第２章　ボーリング調査工事

２－１　資・機材搬入路

１９８２年７月２日先発した調査員１名がPerauに到着し，試錐現地の踏査を行い，その踏査結果に基づいて搬入路の新設建設計画と資・機材の搬入計画などについてC. P. R. M. のボーリング担当者と打合せた。

搬入路はブルドーザー（Caterpillar ５－D）１台にて距離２５㎞，巾員3.５ｍの搬入路が建設された。搬入路は海抜４００～７００ｍの急峻な地形で，樹木が多く，かつ雨季直後のため地盤が軟弱で，搬入路開さく工事は困難であった。

２－２　ボーリング位置

ボーリングが実施された位置はPerau鉱山の西側にあり，Parana（パラナ）州のAdrianopolisから約２５㎞南方に位置し，所要時間は片道約１時間を要する。

各ボーリング孔の位置および標高はつぎのとおりである。

孔名	経距	緯距	標高		
AG－01	701.29E	7251.10N	490ｍ	IP測線G line	8.3
AG－02	701.49E	7251.21N	592ｍ	IP測線G line	10.5
AG－03	701.50E	7251.03N	548ｍ	IP測線G-H line	中間9.8付近

２－３　設営作業

２－３－１　資・機材の搬入

資・機材および作業員はブラジルのPoço de Cardas（ポソ　デ　カルダス）およびBelo Horizonte（ベロ　ホリゾンテ）から７月２０日および８月３０日にボーリング位置まで大型トラックおよびピックアップで運搬された。

２－３－２　設　　営

設営はＡＧ－０１から開始した。ボーリング座の整地はブルドーザーにより行った。

ＡＧ－０２のボーリング座の整地はＡＧ－０１孔掘進中に行い，ＡＧ－０３の搬入路建設とボーリング座の整地はＡＧ－０１孔終了後に実施された。

２－３－３　ボーリング用水

用水はボーリング実施地域を北流するRibeirão Grande（ヒベイロン　グランデ）川の支流を塞き止め，揚水ポンプを使用して給水した。

各孔までの揚水高はＡＧ－０１は１０m，ＡＧ－０２は１１２m，ＡＧ－０３は６８mである。

２－４　掘進作業

本地域は表土が比較的薄いので，HQワイヤーライン工法で掘進を行った。

着岩後NQワイヤーライン工法で掘進し，最終口径はBQワイヤーライン工法とした。

各孔の掘進状況はつぎのとおりである（Fig. Ⅲ－１－１～３）。

２－４－１　ＡＧ－０１

掘　進　長　：　３３１.１５m

コ　ア　ー　長　：　３２６.２０m

コアー採取率　：　９８.５０％（表土を除く）

掘進開始日　：　１９８２年7月２６日

掘進終了日　：　１９８２年9月　１日

０m～0.５５m

ＨＱワイヤーライン工法で表土を掘進した。

0.５５m～２００.１５m

HQ—WLダイヤモンドビットにてベントナイト泥水を使用し，雲母片岩，角閃岩層を掘進した。岩質は安定しているが，１８６.６０m～１８７.７０mおよび１８９.６０m～１８９.９０mで粘土化帯に遭着。この粘土化帯が原因で２００.１５mまで掘進した時ジャーミングを起し掘進不能となる。なお，１５７.３０mでNQ—WLダイヤモンドビットの交換を行った。

２００.１５m～２２２.５０m

抜管，孔内洗滌，セメンテーション，セメントリーミング，掘進をくり返し実施，事故回復に１１日間を要した。２２２.５０mでBQ—WLダイヤモンドビットに交換した。

２２２.５０m～３３１.１５m

BQ—WLダイヤモンドビットにてベントナイト泥水を使用し，雲母片岩，角閃岩，炭酸塩岩類を２５５.９５まで掘進，２５５.９５～２６５.９０mで鉛・亜鉛の鉱石部を捕捉した。その後鉱化帯下盤の石墨片岩－千枚岩，石灰岩を掘進し，３０５.５０m付近から石灰岩と珪岩の互層となり，次第に珪岩優勢となったので掘進を終了した。

