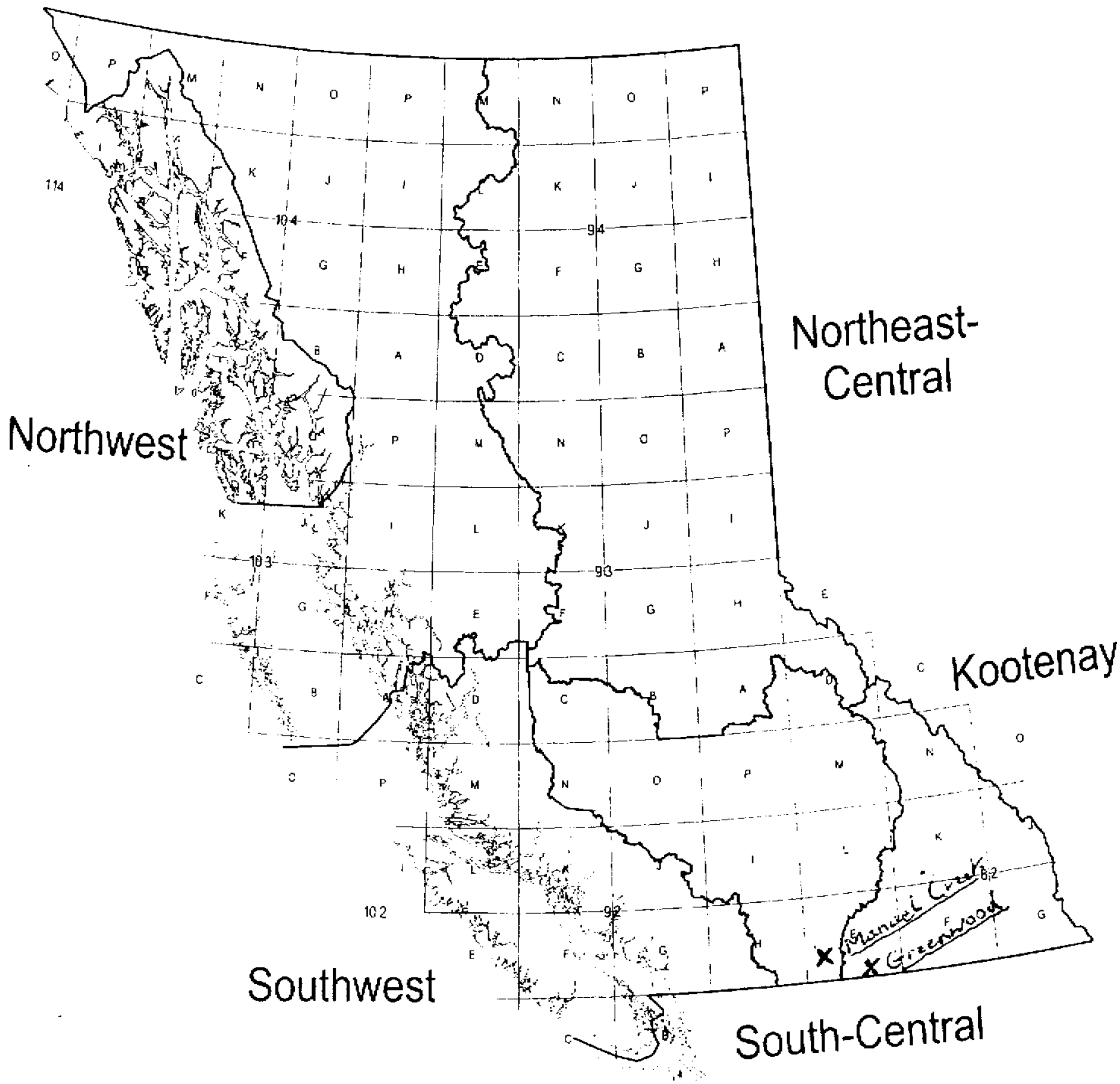
PROSPECTING REPORT
(01/02 P 73)

by B.N. Church

January 2002

Location of Proposed Project(s)

Indicate on this map (using an "**X**") the general location of each of the projects covered by this proposal.



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Photographs

Technical Report
Manuel Creek Project

D. TECHNICAL REPORT

BRITISH COLUMBIA
Ministry of Energy and Mines
Energy and Minerals Division

- One technical report to be completed for each project area.
- **Refer to Program Regulations 15 to 17, page 6.**

SUMMARY OF RESULTS

- This summary section must be filled out by all grantees, one for each project area

Information on this form is confidential for one year and is subject to the provisions of the *Freedom of Information Act*.

Name B. Neil Church Reference Number 01/02-P73

LOCATION/COMMODITIES

Project Area (as listed in Part A) Manuel Creek area MINFILE No. if applicable

Location of Project Area NTS M082E022 Lat 49°14.6' Long 119°43.9'

Description of Location and Access The property is centred 7 Km northeast of Keremeos. Access is from Highway 3A and 10 km south via the Twin Lakes and Grand Oro roads

Prospecting Assistants(s) - give name(s) and qualifications of assistant(s) (see Program Regulation 13, page 6) Florence Niddery of Okanagan Falls FMC no. 119723

Main Commodities Searched For zeolites, in particular clinoptilolite

Known Mineral Occurrences in Project Area

WORK PERFORMED

1. Conventional Prospecting (area) → 6 x 8 = 48 km² 250 hectares
2. Geological Mapping (hectares/scale) 1/20 000 scale; 81 geol. stas. on/near Kitty + Tom claims
3. Geochemical (type and no. of samples) 8 silicate analyses
4. Geophysical (type and line km) nil / 5000 m of line survey, flagging
5. Physical Work (type and amount) GPS survey incl 90 geological stations + claims
6. Drilling (no. holes, size, depth in m, total m) nil
7. Other (specify) 20 samples of X-ray diffraction mineral identification - 6 samples for cation exchange capacity tests

FEEDBACK: comments and suggestions for Prospector Assistance Program

Thanks are owing the B.C. Geological Survey for the support through the Prospectors Assistance Program that has led to the discovery of 4 new zeolite occurrences near Keremeos. The results are in and show that the quality of zeolite mineralization is as good or better than other similar producing deposits at Princeton and in the Kamloops area.

D. TECHNICAL REPORT (continued)

REPORT ON RESULTS

- Those submitting a copy of an Assessment Report or a report of similar quality that covers all the key elements listed below are not required to fill out this section.
- Refer to Program Regulation 17D on page 6 for details before filling this section out (use extra pages if necessary)
- **Supporting data must be submitted with the following TECHNICAL REPORT or any report accepted in lieu of.**

Information on this form is confidential for one year from the date of receipt subject to the provisions of the *Freedom of Information Act*.

Name B. Neil Church Reference Number 01/02 - P73

1. LOCATION OF PROJECT AREA [Outline clearly on accompanying maps of appropriate scale.]

The Manuel Creek project area is focused on the Kitty #1-#7 and Tom #1-#3 claims centred 7 km northeast of Keremeos see Mineral Titles Reference Map M082E007

2. PROGRAM OBJECTIVE [Include original exploration target.]

The main program objective is to determine the extent, control and quality of zeolite mineralization in the middle part of the Marron F. Section in the southern part of the Penticton Tertiary outlier. A secondary objective was to evaluate these Tertiary rocks, such as the glassy phases of the Park Rill andesite F., as a potential component for use in the mineral wool fabrication industry.

3. PROSPECTING RESULTS [Describe areas prospected and significant outcrops/float encountered. Mineralization must be described in terms of specific minerals and how they occur. These details must be shown on accompanying map(s) of appropriate scale; prospecting traverses should be clearly marked.]

The results of this project are the discovery of zeolite (clinoptilolite) mineralization in abundance at several localities within a 5 km belt of Eocene dacitic crystal vitric tuff in the Manuel Creek area, 7 km northeast of Keremeos. These are station nos. Ecoka-21, Man 10, 36, 76 and 78 on the accompanying map (Figure 1). Cation exchange capacity results on samples from these localites are 112.5, 116.1, 100.0, 128.6 and 151.8, respectively (Folder 6). The tuffaceous beds, up to 10 m thick, occur at mid-section in the Marron Formation, between the Kitley Lake member (below) and the Kearns Creek member above (above), in the southern part of the Penticton Tertiary outlier (Figure 2).

A second prospecting target in the Manuel Creek area, the Park Rill andesite (sta. 74, Fig. 2), is a fine grained/glassy potential substitute for a dacitic rock component (used for the fabrication of mineral wool) that is in dwindling supply to the Roxul Inc. plant at Grand Forks B.C. However, this site has a disadvantage compared to similar rocks in the Greenwood area that are much closer to Roxul's plant (see stas. Wool-38, 39, 40 and Figs. 4 and 5).

Background

The word 'zeolite' is derived from a Greek phrase meaning 'boiling stones' in reference to the visible loss of water by rocks rich in these minerals on heating. Zeolite minerals are hydrated aluminosilicates of the alkaline and alkaline earth elements such as sodium, potassium, magnesium, lithium, barium and calcium. They form naturally from the reaction between volcanic ash and alkaline water. The commercial application of natural and synthetic zeolites result from the mineral's capacity for adsorption, catalysis and ion exchange (see 'Mineral Spotlight' in Industrial Minerals, December 2000 isssue). Natural occurring zeolites are used for ion exchange, filtering, odour removal, chemical sieving and gas absorption. Synthetic zeolites are also used as molecular sieves in the purification of gases and liquids, but at much higher cost. Chabazite and clinoptilolite are the two natural zeolites most commonly used in commercial applications. Mordenite, phillipsite and ferrierite can also be used. Chabazite is the most important member of the group, and clinoptilolite is the most abundant. Except for radioactive waste treatment, only a small percentage of clinoptilolites are of sufficient purity to be used for ion exchange; they are more typically used in soil amendments such as vegetation of mine and metallurgical waste sites, animal feed, odour and waste control, dimension stone and construction aggregates (see Moore, 2000; Griffiths, 1987; Mumpton, 1988; Leggo, 2000; Leggo, 2001).

In British Columbia zeolites are most commonly preserved in the Tertiary rocks because of the usual relatively low grade of regional metamorphism of these formations. The interior plateau area of British Columbia is blanketed by a deeply dissected early Tertiary lavas, associated pyroclastic rocks and intercalated sedimentary units. These rocks occur within a northwesterly-trending belt about 150 kilometres wide, extending 800 kilometres from the Republic Mining District in Washington State to the Babine Lake area of central British Columbia. The thickness of these rocks ranges from less than 100 metres to more than 1200 metres. The base of the succession where best developed is composed of fluvial sandstone and conglomerate. The upper boundary of these rocks is generally coincident with a gently rolling 'upland surface' locally unconformably covered by a veneer of Miocene and younger 'plateau' basalts of the Chicotin group.

In the Okanagan - Boundary area, the early Tertiary continental sedimentary and volcanic rocks and associated intrusions fill the Penticton and Kelowna half grabens and the Toroda Creek graben that bisects the Okanagan Highlands in the Midway - Rock creek area. The Springbrook Formation at the base of the succession, is a polymictic conglomerate containing clasts derived from a geologically diverse pre-Tertiary metamorphic terrane. This unit is followed by the Eocene Kettle River Formation consisting of rhyolite tuffs, sandstones, shales and minor conglomerates that are, in turn, overlain conformably by the Marron Formation consisting of phonolite, trachyte and andesite lava flows and breccias. In the north Okanagan area, the Penticton Group is overlain unconforably by Miocene plateau basalts; near Vernon the felsic Penticton volcanics are replaced by Eocene andesites and basalts typical of the Kamloops Group. Structural control of the Tertiary outliers is related to a herringbone pattern of conjugate shears trending northeast and northwest. These are important elements in a north-south stress scheme that is responsible for the many northerly-trending grabens found scattered throughout the southern interior of British Columbia from the Fraser River to the Rocky Mountains. The period 45 to 53 Ma witnessed intense volcanic and tectonic activity across the Cordillera. This period corresponds to northerly movement of the Pacific plate that produced oblique subduction of this plate under the North American craton. This stress engine was active throughout the Cordillera during the Eocene. This resulted in a complex inter-relationship of shears, tension faults and folds and the simultaneous development of grabens, folding and thrusting in coastal areas, the southern interior, including the Penticton area, and eastern British Columbia.

Prospecting

The occurrence of zeolites in British Columbia was first described by Church (1973) during a detailed study of Tertiary rocks of the White Lake basin in the Pentiction area, and subsequently similar studies by others in the Princeton and Cache Creek areas (see Marcille, 1989; Hogg, 1993). These are the most recent significant discoveries of natural zeolites in Western Canada.

In the Penticton area zeolites are abundant in the lower part of the Penticton Group, apparently as the result of 'load' metamorphism, although the composition of the host rocks seems to be a controlling factor. For example, there is a close association of natrolite and secondary analcite with calcite in amygdale fillings in the phonolite lavas of the Yellow Lake member of the Marron Formation. However, it may be that the growth of zeolites was favoured by these alkali- and alumina-rich, silica-undersaturated lavas before loading at the time of eruption and cooling. Also, the association of clinoptilolite and wairakite with tuffaceous sedimentary rocks high in the stratigraphic succession in this area suggests the possiblity of authigenic origin of some zeolites. Such is the case in the Manuel Creek area where zeolitic tuff occurs between the Kearns Creek and Kitley Lake members of the Marron Formation (Hora and Church, 1986).

Prospecting supported by the B.C. Prospectors Assistance Program in the Manuel Creek area was completed in August 2001. With the assistance of air photos and TRIM maps (1:20,000 scale) observations of the geology and mineralization were done from a grid of flagged claim lines and a network of bush roads that service the towers of the West Kootenay Transmission Line that transects the area (Figure 1). A total of 81 field stations were required to constrain the geography and geology of a zeolitized dacite unit (here called the 'Manuel Creek tuff') for a distance of approximately 5 km (Figure 2). There are 12 stations that establish the location of the Manuel Creek tuff; 20 stations are on the underlying Kitley Lake member, 46 on the overlying Kearns Creek member, and a few additional stations on the Nimpit Lake and Park Rill members at the top of the section. In total these rocks comprise a block of Eocene lava flows several thousand feet thick, dipping easterly and faulted against a pre-Tertiary complex of Paleozoic and Mesozoic cherts, greenstones and granitic intrusions.

The Manuel Creek tuff is light coloured, mainly gray or beige, massive and characterized by small scattered black specks of biotite and/or amphibole. In thin secion the rock consists mostly of glassy shards replaced by zeolites and clay. Accessory minerals include plagioclase, sanidine, quartz, biotite, amphibole and smectite (see Appendix I, Folder 2). The Manuel Creek tuff and related sedimentary facies has been traced southerly from a point 2 km north of the West Kootenay power line to about 3 km south of the powerline (Figure 2). The unit ranges up to 10 m thick, strikes on average from 010 to 015 degrees and dips 20 to 30 degrees easterly. Waterlain facies contain local concentrations of carbonacous woody trash and fossil leaves. At the base the unit is intercalated with buff coloured siltstone and sandstone that has been eroded from the underlying Kitley Lake member (stas. 13, 33 and 59). Laterally, the tuff is mixed with some dacitic lapilli breccia and interbedded with brown sandstone containing lithic clasts derived from the Kearns Creek basalt (stas. 37, 78, and 60).

To better determine the frequency and abundance of zeolites and accessory minerals in the Manuel Creek tuff, 20 samples from the 12 stations established on the Manuel Creek tuff were submitted for X-ray diffraction analyses at the Cominco Laboratory in Vancouver (see Appendix I, Folder 2). From this collection the results show that 12 samples contain clinoptilolite as the sole zeolite and that 6 of these samples have moderate to significant amounts of this mineral (i.e. Ecoka 21a, 21b, Man-10b, 36, 76 and 78b). It is noted that sample Man-78b is especially enriched in clinoptilolite accompanied by accessory plagioclase. Sample Man-76, from a location 800 m south of sta. 78, is similar to sample Man-78b but in addition it contains minor quartz and smectite. Sample Man-36 was collected approximately 1 km northwest of sta. 78 and by comparison it has moderate amounts of clinoptilolite, quartz, plagioclase, minor smectite and amphibole. Sample Man-10b is from an outcrop 1.2 km north of sta. 36 - it is relatively enriched in clinoptilolite, contains a moderate amount of quartz, minor plagioclase and smectite. Samples Ecoka-21a and 21b, from the top and bottom of the exposure at station Man-10, are also enriched in clinoptilolite and have essentially the same accessory mineral composition as sample Man-10a. Wairakite, the calcium analogue of analcite, accompanies clinoptilolite as a minor mineral in sample Man-28a and in significant amounts, without clinoptilolite, in samples Man-31, 59 and 60b. No other zeolite minerals were found to be present in the collection.

4. Geochemical Results

Quantitative analyses of zeolite content is done using the cation exchange capacity (CEC) values of the samples according to the method outlined by Marcille (1989) based on clinoptilolite's high selectivity for NH_4^+. (X-ray diffraction allows identification of the zeolite mineral species but only a rough estimate of amounts.) The CEC determinations were completed by BC Research Inc. for 6 samples showing significantly strong zeolite X-ray diffraction patterns (Appendix I, Folder 6). Assuming a CEC (meq/100) value of 220 for pure clinoptilolite, disregarding the effects of other minerals, the following amounts are calulated:

	CEC	%
Ecoka-21a	112.5	51
Man-10b	116.1	53
Man-36	100.0	45
Man-60b	33.9	15
Man-76	128.6	58
Man-78b	151.8	69

These estimates may be high due to the presence of other minerals, particularly smectite. The relatively low result for Man 60b is because the zeolite in this sample is wairakite which is known to have poor cation exchange qualities.

Whole rock silicate analyses of the zeolitized tuff unit were completed on 8 samples from various localities. These analyses were intended to establish the composition range of the tuff and associated waterlain sedimentary facies including the material reworked from the adjacent Kearns Creek and subjacent Kitley Lake units.

The zeolitized rocks consists of beige or light gray shardy tuff, brown volcanic sandstone and buff coloured siltstone. Samples Ecoka-21a, 22c, Man-10b, 60a and 78b are typically dacitic composition (Appendix I, Folders 3 and 5). Ecoka-22c is fresh vitric tuff with a few small, scattered feldspar and amphibole crystals and biotite flakes. Ecoka-21a, Man-10b and Man-78b contain >10% H_20 and significant clinoptilolite - the glassy matrix of these rocks being extensively zeolitized. Man-10a is dacitic tuff with some clay alteration.

Samples Man-31, 22, 60a are andesitic buff coloured and brown volcanic sandstone and siltstone. Samples Man-31 and Man-60b contain >7% H_20 and significant wairakite; Man-22 has less H_20 and wairakite. Man-31 is believed to represent sediment derived from the erosion of Kitley trachyandesite lava underlying the dacitic tuff. Similarly, Man-60b is thought to be partly sourced from nearby Kearns Creek basaltic andesite.

The following tabulation compares the chemical composition of relatively fresh dacitic tuff, analysis no. Man-22c, clinoptilolite enriched tuff Man-78b and the average composition of clinoptilolite as given by the New Mexico Bureau of Mines and USGS:

	Man-22c	Man-78b	Clinoptilolite USGS
SiO_2	67.20	57.79	64.7
TiO_2	0.46	0.49	0.2
Al_2O_3	14.60	14.26	12.6
Fe_2O_3	3.44	3.32	1.8
MnO	0.05	0.02	0.1
MgO	1.50	2.33	1.1
CaO	3.00	4.84	3.7
Na_2O	3.06	1.05	1.0
K_2O	4.34	1.01	3.7
LOI	1.66	13.17	

D. TECHNICAL REPORT (continued)

REPORT ON RESULTS (continued)

5. GEOPHYSICAL RESULTS [Specify the objective of the survey, the method used and the work done. Discuss the results and show the data on an accompanying map of appropriate scale. Any anomalous areas must be indicated on maps by the use of contouring, or some other suitable technique.]

For grid control the following co-ordinates have been established for the Kitty and Tom claims, No.1 claim posts (using a Garmin 12 GPS receiver).

Claim	Co-ordinates			UTM (NAD '83)	
	Latitude	Longitude	elevation	easting	northing
Kitty 1	49°15.510'	119°43.870'	4300'	301300	5459750
Kitty 2	49°15.216'	119°43.910'	4311'	301180	5459250
Kitty 3	49°15.009'	119°44.045'	4368'	301080	5458750
Kitty 4	49°14.659'	119°44.052'	4378'	300950	5458310
Kitty 5	49°14.441'	119°44.133'	4210'	300850	5457775
Tom 1	49°13.889'	119°44.121'	4208'	302120	5456800
Tom 2	49°13.640'	119°43.190'	4027'	301950	5456310
Tom 3	49°13.427'	119°43.221'	4008'	301850	5455790

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5. OTHER RESULTS [**Drilling** - describe objective, type and amount of drilling done. Discuss results, including any significant intersections obtained. Indicate on a map of appropriate scale the drill-hole collar location, the angle of inclination and azimuth. Drill logs correlated with assay results must be included. **Physical Work** - describe the type and amount of physical work done and the reasons for doing it (where not self-evident). This includes lines/grids, trails, trenches, opencuts, undergound work, reclamation, staking of claims, etc. Discuss results where pertinent.]

Physical work for the Manuel Creek project consists of staking 10 two post claims ('Kitty' and 'Tom' claims tenure nos. 388945-388952 and 390678-390679) and associated location lines and grid (Figure 1). The property is centred 4 km southwest of Orofino Mountain, west of the headwaters of Park Rill in the upper part of the Manuel Creek drainage basin. Access to the property is 10 km south of the Twin Lake turnoff from Highway 3A via the Twin Lakes and Grand Oro roads.

The claims are aligned roughly N-S following the 5 km long strike of the zeolitic tuff unit.

The location lines of the Kitty 1-5 claims (striking 188°) and the Tom 1-3 claims (striking 192°) are crossed by the West Kootenay Power Transmission Line forming a 'H' shaped reference grid designed to assist rock sampling and geological mapping.

Signature of Grantee Neil Church Date Jan. 17th, 2002

Signature of person filling out Final Prospecting Report if other than grantee ____________

Table 1a Field Notes for Manuel Creek Area

Field No.	Lat.	Long.	Unit	Description
MAN 1	49°15.3'	119°43.9'	Kitley L.	beige coloured massive feldspar porphyry trachyandesite lava
MAN 2	49°15.0'	119°44.0'	Kitley L.	beige coloured massive feldspar porphyry trachyandesite lava
MAN 3	49°15.4'	119°43.8'	Kitley L.	beige coloured massive feldspar porphyry trachyandesite lava
MAN 4	49°15.3'	119°43.8'	Kitley L.	beige coloured massive feldspar porphyry trachyandesite lava
MAN 5	49°15.1'	119°43.7'	Kitley L.	beige coloured massive feldspar porphyry trachyandesite lava
MAN 6	49°15.0'	119°43.9'	Kitley L.	beige coloured massive feldspar porphyry trachyandesite lava
MAN 7	49°15.0'	119°43.8'	Kearns Cr.	dark brown rubbly vesicular basaltic lava
MAN 8	49°14.9'	119°43.8'	Kitley L.	beige coloured biotiferous feldspathic trachyandsite lava
MAN 9	49°14.8'	119°43.9'	Kitley L.	beige coloured massive feldspar porphyry trachyandesite lava
MAN 10	49°14.8'	119°44.0'	unnamed	light gray zeolitic dacitic dust, lapilli tuff beds 014°/20°SE
MAN 11	49°14.7'	119°44.1'	Kitley L.	beige coloured massive feldspar porphyry trachyandesite lava
MAN 12	49°14.6'	119°44.0'	unnamed	light gray dacitic tuff and tuffaceous shales with plant fossils
MAN 13	49°14.6'	119°43.9'	unnamed	gray tuff between Kitley and Kearns units, beds 118°/16°SE
MAN 14	49°14.5'	119°43.9'	Kearns Cr.	weathered brown vesicular pyroxene-rich basaltic lava
MAN 15	49°14.6'	119°43.7'	Kearns Cr.	weathered dark brown vesicular basaltic lava
MAN 16	49°14.7'	119°43.5'	Kearns Cr.	weathered dark brown rubbly pyroxene-rich basaltic lava
MAN 17	49°14.7'	119°43.3'	Kearns Cr.	weathered brown soil and regolith of basaltic lava
MAN 18	49°14.9'	119°43.3'	Kearns Cr.	weathered brown vesicular pyroxene-rich basaltic lava
MAN 19	49°15.1'	119°43.3'	basement	rocks of mostly fine grained gray Paleozoic chert breccia
MAN 20	49°15.2'	119°43.4'	Kearns Cr.	weathered brown vesicular pyroxene-rich basaltic lava
MAN 21	49°15.2'	119°43.5'	Kearns Cr.	weathered brown vesicular pyroxene-rich basaltic lava
MAN 22	49°15.2'	119°43.6'	unnamed	light gray zeolitized dacitic tuff beds 010°/30°E
MAN 23	49°14.6'	119°44.0'	Kitley L.	rubbly weathered beige coloured feldspar porphyritic lava
MAN 24	49°14.5'	119°43.0'	Kitley L.	beige coloured massive feldspar porphyry trachyandesite lava
MAN 25	49°14.5'	119°44.1'	Kitley L.	pinkish weathered coarse feldspar porphyry trachyandesite
MAN 26	49°14.5'	119°44.2'	Kitley L.	beige coloured massive feldspar porphyry trachyandesite lava
MAN 27	49°14.5'	119°44.1'	Kitley L.	beige coloured massive feldspar porphyry trachyandesite lava
MAN 28	49°14.4'	119°44.0'	unnamed	light gray zeolitized dacitic tuff and tuffaceous sediments
MAN 29	49°14.4'	119°43.9'	Kearns Cr.	fresh dark coloured pyroxene-rich columnar basaltic lava
MAN 30	49°14.3'	119°44.0'	Kitley L.	pink to gray massive feldspar porphyry trachyandesite lava
MAN 31	49°14.3'	119°43.1'	Kitley L.	buff coloured tuffaceous sediment on trachyandesite lava
MAN 32	49°14.2'	119°44.1'	Kitley L.	rubbly beige coloured feldspathic trachyandesite lava
MAN 33	49°14.1'	119°44.0'	unnamed	gray zeolitized dacitic tuff beds 010°/22°E
MAN 34	49°14.6'	119°43.9'	Kearns Cr.	brown weathered vesicular pyroxene-rich basaltic lava
MAN 35	49°15.7'	119°43.8'	Kitley L.	beige coloured massive feldspar porphyry trachyandesite lava
MAN 36	49°14.1'	119°43.9'	unnamed	light gray zeolitized dacitic tuff beds 165°/20°NE
MAN 37	49°14.2'	119°43.8'	Kearns Cr.	medium to dark brown volcanic sandstone, tuffaceous grit
MAN 38	49°14.3'	119°43.8'	Kearns Cr.	brown volcanic sandstone and tuff
MAN 39	49°14.3'	119°43.6'	Kearns Cr.	brown vesicular pyroxene-rich basaltic lava
MAN 40	49°14.2'	119°43.6'	Kearns Cr.	rubbly regolith of pyroxene-rich basaltic lava
MAN 41	49°13.9'	119°43.6'	Kearns Cr.	dark brown vesicular pyroxene-rich columnar basaltic lava
MAN 42	49°13.9'	119°43.5'	Kearns Cr.	massive vesicular pyroxene-rich basaltic lava
MAN 43	49°14.0'	119°43.4'	Kearns Cr.	brown weathered crumbling basaltic tephra
MAN 44	49°14.1'	119°43.3'	Kearns Cr.	brown weathered crumbling basaltic tephra
MAN 45	49°14.0'	119°43.3'	Kearns Cr.	brown weathered crumbling basaltic tephra
MAN 46	49°13.9'	119°43.3'	Kearns Cr.	brown weathered crumbling vesicular basaltic lava
MAN 47	49°13.8'	119°43.3'	Kearns Cr.	brown weathered crumbling vesicular basaltic lava
MAN 48	49°13.6'	119°43.2'	Kearns Cr.	reddish brown weathered crumbling vesicular basaltic lava

Table 1b Field Notes for Manuel Creek Area

Field No.	Lat.	Long.	Unit	Description
MAN 49	49°13.6'	119°43.2'	Kearns Cr.	dark brown weathered rubbly vesicular basaltic lava
MAN 50	49°13.8'	119°43.0'	Kearns Cr.	dark coloured basaltic lava
MAN 51	49°13.9'	119°43.1'	Kearns Cr.	badly weathered dark brown rubbly basaltic lava
MAN 52	49°13.6'	119°43.2'	Kearns Cr.	brown weathered vesicular basaltic lava
MAN 53	49°13.4'	119°43.3'	Kearns Cr.	brown weathered vesicular basaltic lava
MAN 54	49°13.3'	119°43.3'	Kearns Cr.	dark brown weathered rubbly basaltic lava
MAN 55	49°13.3'	119°43.4'	Kearns Cr.	dark brown weathered rubbly basaltic lava
MAN 56	49°13.2'	119°43.4'	Kearns Cr.	dark brown weathered rubbly basaltic lava
MAN 57	49°13.1'	119°43.4'	Kearns Cr.	basaltic lava
MAN 58	49°13.3'	119°43.4'	unnamed	brown gritty sandstone and gray massive dacitic tuff
MAN 59	49°13.5'	119°43.4'	unnamed	brown sandstone and gray dacitic tuff
MAN 60	49°13.6'	119°43.4'	unnamed	brownish siltone and sandstone and gray dacitic tuff
MAN 61	49°13.5'	119°43.4'	Kitley L.	beige coloured massive feldspar porphyry trachyandesite lava
MAN 62	49°13.6'	119°43.3'	Kearns Cr.	fresh dark coloured pyroxene-rich basaltic lava
MAN 63	49°13.4'	119°43.2'	Kearns Cr.	brown weathered massive vesicular basaltic lava
MAN 64	49°14.5'	119°43.3'	Kearns Cr.	brown weathered highly vesicular basaltic lava
MAN 65	49°14.5'	119°43.0'	Kearns Cr.	brown weathered highly vesicular basaltic lava
MAN 66	49°14.6'	119°43.1'	Nimpit L.	tan coloured trachytic lava
MAN 67	49°14.5'	119°42.9'	Kearns Cr.	brown weathered vesicular basaltic lava
MAN 68	49°14.5'	119°43.0'	Kearns Cr.	brown weathered massive basaltic lava
MAN 69	49°14.3'	119°42.8'	Nimpit L.	locally vesicular tan coloured trachytic lava
MAN 70	49°14.1'	119°42.8'		weathered crumbling brownish coloured vesicular lava
MAN 71	49°14.0'	119°42.8'		weathered crumbling brownish coloured vesicular lava
MAN 72	49°13.9'	119°42.8'	Kearns Cr.	basaltic lava
MAN 73	49°13.7'	119°42.8'	Kearns Cr.	brown vesicular lava
MAN 74	49°13.8'	119°42.7'	Park Rill	light brownish weathered merocrystalline andesitic lava
MAN 75	49°14.3'	119°43.0'	Kearns Cr.	brown weathered rubbly basaltic lava
MAN 76	49°13.2'	119°43.4'	unnamed	gray zeolitic dacitic tuff and related sedimentary beds
MAN 77	49°13.5'	119°43.4'	Kitley L.	beige coloured rubbly feldspar porphyry trachyandesite lava
MAN 78	49°13.7'	119°43.4'	unnamed	gray zeolitic dacitic tuff and brown limonitic sandstone
MAN 79	49°13.8'	119°43.4'	unnamed	gray rubbly dacitic tuff
MAN 80	49°13.1'	119°43.4'	Kearns Cr.	fresh dark coloured pyroxene-rich basaltic lava
MAN 81	49°12.8'	119°43.6'	Kitley L.	beige coloured massive feldspar porphyry trachyandesite lava

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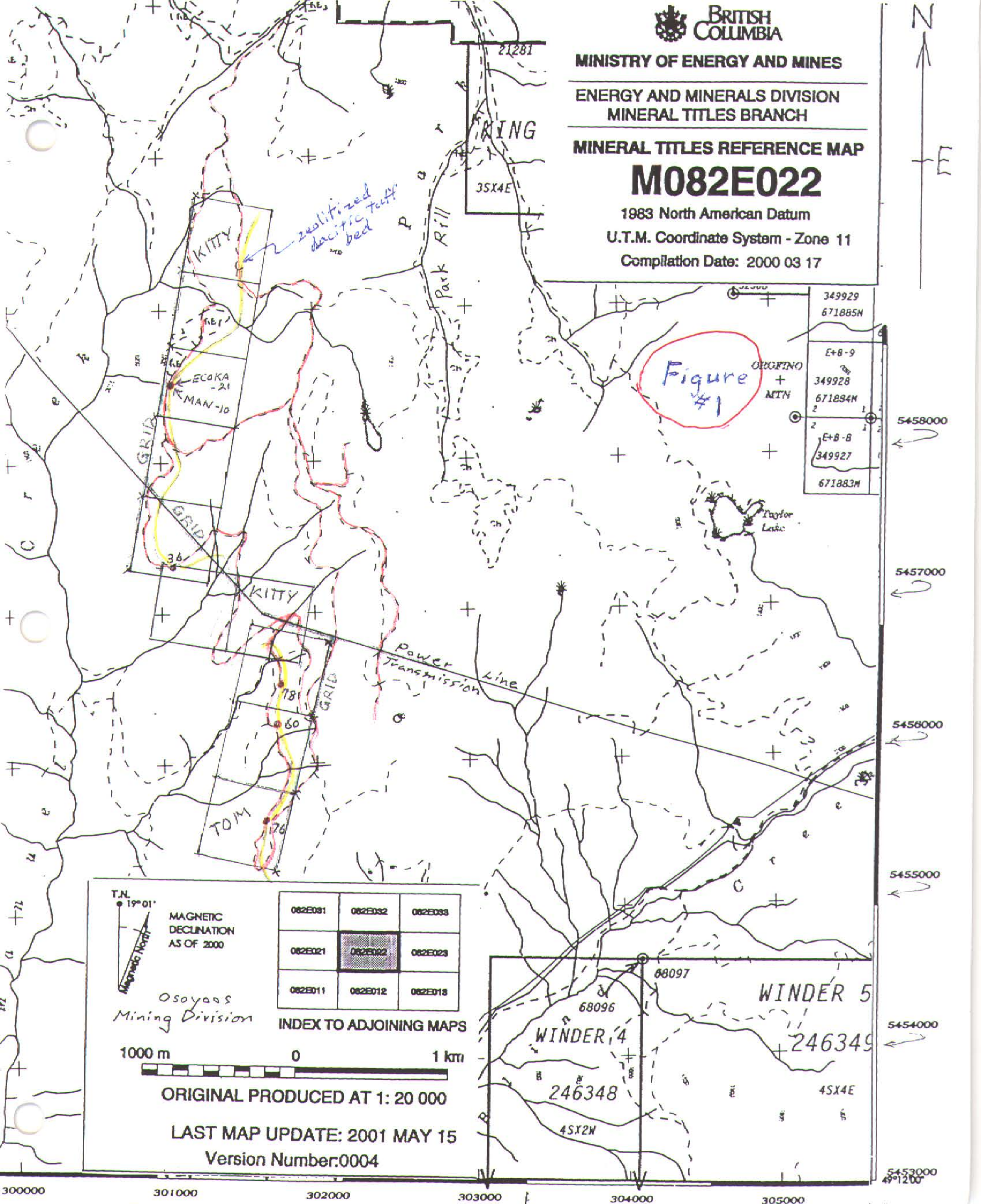

prospecting traverses (routes)

significant outcrops of zealitized tuff

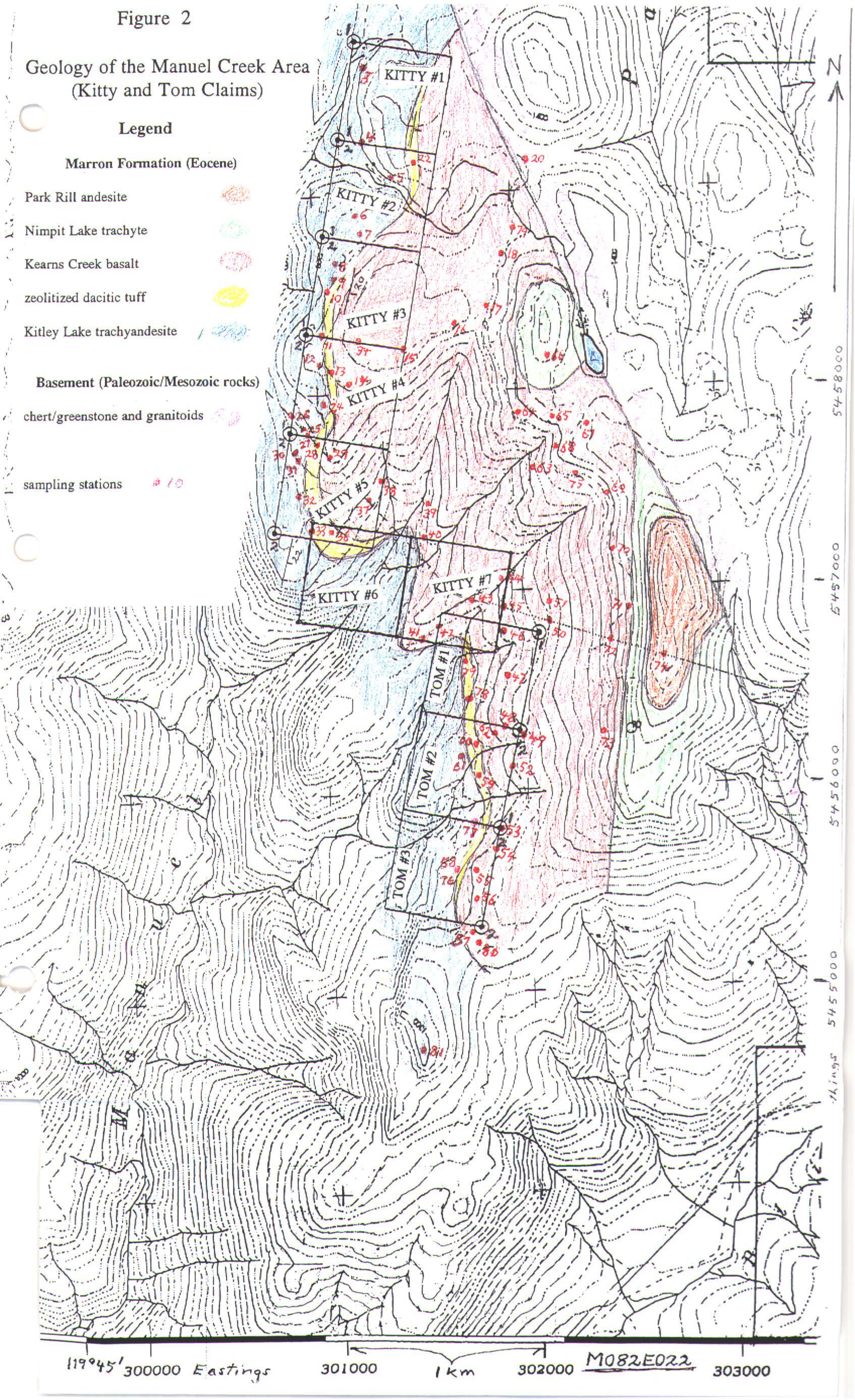

Figure 2

Geology of the Manuel Creek Area (Kitty and Tom Claims)

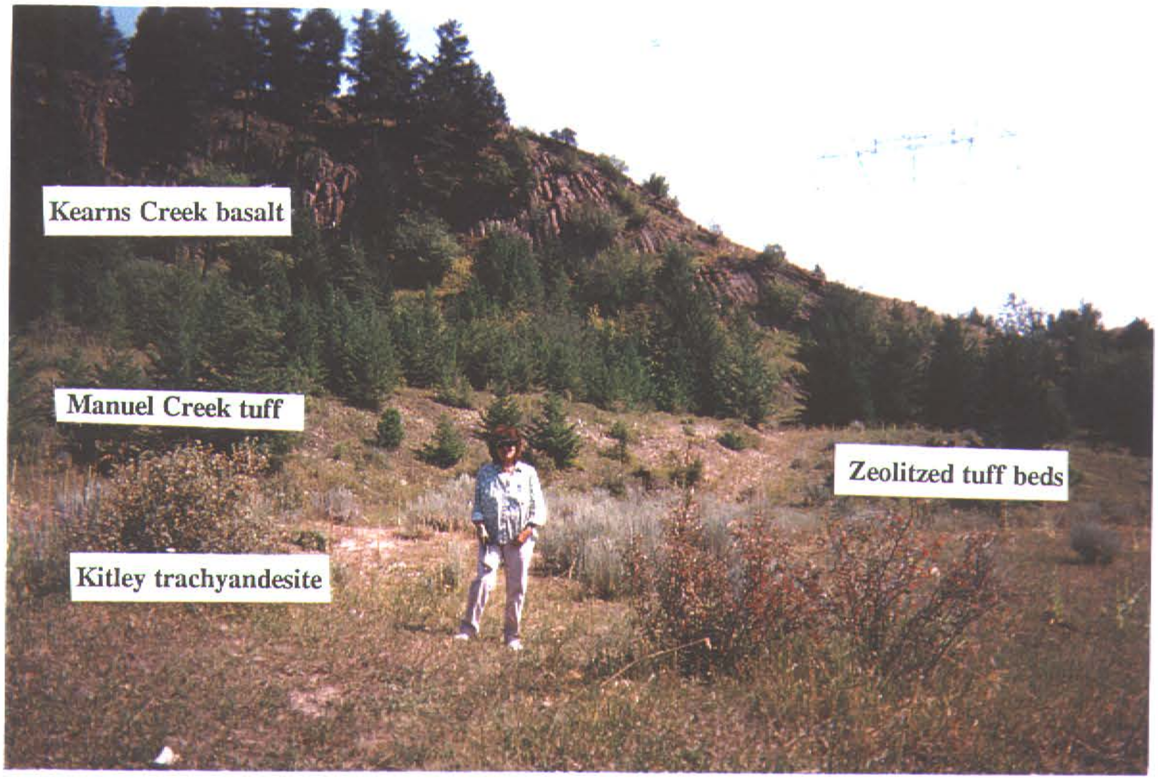

Photo 1 Zeolitzed tuff beds between Kearns Creek basalt and Kitley trachyandesite (sta. Man-28)

Photo 2 Intercalated zeolitized dacitic tuff and tuff breccia (sta. Man-10)

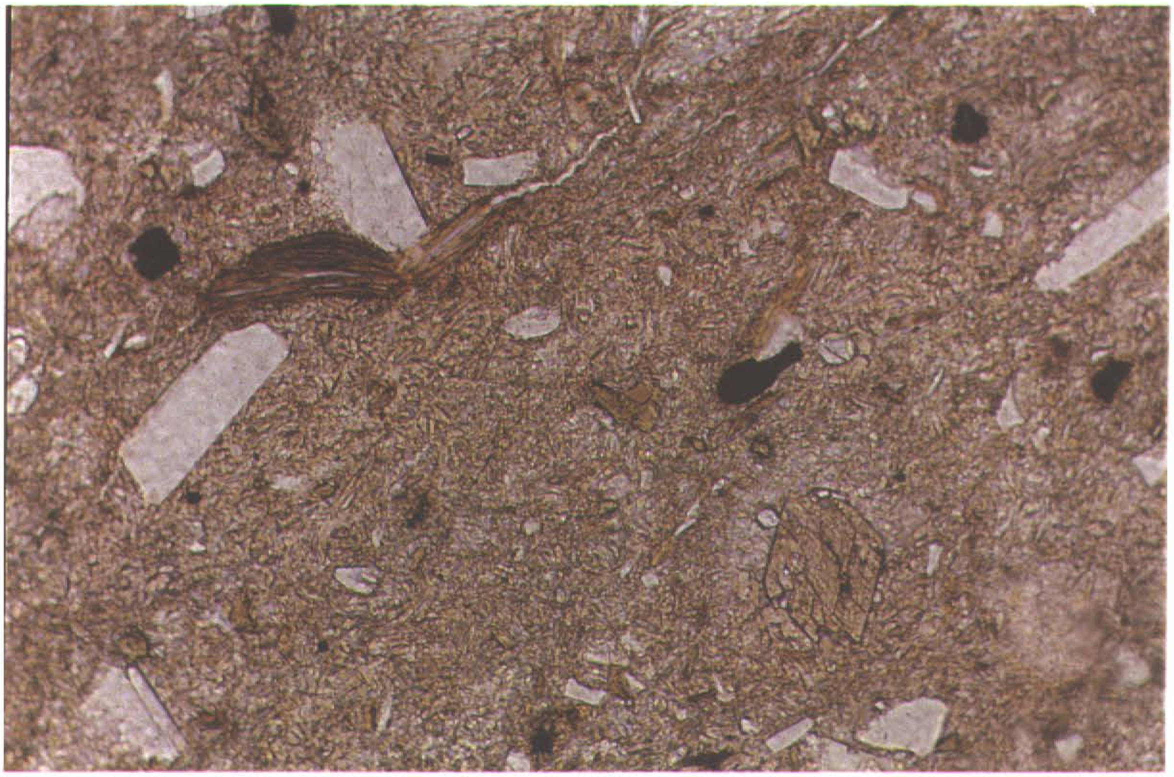

Photo 3 Photomicrograph of zeolitized dacitic crystal vitric tuff (sample Man-10b)

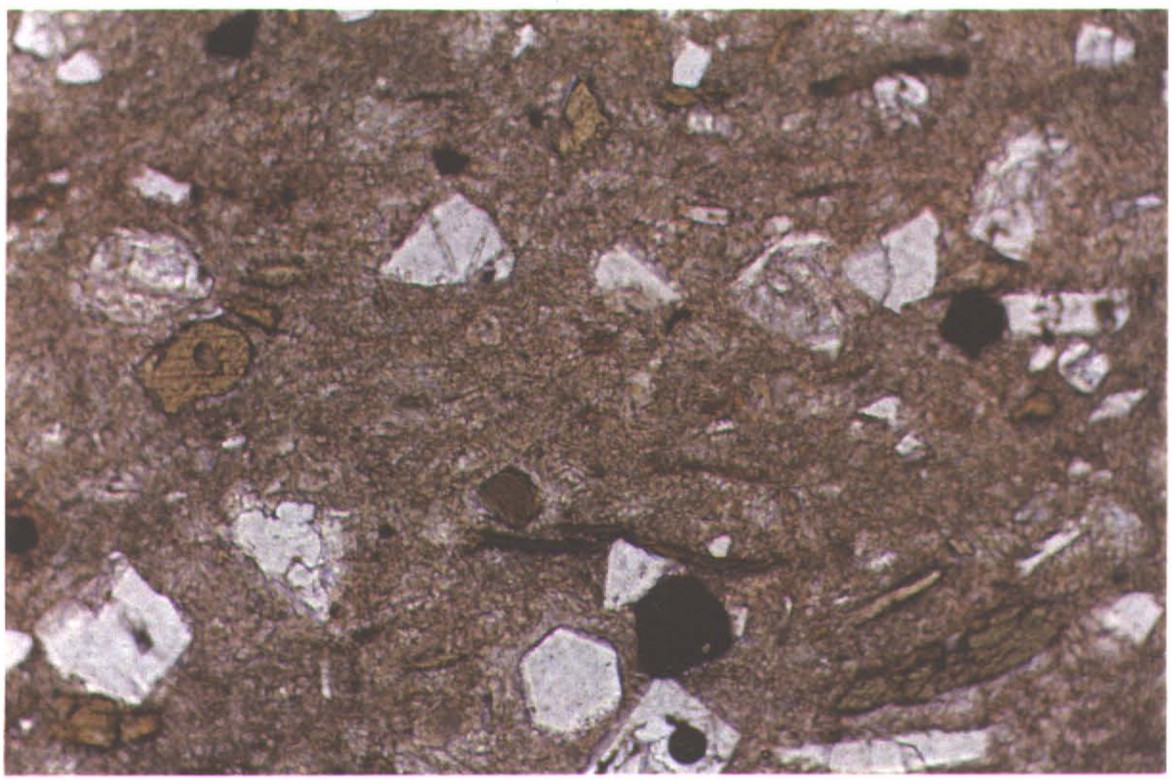

Photo 4 Photomicrograph - feldspar, biotite, and amphibole in shardy matrix (sample Man-10a)

Technical Report
Greenwood Project

D. TECHNICAL REPORT

BRITISH COLUMBIA

Ministry of Energy and Mines
Energy and Minerals Division

- One technical report to be completed for each project area.
- **Refer to Program Regulations 15 to 17, page 6.**

SUMMARY OF RESULTS

- This summary section must be filled out by all grantees, one for each project area

Information on this form is confidential for one year and is subject to the provisions of the *Freedom of Information Act*.

Name B. Neil Church Reference Number 01/02 - P73

LOCATION/COMMODITIES

Project Area (as listed in Part A) Greenwood MINFILE No. if applicable

Location of Project Area NTS M082E027 Lat 49°03' Long 118°42'

Description of Location and Access The project area is centred near Highway 3 in region between Greenwood extending south to the US boundary. The area is accessed by numerous farm and logging roads connected directly to Highway 3

Prospecting Assistants(s) - give name(s) and qualifications of assistant(s) (see Program Regulation 13, page 6)

nil

Main Commodities Searched For

suitable rock components for mineral wool fabrication

Known Mineral Occurrences in Project Area

WORK PERFORMED

1. Conventional Prospecting (area) 13 x 16 = 208 Km²
2. Geological Mapping (hectares/scale)
3. Geochemical (type and no. of samples) 42 silicate analyses
4. Geophysical (type and line km) nil
5. Physical Work (type and amount) claim staking (4)
6. Drilling (no. holes, size, depth in m, total m) nil
7. Other (specify)

FEEDBACK: comments and suggestions for Prospector Assistance Program

The B.C. Geological Survey Branch has been a guide and very helpful through the publication of professional reports and direct advice that has led to the current production of mineral wool, manufactured for thermal and acoustic insulation uses, at the Roxul plant at Grand Forks (see 'Possibilities for the Manufacture of Mineral Wool in British Columbia' by J.M. Cummings).

D. TECHNICAL REPORT (continued)

REPORT ON RESULTS

- Those submitting a copy of an Assessment Report or a report of similar quality that covers all the key elements listed below are not required to fill out this section.
- Refer to Program Regulation 17D on page 6 for details before filling this section out (use extra pages if necessary)
- **Supporting data must be submitted with the following TECHNICAL REPORT or any report accepted in lieu of.**

Information on this form is confidential for one year from the date of receipt subject to the provisions of the *Freedom of Information Act*.

Name B. N. Church Reference Number 01/02-P73

1. LOCATION OF PROJECT AREA [Outline clearly on accompanying maps of appropriate scale.]

The Greenwood project area extends south of the town of Greenwood to the U.S. boundary and includes the claims LOS 1-4 – see Mineral Titles Reference Map M082E007

2. PROGRAM OBJECTIVE [Include original exploration target.]

The objectives of this project is to delineate and evaluate rocks of suitable composition for the manufacture of mineral wool in the Greenwood-Grand Forks area.

3. PROSPECTING RESULTS [Describe areas prospected and significant outcrops/float encountered. Mineralization must be described in terms of specific minerals and how they occur. These details must be shown on accompanying map(s) of appropriate scale; prospecting traverses should be clearly marked.]

The results of this project are several and concern the supply of rock components for making rock wool.

(1) The main result stems from the discovery of Attwood Group basalts in the Greenwood area that are chemically equivalent to the 'Old Diorite', which is currently the principal ingredient used for the fabrication of mineral wool at the Roxul plant in Grand Forks. For example basalt samples nos. 25, 205 and 275 (from the Gidon Creek, Lind Valley and Winnipeg mine areas - Folders 4 and 5) are close to the 'Old Diorite' in composition and represent an alternative raw material source.

(2) The feldspathic phases of the 'Old Diorite', being enriched in labradorite and bytownite, provide a potentially ready alumina-rich component to supply mineral wool fabrication.

(3) The Park Rill andesite, which underlies much of the western part of the Greenwood area (i.e. stas. Wool-38, 39 and 40) has potential to provide an alternative source, substituting for the dacite that is in dwindling supply at the Roxul plant.

3. PROSPECTING RESULTS (continued)

The following observations are from prospecting in the Greenwood area in August and October.

A. Roxul Inc. began quarrying the 'Old Diorite' intrusion on the Winner c.g. claim located 3 km south of Phoenix, just south of the Winnipeg mine road. This development follows in part the recommendations of a consult's report (Church, 1999). The consequence is less reliance by Roxul's plant on the Grand Forks slag deposit which has been a costly component in the fabrication of mineral wool.

B. Sampling from the Winner quarry and Winnipeg mine gives results indicating that the 'Old Diorite' actually has gabbroic composition (Appendix I, Folder 5, analyses nos. 27, 28, 37). Also, in thin sections these rocks consist of partly altered pyroxene and amphibole (33 to 47%), magnetite and ilmenite (1-2%) and plagioclase (51-65%), with the composition of plagioclase ranging from labradorite (An_{60}) to bytownite (An_{85}). The chemistry of feldspar in this range is SiO_2 46-54%, Al_2O_3 27-34%, CaO 11-18%, Na_2O 2-5% (Deer, Howie and Zussman, 1964). Concentration of the feldpar can be readily achieved by crushing the gabbro and subtracting the ferromagneisn fraction by magnetic or/and gravity methods. This produces a high alumina fraction of potential value as a raw material in the preparation of mineral wool (personal communication, Andy Black, Quality Control Manager, Roxul Inc.).

C. The volcanics of the Permo-Carboniferous Attwood Group are typical of modern oceanic island-arcs that are composed mostly of andesite and basalt that have a tholeiitic fractionation trend. Further studies into the origin of these rocks suggest a heterogeneous spinel peridotite mantle source and pyroxene/ olivine fractionation (Dostal, Church and Hoy, 2001). This magmatic evolution produces aluminous lavas (i.e. see analysis L-329, on Table 2, page 81, in Dostal et al. 2001) which are, in part, compositionally analogous to the feldspathic phases of the 'Old Diorite' intrusions in the Greenwood area, and thus potential raw material for Roxul's mineral wool plant. In addition to sample L-329 from the western extremity of Mt. McLaren, prospecting in the Gidon Creek, Lind Valley and Winnipeg mine areas (samples nos. 25, 205 and 275) indicate that favourable aluminous Attwood Gp. basaltic rocks are widely distributed in the region (see map Figure 5 and the Tables in Folders 4 and 5 accompanying this report).

D. The Park Rill andesite is the uppermost member in the Marron Formation in the Penticton area where, in the type section, the unit ranges up to 500 m thick (Church, 1973). The rock is medium to dark brown, fine grained and massive - individual lava flows are distinguished with difficulty. In thin section the rock is composed of about equal parts glass and tabular microlites (< 1 to 3 mm) consisting of plagioclase, diopside and minor magnetite, biotite and/or hornblende. In the southern part of the Penticton Tertiary outlier, in the Manuel Creek area, the unit is faulted and altered. However, fresh exposures of the same unit are seen in cuts along Highway 3 in the area 6 to 8 km southwest of Greenwood (see stas. 38, 39 and 40 on map Figure 5). The Park Rill rocks are fine grained/glassy, which should facilitate refusion, supplementing the dacite that is currently supplied to the Roxul plant.

D. TECHNICAL REPORT (continued)

REPORT ON RESULTS (continued)

4. GEOCHEMICAL RESULTS [Describe all survey types done (rock, soil, silt) and their objective. Show clearly on accompanying map(s) of appropriate scale all sample sites along with all significant values. Any anomalous areas should be indicated on maps by the use of contouring, variable symbol sizes, or some other suitable technique. Include a discussion/interpretation of results. A copy of analysis/assay certificates **must** be included with sample numbers from map. Details of individual rock samples taken are encouraged. Significant geochemical values obtained must be stated.]

Silicate analyses for the Greenwood project are listed in Appendix I, Folders 4 and 5. These comprise 36 analyses of the Attwood Group volcanic rocks, 3 analyses of the 'Old Diorite' unit and 3 analyses of the Park Rill andesite.

Analyses of the 'Old Diorite', sampled from Winner pit (sample Wool-37) and the Winnipeg mine (Wool-27 and 28), shows that these rocks range in composition from average gabbro to anorthositic gabbro. It is these rocks, with SiO_2 content $\leq 50\%$ and $Al_2O_3 > 15\%$, that are used for the fabrication of mineral wool at the Roxul plant in Grand Forks.

The Attwood Group includes the volcanic equivalent of the 'Old Diorite' unit. The composition of the group is characterized by analyses nos. 5, 6, 7, 13, 22, 31, 124, 202, 246, 298, 426, 433 and 461 which includes a range of basalts and andesites. The 'Old Diorite' falls into this range and appears to be consanguous with some Attwood basaltic magmas (see analyses nos. 25, 27, 37, 205 and 275):

	Attwood Group	Attwood Basalts			'Old Diorite'	
	range	25	205	275	27	37
SiO_2	49.62 - 56.90	47.40	50.09	48.53	46.90	47.10
TiO_2	0.35 - 2.14	1.27	0.28	0.15	0.14	0.12
Al_2O_3	14.59 - 16.20	16.00	15.78	17.41	18.40	15.70
Fe_2O_3	8.96 - 12.68	10.10	8.75	7.99	7.96	9.41
MnO	0.08 - 0.22	0.20	0.17	0.15	0.17	0.15
MgO	4.89 - 8.61	5.91	9.50	9.84	9.94	11.40
CaO	1.14 - 10.81	14.20	10.06	11.32	10.90	12.20
Na_2O	1.61 - 4.75	3.13	2.26	1.97	1.99	0.74
K_2O	0.02 - 1.96	0.30	0.34	0.35	0.75	0.32

It is clear from this that some of the Attwood basalts could substitute for the 'Old Diorite' in Roxul's mineral wool process. However, this might require mapping of the Attwood volcanics in detail beyond what is currently available.

D. TECHNICAL REPORT (continued)

REPORT ON RESULTS (continued)

In addition to gabbro or basalt, rocks of intermediate composition provide an alternative source component for mineral wool fabrication. For example there is a local limited supply of dacite which is used at the Roxul plant.

Analyses of the Park Rill andesite (abundant near Greenwood) shows that this rock is compositionally similar and could substitute for the dacite:

	Roxul	Park Rill andesite		
	dacite	38	39	40
SiO_2	62.35	56.20	59.70	56.80
Al_2O_3	15.54	14.00	14.60	14.80
Fe_2O_3	3.98	6.63	5.98	6.33
MgO	1.27	4.84	3.68	3.66
CaO	2.67	5.80	5.25	5.71
Na_2O	3.98	2.73	3.36	3.50
K_2O	5.19	4.03	3.43	3.23
Other	5.02	5.77	4.00	5.97

The Park Rill andesite has the advantage of having a fine grained/glassy texture that should facilitate refusion.

5. OTHER RESULTS [**Drilling** - describe objective, type and amount of drilling done. Discuss results, including any significant intersections obtained. Indicate on a map of appropriate scale the drill-hole collar location, the angle of inclination and azimuth. Drill logs correlated with assay results must be included. **Physical Work** - describe the type and amount of physical work done and the reasons for doing it (where not self-evident). This includes lines/grids, trails, trenches, opencuts, undergound work, reclamation, staking of claims, etc. Discuss results where pertinent.]

Claim staking comprises the main 'physical work' of the Greenwood project. Four two-post claims were initially located on the Permian Attwood volcanic rocks, the 'old diorite' and the Tertiary Park Rill andesite. However, because of excessive snow condition on October 11th, only two of these, claims Low-3 and Low-4, were finally staked and recorded.

The Low-3 claim (Tenure No. 390296) is situated 3 km south by southwest from the town of Greenwood in the area immediately northeast of the Boundary Creek camp site. Access is directly from Highway 3.

The Low-4 claim (Tenure No. 390297) is 5.8 km southwest of Greenwood and 0.8 km northwest of the falls on Boundary Creek. Access is from the Baird gravel pit road.

Signature of Grantee Neil Church Date Jan 17th 2002

Signature of person filling out Final Prospecting Report if other than grantee

Table 2a Field Notes for Greenwood Prospecting Traverses

Field No.	Location Unit Description
WOOL 1	Boundary Falls area, Attwood Gp., black graphitic schistose metasediments, fol. 138°/31° NE
WOOL 2	Boundary Falls area, Attwood Gp., dark siliceous argillite and chert pebble conglomerate
WOOL 3	Boundary Falls, Lat 49°03.0' Long 118°40.5', Attwood Gp. dark blue-gray schist
WOOL 4	Boundary Falls area, Attwood Gp., graywacke, chert pebble conglomerate, beds 121°/34° NE
WOOL 5	Boundary Falls area, Attwood Gp., typical fine grained greenstone with cataclasic textures
WOOL 6	Boundary Falls area, Attwood Gp., typical fine grained greenstone with some carbonates
WOOL 7	Boundary Falls, Lat 49°03.2' Long 118°40.5', Attwood Gp., typical fine grained greenstone
WOOL 8	Boundary Falls, basic hornblende porphyry dike cutting serpentite
WOOL 9	McCarren Creek , Attwood Gp., altered carbonated greenstone (on main road)
WOOL 10	McCarren Creek , Attwood Gp., light gray brittle metasedimentary rocks (on power line)
WOOL 11	McCarren Creek, Lat 49°02.1' Long 118°41.6', Brooklyn Gp?, microdiorite dike
WOOL 12	McCarren Creek, Attwood Gp., mottled green epidotized volcanic breccis (on power line)
WOOL 13	McCarren Creek, Attwood Gp., typical fine grained chloritized greenstone (on power line)
WOOL 14	McCarren Creek, Attwood Gp?, gray microdiorite dike (on power line)
WOOL 15	McCarren Creek, Lat 49°02.0' Long 118°41.0', Attwood Gp., greenstone (on gas pipe line)
WOOL 16	McCarren Creek, Lat 49°02.0' Long 118°41.1' Brooklyn Gp?, andesite dike, (gas pipe line)
WOOL 17	McCarren Creek, Lat 49°01.9' Long 118°41.2', Attwood Gp., greenstone (on gas pipe line)
WOOL 18	McCarren Creek, Attwood Gp?, gray microdiorite dike (on gas pipe line)
WOOL 19	McCarren Creek, Lat 49°01.8' Long 118°41.3', Attwood Gp., diabase dike (on gas pipe line)
WOOL 20	McCarren Creek, Attwood Gp., fine grained, brittle gray greenstone (on gas pipe line)
WOOL 21	McCarren Creek, Lat 49°01.8' Long 118°41.5', Attwood Gp., greenstone (on gas pipe line)
WOOL 22	Rusty Mtn., Lat 49°00.7' Long 118°37.6', Attwood Gp., typical fine grained greenstone
WOOL 23	Rusty Mtn., Lat 49°00.7' Long 118°37.5', Attwood Gp., epidotized greenstone
WOOL 24	Rusty Mtn., Lat 49°00.6' Long 118°37.5', Attwood Gp? gray granular diabase
WOOL 25	Gidon Creek, Lat 49°01.3' Long 118°38.5', Attwood Gp., greenstone /// Winner gabbro
WOOL 26	Winnipeg Mine, Lat 49°04.4' Long 118°34.4', Attwood Gp., greenstone drill core
WOOL 27	Winnipeg Mine, 'Old Diorite' medium grained anorthositic gabbro
WOOL 28	Winnipeg Mine, 'Old Diorite' medium grained gabbro
WOOL 29	Lind Valley, Lat 49°04.4' Long 118°39.6', Attwood Gp., massive pyritiferous greenstone
WOOL 30	Lind Valley, Lat 49°04.2' Long 118°38.3', Attwood Gp., silicified basaltic andesite
WOOL 31	Lind Valley, Lat 49°04.5' Long 118°38.6', Attwood Gp., typical fine grained greenstone
WOOL 32	Lind Valley, Lat 49°04.0' Long 118°36.2', Attwood Gp., typical fine grained greenstone
WOOL 33	Skeff Creek, Lat 49°03.9' Long 118°35.4', Attwood Gp?, silicified andesite
WOOL 34	Skeff Creek, Lat 49°03.9' Long 118°35.4', Attwood Gp., massive greenstone
WOOL 35	Hartford Junction, Lat 49°04.8' Long 118°35.7', Attwood Gp., massive greenstone
WOOL 36	Hartford Junction, Lat 49°04.8' Long 118°35.5', Attwood Gp., massive greenstone
WOOL 37	Winner claim, Lat 49°04.3' Long 118°35.4', 'Old Diorite' medium grained gabbro
WOOL 38	Boundary Creek, Lat 49°02.1' Long 118°43.4', Park Rill Mbr., merocrystalline andesite
WOOL 39	Boundary Creek, Lat 49°01.5' Long 118°44.2', Park Rill Mbr., merocrystalline andesite
WOOL 40	Boundary Creek, Lat 49°01.1' Long 118°44.7', Park Rill Mbr., merocrystalline andesite
WOOL 41	Boundary Creek area, Attwood Gp., massive greenstone
WOOL 42	Boundary Creek area, 'Old Diorite', medium grained gabbro
WOOL 43	Lotzkar Park, Greenwood slag deposit

Table 2b Notes for Greenwood Ancillary Sampling Stations

Sample No.	Location Unit Description
GNW 80	Gibbs Creek area, Brookln Gp., dacitic dike cutting Attwood black shales
90	Winnipeg Mine, Attwood Gp., Greenstone from drill core
124	Idaho Mine pit, Lat 49°05.9' Long 118°36.8', Attwood Gp., typical feeder diabase dike
202	Lind Valley, Attwood Gp., typical massive fine grained greenstone
205	Lind Valley, Attwood Gp., massive brittle greenstone, similar composition to Winner gabbro
207	Lind Valley, Brooklyn Gp?, diorite/microdiorite intrusion
246	Keno claim, Lat 49°03.9' Long 118°35.3', Attwood Gp., typical fine grained greenstone
275	Winnipeg Mine area, Lat 49°05.0' Long 118°33.6', 'Old Diorite', anorthositic gabbro
296	Rusty Mountain, Attwood Gp., silicified basaltic andesite
298	Rusty Mountain, Lat 49°01.2' Long 118°39.3', Attwood Gp., typical fine grained greenstone
303	Lind Valley, Lat 49°04.2' Long 118°35.8', 'Old Diorite', medium grained gabbro
313	Haulage road, 'Old Diorite', medium grained locally rusty weathered gabbro
314	Hartford Junction, Attwood Gp., poss. feeder gabbroic intusion
426	Lind Valley , Attwood Gp., typical massive fine grained greenstone
427	Lind Valley, Lat 49°04.2' Long 118°39.9', Attwood Gp., sheared metasedimentary rocks
433	Porter Creek area, Attwood Gp., typical fine grained greenstone
461	Porter Creek area, Attwood Gp., typical fine grained greenstone
645	Haas Creek area, Attwood Gp., fine grained greenstone

References

Church, B.N. (1986): Geology and Mineralization in the Mount Attwood - Phoenix Area, Greenwood, British Columbia; British Columbia Ministry of Energy, Mines and Petroleum Resources, Paper 1982-2, 65 pages.

Church, B.N. (1999): Overview of Mafic Magmatic Rocks in the Grand Forks Area of South-Central British Columbia and Northern Washingston State; private company report for Rockwool International, Hedehusene, Denmark, 13 pages.