２－４－２　ＡＧ－０２

掘　進　長　：　３３０.５５m

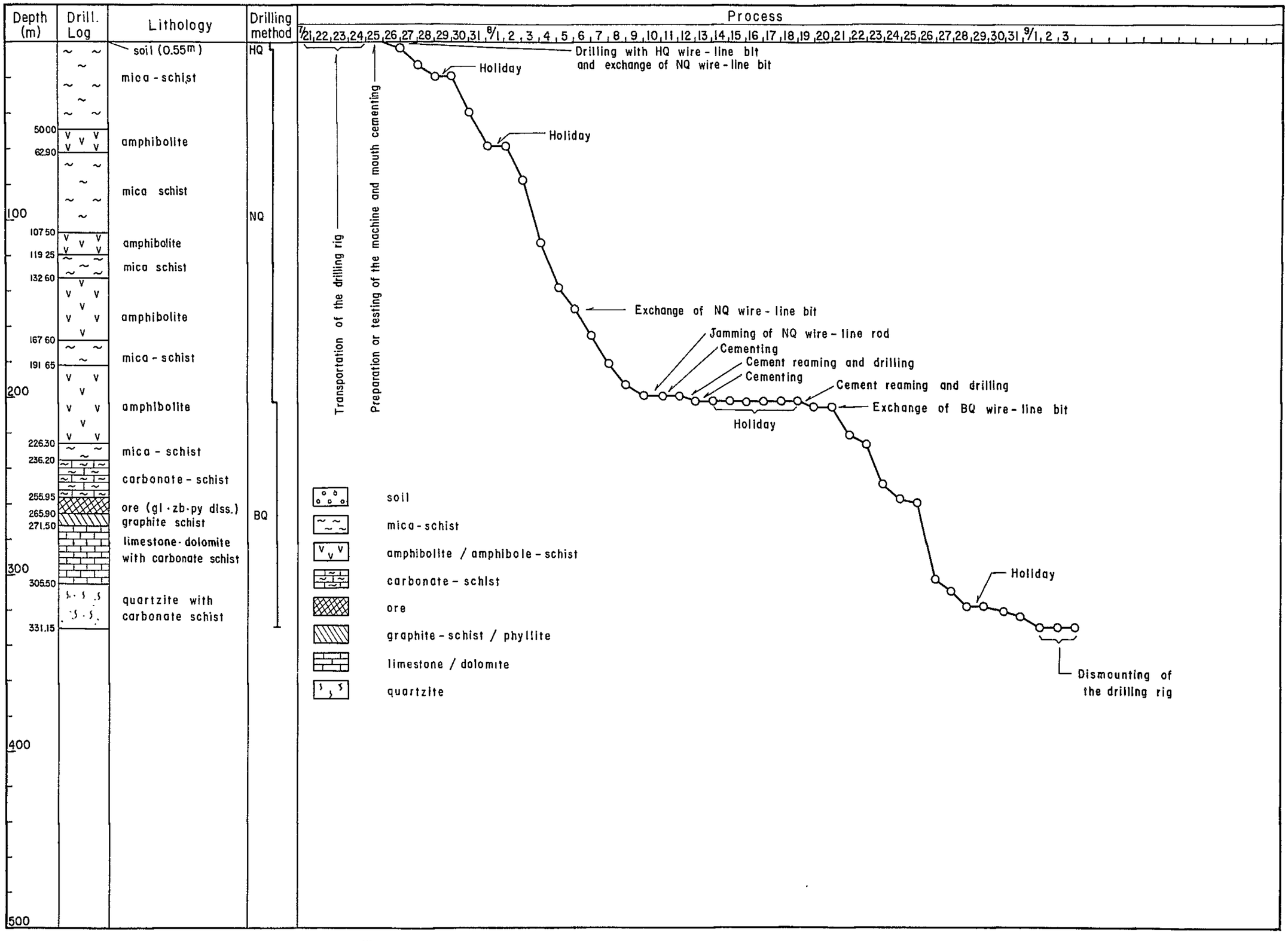


Fig. Ⅲ—1—1 Progress Record of Diamond Drilling AG-01

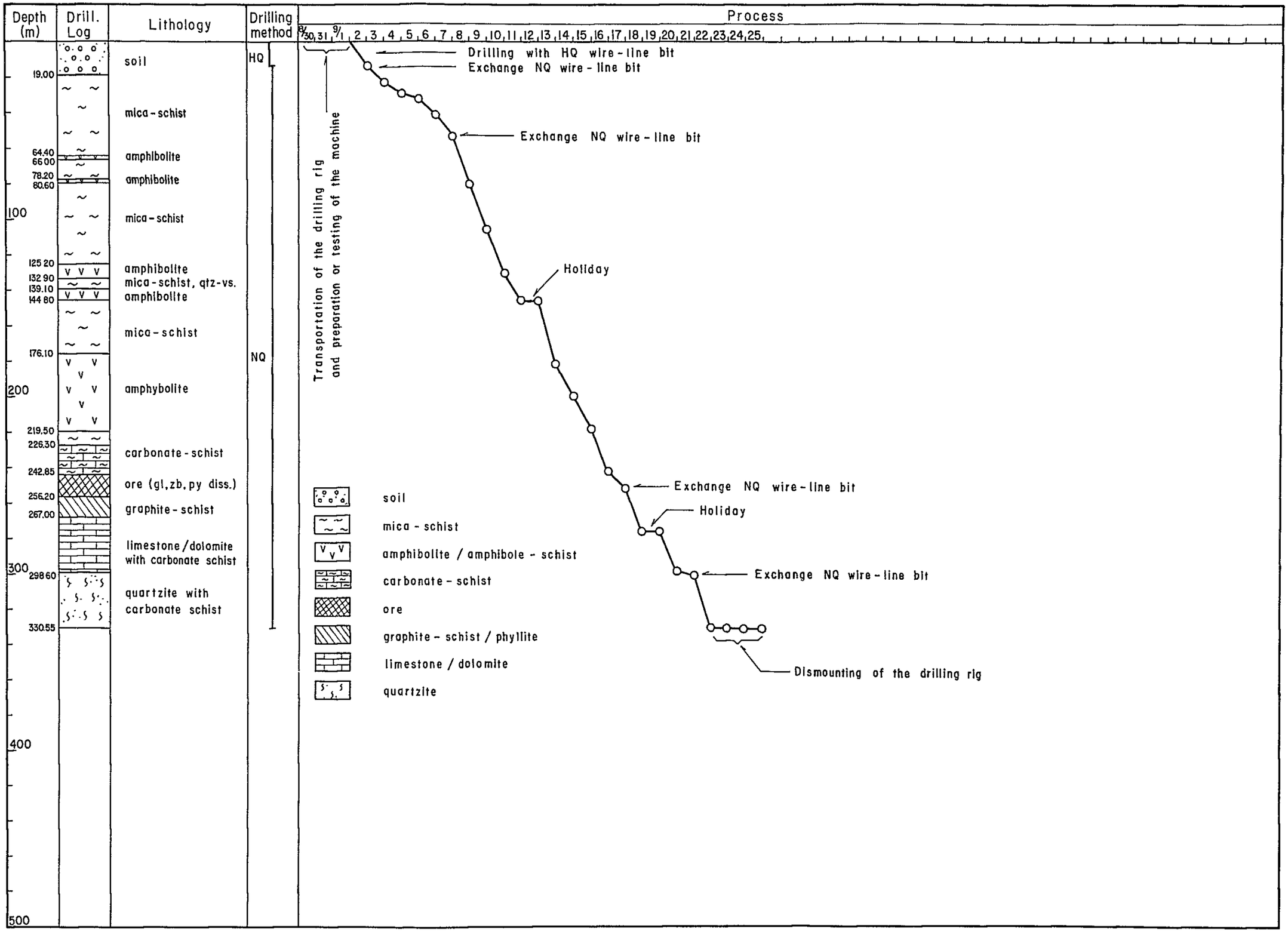


Fig. Ⅲ—1—2 Progress Record of Diamond Drilling AG-02