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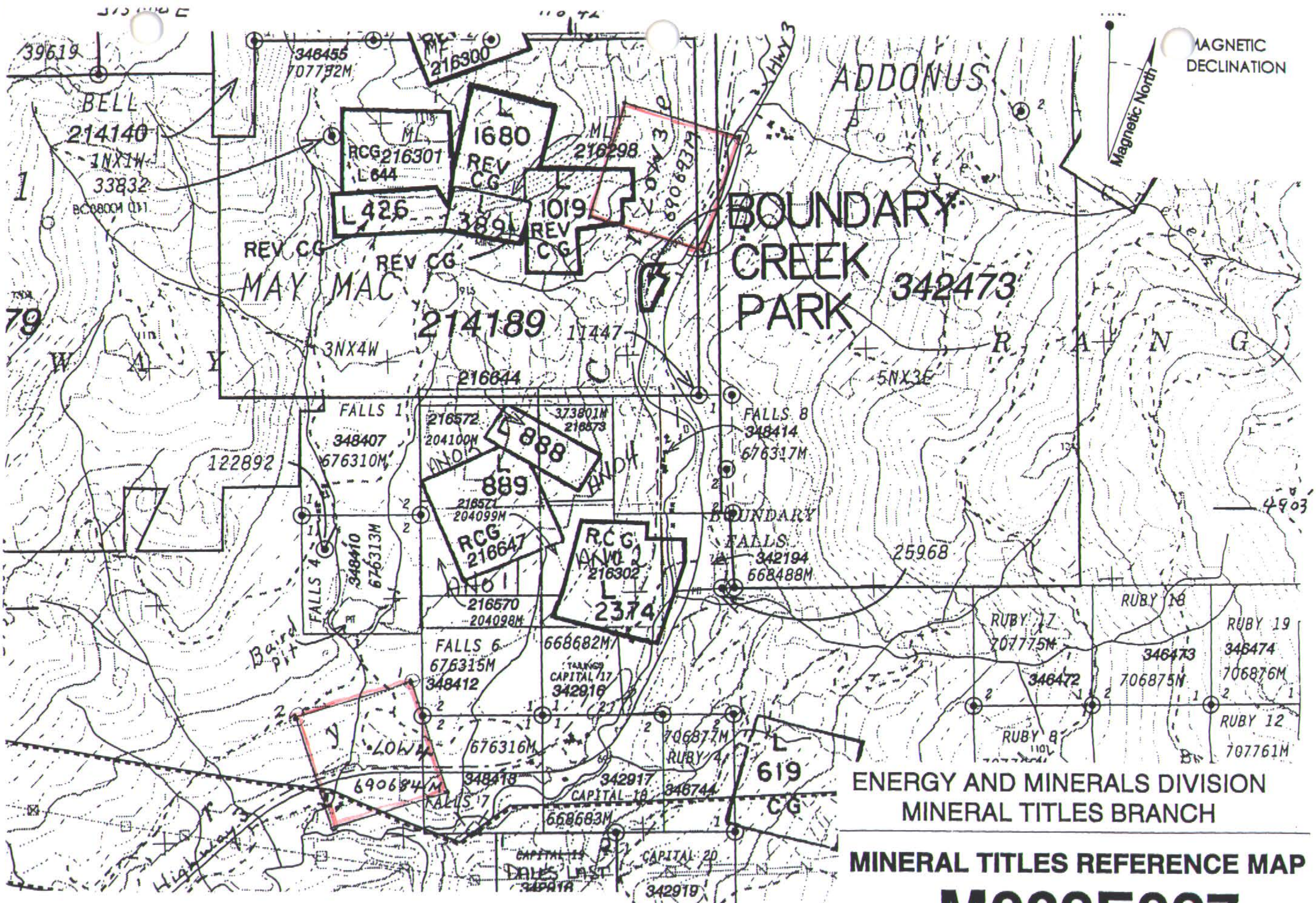

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ORIGINAL PRODUCED AT 1: 20 000

ENERGY AND MINERALS DIVISION
MINERAL TITLES BRANCH

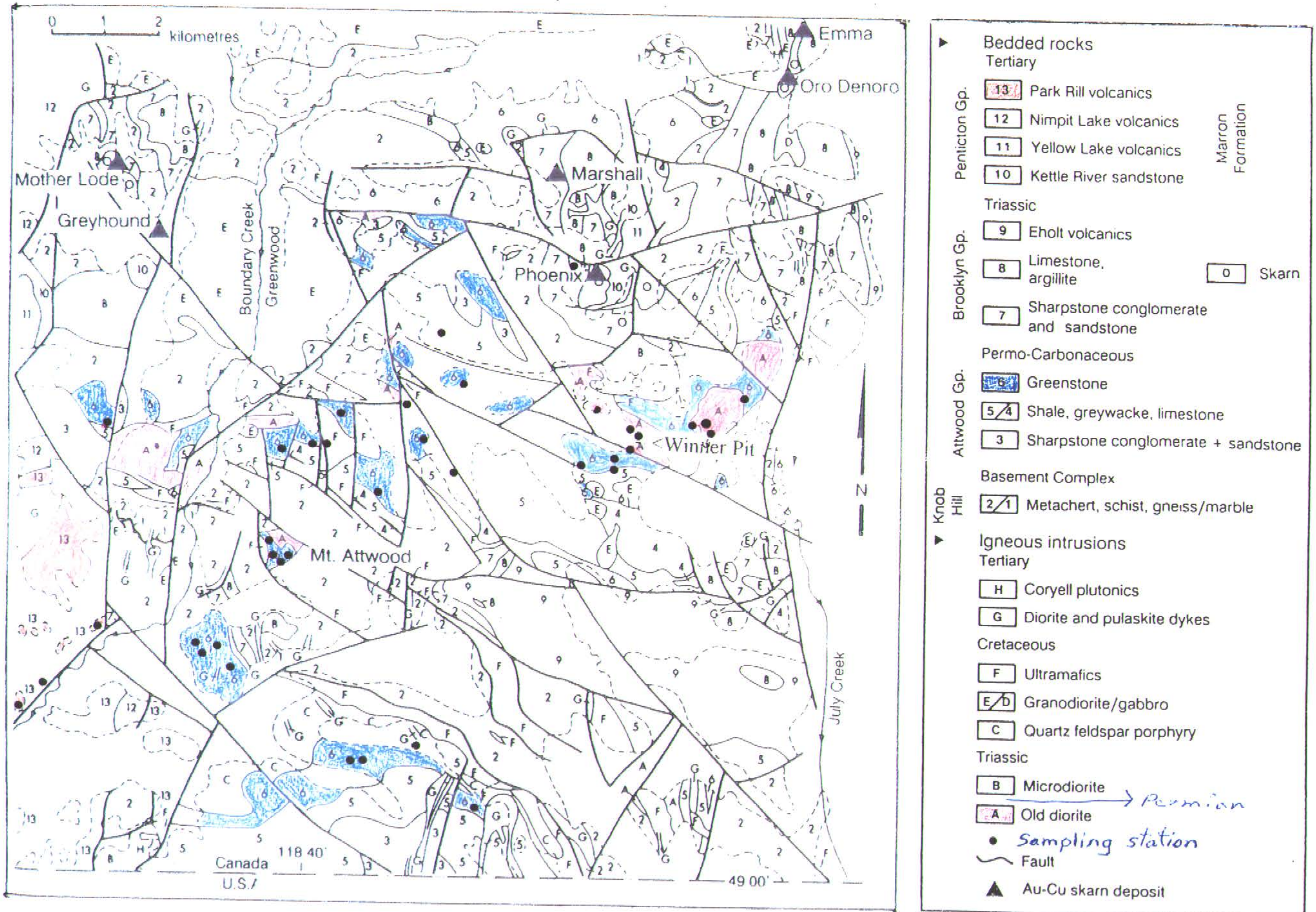
MINERAL TITLES REFERENCE MAP

M082E007

1983 North American Datum

U.T.M. Coordinate System - Zone 11

Figure 4 Distribution of Sampling Localities in the Greenwood Area



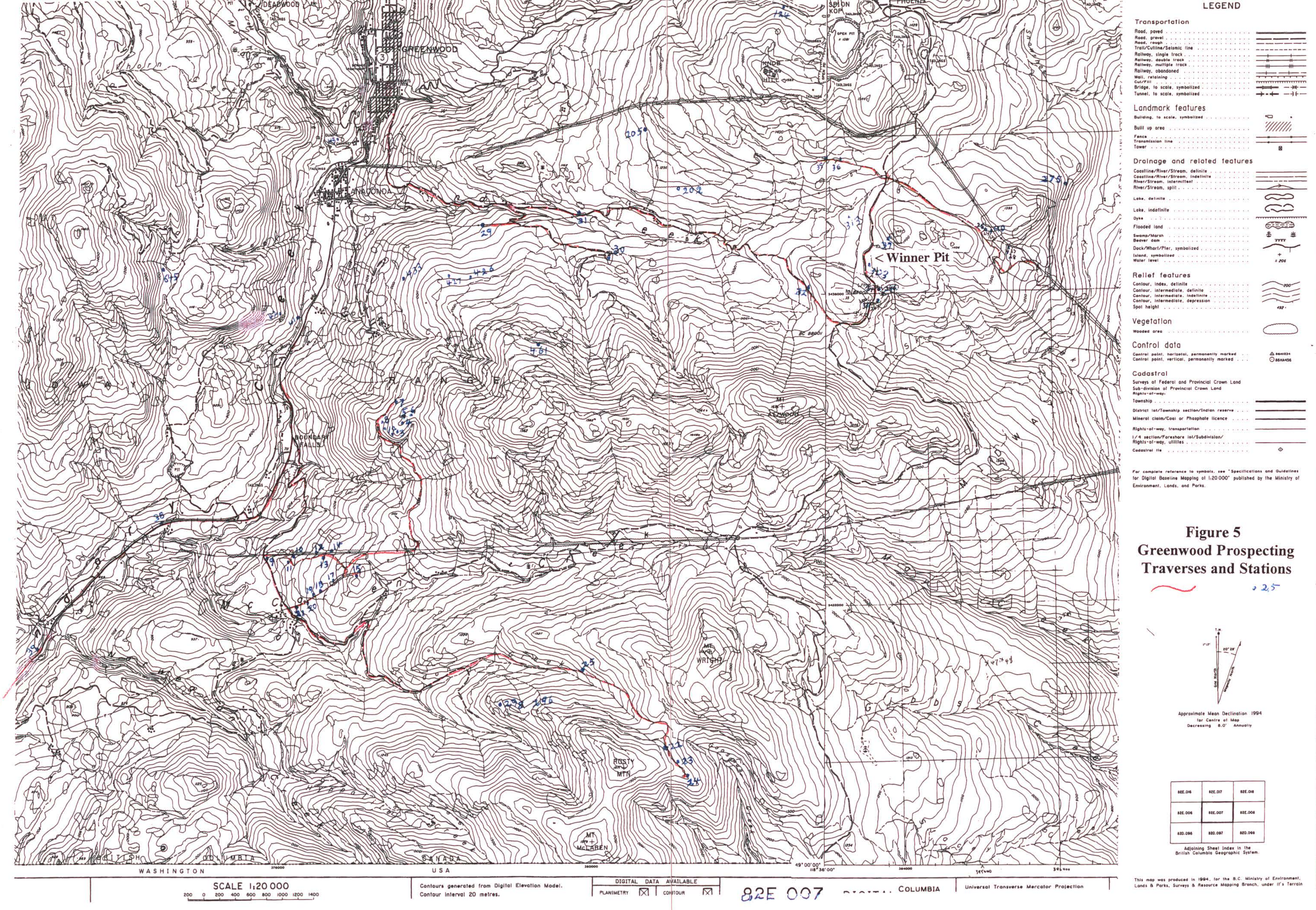


Figure 5
Greenwood Prospecting Traverses and Stations

Photos 5 and 6 Roxul (West) Inc. office and plant, Industrial Parkway, Grand Forks, B.C.

Photo 7 Panorama of Roxul Inc., 'Old Diorite' quarry site, Winner c.g. claim (sta. Wool-37)

Photo 8 Photomicrograph of Park Rill andesite with plagioclase, pyroxene and ore in glassy matrix

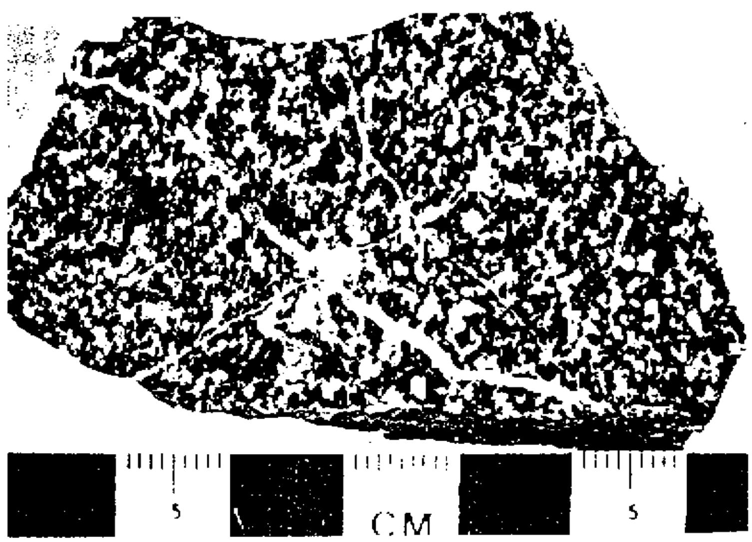


Photo 9 'Old Diorite' showing ophitic intergrowth of plagioclase, pyroxene and amphibole

Appendix I Laboratory Results

teckcominco

J.A. McLeod
Manager, Exploration Technical Services

B. Neil Church
600 Parkridge Street
Victoria, B.C.
V8Z 6N7

11 September, 2001

Dear Neil: ***RE: Eocene (Ecoka/Man) Samples / E.R.L. Job V01-322R***

Twenty (20 samples of Eocene tuffaceous rocks were received for X-ray diffraction study (XRD) with emphasis on zeolite mineral characterization.

LAB NO.	***FIELD NO.***
R01:4168	ECOKA 21A
R01:4169	ECOKA 21B
R01:4170	ECOKA 22B
R01:4171	ECOKA 22C
R01:4172	MAN 10B
R01:4173	MAN 12D
R01:4174	MAN 22
R01:4175	MAN 28A
R01:4176	MAN 28B
R01:4177	MAN 31
R01:4178	MAN 33A
R01:4179	MAN 36
R01:4180	MAN 38
R01:4181	MAN 58
R01:4182	MAN 59
R01:4183	MAN 60A
R01:4184	MAN 60B
R01:4185	MAN 76
R01:4186	MAN 78A
R01:4187	MAN 78B

The samples were split into two fractions. One split was pulverized and was then analyzed by X-ray diffraction. The remaining portion will be kept for possible further analyses.

Random mounts of powdered samples were prepared. X-ray diffraction analysis was performed using a SIEMENS D-500 automated diffractometer with Cu K alpha 1 radiation and a Ni-filter. The X-ray diffraction patterns were collected by step scanning from 5° 2θ to 60° 20θ. The data was interpreted manually using Powder Diffraction Data for Minerals (1974, 1981) as references.

The zeolite group minerals proved to be:

1. Clinoptilolite – $(Na,K,Ca)_{2\text{-}3}Al_3(Al,Si)_2Si_{13}O_{36}12H_2O$ and
2. Wairakite – $CaAl_2Si_4O_{12}2H_2O$ (calcium analogue of Analcime)

No other zeolites were found to be present.

The whole rock X-ray diffraction study results are presented in the attached Table 1.

The X-ray diffraction patterns are attached.

Yours truly,

J.A. McLeod, M.A.Sc., P.Eng.
Manager, Exploration Technical Services
E.R.L.

JAM/skw

App. (Table 1)
Att. (diffractograms)

TABLE 1.

X-RAY DIFFRACTOMETRY STUDY RESULTS

ERL LAB NO	FIELD NO	MINERALS					
R01:4168	Ecoka 21a	Clinoptilotlite (s)	Quartz (mo)	Plagioclase Oligoclase? (mo)	Amphibole Hornblende (vm)	Smectite (mi)	
R01:4169	Ecoka 21b	Clinoptilotlite (s)	Quartz (mo)	Andesine Oligoclase (mo)	Smectite (mi)		
R01:4170	Ecoka 22b	Quartz (mo)	Plagioclase Oligoclase? (mo)	Amphibole Hornblende (vm)	Smectite (vm)	Mica (vm)	
R01:4171	Ecoka 22c	Quartz (mo)	Plagioclase Oligoclase? (mo)	Amphibole Hornblende (vm)	Smectite (vm)	Mica (vm)	
R01:4172	Man 10b	Clinoptilolite (s)	Quartz (mo)	Plagioclase (mi)	Smectite (mi)		
R01:4173	Man 12d	Quartz (mo)	Plagioclase Oligoclase? (mo)	Smectite (mi)	Hornblende ? (vm)	Mica (vm)	
R01:4174	Man 22	Sanidine (s)	Plagioclase Albite? (mo)	Smectite (mo)	Mica Biotite? (mi)	Wairakite (mi)	
R01:4175	Man 28a	Plagioclase Albite (s)	Sanidine (mo)	Clinoptilolite (mi)	Wairakite (mi)	Smectite (mo)	
R01:4176	Man 28b	Quartz (mo)	Plagioclase Oligoclase? (mo)	Clinoptilolite (mi)	Hornblende ? (vm)	Smectite (mi)	
R01:4177	Man 31	Wairakite (s)	Orthoclase (mi)	Smectite (mi)	Diopside? (mi)		
R01:4178	Man 33a	Quartz (mo)	Plagioclase Oligoclase? (mo)	Clinoptilolite (mi)	Hornblende ? (vm)		
R01:4179	Man 36	Quartz (mo)	Plagioclase Oligoclase? (mo)	Clinoptilolite (mo)	Hornblende ? (vm)	Smectite (mi)	
R01:4180	Man 38	Sanidine (s)	Plagioclase (mi)	Quartz (mi)	Smectite (mo)	Clinoptilolite (mi)	Diopside? (mi)
R01:4181	Man 58	Quartz (mo)	Plagioclase Albite? (mo)	Sanidine (mo)	Clinoptilolite (mi)	Smectite (mi)	

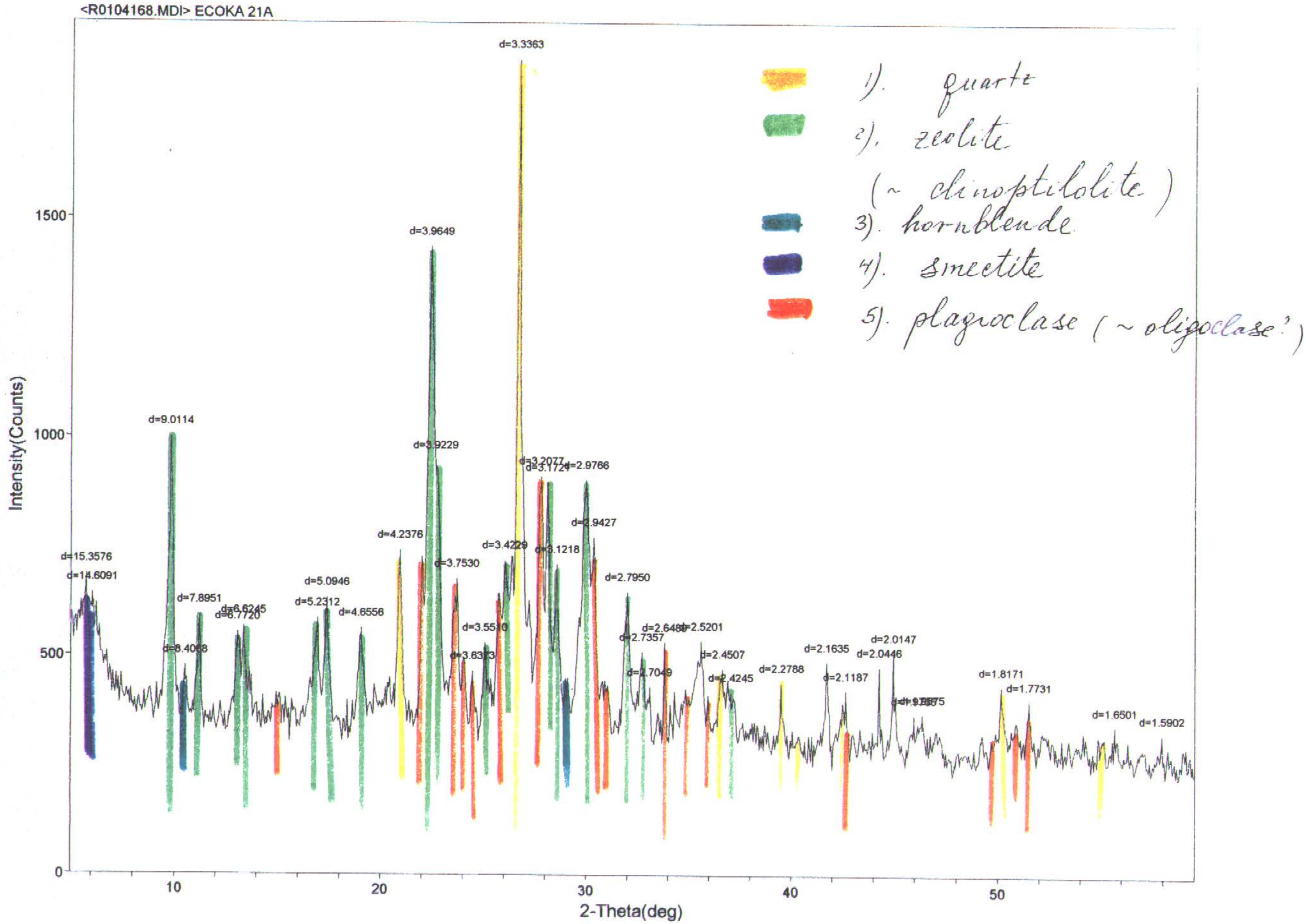
(s) - significant
(mo) - moderate
(mi) - minor
(vm) - very minor

TABLE 1.

X-RAY DIFFRACTOMETRY STUDY RESULTS

ERL LAB NO	FIELD NO	MINERALS					
R01:4182	Man 59	Wairakite (s)	Plagioclase Albite? (mo)	Sanidine (mo)	Smectite (mo)	Quartz (mi)	
R01:4183	Man 60a	Quartz (mo)	Sanidine (mo)	Plagioclase Albite? (mo)	Smectite (mo)	Pyroxene Hedenbergite? (mi)	
R01:4184	Man 60b	Wairakite (s)	Sanidine (mo)	Plagioclase Albite-Oligocl. (mo)	Smectite (mo)		
R01:4185	Man 76	Clinoptilolite (s)	Plagioclase Oligoclase? (s)	Quartz (mi)	Smectite (mi)		
R01:4186	Man 78a	Sanidine (s)	Plagioclase Albite? (s)	Smectite (mo)	Quartz (mi)	Clinoptilolite (mi)	Mica Biotite? (mi)
R01:4187	Man 78b	Clinoptilolite (s)	Plagioclase Albite-Oligocl.				

(s) - significant
(mo) - moderate
(mi) - minor
(vm) - very minor


<R0104168.MDI> ECOKA 21A
Intensity(Counts)
2-Theta(deg)
1). quartz
2). zeolite (~ clinoptilolite)
3). hornblende
4). smectite
5). plagioclase (~ oligoclase?)
d=3.3363
d=3.9649
d=9.0114
d=3.9229
d=3.2077
d=3.1724
d=2.9766
d=2.9427
d=4.2376
d=3.4229
d=3.1218
d=15.3576
d=14.6091
d=3.7530
d=5.0946
d=2.7950
d=7.8951
d=6.6245
d=6.7720
d=5.2312
d=4.6556
d=3.5510
d=8.4068
d=2.6480
d=2.5201
d=2.7357
d=2.0147
d=2.1635
d=2.0446
d=3.6373
d=2.4507
d=2.7049
d=2.4245
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d=2.1187
d=1.8171
d=1.7731
d=1.6501
d=1.5902

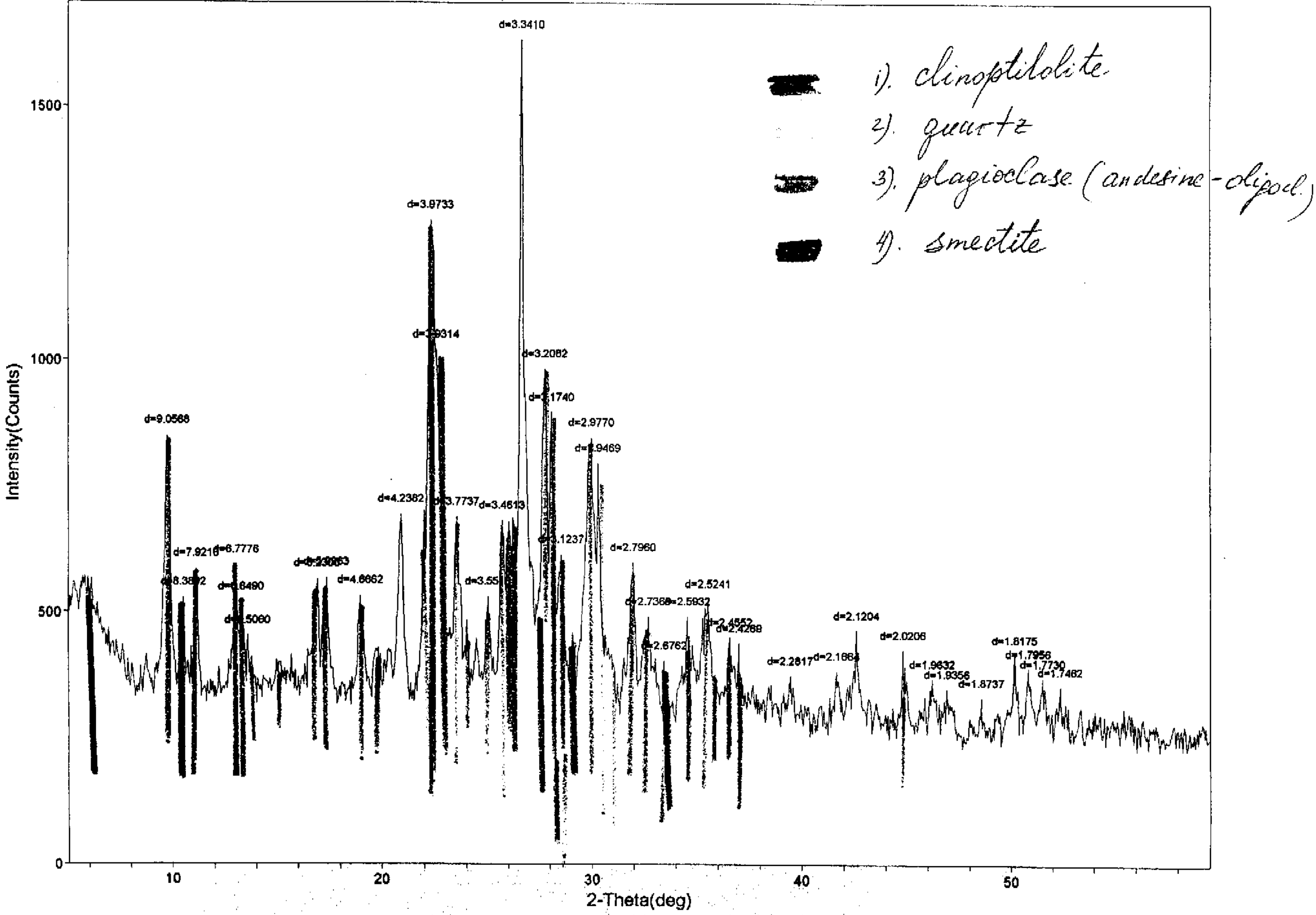
Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 1855, Anode = CU Date: 08-21-01@13:00

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.750	15.3576				541	130	10.0	30	5.3	0.180	>1000	1
2	6.045	14.6091				512	116	8.9	56	9.9	0.381	259	2
3	9.807	9.0114				382	605	46.6	188	33.7	0.247	650	3
4	10.514	8.4068				385	77	5.9	9	1.5	0.089	>1000	4
5	11.198	7.8951				368	210	16.2	39	6.9	0.147	>1000	5
6	13.063	6.7720				361	179	13.8	46	8.2	0.204	>1000	6
7	13.355	6.6245				350	205	15.8	59	10.5	0.228	786	7
8	16.935	5.2312				357	216	16.7	61	10.9	0.224	717	8
9	17.393	5.0946				354	266	20.5	71	12.7	0.213	883	9
10	19.047	4.6556				365	185	14.3	53	9.5	0.228	623	10
11	20.946	4.2376				372	357	27.5	84	14.9	0.186	>1000	11
12	22.405	3.9649				395	1029	79.3	556	100.0	0.432	205	12
13	22.648	3.9229				408	527	40.6	253	45.3	0.383	239	13
14	23.688	3.7530				418	246	19.0	57	10.2	0.185	>1000	14
15	24.453	3.6373				376	76	5.9	9	1.5	0.090	>1000	15
16	25.056	3.5510				382	135	10.4	22	3.8	0.127	>1000	16
17	26.010	3.4229				588	118	9.1	19	3.3	0.125	>1000	17
18	26.697	3.3363				558	1297	100.0	311	55.9	0.192	904	18
19	27.789	3.2077				489	411	31.7	110	19.8	0.214	609	19
20	28.107	3.1721				465	420	32.4	101	18.2	0.192	843	20
21	28.569	3.1218				538	159	12.3	22	3.9	0.110	>1000	21
22	29.995	2.9766				419	472	36.4	256	45.9	0.432	205	22
23	30.349	2.9427				369	391	30.1	122	21.8	0.248	437	23
24	31.995	2.7950				374	260	20.0	70	12.4	0.213	577	24
25	32.707	2.7357				371	126	9.7	24	4.2	0.147	>1000	25
26	33.091	2.7049				342	74	5.7	9	1.5	0.089	>1000	26
27	33.810	2.6489				348	171	13.2	16	2.8	0.073	>1000	27
28	35.596	2.5201				355	167	12.9	49	8.7	0.231	475	28
29	36.639	2.4507				343	115	8.9	33	5.8	0.225	493	29
30	37.048	2.4245				339	66	5.1	20	3.6	0.241	439	30
31	39.513	2.2788				296	131	10.1	19	3.4	0.114	>1000	31
32	41.715	2.1635				304	171	13.2	27	4.8	0.125	>1000	32
33	42.638	2.1187				302	107	8.2	18	3.1	0.127	>1000	33
34	44.263	2.0446				292	172	13.3	18	3.1	0.081	>1000	34
35	44.957	2.0147				283	215	16.6	38	6.7	0.138	>1000	35
36	45.947	1.9735				281	73	5.6	9	1.4	0.088	>1000	36
37	46.344	1.9575				279	77	5.9	16	2.8	0.160	974	37
38	50.162	1.8171				283	137	10.6	24	4.2	0.137	>1000	38
39	51.499	1.7731				288	99	7.6	17	3.0	0.135	>1000	39
40	55.654	1.6501				268	62	4.8	7	1.2	0.087	>1000	40
41	57.946	1.5902				243	70	5.4	8	1.4	0.090	>1000	41
@	End-of-List												

<R0104169.MDI> ECOKA 21B

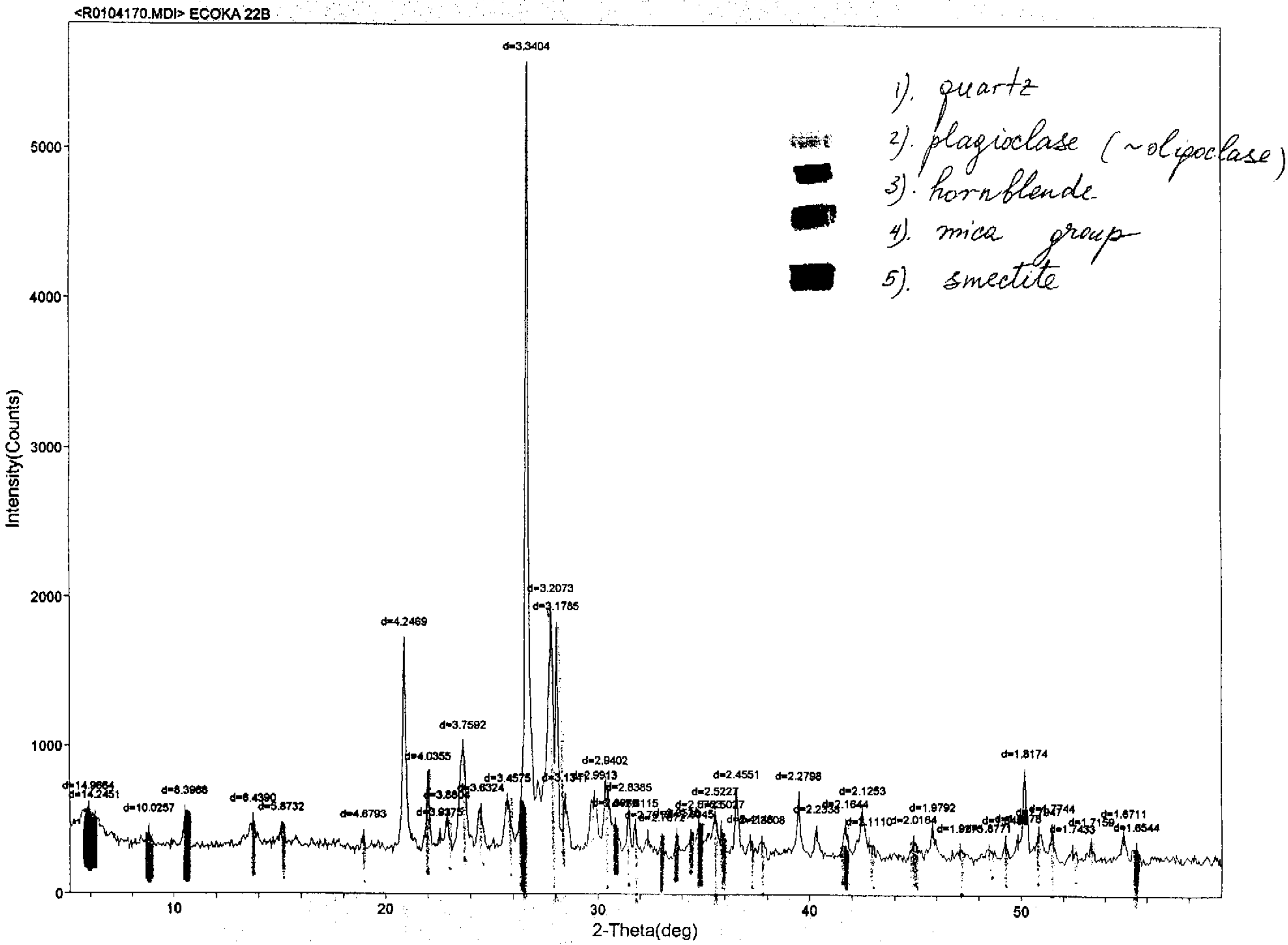


Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 1623, Anode = CU Date: 08-21-01@14:43

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	9.758	9.0568				373	466	44.3	161	33.4	0.275	465	1
2	10.536	8.3892				381	136	12.9	17	3.4	0.096	>1000	2
3	11.160	7.9216				364	210	19.9	39	8.0	0.146	>1000	3
4	13.052	6.7776				348	233	22.1	61	12.5	0.206	>1000	4
5	13.305	6.6490				348	160	15.2	76	15.8	0.380	250	5
6	13.599	6.5060				353	88	8.4	10	2.0	0.089	>1000	6
7	16.939	5.2300				344	211	20.0	94	19.4	0.353	272	7
8	17.387	5.0963				351	207	19.7	61	12.6	0.235	600	8
9	19.003	4.6662				354	168	16.0	48	9.9	0.226	640	9
10	20.943	4.2382				353	331	31.4	102	21.1	0.245	496	10
11	22.357	3.9733				414	854	81.1	481	100.0	0.450	196	11
12	22.598	3.9314				436	574	54.5	246	51.2	0.343	277	12
13	23.556	3.7737				428	250	23.7	54	11.1	0.171	>1000	13
14	25.050	3.5518				387	133	12.6	28	5.6	0.163	>1000	14
15	25.716	3.4613				580	91	8.6	10	2.0	0.086	>1000	15
16	26.660	3.3410				570	1053	100.0	228	47.5	0.173	>1000	16
17	27.785	3.2082				491	481	45.7	136	28.2	0.225	541	17
18	28.090	3.1740				465	421	40.0	90	18.6	0.170	>1000	18
19	28.552	3.1237				525	78	7.4	10	2.1	0.102	>1000	19
20	29.991	2.9770				396	440	41.8	259	53.8	0.470	186	20
21	30.304	2.9469				366	420	39.9	180	37.3	0.341	273	21
22	31.983	2.7960				372	216	20.5	50	10.3	0.184	880	22
23	32.693	2.7369				362	119	11.3	30	6.1	0.198	677	23
24	33.456	2.6762				327	65	6.2	6	1.1	0.066	>1000	24
25	34.560	2.5932				348	133	12.6	22	4.5	0.130	>1000	25
26	35.537	2.5241				359	157	14.9	46	9.6	0.234	466	26
27	36.570	2.4552				331	108	10.3	17	3.5	0.126	>1000	27
28	37.011	2.4269				324	103	9.8	16	3.1	0.117	>1000	28
29	39.460	2.2817				297	65	6.2	13	2.6	0.151	>1000	29
30	41.655	2.1664				302	70	6.6	9	1.8	0.099	>1000	30
31	42.602	2.1204				304	149	14.2	34	7.0	0.180	743	31
32	44.817	2.0206				277	137	13.0	21	4.3	0.120	>1000	32
33	46.202	1.9632				295	61	5.8	8	1.6	0.100	>1000	33
34	46.901	1.9356				268	68	6.5	9	1.7	0.095	>1000	34
35	48.548	1.8737				256	63	6.0	7	1.4	0.088	>1000	35
36	50.150	1.8175				289	116	11.0	18	3.7	0.123	>1000	36
37	50.806	1.7956				294	84	8.0	16	3.1	0.144	>1000	37
38	51.502	1.7730				287	71	6.7	9	1.9	0.100	>1000	38
39	52.350	1.7462				272	70	6.6	8	1.6	0.089	>1000	39
@	End-of-List												