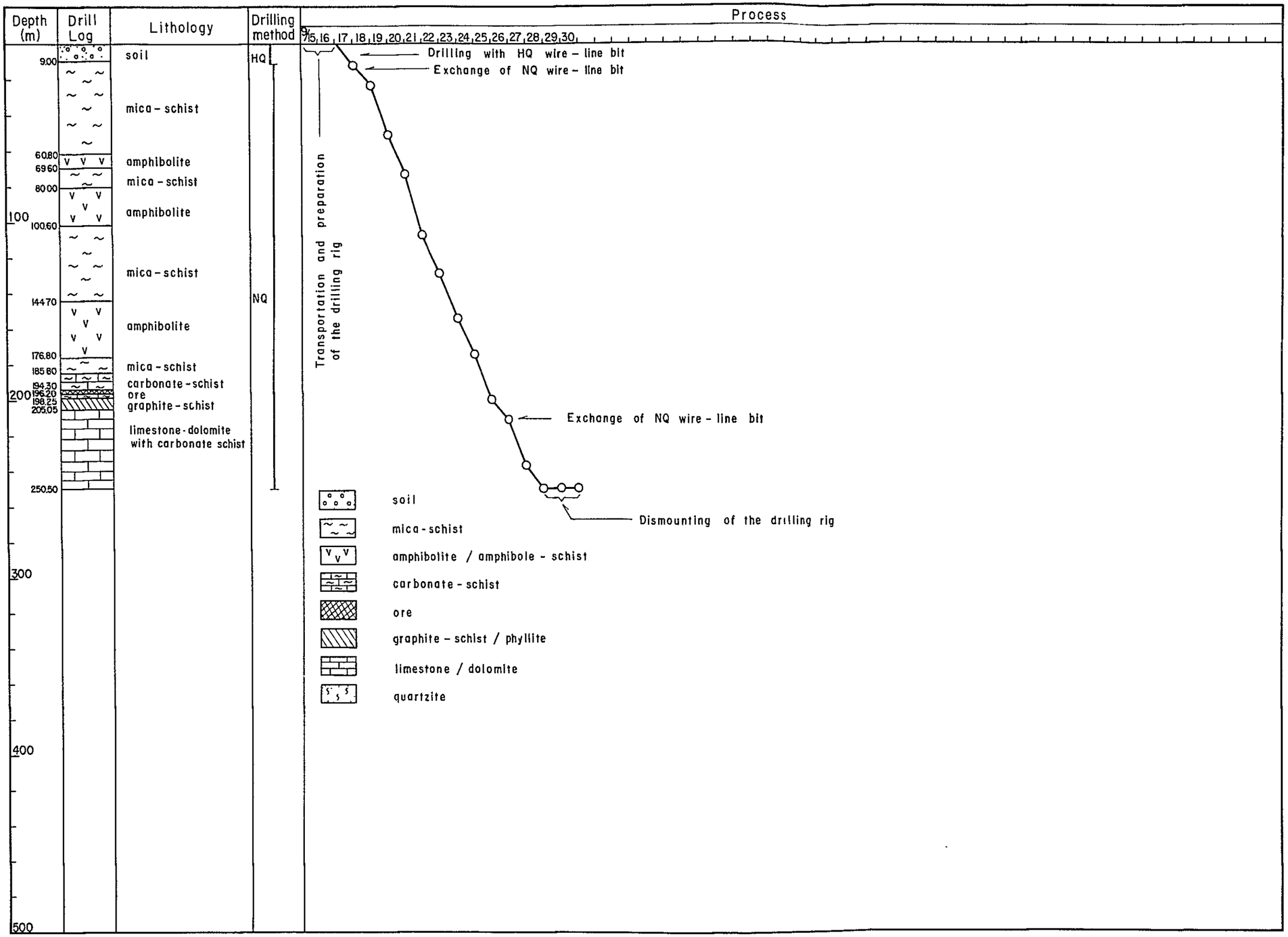


Fig. Ⅲ—1—3 Progress Record of Diamond Drilling AG-03

コ ア ー 長 ： ２９９.９０m

コアー採取率 ： ９６.２６％（表土を除く）

掘進開始日 ： １９８２年９月 ２日

掘進終了日 ： １９８２年９月２２日

０m～１９.００m

ＨＱ－ＷＬ工法にてベントナイト泥水を使用して，表土を掘進，岩質が１９mで安定したのでＨＱケーシングを挿入設置した。

１９.００m～３３０.５５m

ＮＱ－ＷＬダイヤモンドビットにてベントナイト泥水を使用し，安定した雲母片岩，角閃岩，炭酸塩岩，石墨片岩，石灰岩～苦灰岩および石灰岩～珪岩互層を掘進した。この間２４２.８５m～２５２.５０m間で鉛，亜鉛鉱石部を捕捉した。これは先のＡＧ－０１で捕捉した鉱化帯に連続するものと考えられる。尚，ＮＱ－ＷＬダイヤモンドビットの交換は８０.００m，２５１.９０mおよび２９８.７０mで行った。