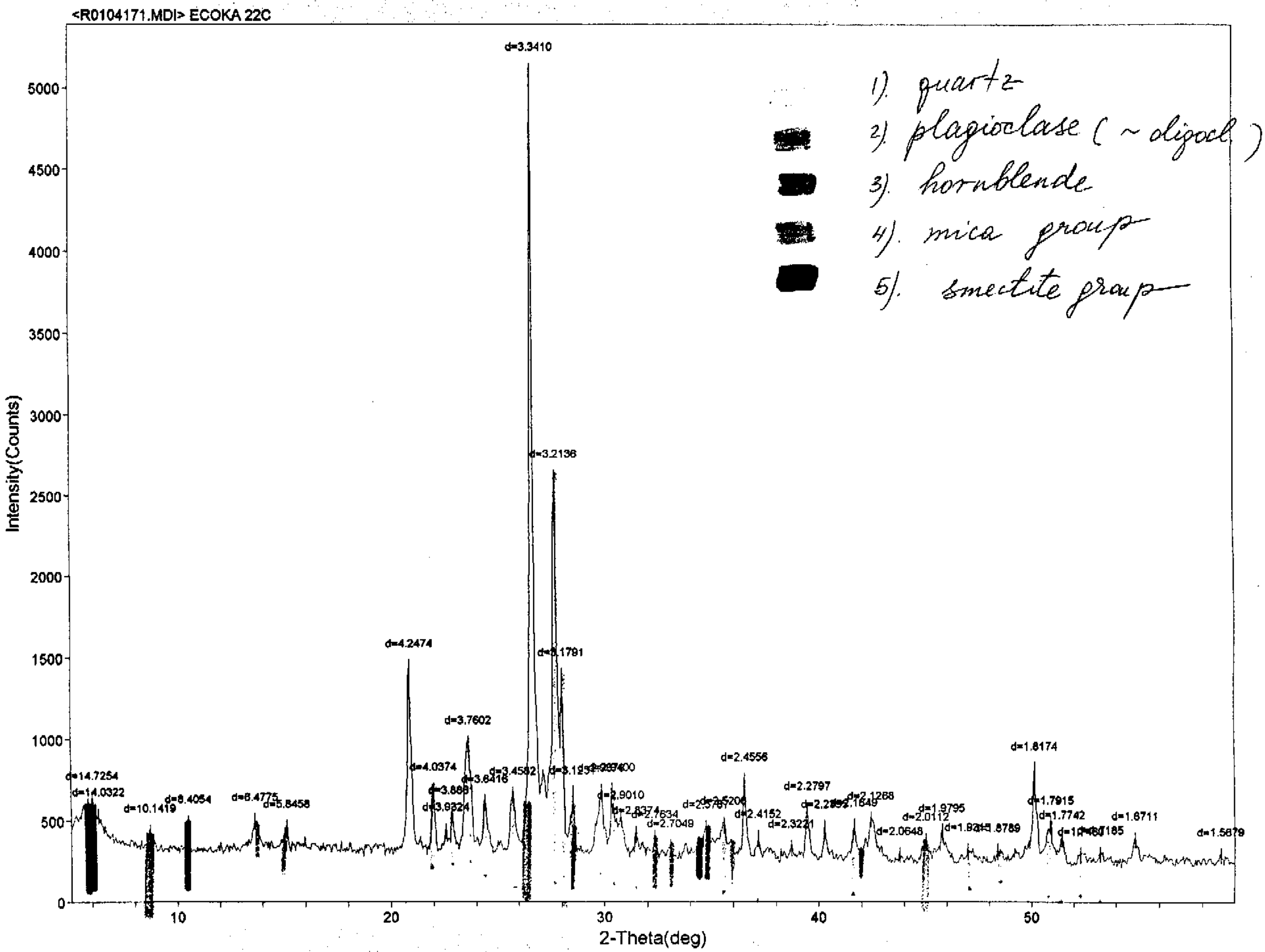

<R0104170.MDI> ECOKA 22B
Intensity(Counts)
2-Theta(deg)
d=3.3404
d=3.2073
d=3.1785
d=4.2469
d=3.7592
d=4.0355
d=1.8174
d=2.4551
d=2.2798
d=2.1253
d=10.0257
d=8.3966
d=6.4390
d=5.6732
d=4.6793
d=14.2451
1). quartz
2). plagioclase (~oligoclase)
3). hornblende
4). mica group
5). smectite

Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 5549, Anode = CU Date: 08-22-01@13:24

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.900	14.9664				427	150	3.0	88	9.2	0.469	193	1
2	6.199	14.2451				411	105	2.1	48	5.0	0.364	278	2
3	8.813	10.0257				319	105	2.1	15	1.5	0.110	>1000	3
4	10.527	8.3968				314	232	4.7	30	3.1	0.103	>1000	4
5	13.741	6.4390				321	174	3.5	55	5.7	0.249	558	5
6	15.072	5.8732				325	112	2.3	21	2.2	0.150	>1000	6
7	18.950	4.6793				315	71	1.4	9	0.8	0.090	>1000	7
8	20.900	4.2469				307	1381	27.9	276	28.8	0.159	>1000	8
9	22.008	4.0355				324	456	9.2	76	7.9	0.133	>1000	9
10	22.562	3.9375				334	66	1.3	8	0.8	0.090	>1000	10
11	22.899	3.8804				333	185	3.7	30	3.1	0.129	>1000	11
12	23.648	3.7592				349	644	13.0	211	22.1	0.262	419	12
13	24.486	3.6324				342	225	4.5	57	5.9	0.201	809	13
14	25.745	3.4575				363	271	5.5	69	7.2	0.203	749	14
15	26.664	3.3404				593	4956	100.0	956	100.0	0.154	>1000	15
16	27.793	3.2073				692	1226	24.7	322	33.6	0.210	642	16
17	28.050	3.1785				311	1483	29.9	268	28.0	0.144	>1000	17
18	28.455	3.1341				311	327	6.6	93	9.7	0.226	532	18
19	29.844	2.9913				402	254	5.1	60	6.2	0.186	899	19
20	30.376	2.9402				407	348	7.0	50	5.2	0.114	>1000	20
21	30.844	2.8966				351	116	2.3	32	3.2	0.214	581	21
22	31.492	2.8385				307	268	5.4	41	4.2	0.120	>1000	22
23	31.802	2.8115				302	164	3.3	23	2.4	0.110	>1000	23
24	32.394	2.7615				286	102	2.1	18	1.8	0.134	>1000	24
25	33.062	2.7072				271	97	2.0	15	1.5	0.118	>1000	25
26	33.762	2.6526				267	135	2.7	18	1.9	0.105	>1000	26
27	34.405	2.6045				321	71	1.4	8	0.8	0.081	>1000	27
28	34.793	2.5763				352	109	2.2	18	1.8	0.128	>1000	28
29	35.558	2.5227				325	223	4.5	46	4.7	0.163	>1000	29
30	35.851	2.5027				302	156	3.1	19	2.0	0.097	>1000	30
31	36.571	2.4551				284	379	7.6	71	7.4	0.149	>1000	31
32	37.204	2.4148				287	71	1.4	13	1.3	0.135	>1000	32
33	37.754	2.3808				268	84	1.7	22	2.3	0.208	571	33
34	39.494	2.2798				267	387	7.8	76	7.9	0.157	>1000	34
35	40.343	2.2338				262	168	3.4	33	3.4	0.156	>1000	35
36	41.696	2.1644				276	192	3.9	41	4.2	0.167	928	36
37	42.500	2.1253				277	281	5.7	90	9.4	0.256	396	37
38	42.801	2.1110				266	82	1.7	34	3.5	0.328	287	38
39	44.916	2.0164				255	105	2.1	19	2.0	0.143	>1000	39
40	45.809	1.9792				263	184	3.7	36	3.7	0.155	>1000	40
41	47.109	1.9275				234	68	1.4	14	1.4	0.161	950	41
42	48.455	1.8771				240	64	1.3	14	1.4	0.170	799	42
43	49.250	1.8486				258	102	2.1	16	1.7	0.124	>1000	43
44	49.849	1.8278				303	71	1.4	9	0.9	0.097	>1000	44
45	50.153	1.8174				315	498	10.0	105	10.9	0.167	818	45
46	50.832	1.7947				312	107	2.2	19	1.9	0.138	>1000	46
47	51.458	1.7744				265	178	3.6	28	2.9	0.123	>1000	47
48	52.446	1.7433				232	72	1.5	14	1.4	0.153	>1000	48
49	53.346	1.7159				246	108	2.2	17	1.7	0.122	>1000	49
50	54.897	1.6711				232	180	3.6	43	4.4	0.188	629	50
51	55.496	1.6544				249	70	1.4	9	0.9	0.096	>1000	51


<R0104171.MDI> ECOKA 22C
Intensity(Counts)
2-Theta(deg)
d=3.3410
d=3.2136
d=3.1791
d=4.2474
d=3.7602
d=4.0374
d=3.6416
d=3.4582
d=14.7254
d=14.0322
d=10.1419
d=8.4054
d=6.4775
d=5.8458
d=2.9010
d=2.7049
d=2.4556
d=2.4152
d=2.2797
d=2.3221
d=2.1268
d=2.0648
d=2.0112
d=1.9795
d=1.8789
d=1.8174
d=1.7915
d=1.7742
d=1.6711
d=1.5679
1). quartz
2). plagioclase (~oligocl.)
3). hornblende
4). mica group
5). smectite group

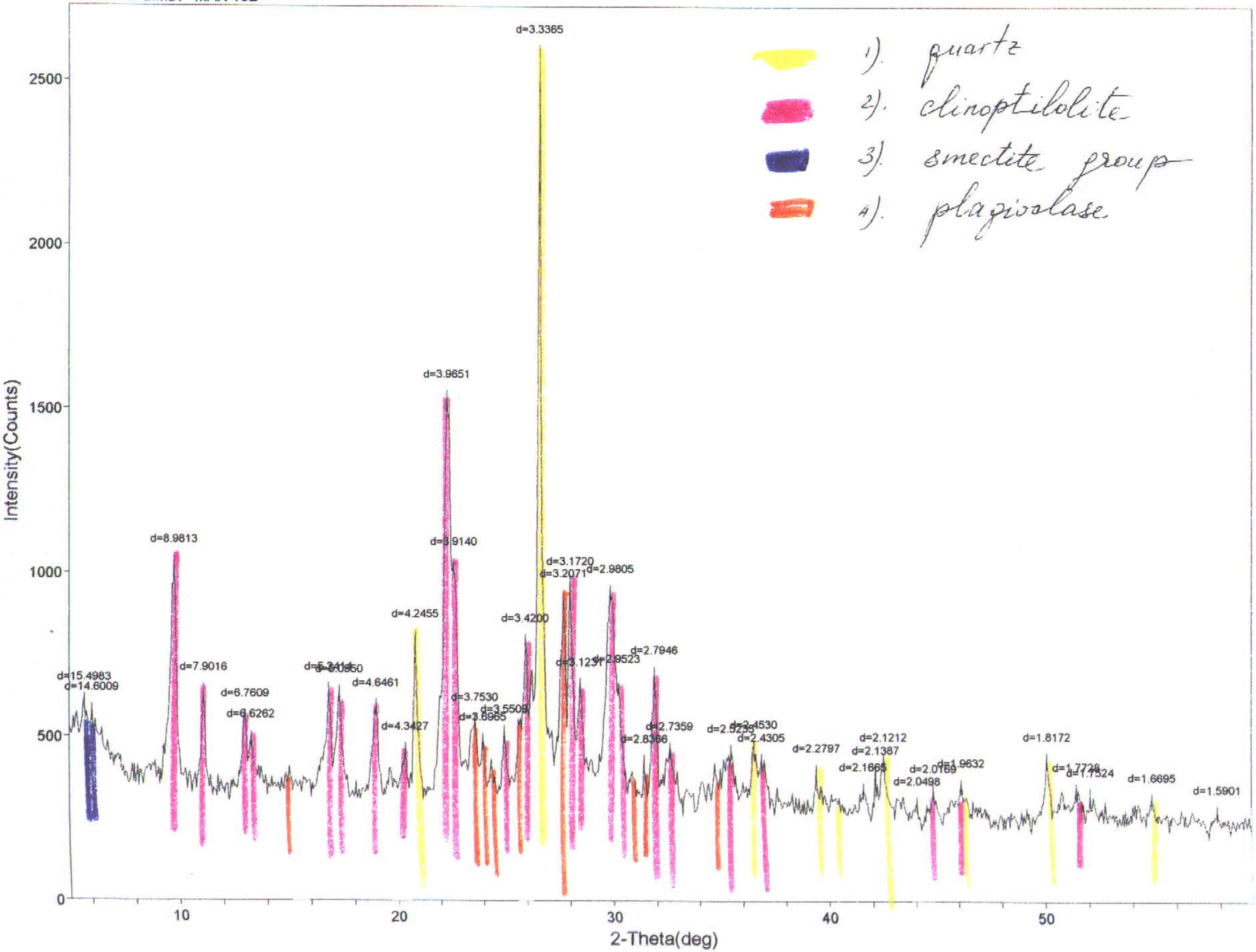
Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 5130, Anode = CU Date: 08-22-01@13:49

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.997	14.7254				437	205	4.5	102	11.0	0.398	243	1
2	6.294	14.0322				439	102	2.2	26	2.7	0.198	>1000	2
3	8.712	10.1419				331	107	2.3	17	1.8	0.124	>1000	3
4	10.516	8.4054				337	159	3.5	25	2.6	0.121	>1000	4
5	13.659	6.4775				327	182	4.0	51	5.4	0.220	950	5
6	15.143	5.8458				357	110	2.4	13	1.4	0.092	>1000	6
7	20.897	4.2474				328	1124	24.5	245	26.3	0.174	>1000	7
8	21.997	4.0374				367	326	7.1	52	5.6	0.127	>1000	8
9	22.592	3.9324				372	74	1.6	8	0.8	0.076	>1000	9
10	22.865	3.8861				367	183	4.0	20	2.1	0.086	>1000	10
11	23.642	3.7602				373	609	13.3	204	22.0	0.267	403	11
12	24.424	3.6416				369	250	5.4	42	4.5	0.132	>1000	12
13	25.740	3.4582				366	304	6.6	72	7.7	0.188	>1000	13
14	26.659	3.3410				542	4588	100.0	927	100.0	0.162	>1000	14
15	27.737	3.2136				661	1967	42.9	437	47.2	0.178	>1000	15
16	28.044	3.1791				618	781	17.0	119	12.8	0.122	>1000	16
17	28.557	3.1231				507	166	3.6	16	1.7	0.077	>1000	17
18	29.882	2.9876				392	297	6.5	62	6.6	0.166	>1000	18
19	30.378	2.9400				418	273	6.0	36	3.8	0.104	>1000	19
20	30.796	2.9010				363	156	3.4	35	3.7	0.176	>1000	20
21	31.504	2.8374				311	114	2.5	18	1.9	0.125	>1000	21
22	32.371	2.7634				325	76	1.7	8	0.8	0.077	>1000	22
23	33.091	2.7049				285	60	1.3	7	0.7	0.090	>1000	23
24	34.760	2.5787				345	116	2.5	29	3.1	0.198	654	24
25	35.588	2.5206				339	144	3.1	27	2.9	0.148	>1000	25
26	36.563	2.4556				298	456	9.9	76	8.1	0.132	>1000	26
27	37.196	2.4152				289	113	2.5	16	1.7	0.108	>1000	27
28	38.746	2.3221				277	66	1.4	8	0.8	0.089	>1000	28
29	39.496	2.2797				273	304	6.6	62	6.6	0.161	>1000	29
30	40.311	2.2355				267	197	4.3	29	3.1	0.118	>1000	30
31	41.685	2.1649				299	174	3.8	27	2.9	0.122	>1000	31
32	42.467	2.1268				300	216	4.7	55	5.8	0.201	588	32
33	43.808	2.0648				243	54	1.2	5	0.5	0.073	>1000	33
34	45.038	2.0112				278	107	2.3	17	1.8	0.123	>1000	34
35	45.801	1.9795				271	169	3.7	34	3.6	0.158	>1000	35
36	47.006	1.9315				241	81	1.8	10	1.0	0.095	>1000	36
37	48.405	1.8789				255	63	1.4	7	0.7	0.084	>1000	37
38	50.154	1.8174				322	500	10.9	98	10.5	0.155	>1000	38
39	50.932	1.7915				302	187	4.1	30	3.2	0.126	>1000	39
40	51.464	1.7742				289	109	2.4	18	1.9	0.128	>1000	40
41	52.356	1.7460				234	63	1.4	14	1.5	0.177	710	41
42	53.259	1.7185				247	59	1.3	8	0.8	0.096	>1000	42
43	54.897	1.6711				263	130	2.8	28	3.0	0.172	746	43
44	58.849	1.5679				236	60	1.3	8	0.8	0.097	>1000	44
@	End-of-List												

<R0104172.MDI> MAN 10B



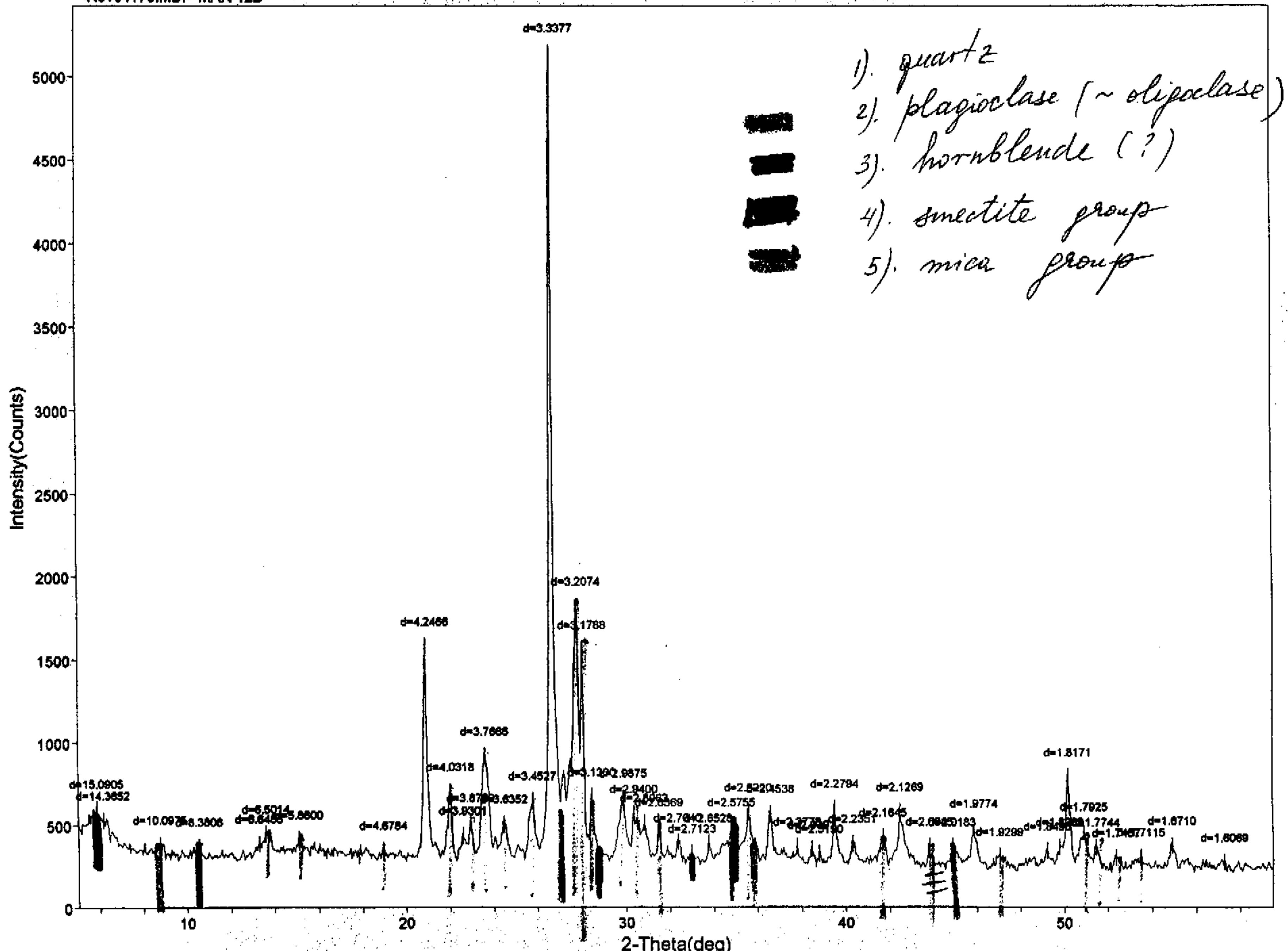
Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 2598, Anode = CU Date: 08-22-01@14:12

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.698	15.4983				522	91	4.5	11	1.8	0.095	>1000	1
2	6.048	14.6009				496	86	4.3	10	1.5	0.088	>1000	2
3	9.840	8.9813				376	658	32.6	196	32.1	0.238	775	3
4	11.189	7.9016				346	298	14.8	57	9.3	0.153	>1000	4
5	13.084	6.7609				342	223	11.0	65	10.6	0.233	726	5
6	13.351	6.6262				343	157	7.8	43	7.0	0.216	>1000	6
7	16.902	5.2414				338	309	15.3	115	18.7	0.296	359	7
8	17.391	5.0950				350	290	14.4	78	12.7	0.214	855	8
9	19.086	4.6461				337	261	12.9	62	10.1	0.189	>1000	9
10	20.434	4.3427				383	81	4.0	8	1.3	0.079	>1000	10
11	20.907	4.2455				341	469	23.2	86	14.1	0.147	>1000	11
12	22.404	3.9651				383	1158	57.4	610	100.0	0.421	212	12
13	22.700	3.9140				401	629	31.2	223	36.4	0.283	370	13
14	23.688	3.7530				411	143	7.1	27	4.4	0.149	>1000	14
15	24.055	3.6965				387	107	5.3	12	2.0	0.089	>1000	15
16	25.057	3.5509				360	158	7.8	25	4.1	0.126	>1000	16
17	26.033	3.4200				605	192	9.5	25	4.1	0.104	>1000	17
18	26.696	3.3365				579	2019	100.0	367	60.0	0.145	>1000	18
19	27.794	3.2071				460	474	23.5	120	19.6	0.202	717	19
20	28.108	3.1720				442	530	26.3	123	20.1	0.185	998	20
21	28.558	3.1231				537	126	6.2	15	2.5	0.095	>1000	21
22	29.955	2.9805				380	569	28.2	301	49.2	0.422	210	22
23	30.248	2.9523				364	309	15.3	141	23.0	0.363	253	23
24	31.513	2.8366				356	72	3.6	6	0.9	0.063	>1000	24
25	32.000	2.7946				379	321	15.9	66	10.7	0.162	>1000	25
26	32.705	2.7359				354	112	5.5	27	4.4	0.193	735	26
27	35.546	2.5235				332	128	6.3	30	4.9	0.185	777	27
28	36.603	2.4530				316	156	7.7	38	6.2	0.194	672	28
29	36.955	2.4305				309	124	6.1	54	8.7	0.343	270	29
30	39.497	2.2797				295	106	5.3	14	2.2	0.101	>1000	30
31	41.653	2.1665				273	69	3.4	14	2.2	0.155	>1000	31
32	42.221	2.1387				276	118	5.8	16	2.5	0.103	>1000	32
33	42.585	2.1212				280	155	7.7	36	5.8	0.182	718	33
34	44.146	2.0498				245	54	2.7	7	1.0	0.089	>1000	34
35	44.906	2.0169				246	92	4.6	17	2.7	0.143	>1000	35
36	46.202	1.9632				271	84	4.2	15	2.4	0.137	>1000	36
37	50.159	1.8172				270	167	8.3	33	5.4	0.157	976	37
38	51.506	1.7728				272	71	3.5	8	1.3	0.090	>1000	38
39	52.151	1.7524				268	59	2.9	6	0.9	0.073	>1000	39
40	54.954	1.6695				251	60	3.0	8	1.3	0.102	>1000	40
41	57.948	1.5901				222	53	2.6	7	1.0	0.092	>1000	41
@	End-of-List												

<R0104173.MDI> MAN 12D



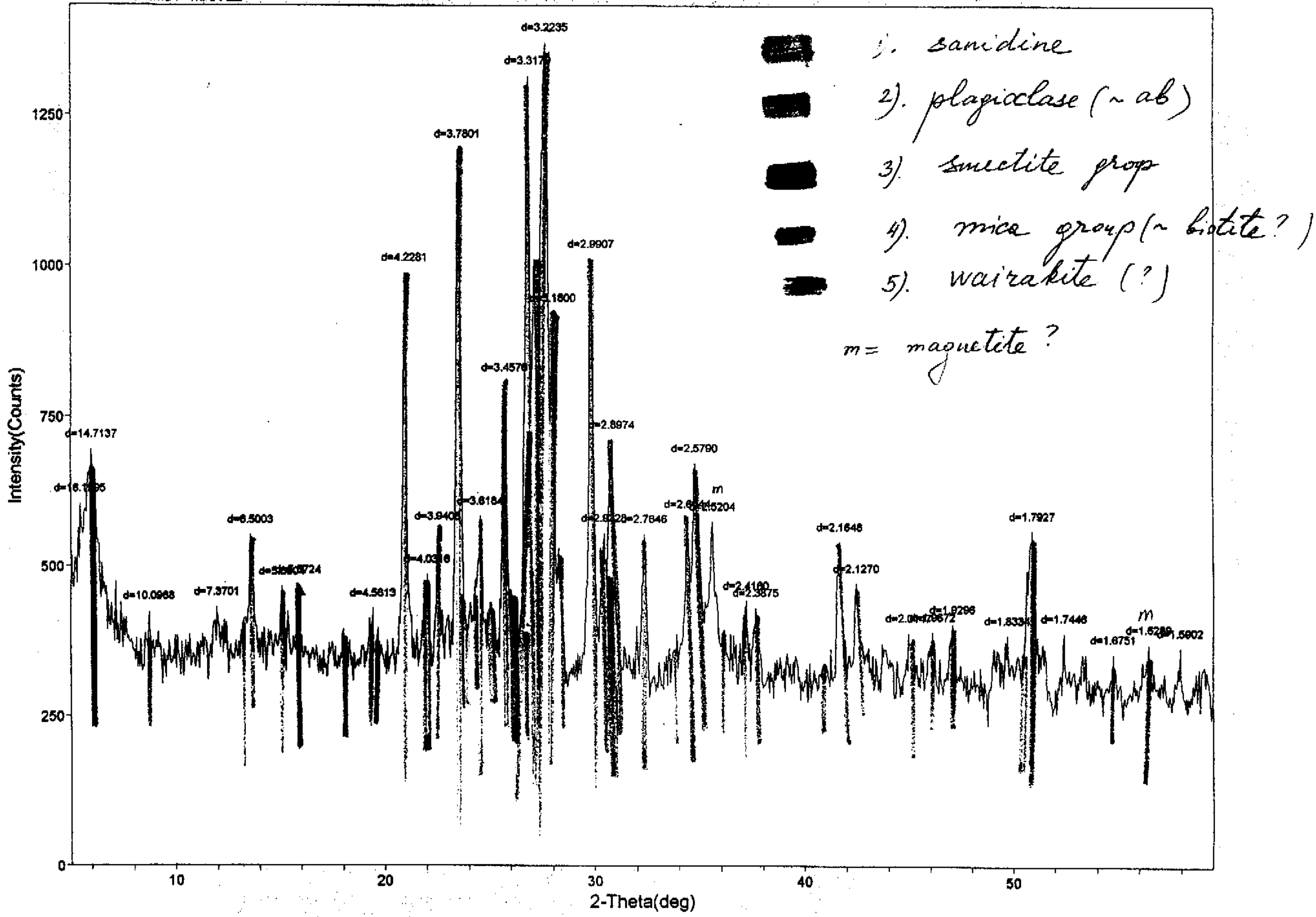
Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 5165, Anode = CU Date: 08-22-01@14:36

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.852	15.0905				442	169	3.7	82	8.7	0.385	256	1
2	6.148	14.3652				422	118	2.6	53	5.6	0.354	293	2
3	8.750	10.0975				328	64	1.4	8	0.8	0.098	>1000	3
4	10.547	8.3806				305	73	1.6	10	1.0	0.099	>1000	4
5	13.306	6.6485				314	82	1.8	16	1.6	0.149	>1000	5
6	13.609	6.5014				325	130	2.8	32	3.4	0.195	>1000	6
7	15.106	5.8600				339	80	1.7	11	1.1	0.101	>1000	7
8	18.953	4.6784				297	59	1.3	7	0.7	0.089	>1000	8
9	20.901	4.2466				312	1281	27.8	271	29.0	0.169	>1000	9
10	22.028	4.0318				320	391	8.5	74	7.9	0.150	>1000	10
11	22.605	3.9301				334	111	2.4	18	1.9	0.129	>1000	11
12	22.944	3.8730				349	173	3.8	26	2.8	0.119	>1000	12
13	23.601	3.7666				407	520	11.3	168	18.0	0.258	431	13
14	24.467	3.6352				360	156	3.4	30	3.1	0.149	>1000	14
15	25.782	3.4527				370	284	6.2	62	6.6	0.174	>1000	15
16	26.687	3.3377				559	4606	100.0	934	100.0	0.162	>1000	16
17	27.792	3.2074				650	1185	25.7	336	35.9	0.227	533	17
18	28.047	3.1788				313	1261	27.4	257	27.5	0.163	>1000	18
19	28.466	3.1330				502	177	3.8	17	1.7	0.072	>1000	19
20	29.883	2.9875				382	290	6.3	66	7.0	0.180	>1000	20
21	30.377	2.9400				409	167	3.6	24	2.5	0.110	>1000	21
22	30.848	2.8963				358	164	3.6	34	3.6	0.163	>1000	22
23	31.510	2.8369				336	159	3.5	23	2.4	0.111	>1000	23
24	32.363	2.7640				301	101	2.2	12	1.3	0.093	>1000	24
25	32.998	2.7123				275	60	1.3	7	0.7	0.087	>1000	25
26	33.759	2.6528				295	104	2.3	12	1.2	0.085	>1000	26
27	34.804	2.5755				366	128	2.8	20	2.1	0.122	>1000	27
28	35.567	2.5220				334	251	5.4	54	5.7	0.170	>1000	28
29	36.590	2.4538				298	278	6.0	59	6.2	0.167	>1000	29
30	37.803	2.3778				283	93	2.0	10	1.0	0.082	>1000	30
31	38.454	2.3391				277	81	1.8	9	0.9	0.086	>1000	31
32	38.800	2.3190				270	64	1.4	7	0.7	0.079	>1000	32
33	39.503	2.2794				275	333	7.2	66	7.0	0.157	>1000	33
34	40.318	2.2351				267	128	2.8	23	2.4	0.139	>1000	34
35	41.693	2.1645				284	150	3.3	34	3.5	0.176	797	35
36	42.466	2.1269				274	313	6.8	79	8.4	0.200	594	36
37	43.816	2.0645				255	122	2.6	15	1.6	0.098	>1000	37
38	44.873	2.0183				260	114	2.5	17	1.8	0.116	>1000	38
39	45.853	1.9774				257	230	5.0	56	6.0	0.194	616	39
40	47.049	1.9299				233	82	1.8	23	2.4	0.219	498	40
41	49.239	1.8490				271	78	1.7	10	1.0	0.098	>1000	41
42	49.808	1.8292				289	87	1.9	11	1.1	0.098	>1000	42
43	50.162	1.8171				299	502	10.9	111	11.8	0.175	733	43
44	50.901	1.7925				288	181	3.9	52	5.6	0.229	461	44
45	51.457	1.7744				289	84	1.8	10	1.0	0.090	>1000	45
46	52.366	1.7457				234	77	1.7	13	1.4	0.134	>1000	46
47	53.497	1.7115				240	74	1.6	8	0.8	0.077	>1000	47
48	54.901	1.6710				253	133	2.9	29	3.1	0.172	749	48
49	57.285	1.6069				229	55	1.2	6	0.6	0.076	>1000	49
@	End-of-List												

<R0104174.MDI> MAN 22



Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 1362, Anode = CU Date: 08-22-01@15:03

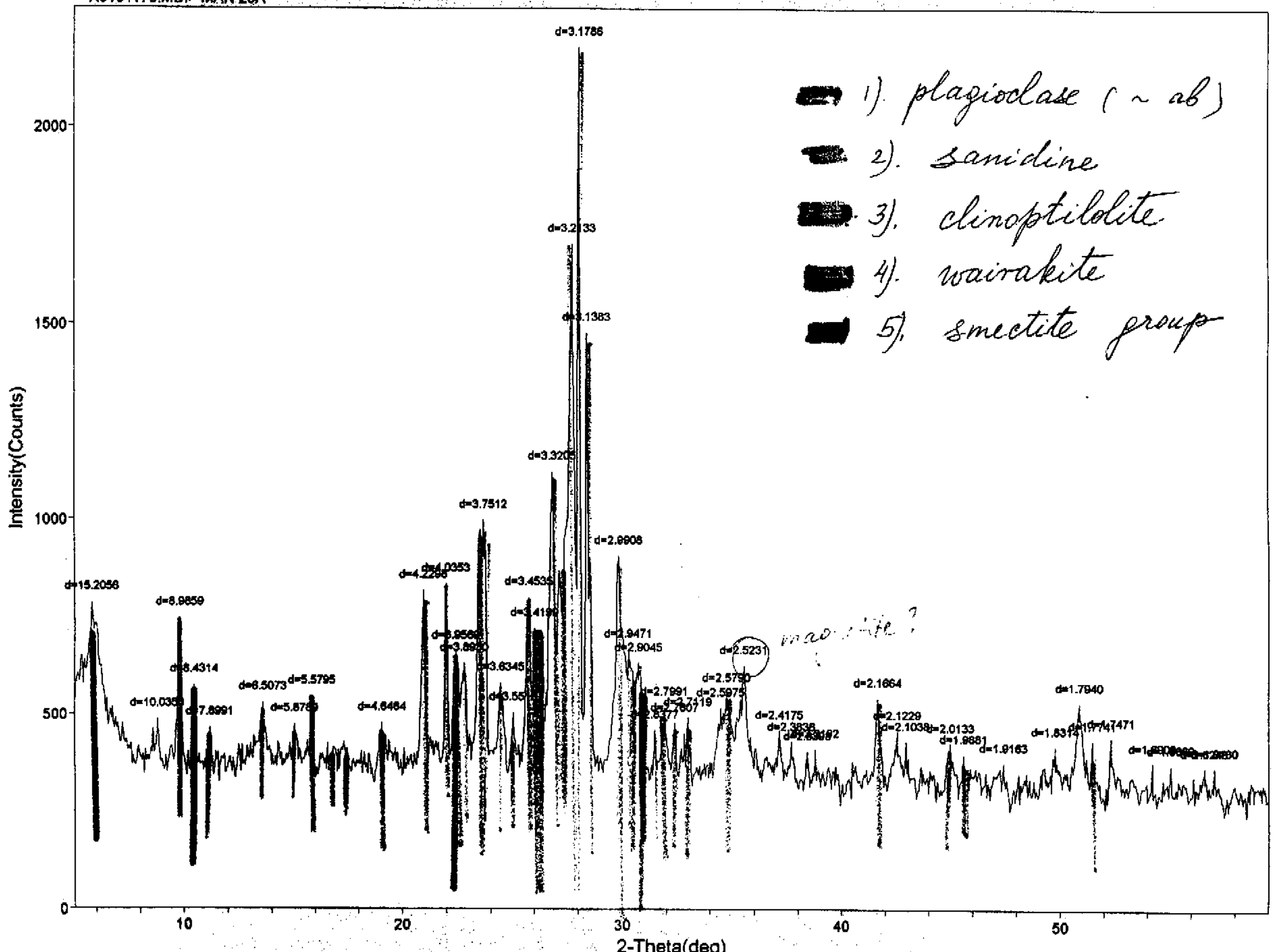
Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.464	16.1595				489	106	10.2	18	2.9	0.133	>1000	1
2	6.002	14.7137				452	234	22.6	130	21.3	0.444	208	2
3	8.751	10.0968				344	69	6.7	8	1.2	0.086	>1000	3
4	11.998	7.3701				356	64	6.2	8	1.2	0.094	>1000	4
5	13.611	6.5003				357	185	17.8	30	4.9	0.129	>1000	5
6	15.106	5.8604				388	67	6.5	9	1.3	0.097	>1000	6
7	15.891	5.5724				372	86	8.3	10	1.6	0.091	>1000	7
8	19.445	4.5613				340	78	7.5	9	1.4	0.086	>1000	8
9	20.994	4.2281				355	624	60.2	137	22.4	0.176	>1000	9
10	22.029	4.0316				368	108	10.4	18	2.9	0.132	>1000	10
11	22.544	3.9408				380	168	16.2	24	3.9	0.112	>1000	11
12	23.515	3.7801				401	785	75.7	189	30.8	0.192	>1000	12
13	24.582	3.6184				399	175	16.9	28	4.5	0.126	>1000	13
14	25.744	3.4576				381	416	40.1	102	16.6	0.196	861	14
15	26.848	3.3179				371	936	90.3	291	47.5	0.248	448	15
16	27.650	3.2235				325	1037	100.0	612	100.0	0.472	185	16
17	28.036	3.1800				317	595	57.4	162	26.3	0.217	589	17
18	29.850	2.9907				417	585	56.4	135	22.1	0.184	934	18
19	30.459	2.9323				419	126	12.2	15	2.4	0.094	>1000	19
20	30.836	2.8974				395	307	29.6	81	13.2	0.210	605	20
21	32.356	2.7646				321	223	21.5	53	8.6	0.188	804	21
22	34.406	2.6044				391	178	17.2	37	5.9	0.163	>1000	22
23	34.756	2.5790				412	251	24.2	77	12.5	0.243	440	23
24	35.591	2.5204				407	158	15.2	32	5.1	0.158	>1000	24
25	37.183	2.4160				327	104	10.0	20	3.1	0.147	>1000	25
26	37.645	2.3875				317	102	9.8	20	3.1	0.151	>1000	26
27	41.687	2.1648				330	201	19.4	47	7.6	0.186	693	27
28	42.465	2.1270				329	132	12.7	24	3.9	0.145	>1000	28
29	44.956	2.0147				314	63	6.1	8	1.2	0.095	>1000	29
30	46.103	1.9672				317	62	6.0	9	1.4	0.108	>1000	30
31	47.055	1.9296				305	87	8.4	24	3.8	0.213	519	31
32	49.688	1.8334				311	63	6.1	8	1.2	0.091	>1000	32
33	50.893	1.7927				309	241	23.2	103	16.7	0.340	279	33
34	52.402	1.7446				286	92	8.9	10	1.6	0.085	>1000	34
35	54.755	1.6751				279	64	6.2	9	1.3	0.100	>1000	35
36	56.443	1.6289				275	85	8.2	10	1.6	0.092	>1000	36
37	57.945	1.5902				273	81	7.8	10	1.5	0.091	>1000	37
@	End-of-List												

28A

<R0104175.MDI> MAN 23A



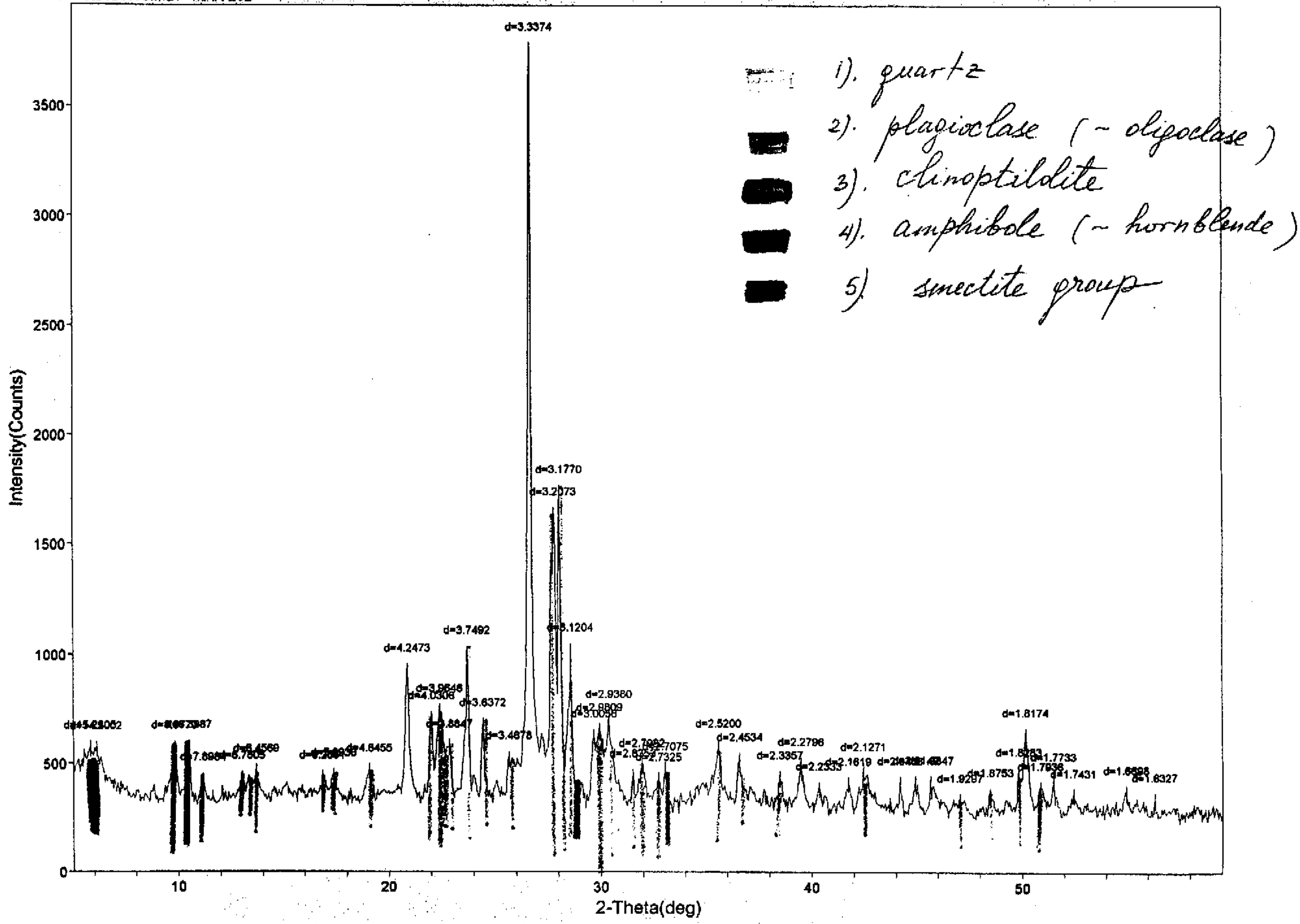
Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 2191, Anode = CU Date: 08-22-01@15:28

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.807	15.2056				546	222	17.0	86	32.2	0.310	379	1
2	8.805	10.0350				372	99	7.6	16	5.6	0.121	>1000	2
3	9.835	8.9859				379	350	26.8	68	25.3	0.154	>1000	3
4	10.483	8.4314				382	176	13.5	26	9.7	0.117	>1000	4
5	11.192	7.8991				373	75	5.7	9	3.1	0.088	>1000	5
6	13.596	6.5073				380	134	10.3	36	13.2	0.211	>1000	6
7	15.058	5.8789				380	78	6.0	10	3.6	0.099	>1000	7
8	15.871	5.5795				370	159	12.2	24	8.8	0.117	>1000	8
9	19.085	4.6464				352	110	8.4	22	8.0	0.155	>1000	9
10	20.985	4.2298				382	418	32.0	77	28.7	0.147	>1000	10
11	22.009	4.0353				455	362	27.7	42	15.6	0.092	>1000	11
12	22.451	3.9569				408	237	18.1	71	26.6	0.239	512	12
13	22.824	3.8930				444	170	13.0	30	11.0	0.138	>1000	13
14	23.699	3.7512				432	551	42.2	152	57.0	0.221	611	14
15	24.472	3.6345				411	154	11.8	27	9.8	0.136	>1000	15
16	25.052	3.5516				394	95	7.3	11	3.9	0.087	>1000	16
17	25.776	3.4535				452	331	25.3	95	35.5	0.229	537	17
18	26.033	3.4199				462	242	18.5	36	13.4	0.118	>1000	18
19	26.827	3.3205				759	349	26.7	52	19.4	0.119	>1000	19
20	27.740	3.2133				873	818	62.6	156	58.3	0.152	>1000	20
21	28.048	3.1786				884	1307	100.0	145	54.2	0.089	>1000	21
22	28.416	3.1383				369	1095	83.8	267	100.0	0.195	793	22
23	29.850	2.9908				469	422	32.3	139	51.9	0.263	397	23
24	30.303	2.9471				366	285	21.8	203	76.0	0.569	150	24
25	30.758	2.9045				525	91	7.0	14	5.0	0.118	>1000	25
26	31.500	2.8377				359	85	6.5	8	3.0	0.074	>1000	26
27	31.946	2.7991				371	132	10.1	22	8.2	0.133	>1000	27
28	32.403	2.7607				360	102	7.8	15	5.4	0.113	>1000	28
29	33.003	2.7119				366	110	8.4	12	4.3	0.084	>1000	29
30	34.501	2.5975				415	86	6.6	17	6.2	0.153	>1000	30
31	34.755	2.5790				399	140	10.7	44	16.3	0.248	424	31
32	35.552	2.5231				420	190	14.5	43	15.8	0.178	882	32
33	37.159	2.4175				337	107	8.2	18	6.6	0.132	>1000	33
34	37.708	2.3836				340	73	5.6	9	3.2	0.093	>1000	34
35	38.442	2.3398				326	63	4.8	8	2.6	0.090	>1000	35
36	38.796	2.3192				330	65	5.0	7	2.3	0.076	>1000	36
37	41.655	2.1664				327	200	15.3	44	16.3	0.174	818	37
38	42.550	2.1229				323	120	9.2	34	12.5	0.222	493	38
39	42.955	2.1038				320	95	7.3	11	3.9	0.087	>1000	39
40	44.989	2.0133				322	89	6.8	18	6.6	0.158	>1000	40
41	45.591	1.9881				312	70	5.4	8	3.0	0.090	>1000	41
42	47.402	1.9163				292	68	5.2	8	2.9	0.092	>1000	42
43	49.746	1.8314				320	83	6.4	15	5.4	0.139	>1000	43
44	50.854	1.7940				323	193	14.8	60	22.1	0.245	421	44
45	51.468	1.7741				345	73	5.6	7	2.5	0.074	>1000	45
46	52.323	1.7471				292	134	10.3	19	7.0	0.111	>1000	46
47	54.200	1.6909				293	68	5.2	6	2.1	0.065	>1000	47
48	55.046	1.6669				291	65	5.0	7	2.3	0.076	>1000	48
49	56.597	1.6248				280	68	5.2	13	4.8	0.152	996	49
50	57.050	1.6130				279	70	5.4	8	2.9	0.089	>1000	50
@	End-of-List												

<R0104176.MDI> MAN 28B



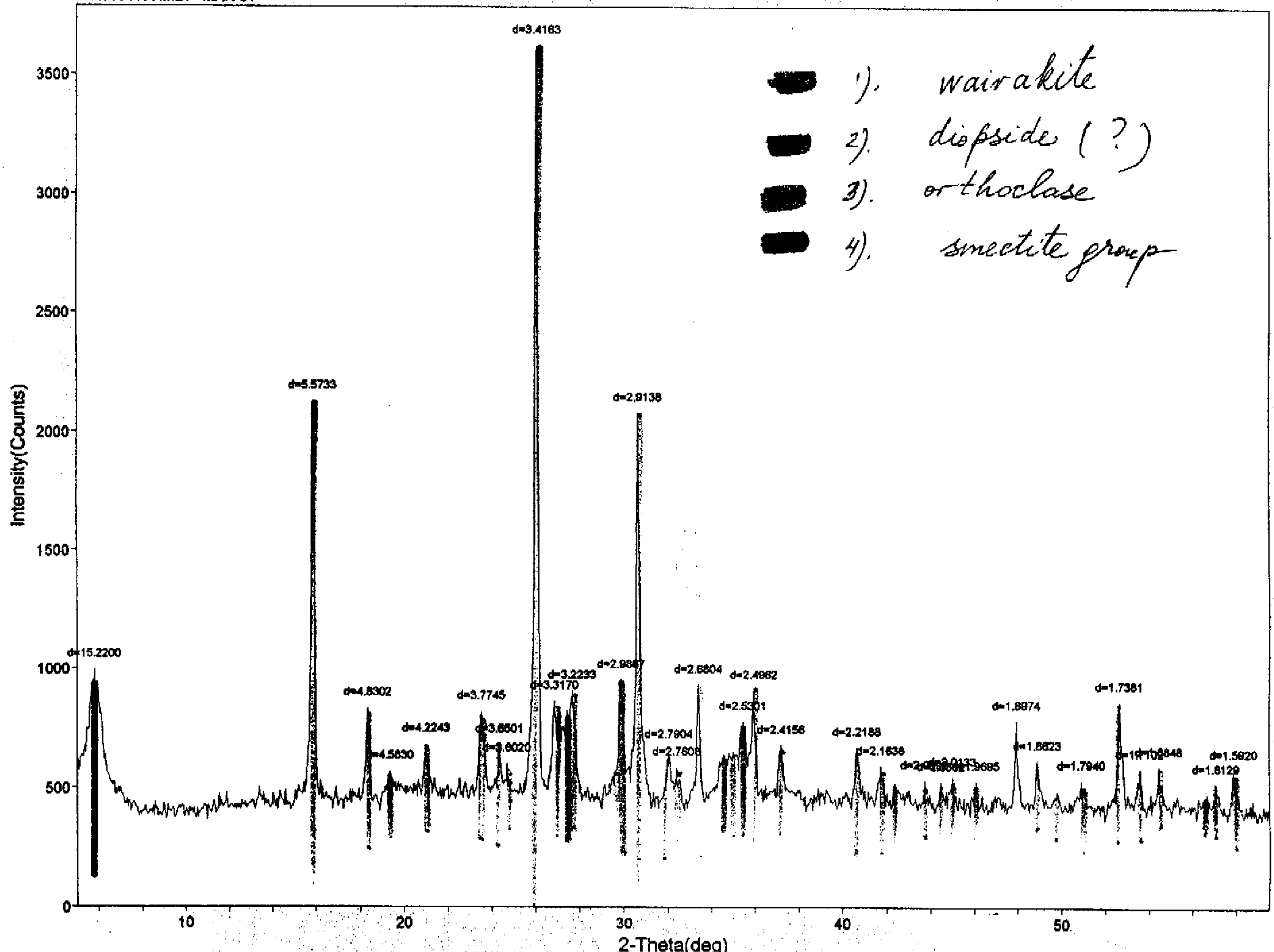
Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 3768, Anode = CU Date: 08-22-01@16:18

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.802	15.2205				463	111	3.4	27	3.9	0.192	>1000	1
2	6.090	14.5002				443	128	4.0	54	7.8	0.334	323	2
3	9.844	8.9773				367	206	6.4	44	6.4	0.170	>1000	3
4	10.524	8.3987				354	222	6.9	35	5.1	0.125	>1000	4
5	11.193	7.8984				328	99	3.1	18	2.5	0.141	>1000	5
6	13.046	6.7805				346	90	2.8	17	2.4	0.145	>1000	6
7	13.703	6.4569				342	125	3.9	28	4.1	0.179	>1000	7
8	16.857	5.2551				344	93	2.9	12	1.7	0.100	>1000	8
9	17.396	5.0936				345	102	3.2	25	3.6	0.193	>1000	9
10	19.089	4.6455				341	127	3.9	15	2.2	0.094	>1000	10
11	20.898	4.2473				348	582	18.0	135	19.5	0.184	>1000	11
12	22.035	4.0306				366	343	10.6	74	10.7	0.172	>1000	12
13	22.407	3.9646				366	378	11.7	234	34.0	0.494	175	13
14	22.873	3.8847				428	151	4.7	26	3.7	0.134	>1000	14
15	23.712	3.7492				399	612	18.9	123	17.8	0.160	>1000	15
16	24.453	3.6372				390	288	8.9	41	5.8	0.112	>1000	16
17	25.667	3.4678				452	74	2.3	7	0.9	0.068	>1000	17
18	26.689	3.3374				538	3230	100.0	687	100.0	0.170	>1000	18
19	27.792	3.2073				607	1036	32.1	271	39.4	0.209	652	19
20	28.063	3.1770				635	1109	34.3	164	23.8	0.118	>1000	20
21	28.583	3.1204				570	453	14.0	56	8.1	0.099	>1000	21
22	29.699	3.0056				366	260	8.0	68	9.8	0.206	646	22
23	29.950	2.9809				349	307	9.5	173	25.1	0.450	196	23
24	30.399	2.9380				349	369	11.4	157	22.8	0.339	275	24
25	31.528	2.8353				366	80	2.5	8	1.1	0.072	>1000	25
26	31.957	2.7982				337	154	4.8	43	6.1	0.218	546	26
27	32.746	2.7325				331	97	3.0	17	2.5	0.140	>1000	27
28	33.057	2.7075				318	159	4.9	25	3.5	0.121	>1000	28
29	35.597	2.5200				371	211	6.5	46	6.7	0.173	973	29
30	36.597	2.4534				340	180	5.6	36	5.1	0.156	>1000	30
31	38.511	2.3357				314	123	3.8	21	3.0	0.132	>1000	31
32	39.497	2.2796				314	184	5.7	44	6.3	0.189	684	32
33	40.352	2.2333				307	78	2.4	13	1.9	0.133	>1000	33
34	41.745	2.1619				303	105	3.3	19	2.7	0.141	>1000	34
35	42.463	2.1271				304	173	5.4	57	8.3	0.262	383	35
36	44.219	2.0466				285	126	3.9	17	2.4	0.105	>1000	36
37	44.952	2.0149				281	134	4.1	32	4.6	0.187	661	37
38	45.675	1.9847				281	134	4.1	20	2.8	0.113	>1000	38
39	47.053	1.9297				271	61	1.9	8	1.1	0.100	>1000	39
40	48.503	1.8753				268	92	2.8	18	2.5	0.151	>1000	40
41	49.835	1.8283				293	161	5.0	25	3.6	0.124	>1000	41
42	50.155	1.8174				323	312	9.7	88	12.7	0.224	478	42
43	50.866	1.7936				302	86	2.7	18	2.5	0.161	889	43
44	51.492	1.7733				282	152	4.7	23	3.3	0.120	>1000	44
45	52.449	1.7431				279	77	2.4	9	1.3	0.092	>1000	45
46	54.941	1.6698				291	81	2.5	10	1.4	0.098	>1000	46
47	56.301	1.6327				267	72	2.2	7	0.9	0.067	>1000	47
@	End-of-List												

<R0104177.MDI> MAN 31

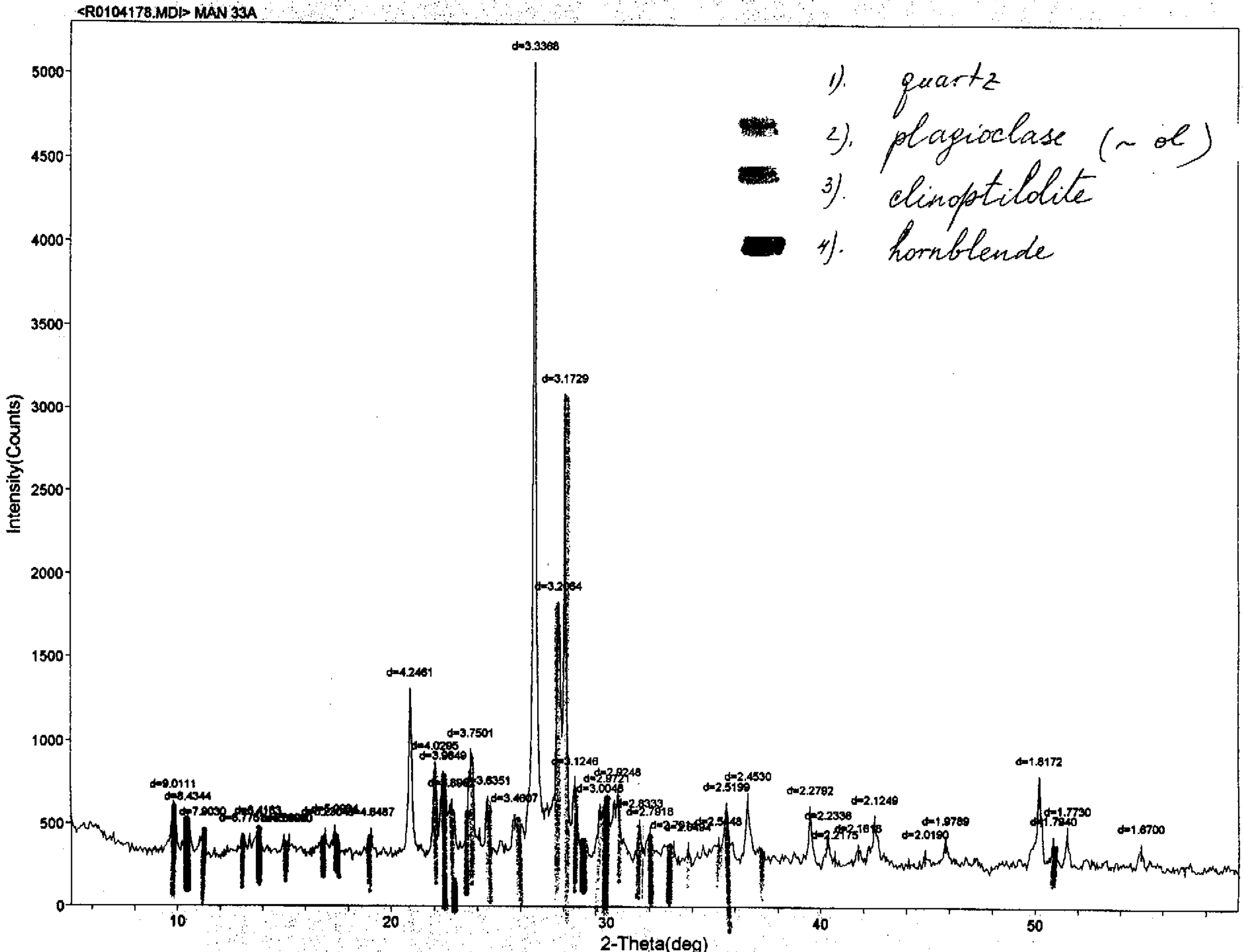


Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 3603, Anode = CU Date: 08-22-01@16:42

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.802	15.2200				559	409	13.2	241	39.5	0.471	192	1
2	15.889	5.5733				437	1668	53.8	332	54.4	0.159	>1000	2
3	18.353	4.8302				462	345	11.1	67	10.9	0.154	>1000	3
4	19.352	4.5830				458	83	2.7	18	2.9	0.171	>1000	4
5	21.013	4.2243				509	146	4.7	27	4.3	0.143	>1000	5
6	23.551	3.7745				497	296	9.6	77	12.5	0.205	774	6
7	24.365	3.6501				498	155	5.0	24	3.8	0.119	>1000	7
8	24.696	3.6020				491	81	2.6	9	1.4	0.082	>1000	8
9	26.061	3.4163				505	3098	100.0	611	100.0	0.158	>1000	9
10	26.856	3.3170				550	287	9.3	63	10.2	0.174	>1000	10
11	27.652	3.2233				518	363	11.7	137	22.4	0.301	327	11
12	29.891	2.9867				549	378	12.2	81	13.3	0.171	>1000	12
13	30.657	2.9138				532	1526	49.3	315	51.5	0.165	>1000	13
14	32.049	2.7904				449	182	5.9	41	6.7	0.179	964	14
15	32.402	2.7608				450	109	3.5	18	2.9	0.131	>1000	15
16	33.402	2.6804				458	448	14.5	78	12.7	0.139	>1000	16
17	35.450	2.5301				560	191	6.2	56	9.1	0.232	472	17
18	35.948	2.4962				619	263	8.5	38	6.1	0.113	>1000	18
19	37.190	2.4156				491	161	5.2	34	5.5	0.168	>1000	19
20	40.627	2.2188				463	181	5.8	32	5.1	0.138	>1000	20
21	41.708	2.1638				456	108	3.5	22	3.5	0.158	>1000	21
22	43.703	2.0695				424	80	2.6	8	1.2	0.073	>1000	22
23	44.457	2.0362				418	80	2.6	10	1.6	0.098	>1000	23
24	44.990	2.0133				423	96	3.1	12	1.8	0.092	>1000	24
25	46.047	1.9695				423	78	2.5	10	1.5	0.095	>1000	25
26	47.903	1.8974				424	333	10.7	59	9.6	0.141	>1000	26
27	48.864	1.8623				428	160	5.2	27	4.3	0.131	>1000	27
28	50.854	1.7940				413	93	3.0	12	1.8	0.095	>1000	28
29	52.612	1.7381				421	417	13.5	85	13.9	0.162	861	29
30	53.540	1.7102				426	129	4.2	22	3.5	0.132	>1000	30
31	54.412	1.6848				414	151	4.9	25	4.0	0.128	>1000	31
32	57.055	1.6129				409	85	2.7	11	1.7	0.099	>1000	32
33	57.874	1.5920				405	151	4.9	24	3.8	0.124	>1000	33
@	End-of-List												


<R0104178.MDI> MAN 33A
Intensity(Counts)
2-Theta(deg)
1). quartz
2). plagioclase (~ ol)
3). clinoptilolite
4). hornblende
d=3.3368
d=3.1729
d=4.2461
d=3.7501
d=4.0295
d=3.9649
d=3.6351
d=3.4607
d=3.1246
d=2.9248
d=2.9721
d=3.0048
d=2.8333
d=2.7918
d=9.0111
d=8.4344
d=7.9030
d=4.6487
d=2.5199
d=2.4530
d=2.2792
d=2.2336
d=2.2175
d=2.1249
d=2.1618
d=2.0190
d=1.9789
d=1.8172
d=1.7730
d=1.7940
d=1.6700

Cominco ERL

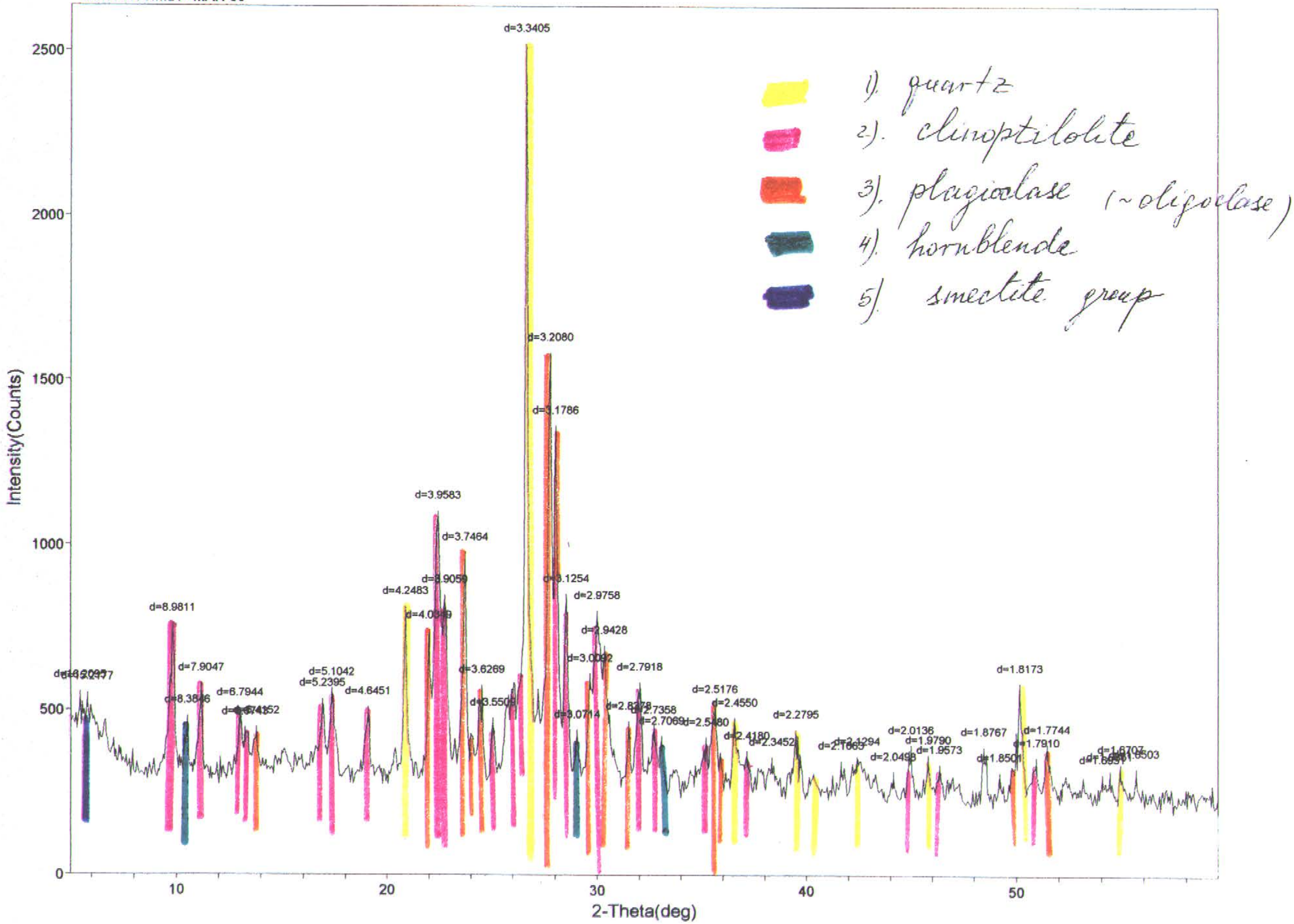
Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 5044, Anode = CU Date: 08-23-01@09:02

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	9.807	9.0111				355	241	5.4	60	7.2	0.198	>1000	1
2	10.480	8.4344				354	169	3.8	24	2.8	0.111	>1000	2
3	11.187	7.9030				318	111	2.5	20	2.3	0.141	>1000	3
4	13.057	6.7751				318	76	1.7	10	1.1	0.097	>1000	4
5	13.790	6.4163				328	111	2.5	27	3.1	0.187	>1000	5
6	15.004	5.8999				325	66	1.5	7	0.8	0.080	>1000	6
7	15.248	5.8060				321	70	1.6	9	1.1	0.101	>1000	7
8	16.937	5.2304				317	116	2.6	21	2.5	0.143	>1000	8
9	17.397	5.0934				315	136	3.0	30	3.6	0.174	>1000	9
10	19.075	4.6487				310	123	2.7	22	2.5	0.137	>1000	10
11	20.903	4.2461				310	964	21.4	190	22.8	0.157	>1000	11
12	22.041	4.0295				342	492	10.9	95	11.3	0.153	>1000	12
13	22.405	3.9649				349	426	9.5	168	20.2	0.315	313	13
14	22.805	3.8962				456	153	3.4	40	4.7	0.205	804	14
15	23.706	3.7501				383	530	11.8	146	17.5	0.219	623	15
16	24.467	3.6351				366	258	5.7	39	4.7	0.120	>1000	16
17	25.721	3.4607				429	90	2.0	14	1.7	0.123	>1000	17
18	26.694	3.3368				540	4504	100.0	832	100.0	0.148	>1000	18
19	27.801	3.2064				604	1196	26.6	271	32.5	0.181	>1000	19
20	28.100	3.1729				444	2614	58.0	387	46.5	0.118	>1000	20
21	28.544	3.1246				309	435	9.7	127	15.2	0.232	503	21
22	29.707	3.0048				353	228	5.1	61	7.3	0.212	603	22
23	30.042	2.9721				312	327	7.3	225	27.1	0.550	156	23
24	30.540	2.9248				349	329	7.3	71	8.5	0.172	>1000	24
25	31.551	2.8333				303	187	4.2	32	3.8	0.135	>1000	25
26	32.032	2.7918				313	127	2.8	24	2.8	0.146	>1000	26
27	33.134	2.7014				300	61	1.4	7	0.8	0.090	>1000	27
28	33.804	2.6494				271	77	1.7	9	1.1	0.092	>1000	28
29	35.238	2.5448				295	88	2.0	17	2.0	0.151	>1000	29
30	35.598	2.5199				298	292	6.5	74	8.8	0.201	629	30
31	36.603	2.4530				283	373	8.3	83	9.9	0.177	876	31
32	39.506	2.2792				269	304	6.7	57	6.8	0.149	>1000	32
33	40.346	2.2336				254	169	3.8	32	3.8	0.149	>1000	33
34	40.653	2.2175				251	55	1.2	7	0.8	0.091	>1000	34
35	41.748	2.1618				283	63	1.4	13	1.5	0.156	>1000	35
36	42.509	2.1249				265	251	5.6	81	9.6	0.255	398	36
37	44.856	2.0190				254	57	1.3	7	0.8	0.095	>1000	37
38	45.815	1.9789				262	131	2.9	24	2.8	0.143	>1000	38
39	50.161	1.8172				265	494	11.0	122	14.6	0.197	589	39
40	50.853	1.7940				287	107	2.4	17	2.0	0.123	>1000	40
41	51.500	1.7730				263	192	4.3	33	3.9	0.136	>1000	41
42	54.936	1.6700				264	89	2.0	17	2.0	0.148	>1000	42
@	End-of-List												

<R0104179.MDI> MAN 36



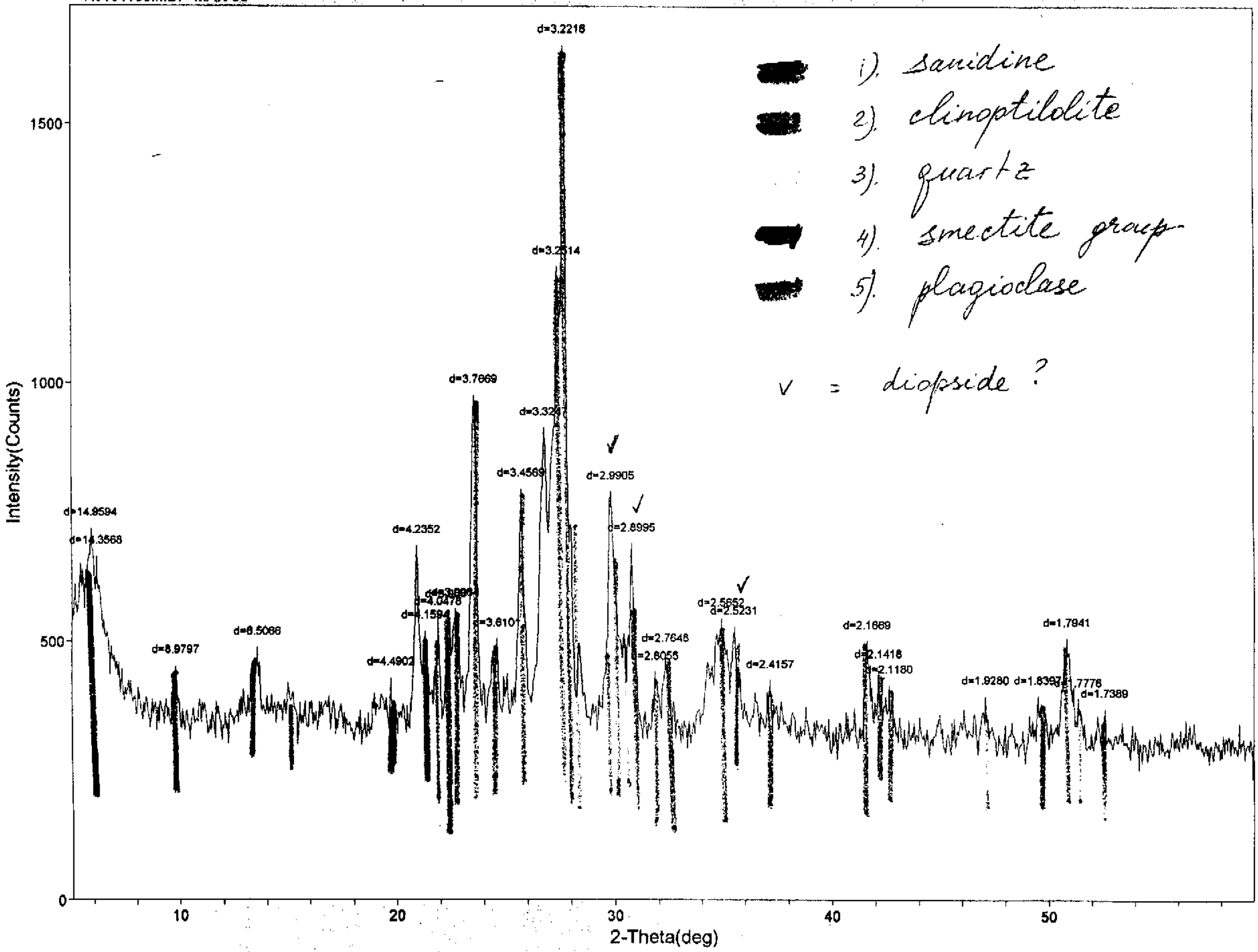
Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 2509, Anode = CU Date: 08-23-01@09:32

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.447	16.2095				463	75	3.7	8	2.0	0.085	>1000	1
2	5.803	15.2177				444	90	4.5	10	2.5	0.087	>1000	2
3	9.840	8.9811				321	422	21.0	109	27.7	0.206	>1000	3
4	10.542	8.3846				339	125	6.2	13	3.3	0.082	>1000	4
5	11.184	7.9047				318	244	12.2	39	9.8	0.126	>1000	5
6	13.019	6.7944				322	163	8.1	30	7.4	0.143	>1000	6
7	13.254	6.6743				327	101	5.0	36	9.2	0.285	403	7
8	13.793	6.4152				342	90	4.5	11	2.7	0.095	>1000	8
9	16.908	5.2395				318	198	9.9	67	17.0	0.270	428	9
10	17.360	5.1042				318	232	11.6	60	15.3	0.207	>1000	10
11	19.091	4.6451				294	197	9.8	45	11.3	0.179	>1000	11
12	20.893	4.2483				302	494	24.6	98	24.8	0.158	>1000	12
13	22.011	4.0349				308	416	20.7	85	21.5	0.162	>1000	13
14	22.443	3.9583				355	732	36.5	300	76.3	0.327	295	14
15	22.748	3.9059				377	455	22.7	144	36.4	0.251	458	15
16	23.730	3.7464				364	596	29.7	112	28.5	0.150	>1000	16
17	24.524	3.6269				343	216	10.8	33	8.3	0.120	>1000	17
18	25.057	3.5509				334	124	6.2	21	5.2	0.131	>1000	18
19	26.663	3.3405				503	2006	100.0	393	100.0	0.156	>1000	19
20	27.786	3.2080				558	1010	50.3	227	57.6	0.179	>1000	20
21	28.049	3.1786				569	778	38.8	146	37.0	0.149	>1000	21
22	28.536	3.1254				528	307	15.3	46	11.6	0.119	>1000	22
23	29.049	3.0714				340	82	4.1	9	2.3	0.087	>1000	23
24	29.663	3.0092				348	246	12.3	51	12.9	0.164	>1000	24
25	30.004	2.9758				320	464	23.1	250	63.6	0.430	206	25
26	30.348	2.9428				308	371	18.5	169	43.0	0.364	252	26
27	31.499	2.8378				333	115	5.7	13	3.3	0.089	>1000	27
28	32.032	2.7918				316	251	12.5	59	14.8	0.185	844	28
29	32.706	2.7358				305	131	6.5	29	7.2	0.173	>1000	29
30	33.066	2.7069				286	117	5.8	21	5.2	0.139	>1000	30
31	35.193	2.5480				283	117	5.8	21	5.3	0.142	>1000	31
32	35.632	2.5176				303	197	9.8	48	12.1	0.193	688	32
33	36.571	2.4550				300	159	7.9	27	6.7	0.132	>1000	33
34	37.152	2.4180				285	74	3.7	15	3.7	0.157	>1000	34
35	38.349	2.3452				263	78	3.9	20	4.9	0.199	620	35
36	39.500	2.2795				262	162	8.1	44	11.0	0.212	539	36
37	41.658	2.1663				264	66	3.3	7	1.7	0.082	>1000	37
38	42.413	2.1294				273	70	3.5	16	3.9	0.174	816	38
39	44.146	2.0498				237	59	2.9	7	1.7	0.090	>1000	39
40	44.982	2.0136				246	132	6.6	24	6.1	0.144	>1000	40
41	45.814	1.9790				254	94	4.7	14	3.5	0.117	>1000	41
42	46.350	1.9573				258	60	3.0	8	1.9	0.098	>1000	42
43	48.465	1.8767				229	145	7.2	28	6.9	0.150	>1000	43
44	49.209	1.8501				238	57	2.8	7	1.7	0.093	>1000	44
45	50.158	1.8173				271	295	14.7	74	18.7	0.199	575	45
46	50.945	1.7910				274	67	3.3	8	2.0	0.094	>1000	46
47	51.457	1.7744				263	118	5.9	21	5.2	0.138	>1000	47
48	54.054	1.6951				235	55	2.7	7	1.6	0.093	>1000	48
49	54.402	1.6851				241	59	2.9	7	1.5	0.081	>1000	49
50	54.910	1.6707				247	75	3.7	8	1.9	0.082	>1000	50
51	55.648	1.6503				235	73	3.6	9	2.1	0.088	>1000	51

<R0104180.MDI> MAN 38

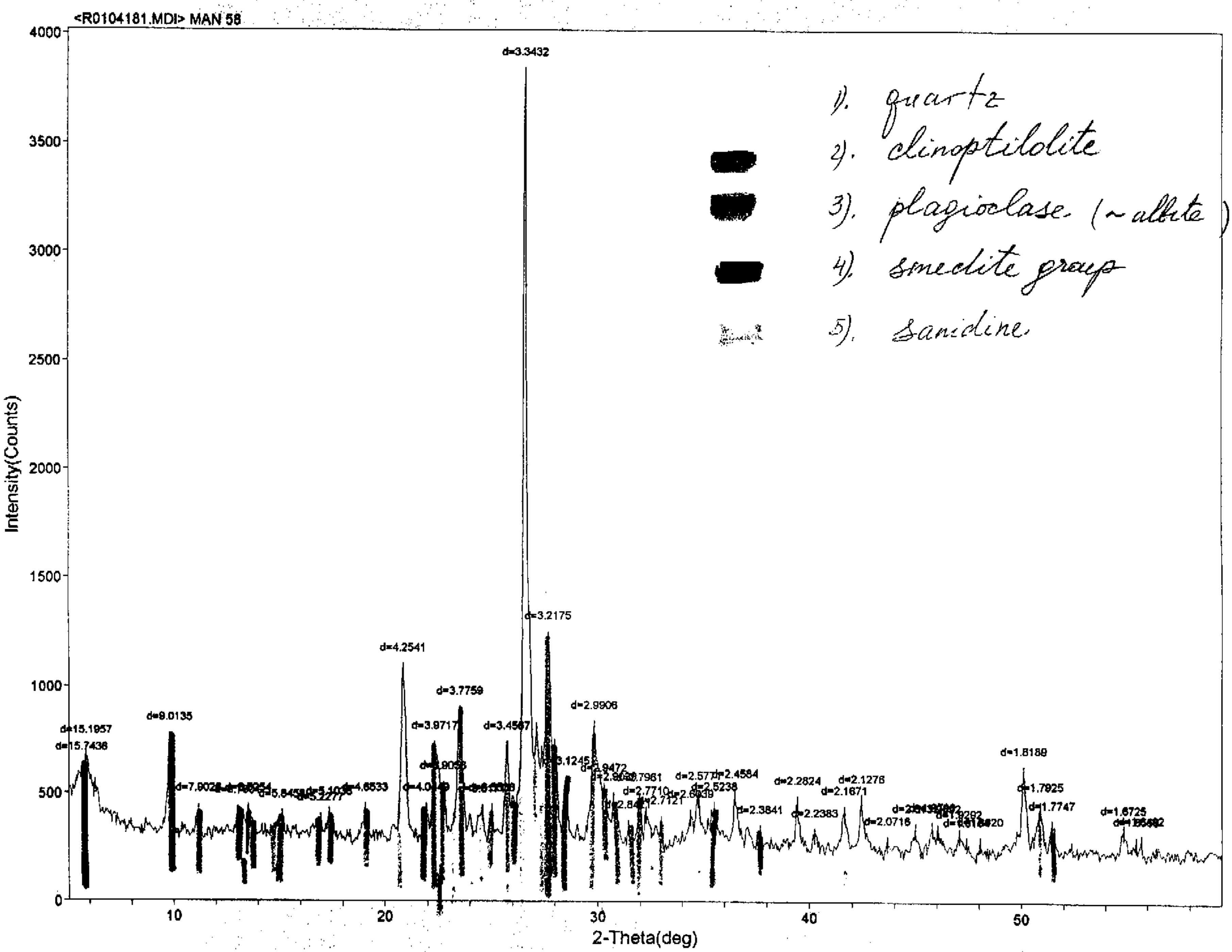


Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 1643, Anode = CU Date: 08-23-01@10:03

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.903	14.9594				534	173	17.0	61	14.1	0.281	480	1
2	6.151	14.3568				514	139	13.6	50	11.5	0.286	454	2
3	9.842	8.9797				350	91	8.9	18	3.9	0.149	>1000	3
4	13.598	6.5066				360	116	11.4	28	6.3	0.187	>1000	4
5	19.755	4.4902				345	73	7.2	8	1.6	0.077	>1000	5
6	20.958	4.2352				376	298	29.2	69	15.8	0.183	>1000	6
7	21.345	4.1594				381	127	12.5	30	6.9	0.188	>1000	7
8	21.940	4.0478				407	127	12.5	17	3.8	0.104	>1000	8
9	22.444	3.9581				407	142	13.9	34	7.8	0.190	>1000	9
10	22.745	3.9064				407	145	14.2	37	8.5	0.202	860	10
11	23.599	3.7669				397	569	55.8	169	39.2	0.237	511	11
12	24.640	3.6101				387	106	10.4	13	2.8	0.092	>1000	12
13	25.750	3.4569				397	388	38.0	101	23.2	0.206	709	13
14	26.792	3.3247				707	196	19.2	36	8.1	0.143	>1000	14
15	27.408	3.2514				460	757	74.2	432	100.0	0.456	193	15
16	27.667	3.2216				623	1020	100.0	427	98.9	0.334	282	16
17	29.853	2.9905				420	360	35.3	116	26.9	0.258	410	17
18	30.812	2.8995				445	234	22.9	37	8.5	0.126	>1000	18
19	31.872	2.8055				336	93	9.1	18	4.0	0.150	>1000	19
20	32.353	2.7648				329	135	13.2	39	9.0	0.230	491	20
21	34.948	2.5652				366	167	16.4	98	22.5	0.465	189	21
22	35.551	2.5231				432	85	8.3	11	2.4	0.096	>1000	22
23	37.189	2.4157				348	65	6.4	7	1.5	0.079	>1000	23
24	41.645	2.1669				350	140	13.7	30	6.8	0.167	932	24
25	42.156	2.1418				323	110	10.8	17	3.8	0.120	>1000	25
26	42.653	2.1180				340	64	6.3	7	1.6	0.086	>1000	26
27	47.097	1.9280				312	71	7.0	8	1.8	0.088	>1000	27
28	49.504	1.8397				311	72	7.1	9	2.0	0.096	>1000	28
29	50.852	1.7941				311	184	18.0	80	18.4	0.344	275	29
30	51.357	1.7776				310	69	6.8	9	2.0	0.100	>1000	30
31	52.588	1.7389				297	61	6.0	7	1.5	0.084	>1000	31
@	End-of-List												


<R0104181.MDI> MAN 58
Intensity(Counts)
2-Theta(deg)
d=3.3432
d=3.2175
d=4.2541
d=3.7759
d=2.9906
d=9.0135
d=15.1957
d=15.7436
d=1.8189
1). quartz
2). clinoptilolite
3). plagioclase (~albite)
4). smectite group
5). sanidine

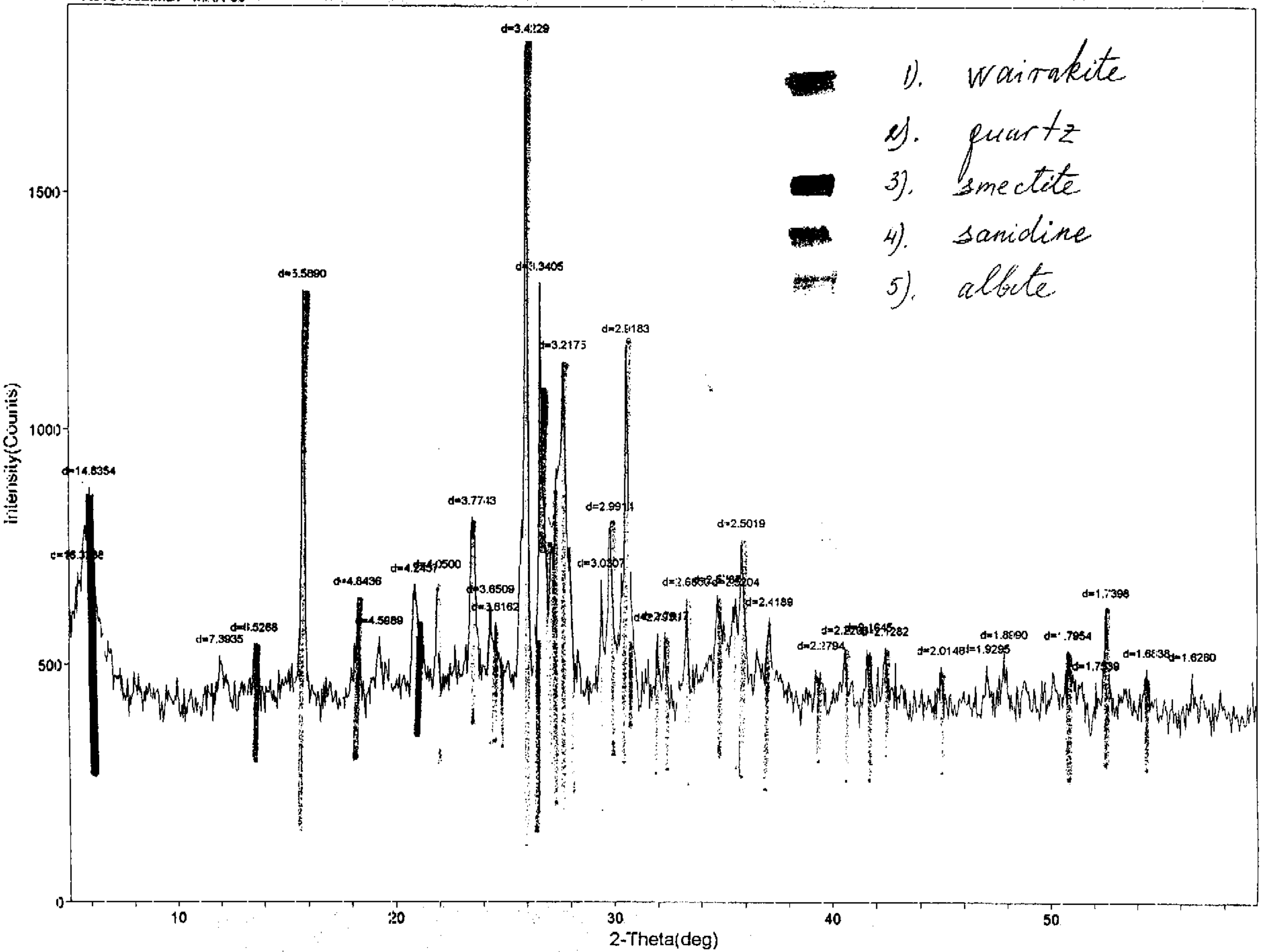
Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 3827, Anode = CU Date: 08-23-01@10:57

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.609	15.7436				491	118	3.6	42	5.7	0.281	484	1
2	5.811	15.1957				473	216	6.6	94	12.9	0.345	306	2
3	9.805	9.0135				313	439	13.4	100	13.7	0.181	>1000	3
4	11.187	7.9026				296	125	3.8	14	1.9	0.086	>1000	4
5	13.047	6.7801				318	93	2.8	10	1.3	0.083	>1000	5
6	13.558	6.5254				314	108	3.3	26	3.5	0.188	>1000	6
7	15.143	5.8458				311	82	2.5	11	1.4	0.101	>1000	7
8	16.946	5.2277				301	77	2.4	10	1.3	0.095	>1000	8
9	17.361	5.1038				298	107	3.3	19	2.5	0.136	>1000	9
10	19.057	4.6533				276	150	4.6	38	5.2	0.202	>1000	10
11	20.864	4.2541				287	791	24.1	213	29.4	0.215	718	11
12	21.956	4.0449				359	68	2.1	7	1.0	0.081	>1000	12
13	22.366	3.9717				313	401	12.2	116	16.0	0.231	560	13
14	22.749	3.9056				328	197	6.0	48	6.6	0.194	>1000	14
15	23.542	3.7759				334	545	16.6	147	20.3	0.216	655	15
16	24.591	3.6171				324	96	2.9	12	1.6	0.094	>1000	16
17	25.036	3.5538				332	94	2.9	10	1.3	0.080	>1000	17
18	25.752	3.4567				412	302	9.2	50	6.8	0.131	>1000	18
19	26.642	3.3432				551	3276	100.0	725	100.0	0.177	>1000	19
20	27.703	3.2175				564	662	20.2	157	21.7	0.190	907	20
21	28.544	3.1245				367	182	5.6	25	3.4	0.108	>1000	21
22	29.852	2.9906				337	476	14.5	175	24.1	0.293	336	22
23	30.302	2.9472				288	229	7.0	115	15.9	0.401	223	23
24	30.765	2.9039				381	96	2.9	11	1.4	0.085	>1000	24
25	31.451	2.8421				283	65	2.0	6	0.8	0.071	>1000	25
26	31.982	2.7961				344	130	4.0	17	2.3	0.103	>1000	26
27	32.280	2.7710				271	140	4.3	22	2.9	0.121	>1000	27
28	33.000	2.7121				276	91	2.8	9	1.2	0.078	>1000	28
29	34.414	2.6039				306	92	2.8	16	2.2	0.137	>1000	29
30	34.782	2.5771				303	179	5.5	41	5.6	0.181	841	30
31	35.541	2.5238				322	111	3.4	26	3.5	0.183	797	31
32	36.520	2.4584				291	202	6.2	34	4.6	0.131	>1000	32
33	37.700	2.3841				266	60	1.8	8	1.1	0.104	>1000	33
34	39.447	2.2824				248	215	6.6	42	5.8	0.155	>1000	34
35	40.259	2.2383				246	65	2.0	13	1.8	0.157	>1000	35
36	41.640	2.1671				256	161	4.9	40	5.4	0.196	623	36
37	42.451	2.1276				251	219	6.7	46	6.2	0.165	961	37
38	43.657	2.0716				224	52	1.6	6	0.7	0.082	>1000	38
39	44.994	2.0131				235	101	3.1	17	2.3	0.129	>1000	39
40	45.793	1.9798				239	102	3.1	19	2.6	0.145	>1000	40
41	46.055	1.9692				239	96	2.9	17	2.3	0.136	>1000	41
42	47.066	1.9292				229	80	2.4	15	2.0	0.147	>1000	42
43	47.398	1.9164				218	52	1.6	7	0.8	0.092	>1000	43
44	48.050	1.8920				209	64	2.0	8	1.0	0.088	>1000	44
45	50.110	1.8189				273	331	10.1	76	10.4	0.182	678	45
46	50.900	1.7925				265	174	5.3	47	6.4	0.213	515	46
47	51.446	1.7747				256	96	2.9	15	2.0	0.122	>1000	47
48	54.846	1.6725				221	110	3.4	29	4.0	0.208	533	48
49	55.446	1.6558				211	68	2.1	8	1.0	0.085	>1000	49
50	55.687	1.6492				219	66	2.0	7	0.9	0.081	>1000	50
@	End-of-List												

<R0104182.MDI> MAN 59



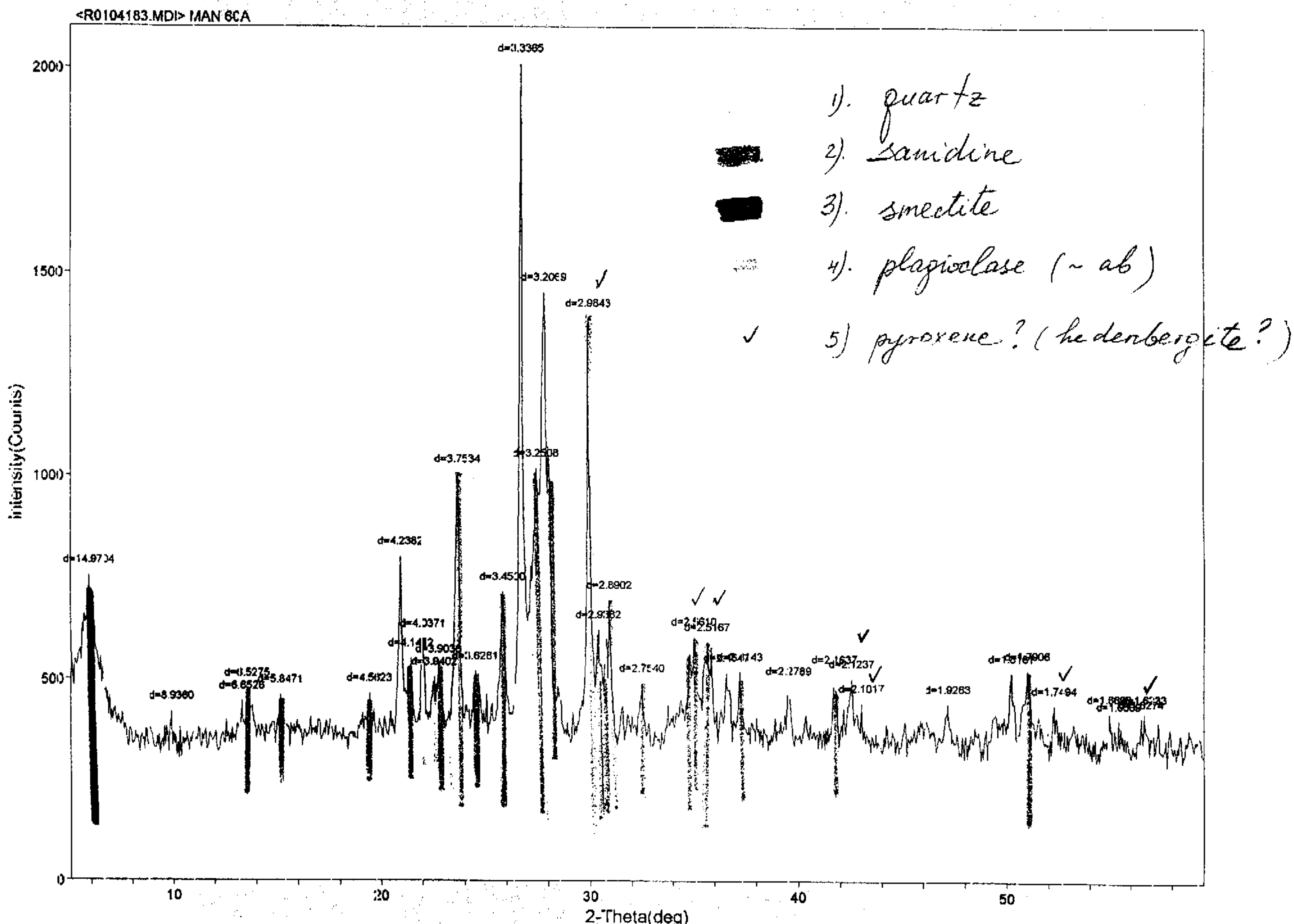
Cominco ERL

Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 1802, Anode = CU Date: 08-23-01@11:32

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.409	16.3238				600	85	6.6	11	4.4	0.101	>1000	1
2	5.952	14.8354				565	299	23.3	144	58.5	0.383	258	2
3	11.960	7.3935				420	85	6.6	11	4.5	0.103	>1000	3
4	13.555	6.5268				427	104	8.1	13	5.1	0.096	>1000	4
5	15.844	5.5890				435	848	66.1	146	59.5	0.137	>1000	5
6	18.301	4.8436				426	204	15.9	40	16.0	0.153	>1000	6
7	19.284	4.5989				444	102	8.0	20	7.8	0.149	>1000	7
8	20.906	4.2457				471	187	14.6	48	19.4	0.203	931	8
9	21.928	4.0500				491	176	13.7	22	9.0	0.100	>1000	9
10	23.552	3.7743				491	312	24.3	87	35.6	0.223	598	10
11	24.360	3.6509				499	115	9.0	18	7.3	0.125	>1000	11
12	24.597	3.6162				493	83	6.5	10	3.7	0.087	>1000	12
13	26.010	3.4229				520	1282	100.0	245	100.0	0.152	>1000	13
14	26.663	3.3405				624	675	52.7	108	43.9	0.127	>1000	14
15	27.703	3.2175				592	541	42.2	230	93.9	0.339	270	15
16	29.448	3.0307				556	114	8.9	10	3.8	0.065	>1000	16
17	29.844	2.9914				540	251	19.6	49	19.8	0.154	>1000	17
18	30.609	2.9183				509	659	51.4	164	67.1	0.199	700	18
19	32.008	2.7939				431	123	9.6	17	6.9	0.110	>1000	19
20	32.355	2.7647				430	128	10.0	19	7.4	0.113	>1000	20
21	33.343	2.6850				460	170	13.3	23	9.4	0.108	>1000	21
22	34.761	2.5787				518	118	9.2	21	8.2	0.136	>1000	22
23	35.591	2.5204				503	127	9.9	45	18.0	0.277	357	23
24	35.863	2.5019				504	251	19.6	55	22.1	0.172	991	24
25	37.138	2.4189				456	132	10.3	24	9.6	0.142	>1000	25
26	39.502	2.2794				412	82	6.4	11	4.1	0.098	>1000	26
27	40.594	2.2206				413	115	9.0	20	8.0	0.136	>1000	27
28	41.694	2.1645				426	108	8.4	21	8.4	0.151	>1000	28
29	42.440	2.1282				428	97	7.6	18	7.2	0.144	>1000	29
30	44.960	2.0146				410	75	5.9	10	3.8	0.100	>1000	30
31	47.058	1.9295				413	76	5.9	10	3.7	0.096	>1000	31
32	47.860	1.8990				419	100	7.8	16	6.4	0.126	>1000	32
33	50.811	1.7954				404	114	8.9	21	8.5	0.145	>1000	33
34	52.103	1.7539				388	66	5.1	7	2.7	0.081	>1000	34
35	52.558	1.7398				398	211	16.5	50	20.1	0.187	642	35
36	54.447	1.6838				405	76	5.9	11	4.2	0.108	>1000	36
37	56.553	1.6260				387	87	6.8	10	3.9	0.087	>1000	37
@	End-of-List												

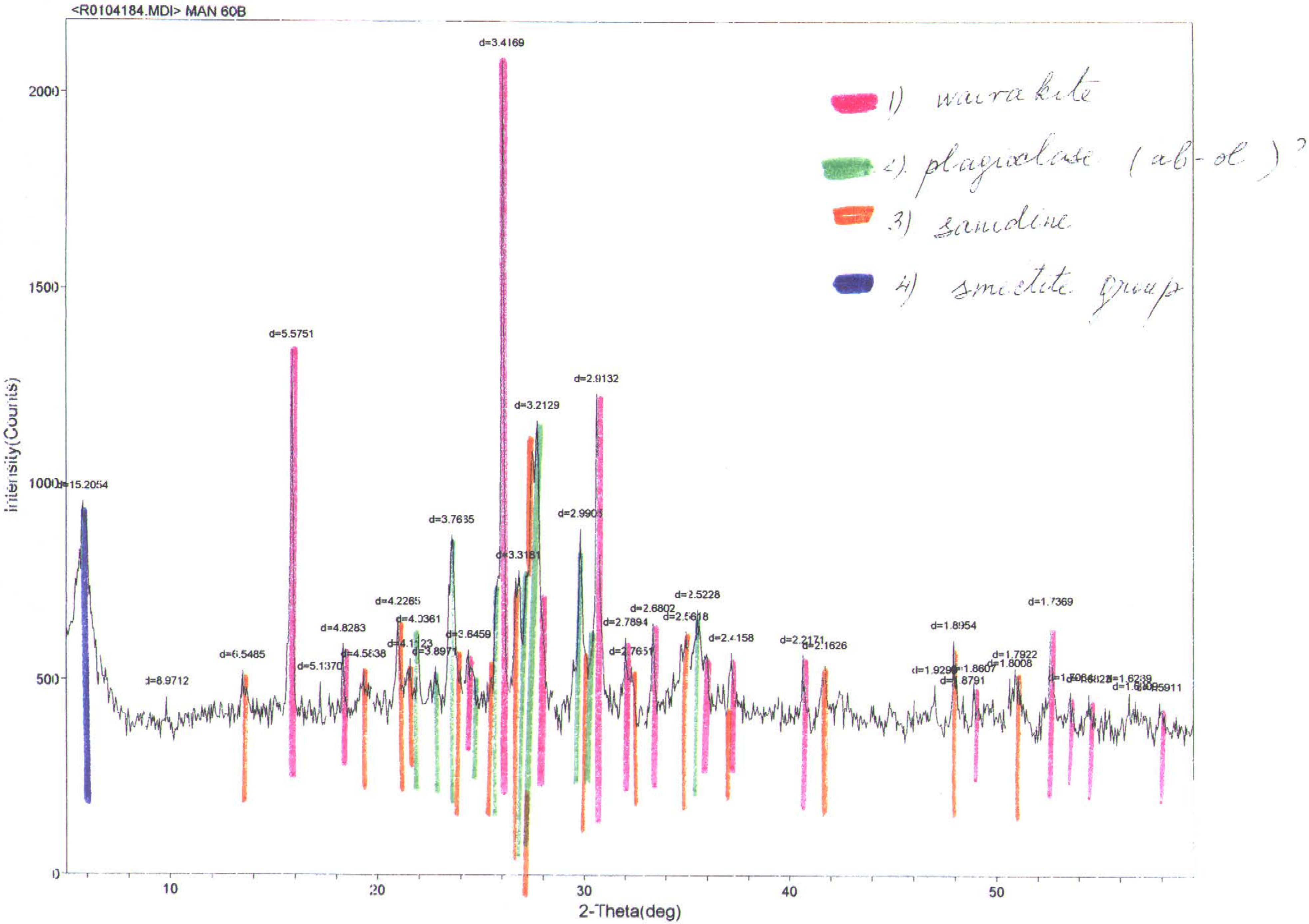

<R0104183.MDI> MAN 60A
Intensity(Counts)
2-Theta(deg)
d=3.3365
d=3.2069
d=2.9843
d=3.7534
d=4.2382
d=14.9704
d=3.4520
d=2.8902
d=8.9360
d=5.8471
d=4.5623
d=2.7540
d=2.2789
d=2.1017
d=1.9263
d=1.7494
1). quartz
2). sanidine
3). smectite
4). plagioclase (~ ab)
5) pyroxene ? (hedenbergite ?)

Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 2001, Anode = CU Date: 08-23-01@12:26

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.899	14.9704				489	250	17.8	128	35.8	0.408	234	1
2	9.890	8.9360				331	73	5.2	9	2.4	0.094	>1000	2
3	13.298	6.6526				359	71	5.1	8	2.2	0.086	>1000	3
4	13.554	6.5275				360	101	7.2	12	3.2	0.090	>1000	4
5	15.140	5.8471				363	82	5.8	10	2.6	0.089	>1000	5
6	19.440	4.5623				366	84	6.0	10	2.5	0.086	>1000	6
7	20.943	4.2382				391	395	28.1	82	22.8	0.164	>1000	7
8	21.440	4.1412				444	92	6.5	11	2.8	0.088	>1000	8
9	21.999	4.0371				428	155	11.0	28	7.6	0.140	>1000	9
10	22.547	3.9402				399	91	6.5	22	6.1	0.192	>1000	10
11	22.761	3.9036				407	114	8.1	22	6.1	0.153	>1000	11
12	23.685	3.7534				403	586	41.7	144	40.2	0.195	966	12
13	24.516	3.6281				414	90	6.4	17	4.6	0.144	>1000	13
14	25.802	3.4500				419	279	19.9	64	18.0	0.183	>1000	14
15	26.696	3.3365				586	1405	100.0	248	69.6	0.141	>1000	15
16	27.414	3.2508				635	369	26.3	114	32.0	0.247	451	16
17	27.796	3.2069				559	881	62.7	356	100.0	0.323	295	17
18	29.916	2.9843				451	925	65.8	158	44.3	0.136	>1000	18
19	30.397	2.9382				520	86	6.1	10	2.6	0.087	>1000	19
20	30.914	2.8902				461	217	15.4	35	9.7	0.128	>1000	20
21	32.484	2.7540				364	111	7.9	19	5.3	0.135	>1000	21
22	35.008	2.5610				416	173	12.3	46	12.9	0.212	562	22
23	35.645	2.5167				411	165	11.7	63	17.7	0.305	314	23
24	36.576	2.4547				385	116	8.3	19	5.3	0.130	>1000	24
25	37.211	2.4143				375	128	9.1	20	5.5	0.123	>1000	25
26	39.511	2.2789				355	114	8.1	21	5.8	0.144	>1000	26
27	41.710	2.1637				373	125	8.9	23	6.2	0.141	>1000	27
28	42.532	2.1237				367	120	8.5	22	6.0	0.141	>1000	28
29	43.000	2.1017				353	73	5.2	7	1.9	0.075	>1000	29
30	47.141	1.9263				336	89	6.3	16	4.6	0.155	>1000	30
31	50.193	1.8161				380	122	8.7	22	6.0	0.141	>1000	31
32	50.958	1.7906				365	144	10.2	47	13.0	0.258	392	32
33	52.246	1.7494				343	79	5.6	10	2.7	0.098	>1000	33
34	54.948	1.6696				318	85	6.0	16	4.3	0.144	>1000	34
35	55.406	1.6569				318	68	4.8	7	1.8	0.077	>1000	35
36	56.500	1.6274				325	67	4.8	8	2.0	0.084	>1000	36
37	56.657	1.6233				326	77	5.5	9	2.5	0.091	>1000	37
@	End-of-List												



Cominco ERL

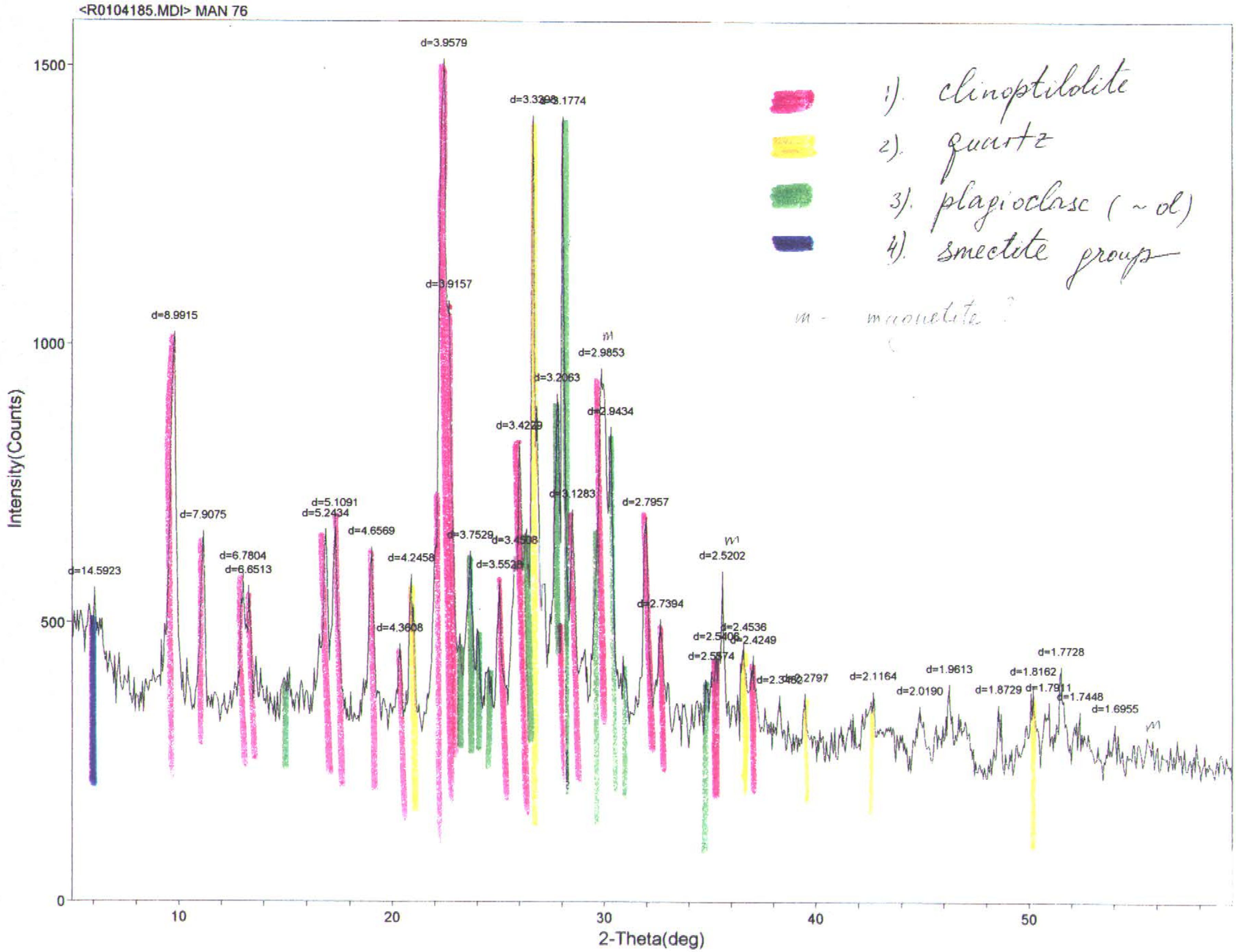
<c:\progra~1\datascan\data-01> Thursday, Aug 23, 2001 @01:38p

Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 2081, Anode = CU Date: 08-23-01@12:58

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.808	15.2054				585	355	22.3	195	68.5	0.438	212	1
2	9.851	8.9712				372	67	4.2	7	2.3	0.079	>1000	2
3	13.510	6.5485				409	100	6.3	16	5.5	0.125	>1000	3
4	15.883	5.5751				419	912	57.3	152	53.5	0.133	>1000	4
5	17.248	5.1370				408	72	4.5	6	2.1	0.066	>1000	5
6	18.360	4.8283				412	166	10.4	22	7.6	0.105	>1000	6
7	19.348	4.5838				423	89	5.6	11	3.8	0.097	>1000	7
8	21.002	4.2265				451	197	12.4	34	11.9	0.137	>1000	8
9	21.592	4.1123				441	98	6.2	12	3.9	0.090	>1000	9
10	22.005	4.0361				458	144	9.1	17	5.8	0.092	>1000	10
11	22.800	3.8971				446	73	4.6	10	3.2	0.099	>1000	11
12	23.602	3.7665				468	389	24.5	126	44.1	0.257	433	12
13	24.394	3.6459				472	92	5.8	12	4.2	0.103	>1000	13
14	26.056	3.4169				490	1591	100.0	285	100.0	0.143	>1000	14
15	26.847	3.3181				634	133	8.4	17	5.8	0.100	>1000	15
16	27.744	3.2129				556	595	37.4	199	70.0	0.267	391	16
17	29.853	2.9905				505	369	23.2	82	28.5	0.176	>1000	17
18	30.663	2.9132				510	709	44.6	148	52.0	0.167	>1000	18
19	32.060	2.7894				428	168	10.6	28	9.6	0.129	>1000	19
20	32.351	2.7651				419	103	6.5	28	9.8	0.216	559	20
21	33.404	2.6802				429	203	12.8	34	11.9	0.133	>1000	21
22	34.997	2.5618				513	98	6.2	19	6.5	0.151	>1000	22
23	35.556	2.5228				484	184	11.6	64	22.4	0.277	359	23
24	37.187	2.4158				442	115	7.2	19	6.4	0.127	>1000	24
25	40.660	2.2171				392	161	10.1	24	8.4	0.119	>1000	25
26	41.732	2.1626				405	133	8.4	22	7.6	0.129	>1000	26
27	47.046	1.9299				397	78	4.9	9	3.0	0.086	>1000	27
28	47.956	1.8954				380	210	13.2	40	13.7	0.149	>1000	28
29	48.400	1.8791				382	67	4.2	7	2.4	0.080	>1000	29
30	48.910	1.8607				394	86	5.4	10	3.2	0.085	>1000	30
31	50.650	1.8008				393	100	6.3	11	3.7	0.083	>1000	31
32	50.909	1.7922				383	133	8.4	57	19.9	0.341	278	32
33	52.653	1.7369				382	270	17.0	51	17.9	0.150	>1000	33
34	53.600	1.7084				387	70	4.4	8	2.8	0.091	>1000	34
35	54.501	1.6823				378	75	4.7	9	2.9	0.089	>1000	35
36	56.445	1.6289				372	83	5.2	9	3.2	0.086	>1000	36
37	56.748	1.6209				361	74	4.7	10	3.2	0.097	>1000	37
38	57.909	1.5911				364	68	4.3	9	2.8	0.094	>1000	38
@	End-of-List												

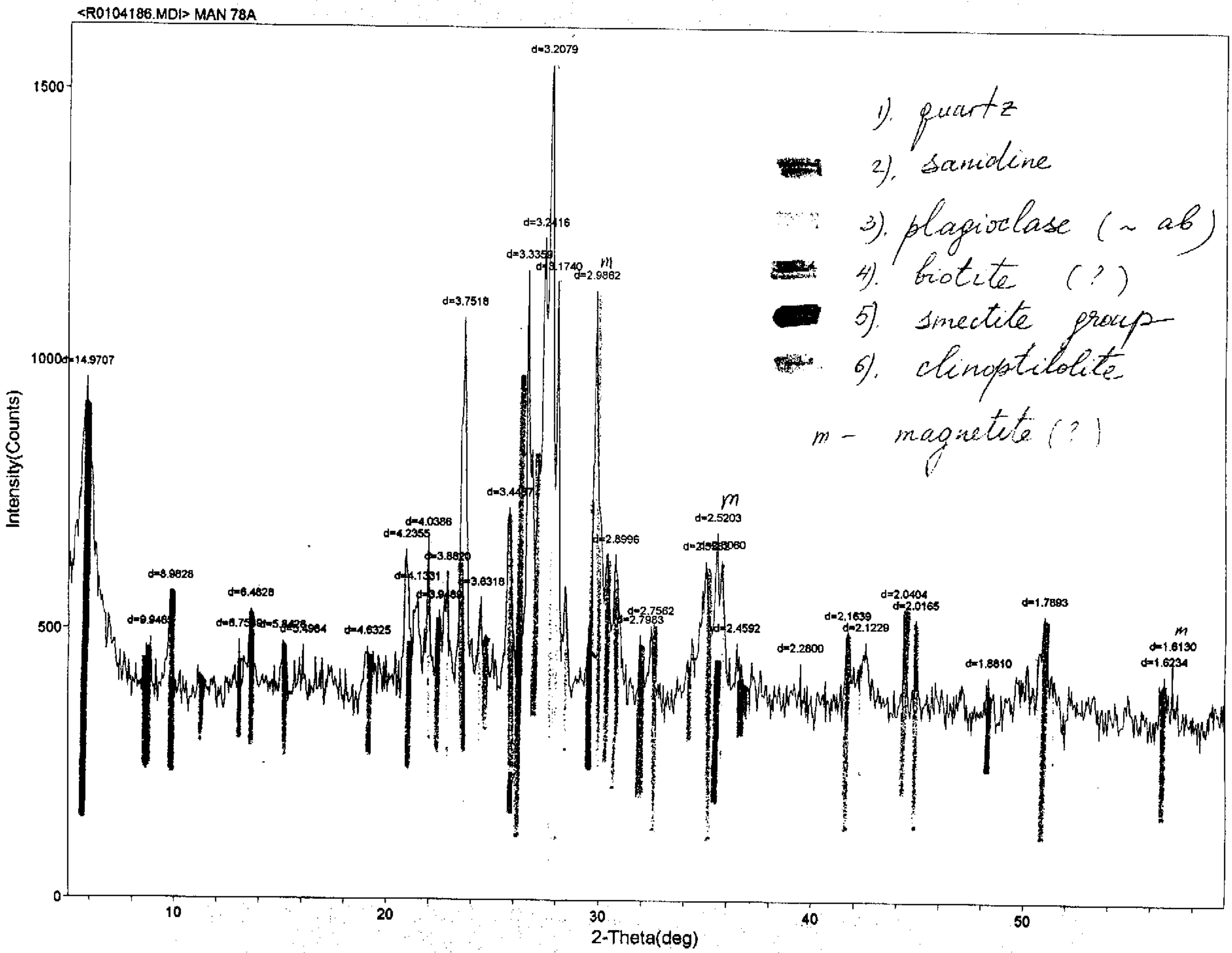

<R0104185.MDI> MAN 76
Intensity(Counts)
2-Theta(deg)
d=3.9579
d=3.3398
d=3.1774
d=3.9157
d=8.9915
d=2.9853
d=3.2063
d=2.9434
d=3.4229
d=3.1283
d=2.7957
d=5.1091
d=5.2434
d=7.9075
d=4.6569
d=3.7529
d=3.4508
d=6.7804
d=6.6513
d=4.2458
d=3.5528
d=14.5923
d=2.5202
d=2.7394
d=4.3608
d=2.4536
d=2.5406
d=2.4249
d=2.5574
d=2.3462
d=2.2797
d=2.1164
d=1.9613
d=2.0190
d=1.8729
d=1.8162
d=1.7911
d=1.7728
d=1.7448
d=1.6955
1). clinoptilolite
2). quartz
3). plagioclase (~ol)
4). smectite group
m - magnetite ?

Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 1506, Anode = CU Date: 08-23-01@14:40

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	6.052	14.5923				461	91	8.2	11	1.6	0.089	>1000	1
2	9.829	8.9915				381	632	56.6	198	31.6	0.250	620	2
3	11.180	7.9075				353	302	27.1	63	9.9	0.164	>1000	3
4	13.046	6.7804				358	223	20.0	60	9.5	0.214	>1000	4
5	13.301	6.6513				350	206	18.5	50	7.9	0.191	>1000	5
6	16.895	5.2434				351	308	27.6	87	13.8	0.225	707	6
7	17.343	5.1091				352	326	29.2	101	16.1	0.248	516	7
8	19.041	4.6569				333	294	26.3	78	12.4	0.211	849	8
9	20.348	4.3608				358	94	8.4	15	2.4	0.127	>1000	9
10	20.905	4.2458				349	229	20.5	53	8.4	0.184	>1000	10
11	22.445	3.9579				390	1116	100.0	626	100.0	0.448	197	11
12	22.690	3.9157				418	653	58.5	209	33.4	0.256	443	12
13	23.688	3.7529				416	205	18.4	46	7.3	0.178	>1000	13
14	25.044	3.5528				390	177	15.9	30	4.7	0.132	>1000	14
15	25.796	3.4508				510	101	9.1	13	2.1	0.102	>1000	15
16	26.010	3.4229				569	249	22.3	44	7.0	0.140	>1000	16
17	26.669	3.3398				652	753	67.5	114	18.1	0.120	>1000	17
18	27.801	3.2063				470	434	38.9	124	19.7	0.227	529	18
19	28.060	3.1774				464	939	84.1	203	32.3	0.172	>1000	19
20	28.509	3.1283				571	125	11.2	15	2.3	0.092	>1000	20
21	29.906	2.9853				398	551	49.4	283	45.2	0.411	217	21
22	30.342	2.9434				376	468	41.9	128	20.3	0.218	562	22
23	31.986	2.7957				374	307	27.5	72	11.4	0.186	840	23
24	32.662	2.7394				363	134	12.0	26	4.0	0.150	>1000	24
25	35.059	2.5574				326	77	6.9	10	1.6	0.102	>1000	25
26	35.299	2.5406				346	93	8.3	24	3.7	0.200	639	26
27	35.593	2.5202				344	241	21.6	43	6.7	0.139	>1000	27
28	36.593	2.4536				332	124	11.1	31	4.9	0.199	632	28
29	37.042	2.4249				324	109	9.8	31	4.8	0.222	504	29
30	38.299	2.3482				299	62	5.6	9	1.3	0.103	>1000	30
31	39.496	2.2797				282	83	7.4	15	2.4	0.143	>1000	31
32	42.687	2.1164				286	82	7.3	16	2.4	0.147	>1000	32
33	44.856	2.0190				262	80	7.2	22	3.4	0.213	524	33
34	46.251	1.9613				276	105	9.4	22	3.5	0.166	866	34
35	48.571	1.8729				256	89	8.0	15	2.2	0.126	>1000	35
36	50.191	1.8162				282	96	8.6	18	2.8	0.147	>1000	36
37	50.942	1.7911				290	59	5.3	6	1.0	0.081	>1000	37
38	51.506	1.7728				286	128	11.5	22	3.5	0.136	>1000	38
39	52.396	1.7448				273	60	5.4	7	1.0	0.082	>1000	39
40	54.043	1.6955				249	62	5.6	8	1.1	0.092	>1000	40
@	End-of-List												


<R0104186.MDI> MAN 78A
Intensity(Counts)
2-Theta(deg)
0
500
1000
1500
10
20
30
40
50
d=3.2079
d=3.2416
d=3.3359
d=3.1740
d=2.9862
d=3.7518
d=14.9707
d=3.4497
d=4.0386
d=4.2355
d=2.8996
d=2.5203
d=3.8820
d=8.9828
d=4.1331
d=3.6316
d=6.4828
d=2.7562
d=2.7983
d=9.9469
d=4.6325
d=2.4592
d=2.2800
d=2.1639
d=2.1229
d=2.0404
d=2.0165
d=1.7883
d=1.8810
d=1.6130
d=1.6234
m
1). quartz
2). sanidine
3). plagioclase (~ ab)
4). biotite (?)
5). smectite group
6). clinoptilolite
m - magnetite (?)

<R0104186.MDI> MAN 78A [JADE - Peak List Report]

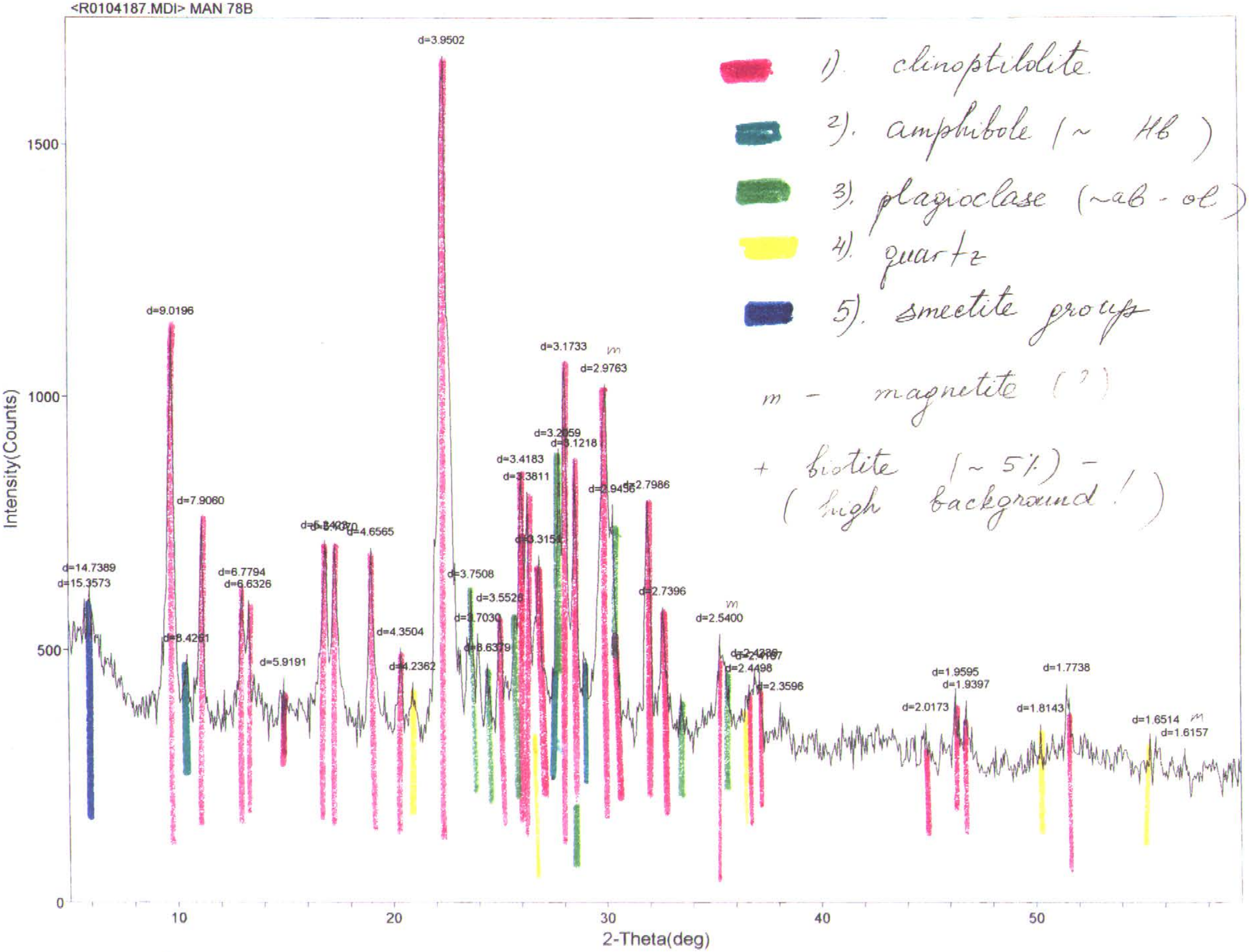
Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 1541, Anode = CU Date: 08-23-01@15:06

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.899	14.9707				580	377	39.4	202	73.2	0.428	219	1
2	8.883	9.9465				403	70	7.3	8	2.7	0.086	>1000	2
3	9.838	8.9828				388	171	17.9	28	10.1	0.131	>1000	3
4	13.098	6.7539				388	81	8.5	7	2.3	0.064	>1000	4
5	13.648	6.4828				400	127	13.3	28	9.8	0.170	>1000	5
6	15.151	5.8428				394	73	7.6	9	3.2	0.098	>1000	6
7	16.106	5.4984				391	68	7.1	7	2.3	0.074	>1000	7
8	19.143	4.6325				379	79	8.3	18	6.5	0.181	>1000	8
9	20.957	4.2355				433	207	21.7	45	16.3	0.174	>1000	9
10	21.482	4.1331				436	125	13.1	24	8.3	0.147	>1000	10
11	21.991	4.0386				457	205	21.4	25	8.9	0.096	>1000	11
12	22.497	3.9489				454	72	7.5	15	5.4	0.166	>1000	12
13	22.890	3.8820				444	154	16.1	17	6.1	0.088	>1000	13
14	23.695	3.7518				441	632	66.1	175	63.3	0.221	609	14
15	24.490	3.6318				434	117	12.2	14	5.1	0.095	>1000	15
16	25.827	3.4467				433	286	29.9	66	23.8	0.184	>1000	16
17	26.701	3.3359				619	542	56.7	87	31.4	0.128	>1000	17
18	27.492	3.2416				884	337	35.3	68	24.5	0.160	>1000	18
19	27.787	3.2079				585	956	100.0	276	100.0	0.231	512	19
20	28.090	3.1740				414	726	75.9	135	48.7	0.148	>1000	20
21	29.896	2.9862				474	650	68.0	172	62.1	0.211	610	21
22	30.811	2.8996				519	114	11.9	15	5.1	0.099	>1000	22
23	31.956	2.7983				386	97	10.1	11	3.8	0.086	>1000	23
24	32.457	2.7562				378	122	12.8	20	7.2	0.130	>1000	24
25	35.048	2.5582				427	195	20.4	82	29.4	0.333	281	25
26	35.592	2.5203				426	249	26.0	84	30.3	0.268	375	26
27	35.802	2.5060				465	159	16.6	35	12.6	0.175	927	27
28	36.508	2.4592				402	67	7.0	8	2.7	0.088	>1000	28
29	39.491	2.2800				361	72	7.5	8	2.5	0.078	>1000	29
30	41.706	2.1639				420	74	7.7	14	4.8	0.143	>1000	30
31	42.549	2.1229				391	82	8.6	17	6.1	0.165	956	31
32	44.359	2.0404				376	160	16.7	17	5.8	0.080	>1000	32
33	44.914	2.0165				366	149	15.6	18	6.3	0.093	>1000	33
34	48.347	1.8810				344	65	6.8	9	3.1	0.105	>1000	34
35	50.996	1.7893				383	142	14.9	41	14.6	0.227	467	35
36	56.652	1.6234				333	83	8.7	22	7.6	0.203	556	36
37	57.049	1.6130				339	107	11.2	11	3.7	0.077	>1000	37
@	End-of-List												

<R0104187.MDI> MAN 78B



<R0104187.MDI> MAN 78B [JADE - Peak List Report]

Scan Parameters: Range = 5.0-59.5/0.05, Dwell = 1(sec), Max-I = 1665, Anode = CU Date: 08-23-01@16:04

Search Parameters: Filter = 11(pts), Threshold = 3.0(esd), Peak-Cutoff = 0.5%, 2-Theta Zero Offset = 0.0(deg)

Note: Intensity data from raw counts, Summit peak location, Wavelength for computing d-spacing = 1.540562<CU, K-alpha1>

#	2-Theta	d(A)	h	k	l	BG	Peak	P%	Area	A%	FWHM	Size(A)	#
1	5.750	15.3573				506	80	6.3	8	1.0	0.074	>1000	1
2	5.991	14.7389				497	120	9.4	15	2.1	0.100	>1000	2
3	9.798	9.0196				399	728	57.1	242	33.2	0.265	513	3
4	10.490	8.4261				409	70	5.5	9	1.1	0.093	>1000	4
5	11.182	7.9060				388	363	28.5	67	9.2	0.147	>1000	5
6	13.048	6.7794				373	236	18.5	67	9.1	0.224	885	6
7	13.338	6.6326				369	216	17.0	45	6.1	0.165	>1000	7
8	14.955	5.9191				364	68	5.3	7	1.0	0.082	>1000	8
9	16.899	5.2423				373	330	25.9	135	18.4	0.325	307	9
10	17.350	5.1070				377	322	25.3	103	14.0	0.254	487	10
11	19.043	4.6565				350	340	26.7	101	13.9	0.237	556	11
12	20.397	4.3504				344	148	11.6	25	3.3	0.132	>1000	12
13	20.953	4.2362				340	84	6.6	16	2.1	0.147	>1000	13
14	22.489	3.9502				391	1274	100.0	728	100.0	0.457	192	14
15	23.702	3.7508				417	189	14.8	34	4.5	0.140	>1000	15
16	24.012	3.7030				406	114	8.9	14	1.8	0.091	>1000	16
17	24.448	3.6379				386	75	5.9	9	1.1	0.089	>1000	17
18	25.045	3.5526				398	161	12.6	33	4.4	0.160	>1000	18
19	26.046	3.4183				455	380	29.8	122	16.7	0.256	426	19
20	26.338	3.3811				425	376	29.5	90	12.3	0.191	943	20
21	26.872	3.3151				490	185	14.5	28	3.7	0.117	>1000	21
22	27.805	3.2059				513	374	29.4	80	10.9	0.170	>1000	22
23	28.096	3.1733				439	619	48.6	173	23.7	0.223	549	23
24	28.569	3.1218				584	283	22.2	42	5.7	0.116	>1000	24
25	29.999	2.9763				402	613	48.1	337	46.3	0.439	201	25
26	30.339	2.9436				392	384	30.1	124	17.0	0.258	409	26
27	31.952	2.7986				400	384	30.1	97	13.3	0.201	659	27
28	32.659	2.7396				404	168	13.2	30	4.1	0.142	>1000	28
29	35.307	2.5400				352	168	13.2	52	7.0	0.243	437	29
30	36.652	2.4498				351	70	5.5	10	1.3	0.107	>1000	30
31	36.905	2.4336				349	102	8.0	40	5.4	0.309	309	31
32	37.140	2.4187				348	97	7.6	17	2.3	0.139	>1000	32
33	38.106	2.3596				324	61	4.8	6	0.8	0.076	>1000	33
34	44.895	2.0173				281	63	4.9	8	1.0	0.091	>1000	34
35	46.295	1.9595				276	137	10.8	27	3.7	0.157	>1000	35
36	46.797	1.9397				289	100	7.8	17	2.3	0.132	>1000	36
37	50.245	1.8143				282	60	4.7	5	0.6	0.062	>1000	37
38	51.477	1.7738				294	128	10.0	21	2.9	0.130	>1000	38
39	55.607	1.6514				259	60	4.7	7	0.9	0.086	>1000	39
40	56.945	1.6157				240	54	4.2	8	1.0	0.104	>1000	40
@	End-of-List												

Folder 2

Folder 3

Subject: **Major oxide data**
Date: Fri, 5 Oct 2001 13:49:02 -0700
From: susie.woo@teckcominco.com
To: nchurch@bc.sympatico.ca

<<v010322.CSV>>
hardcopy with invoice will be couriered with your samples

Susie Woo
Lab Administrator
Teck Cominco Metals Ltd., E.R.L.

CHURCH, NEIL-X01

Job V 01-0322R

ECOKA/MAN SAMPLES

Report date 4 OCT

LAB NO	FIELD NUMBER	SiO2	TiO2	Al2O3	Fe2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	Ba(4)	LOI	TOTAL
		%	%	%	%	%	%	%	%	%	%	%	%	%	%
R0104168	ECOKA 21A	59.90	0.47	13.51	3.36		0.03	2.41	4.19	1.22	2.16	0.18	0.18	11.50	99.11
R0104171	ECOKA 22C	67.20	0.46	14.60	3.44		0.05	1.50	3.00	3.06	4.34	0.15	0.08	1.66	99.54
R0104177	MAN 31	50.38	0.93	15.68	6.75		0.07	3.75	3.48	5.05	3.60	0.61	0.13	9.28	99.71
R0104184	MAN 60B	52.25	0.93	15.77	6.59		0.10	3.30	4.86	3.43	4.34	0.70	0.15	7.17	99.59
R0104187	MAN 78B	57.79	0.49	14.26	3.32		0.02	2.33	4.84	1.05	1.10	0.18	0.21	13.17	98.76

I=insufficient sample X=small sample E=exceeds calibration C=being checked R=revised
If requested analyses are not shown ,results are to follow

ANALYTICAL METHODS
FeO determined by acid digestion /volumetric.LOI determined gravimetrically
Other elements by Li borate fusion/XRF .Where no FeO value shown 'Fe2O3' is total Fe as Fe2O3

Folder 4

Saint Mary's Univ.
Received
Sep 5th/01

Sample Name	GNW-427	GNW-433	GNW-461	LEX-296	GNW-202	GNW-426	GNW-246	GCS90-24-12	GNW-645
Mg Number	69.25	64.78	48.87	51.95	54.77	57.00	61.16	70.26	41.22
SiO2	64.10	55.24	54.14	58.21	53.45	51.64	53.31	46.91	48.53
TiO2	0.34	0.39	0.69	1.09	0.53	0.43	0.36	0.24	2.42
Al2O3	11.24	14.78	14.59	15.39	16.51	15.29	15.89	13.51	12.80
Fe2O3	5.11	9.27	12.68	9.47	9.19	9.68	9.62	11.05	12.82
MnO	0.08	0.20	0.19	0.05	0.16	0.17	0.20	0.16	0.27
MgO	5.81	8.61	6.12	5.17	5.62	6.48	7.65	13.18	4.54
CaO	4.11	4.35	2.21	3.88	10.81	5.32	5.27	9.37	10.47
Na2O	2.81	2.75	3.72	3.44	1.61	4.38	4.06	0.95	3.97
K2O	0.36	0.25	0.07	0.18	0.24	0.08	0.94	1.06	0.81
P2O5	0.03	0.03	0.04	0.17	0.03	0.03	0.02	0.01	0.31
LOI	5.80	4.10	5.70	3.40	1.80	7.00	2.60	3.50	3.31
Cr	176.00	85.00	25.00	26.00	29.00	100.00	157.00	1047.00	0.00
Ni	32.00	44.00	10.00	24.00	25.00	52.00	64.00	267.00	0.00
Co	19.00	21.00	28.00	0.00	0.00	0.00	31.00	30.00	0.00
V	162.00	271.00	356.00	292.00	337.00	309.00	245.00	211.00	0.00
Cu	0.00	0.00	0.00	8.00	53.00	42.00	0.00	0.00	0.00
Zn	55.00	155.00	112.00	86.00	57.00	101.00	104.00	64.00	0.00
Rb	13.00	9.00	2.00	0.00	5.00	0.00	26.00	50.00	0.00
Ba	201.00	173.00	109.00	539.00	77.00	64.00	228.00	86.00	0.00
Sr	203.00	127.00	44.00	229.00	160.00	125.00	113.00	59.00	0.00
Ga	8.00	13.00	19.00	14.00	15.00	11.00	15.00	15.00	0.00
Nb	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00
Zr	13.00	17.00	25.00	67.00	39.00	29.00	14.00	9.00	0.00
Y	10.00	15.00	14.00	44.00	16.00	12.00	10.00	8.00	0.00
Th	0.00	2.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
U	0.00	3.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
La	0.00	0.00	6.00	0.00	0.00	0.00	0.00	9.00	0.00
Ce	9.00	10.00	20.00	0.00	0.00	0.00	21.00	23.00	0.00
Nd	4.00	3.00	8.00	0.00	0.00	0.00	7.00	10.00	0.00

Sample	Mg#	SiO2	TiO2	Al2O3	Fe2O3*	MnO	MgO	CaO	Na2O	K2O
GNW-207	45.55	61.14	0.42	17.16	5.16	0.11	2.18	4.55	2.76	2.43
GNW-303	58.32	46.98	0.52	14.98	12.61	0.22	8.91	12.39	1.49	0.53
GNW-313	73.80	49.66	0.19	16.84	6.28	0.13	8.93	9.92	1.70	2.36
GNW-314	72.99	50.32	0.16	13.70	8.25	0.19	11.26	9.30	2.28	0.53
PH-275	70.92	48.53	0.15	17.41	7.99	0.15	9.84	11.32	1.97	0.35
LEX-298	51.63	50.32	1.12	15.06	11.26	0.16	6.07	6.13	4.75	0.55
GNW-80	40.01	67.70	0.70	16.10	2.91	0.03	0.98	0.50	6.69	0.83
GNW-205	68.26	50.09	0.28	15.78	8.75	0.17	9.50	10.06	2.26	0.34
LEX-296	51.95	58.21	1.09	15.39	9.47	0.05	5.17	3.88	3.44	0.18
PH-124	51.2	49.62	2.14	15.11	10.95	0.15	5.8	6.75	3.75	1.83

Folder 5

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Monday, September 24, 2001

Date Rec. : 17 September 2001
LR Report : CA9053-SEP01
Project : 2102346
Client Ref : File # A103085

CERTIFICATE OF ANALYSIS

Final Report

Sample ID	SiO2 %	Al2O3 %	Fe2O3 %	MgO %	CaO %	Na2O %	K2O %	TiO2 %	P2O5 %	MnO %	Cr2O3 %	V2O5 %	LOI %	Sum %
1: WOOL-3	72.9	8.75	3.40	1.48	4.06	3.84	0.17	0.36	0.06	0.12	< 0.01	< 0.01	4.30	99.5
2: WOOL-5	56.9	15.1	10.9	7.78	1.14	3.43	0.02	0.60	0.04	0.16	< 0.01	0.06	5.01	101.1
3: WOOL-6	50.6	14.9	9.00	6.54	5.81	3.87	0.07	0.45	0.03	0.15	< 0.01	0.05	7.49	98.9
4: WOOL-7	55.5	15.5	8.96	6.67	6.07	4.99	0.10	0.35	0.03	0.16	< 0.01	0.04	2.40	100.8
5: WOOL-10	66.9	13.3	8.19	3.09	0.55	3.81	1.26	0.68	0.08	0.07	0.02	0.04	2.77	100.7
6: WOOL-11	54.9	16.3	6.69	3.21	3.25	2.33	8.27	0.93	0.16	0.05	< 0.01	0.03	2.77	98.9
7: WOOL-13	51.6	16.2	10.2	6.88	4.77	4.72	1.96	1.16	0.19	0.08	< 0.01	0.06	2.46	100.3
8: WOOL-16	58.4	15.7	8.65	3.93	2.04	2.72	2.84	1.03	0.24	0.14	< 0.01	0.04	3.48	99.2
9: WOOL-22	51.2	14.6	10.4	4.89	8.67	4.11	1.80	0.87	0.39	0.16	< 0.01	0.05	2.60	99.7
10: WOOL-25	47.4	16.0	10.1	5.91	14.2	3.13	0.30	1.27	0.14	0.20	0.01	0.06	1.39	100.1
11: WOOL-27	46.9	18.4	7.96	9.94	10.9	1.99	0.75	0.14	< 0.01	0.17	< 0.01	0.03	3.59	100.8
12: WOOL-28	51.1	18.2	4.57	8.12	10.9	2.69	0.86	0.12	< 0.01	0.09	0.01	0.02	2.30	99.0
13: WOOL-29	54.0	15.1	13.2	4.60	7.43	3.69	0.15	0.83	0.06	0.22	< 0.01	0.06	1.57	100.8
14: WOOL-30	52.6	13.1	7.90	8.02	6.62	3.80	3.08	0.86	0.48	0.13	0.05	0.02	2.41	99.1
15: WOOL-31	52.4	15.9	10.1	7.04	6.91	2.81	0.22	0.42	0.03	0.22	< 0.01	0.05	4.47	100.6

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Report : CA9053-SEP01

Sample ID	SiO2 %	Al2O3 %	Fe2O3 %	MgO %	CaO %	Na2O %	K2O %	TiO2 %	P2O5 %	MnO %	Cr2O3 %	V2O5 %	LOI %	Sum %
16: WOOL-32	53.0	15.5	10.1	5.33	5.78	4.05	0.28	0.57	0.04	0.21	< 0.01	0.05	5.14	100.1
17: WOOL-33	58.3	14.8	9.03	5.58	2.30	5.53	0.18	0.49	0.04	0.16	< 0.01	0.04	3.15	99.6
18: WOOL-37	47.1	15.7	9.41	11.4	12.2	0.74	0.32	0.12	< 0.01	0.15	< 0.01	0.03	3.24	100.4
19: WOOL-38	56.2	14.0	6.63	4.84	5.80	2.73	4.03	0.95	0.57	0.11	< 0.01	0.03	3.40	99.3
20: WOOL-39	59.7	14.6	5.98	3.68	5.25	3.36	3.43	0.83	0.56	0.08	< 0.01	0.02	2.98	100.5
21: WOOL-40	56.8	14.8	6.33	3.66	5.71	3.50	3.23	0.86	0.54	0.09	< 0.01	0.03	3.27	98.9
22: MAN-10	60.8	13.6	3.34	2.20	4.18	1.27	2.18	0.51	0.22	0.05	< 0.01	< 0.01	11.0	99.4
23: MAN-22	56.7	16.1	5.44	3.06	3.80	1.91	7.46	0.87	0.49	0.10	< 0.01	0.03	4.17	100.2
24: MAN-60	59.4	13.7	3.08	1.91	4.71	1.08	2.01	0.50	0.19	0.04	< 0.01	0.02	11.7	98.3
25: GSC-85-5	55.1	15.7	11.4	4.20	5.27	5.85	0.73	0.61	0.04	0.24	< 0.01	0.06	1.82	101.0
26: DDH-80/8	56.9	16.0	8.24	5.52	5.15	5.75	0.58	0.52	0.03	0.15	< 0.01	0.05	2.03	100.8
27:DUP: WOOL-3	73.7	8.76	3.35	1.47	4.09	3.80	0.17	0.37	0.07	0.12	< 0.01	< 0.01	4.34	100.3

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Folder 6

Results of CEC Analysis

Sample	CEC (meq/100g)
Man 60B	33.9
Man 76	128.6
Man 78B	151.8
Man 36	100.0
Man 10B	116.1
Ecoka 21A	112.5

The Manuel Creek Zeolite Deposit (82E/04E)

B.N. Church, Ph.D., P.Eng.

The Cordilleran Roundup Meeting, January 22nd, 2002

Key Words: Industrial minerals, zeolites, Penticton Tertiary outlier, clinoptilolite, X-ray diffraction, chemical analyses, cation exchange capacity.

Abstract

Zeolite mineralization (clinoptilolite) is found in abundance (to 69%) at 4 localities within a 5 km long belt of Eocene dacitic crystal vitric tuff beds (the Manuel Creek tuff) in the Keremeos area of south-central British Columbia. The unit occurs between the Kitley Lake trachyandesite member (below) and the Kearns Creek basaltic member (above) at mid-section in the Marron Formation in the southern part of the Penticton Tertiary outlier. These zeolitic beds range up to 10 m thick and dip ~ 20 degrees easterly. Geochemical results show that the quality of zeolite mineralization is as good or better than other similar producing deposits at Princeton and in the Kamloops area.

Location and Access

The property, consisting of 10 two post claims (Kitty 1-7; Tom 1-3), is located in the headwater area of Manuel Creek between 3900 and 4200 m elevation, centred 7 km northeast of Keremeos. Access to the property is 10 km south of the Twin Lakes turnoff from Highway 3A via the Twin Lakes and Grand Oro roads.

Program Objective

The main program objective is to determine the extent, control and quality of the zeolite mineralization in the middle part of the Marron Formation in the southern part of the Penticton Tertiary outlier.

Background

The word 'zeolite' is derived from a Greek phrase meaning 'boiling stones' in reference to the visible loss of water on heating. Zeolite minerals are hydrated aluminosilicates of the alkaline and alkaline earth elements such as sodium, potassium, magnesium, lithium, barium and calcium. They form naturally from the reaction between volcanic ash and alkaline water. The commercial application of natural and synthetic zeolites stems from the mineral's capacity for adsorption, catalysis and ion exchange. Natural occurring zeolites are used for ion exchange, filtering, odour removal, chemical sieving and gas absorption. Synthetic zeolites are also used as molecular sieves in the purification of gases and liquids, but at much higher cost. Chabazite and clinoptilolite are the two natural zeolites most commonly used in commercial applications. Mordenite, phillipsite and ferrierite can also be used. Chabazite is the most important member of the group, and clinoptilolite is the most abundant. Except for radioactive waste treatment, only a small percentage of clinoptilolites have sufficient purity to be used for ion exchange; they are more typically used in soil amendments such as vegetation of mine and metallurgical waste sites, animal feed, odour and waste control, dimension stone and construction aggregates (see Moore, 2000; Griffiths, 1987; Mumpton, 1988; Leggo, 2000; Leggo, 2001).

Geological Setting

In British Columbia zeolites are most commonly preserved in the Tertiary rocks because of the usual relatively low grade of regional metamorphism of these formations. The interior plateau area of British Columbia is blanketed by a deeply dissected early Tertiary lavas, associated pyroclastic rocks and intercalated sedimentary units. These rocks occur within a northwesterly-trending belt about 150 kilometres wide, extending 800 kilometres from the Republic Mining District in Washington State to the Babine Lake area of central British Columbia. The thickness of these rocks ranges from less than 100 metres to more than 1200 metres. The base of the succession where best developed is composed of fluvial sandstone and conglomerate. The upper boundary of these rocks is generally coincident with a gently rolling 'upland surface' locally unconformably covered by a veneer of Miocene and younger 'plateau' basalts of the Chicotin group.

In the Okanagan - Boundary region, the early Tertiary continental sedimentary and volcanic rocks and associated intrusions fill the Penticton and Kelowna half grabens and the Toroda Creek graben that bisects the Okanagan Highlands in the Midway - Rock creek area. The Springbrook Formation at the base of the succession, is a polymictic conglomerate containing clasts derived from a geologically diverse pre-Tertiary metamorphic terrane. This unit is followed by the Eocene Kettle River Formation consisting of rhyolite tuffs, sandstones, shales and minor conglomerates that are, in turn, overlain conformably by the Marron Formation consisting of phonolite, trachyte and andesite lava flows and breccias. In the north Okanagan area, the Penticton Group is overlain unconforably by Miocene plateau basalts; near Vernon the felsic Penticton volcanics are replaced by Eocene andesites and basalts typical of the Kamloops Group. Structural control of the Tertiary outliers is related to a herringbone pattern of conjugate shears trending northeast and northwest. These are important elements in a north-south stress scheme that is responsible for the many northerly-trending grabens found scattered throughout the southern interior of British Columbia from the Fraser River to the Rocky Mountains. The period 45 to 53 Ma witnessed intense volcanic and tectonic activity across the Cordillera. This period corresponds to northerly movement of the Pacific plate that produced oblique subduction of this plate under the North American craton. This stress engine was active throughout the Cordillera during the Eocene. This resulted in a complex inter-relationship of shears, tension faults and folds and the simultaneous development of grabens, folding and thrusting in coastal areas, the southern interior, including the Penticton area, and eastern British Columbia.

Mineralization

The occurrence of zeolites in British Columbia was first described by Church (1973) in a detailed study of the Tertiary rocks of the White Lake basin near Pentiction area. Similar studies were done subsequently in the Princeton and Cache Creek areas (see Marcille, 1989; Hogg, 1993). These describe some of the most significant deposits of natural zeolites in Western Canada.

In the Penticton area zeolites are abundant in the lower part of the Penticton Group, possibly as the result of 'load' metamorphism, although the composition of the host rocks was a no doubt controlling factor. There is a close association of natrolite and secondary analcite with calcite in amygdale fillings in the phonolite lavas of the Yellow Lake member of the Marron Formation. Clearly, the growth of these zeolites was favoured by the alkali- and alumina-rich lavas at the time of eruption and cooling before much loading. At Manuel Creek clinoptilolite and wairakite are associated with tuffaceous sedimentary rocks high in the stratigraphic succession of the Marron Formation, suggesting the possibility of an authigenic origin of these zeolites (Hora and Church, 1986).

The Manuel Creek tuff is light coloured, mainly gray or beige, massive and characterized by small scattered black specks of biotite and/or amphibole. In thin secion the rock consists mostly of glassy shards replaced by zeolites and clay. Accessory minerals include plagioclase, sanidine, quartz, biotite, amphibole and smectite. The Manuel Creek tuff and associated sedimentary facies has been traced southerly from a point 2 km north of the West Kootenay power line to about 3 km south of the powerline (Figure 2). The unit ranges up to 10 m thick, strikes on average from 010 to 015 degrees and dips 20 to 30 degrees easterly. The related waterlain facies contain local concentrations of carbonacous woody trash and fossil leaves. At the base the unit is intercalated with buff coloured siltstone and sandstone eroded from the underlying Kitley Lake member (stas. 13, 33 and 59). Laterally, the tuff is mixed with lapilli and breccia and interbedded brown sandstone containing lithic clasts derived from the Kearns Creek basalt (stas. 37, 78, and 60).

To determine the mineral composition of the Manuel Creek tuff, 20 samples from the 12 stations on the tuff were submitted for X-ray diffraction analyses at the Cominco Laboratory in Vancouver. From this collection the results show that 12 samples have clinoptilolite as the sole zeolite and that 6 of these samples have moderate to significant amounts of this mineral (i.e. Ecoka 21a, 21b, Man-10b, 36, 76 and 78b). It is noted that sample Man-78b is especially enriched in clinoptilolite accompanied by accessory plagioclase. Sample Man-76, from a location 800 m south of sta. 78, is similar to sample Man-78b but in addition it contains minor quartz and smectite. Sample Man-36 was collected approximately 1 km northwest of sta. 78 and by comparison it has moderate amounts of clinoptilolite, quartz, plagioclase, minor smectite and amphibole. Sample Man-10b is from an outcrop 1.2 km north of sta. 36 - it is relatively enriched in clinoptilolite, contains a moderate amount of quartz, minor plagioclase and smectite. Samples Ecoka-21a and 21b, from the top and bottom of the exposure at station Man-10, have essentially the same accessory mineral composition as the clinoptilolite-rich Man-10a sample. Wairakite, the calcium analogue of analcite, accompanies clinoptilolite as a minor mineral in sample Man-28a and in significant amounts, without clinoptilolite, in samples Man-31, 59 and 60b. No other zeolite mineral species were found in the collection.

Geochemistry

Quantitative analyses of zeolite content is done using the cation exchange capacity (CEC) values of the samples according to the method outlined by Marcille (1989) based on clinoptilolite's high selectivity for NH_4^+. (X-ray diffraction allows identification of the zeolite mineral species but only a rough estimate of amounts.) The CEC determinations were completed by BC Research Inc. for 6 samples showing significantly strong zeolite X-ray diffraction patterns. Assuming a CEC (meq/100) value of 220 for pure clinoptilolite, disregarding the effects of other minerals, the following amounts are calulated:

	CEC	%
Ecoka-21a	112.5	51
Man-10b	116.1	53
Man-36	100.0	45
Man-60b	33.9	15
Man-76	128.6	58
Man-78b	151.8	69

These estimates may be high due to the presence of other minerals, particularly smectite. The relatively low result for Man 60b is because the zeolite in this sample is wairakite which is known to have poor cation exchange qualities.

Whole rock silicate analyses of the zeolitized tuff unit were completed on 8 samples from various localities. These analyses were intended to establish the composition range of the tuff and associated waterlain sedimentary facies including the material reworked from the adjacent Kearns Creek and subjacent Kitley Lake units.

The zeolitized rocks consists of beige or light gray shardy tuff, brown volcanic sandstone and buff coloured siltstone. Samples Ecoka-21a, 22c, Man-10b, 60a and 78b are typically dacitic composition. Ecoka-22c is fresh vitric tuff with a few small, scattered feldspar and amphibole crystals and biotite flakes. Ecoka-21a, Man-10b and Man-78b contain >10% H_2O and significant clinoptilolite - the glassy matrix of these rocks being extensively zeolitized. Man-10a is dacitic tuff with some clay alteration.

Samples Man-31, 22, 60a are andesitic buff coloured and brown volcanic sandstone and siltstone. Samples Man-31 and Man-60b contain >7% H_2O and significant wairakite; Man-22 has less H_2O and wairakite. Man-31 is believed to represent sediment derived from the erosion of Kitley trachyandesite lava underlying the dacitic tuff. Similarly, Man-60b is thought to be partly sourced from nearby Kearns Creek basaltic andesite.

The following tabulation compares the chemical composition of relatively fresh dacitic tuff, analysis no. Man-22c, clinoptilolite enriched tuff Man-78b and the average composition of clinoptilolite as given by the New Mexico Bureau of Mines and USGS:

	Man-22c	Man-78b	Clinoptilolite USGS
SiO_2	67.20	57.79	64.7
TiO_2	0.46	0.49	0.2
Al_2O_3	14.60	14.26	12.6
Fe_2O_3	3.44	3.32	1.8
MnO	0.05	0.02	0.1
MgO	1.50	2.33	1.1
CaO	3.00	4.84	3.7
Na_2O	3.06	1.05	1.0
K_2O	4.34	1.01	3.7
LOI	1.66	13.17	

Work Done

Prospecting supported by the B.C. Prospectors Assistance Program in the Manuel Creek area was completed in August 2001. With the assistance of air photos and TRIM maps (1:20,000 scale) observations of the geology and mineralization were done from a grid of flagged claim lines and a network of bush roads that service the towers of the West Kootenay Transmission Line that transects the area (Figure 1). A total of 81 field stations were required to constrain the geography and geology of a zeolitized dacite unit (here called the 'Manuel Creek tuff') for a distance of approximately 5 km (Figure 2). There are 12 stations that establish the location of the Manuel Creek tuff; 20 stations are on the underlying Kitley Lake member, 46 on the overlying Kearns Creek member, and a few additional stations on the Nimpit Lake and Park Rill members at the top of the section. In total these rocks comprise a block of Eocene lava flows several thousand feet thick, dipping easterly and faulted against a pre-Tertiary complex of Paleozoic and Mesozoic cherts, greenstones and granitic intrusions.

Physical work for the Manuel Creek project consists of staking 10 two post claims ('Kitty' and 'Tom' claims tenure nos. 388945-388952 and 390678-390679) and associated location lines and grid (Figure 1). The property is centred 4 km southwest of Orofino Mountain, west of the headwaters of Park Rill in the upper part of the Manuel Creek drainage basin. Access to the property is 10 km south of the Twin Lake turnoff from Highway 3A via the Twin Lakes and Grand Oro roads.

The claims are aligned roughly N-S following the 5 km long strike of the zeolitic tuff unit.

The location lines of the Kitty 1-5 claims (striking 188°) and the Tom 1-3 claims (striking 192°) are crossed by the West Kootenay Power Transmission Line forming a 'H' shaped reference grid designed to assist rock sampling and geological mapping.

For grid control the following co-ordinates have been established for the Kitty and Tom claims, No.1 claim posts (using a Garmin 12 GPS receiver).

Claim	Co-ordinates			UTM (NAD '83)	
	Latitude	Longitude	elevation	easting	northing
Kitty 1	49°15.510'	119°43.870'	4300'	301300	5459750
Kitty 2	49°15.216'	119°43.910'	4311'	301180	5459250
Kitty 3	49°15.009'	119°44.045'	4368'	301080	5458750
Kitty 4	49°14.659'	119°44.052'	4378'	300950	5458310
Kitty 5	49°14.441'	119°44.133'	4210'	300850	5457775
Tom 1	49°13.889'	119°44.121'	4208'	302120	5456800
Tom 2	49°13.640'	119°43.190'	4027'	301950	5456310
Tom 3	49°13.427'	119°43.221'	4008'	301850	5455790

Markets

World production of natural zeolites is estimated to be 3-4 million tonnes annually (Mineral Spotlight *in* Industrial Minerals, December 2000 issue). China is the largest producer at about 2.5 million tonnes annually and reserves are estimated to be 950 million tonnes. There are 50 mines where a large part of the output is used as a cement additive. Cuba, Japan, USA and Hungary are the other significant producers. The biggest markets for zeolite in the USA are pet litter, animal feed and horticulture. Zeotech Inc. in Washington state is investigating the use of zeolite as a medium to store hydrogen gas for fuel - the goal being to reduce the risk of hydrogen explosion.

Marcille-Kerslake (1991) has reported the onsite price for zeolites from Teague Minerals in Oregon, on a truck load basis,was $85US per ton. Transportation costs vary depending on distance, but typically range from $0.55 to $1.60US per ton, per 10 miles.

Currently cat litter in Canada sells for $10CAN for a 40 pound bag.

Conclusions

The results of this project are the discovery of zeolite (clinoptilolite) mineralization in abundance at several localities within a 5 km belt of Eocene dacitic crystal vitric tuff in the Manuel Creek area, 7 km northeast of Keremeos. These are station nos. Ecoka-21, Man 10, 36, 76 and 78 on the accompanying map (Figure 1). Cation exchange capacity results on samples from these localites are 112.5, 116.1, 100.0, 128.6 and 151.8, respectively. The tuffaceous beds, up to 10 m thick, occur at mid-section in the Marron Formation, between the Kitley Lake member (below) and the Kearns Creek member above (above), in the southern part of the Penticton Tertiary outlier (Figure 2). The Manuel Creek zeolite deposits are conveniently exposed along existing secondary roads which connect directly within ten kilometers to Highways 3 which in turn leads to leads directly to the railway terminal at Oroville, Washington.

References

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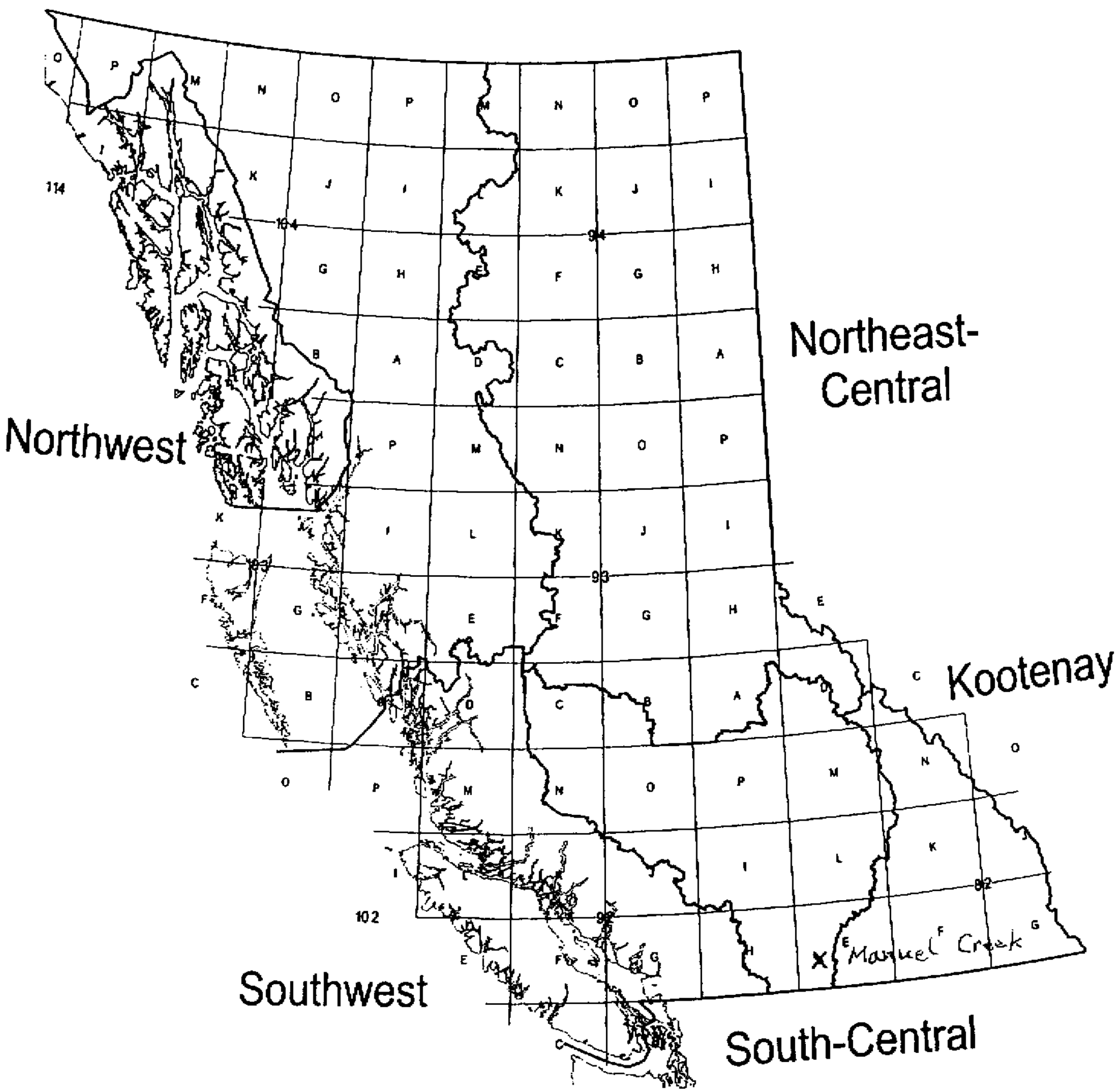
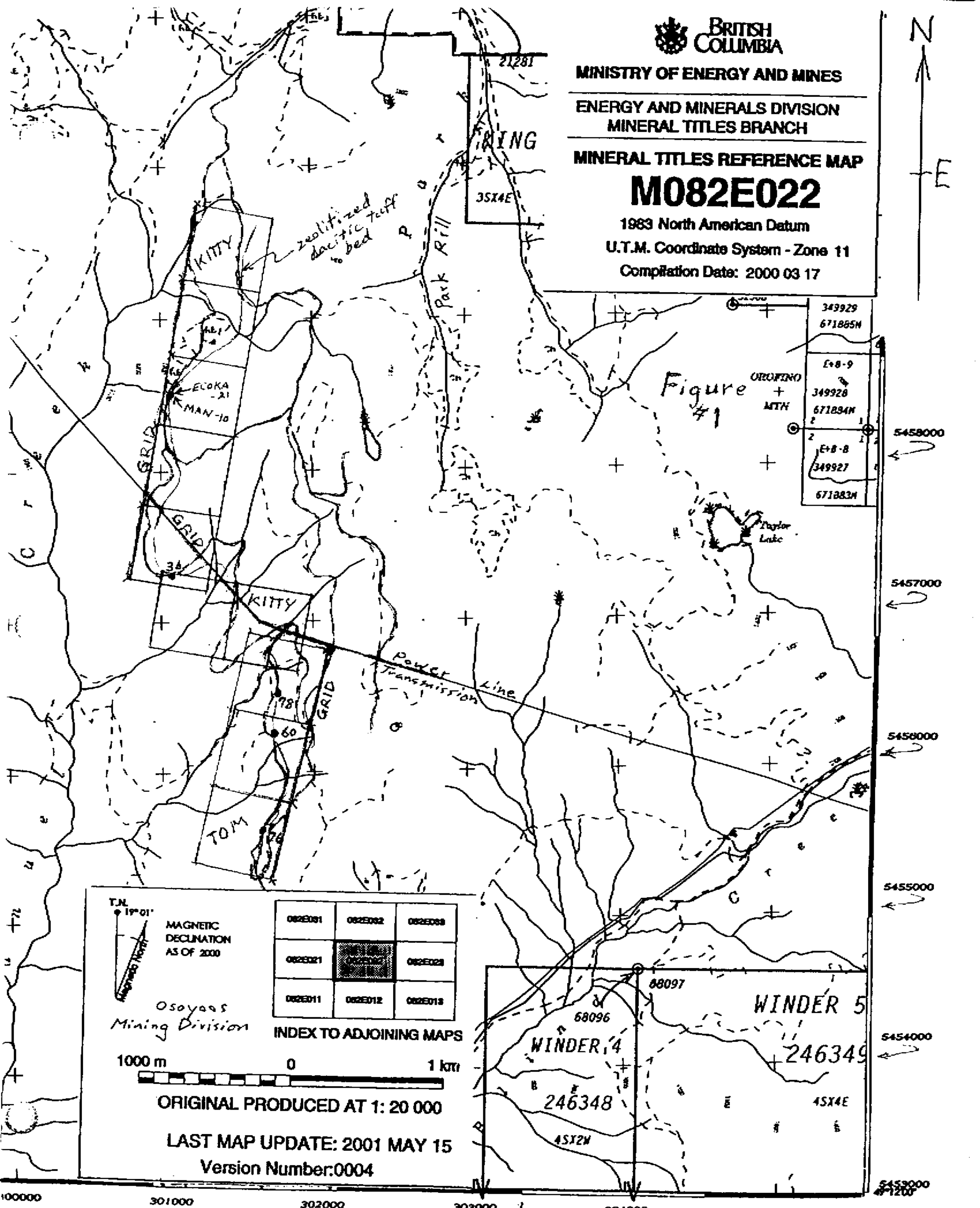
Location of Proposed Project

Indicate on this map (using an "**X**") the general location of each of the projects covered by this proposal.

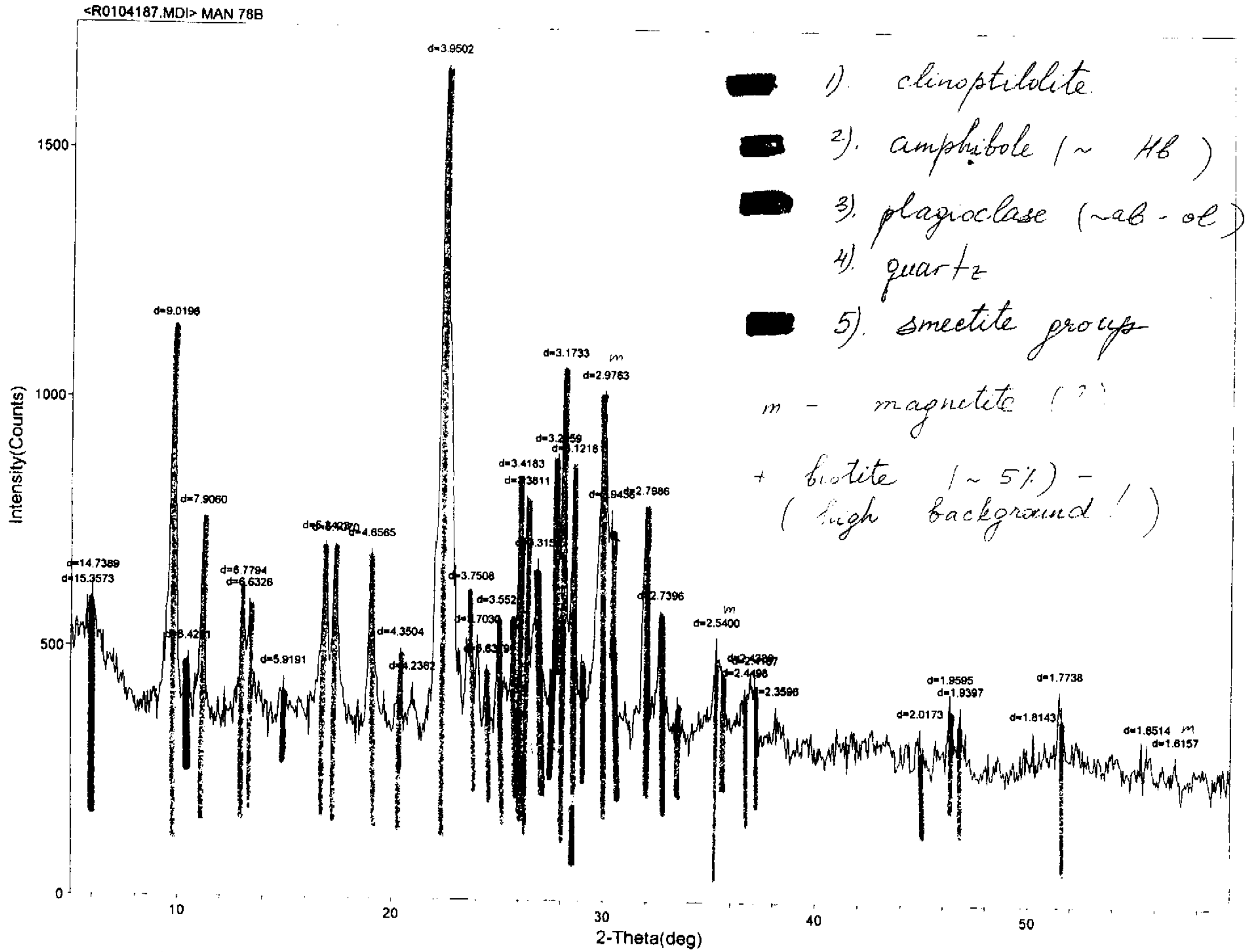




prospecting traverses (routes)

119° 42'

• significant outcrops of zeolitized tuff


<R0104187.MDI> MAN 78B
Intensity(Counts)
2-Theta(deg)
0
500
1000
1500
10
20
30
40
50
d=3.9502
d=9.0196
d=7.9060
d=14.7389
d=15.3573
d=6.7794
d=6.6326
d=5.9191
d=4.6565
d=4.3504
d=4.2362
d=3.7508
d=3.4183
d=3.1733
d=3.1218
d=2.9763
d=2.7986
d=2.7396
d=2.5400
d=2.4498
d=2.3596
d=2.0173
d=1.9595
d=1.9397
d=1.8143
d=1.7738
d=1.6514
d=1.6157
m
1). clinoptilolite
2). amphibole (~ Hb)
3). plagioclase (~ab - ol)
4). quartz
5). smectite group
m - magnetite (?)
+ biotite (~ 5%) -
(high background!)