２－４－３ ＡＧ－０３

掘 進 長 ： ２５０.５０m

コ ア ー 長 ： ２３８.３５m

コアー採取率 ： ９８.６９％（表土を除く）

掘進開始日 ： １９８２年９月１７日

掘進終了日 ： １９８２年９月２８日

０m～９.００m

ＨＱ－ＷＬ工法にてベントナイト泥水を使用して，表土を掘進，岩質が９.００mで安定したので，ＨＱケーシング挿入設置した。

９.００m～２５０.５０m

ＮＱ－ＷＬダイヤモンドビットにてベントナイト泥水を使用し，雲母片岩，角閃岩，炭酸塩岩，石墨片岩，石灰岩～苦灰岩を掘進した。この間１９４.３０m～１９６.２０m間で鉛，亜鉛鉱石部を捕捉した。

なお，ＮＱ－ＷＬダイヤモンドビットの交換は，２００.１０mで行った。

２－５ 孔曲り測定

一般に変成岩地帯でボーリングを実施した場合，ボーリング孔は地層面または片理面に垂直な方向に曲ろうとする傾向があり，このために孔曲りが起る。本ボーリング調査においてはこの孔曲りの状況を正確に把握するため，測定器トロバリーを用いて孔曲り測定を実施した。

結果は下記の通りで，最大２３°を示した。このほか傾斜測定と同時に方向の測定も実施されたが，この地域の角閃岩中には磁硫鉄鉱が鉱染することや，鉱床上盤に〝Magnetite zone〟が存在することから，測定結果は使用に耐えるものではない。

ＡＧ－０１

測定深度（m）	曲り角度
５０	７
１００	８
１５０	１８
２００	１８
２５０	２２
３００	２３

ＡＧ－０２

測定深度（m）	曲り角度
５０	１
１００	８
１５０	１０
２００	１５
２５０	２０
３００	２３

ＡＧ－０３

測定深度（m）	曲り角度
５０	１
１００	９
１５０	１６
２００	２１
２５０	２３

第 3 章　ボーリング孔の地質および鉱化作用 (Fig.Ⅲ−2−1~2)

3 − 1　AG − 0 1

(1) 目的：Perau 鉱山西部における IP・SIP 異常帯の状況解明と地質構造解明のため，AG − 0 1 が実施された。

(2) 位置：Perau 鉱山西部で IP 測線 G − Line の測点 No.8 付近

経　距　　7 0 1.2 9 E

緯　距　　7 2 5 1.1 0 N

標　高　　4 9 0 m

(3) 岩質：0.5 5 m で着岩，以下 Açungui I 層の変成岩類から成る。2 3 6.2 0 m まで雲母片岩（白雲母，黒雲母片岩など）を主とし，角閃岩〜角閃石片岩を挟在する。雲母片岩はしばしば石墨質雲母片岩となり，黄鉄鉱が片理面に沿ってフィルム状に分布する。しばしば石英脈（セグレゲーション）が雲母片岩を切って分布する。角閃岩または角閃片岩は雲母片岩と調和的に挟在し，わずかに黄鉄鉱や磁硫鉄鉱を伴い，稀に黄銅鉱を随伴することがある。しばしば方解石脈が発達する。

2 3 6.2 0 m〜3 0 5.5 0 m 間は〝Perau Horizon〟と呼ばれる石灰岩・苦灰岩〜炭酸塩岩片岩および石墨片岩などから成る。

2 3 6.2 0 m〜2 4 1.0 0 m 間は炭酸塩片岩中に〝Magnetite zone〟が発達するこの地域では鉱床上盤の Key bed として有効に活用されている。

2 5 5.9 5 m〜2 6 5.9 0 m 間で重晶石−硫化鉱物帯の鉛，亜鉛鉱石部を捕捉した。

2 6 5.9 0 m〜2 7 1.5 0 m 間は石墨片岩から成る。この地域では鉱床下盤の Key bed として有効である。片理面に沿って弱い黄鉄鉱の鉱化作用が認められる。

2 7 1.5 0 m〜3 0 5.5 0 m 間は石灰岩〜苦灰岩を主とし，炭酸塩岩片岩を挟在する。

3 0 5.5 0 m〜3 3 1.1 5 m 間は石灰岩および珪岩の互層で，下位の珪岩層への漸移帯の岩相を示す。

地質層序的には珪岩を挟在する所から〝Perau Horizon〟より下盤の珪岩層としているので，本孔の目的は充分に達せられた。

(4) 鉱化作用および品位：鉱石部の連続サンプリング試料の分析結果はつぎのとおりである。

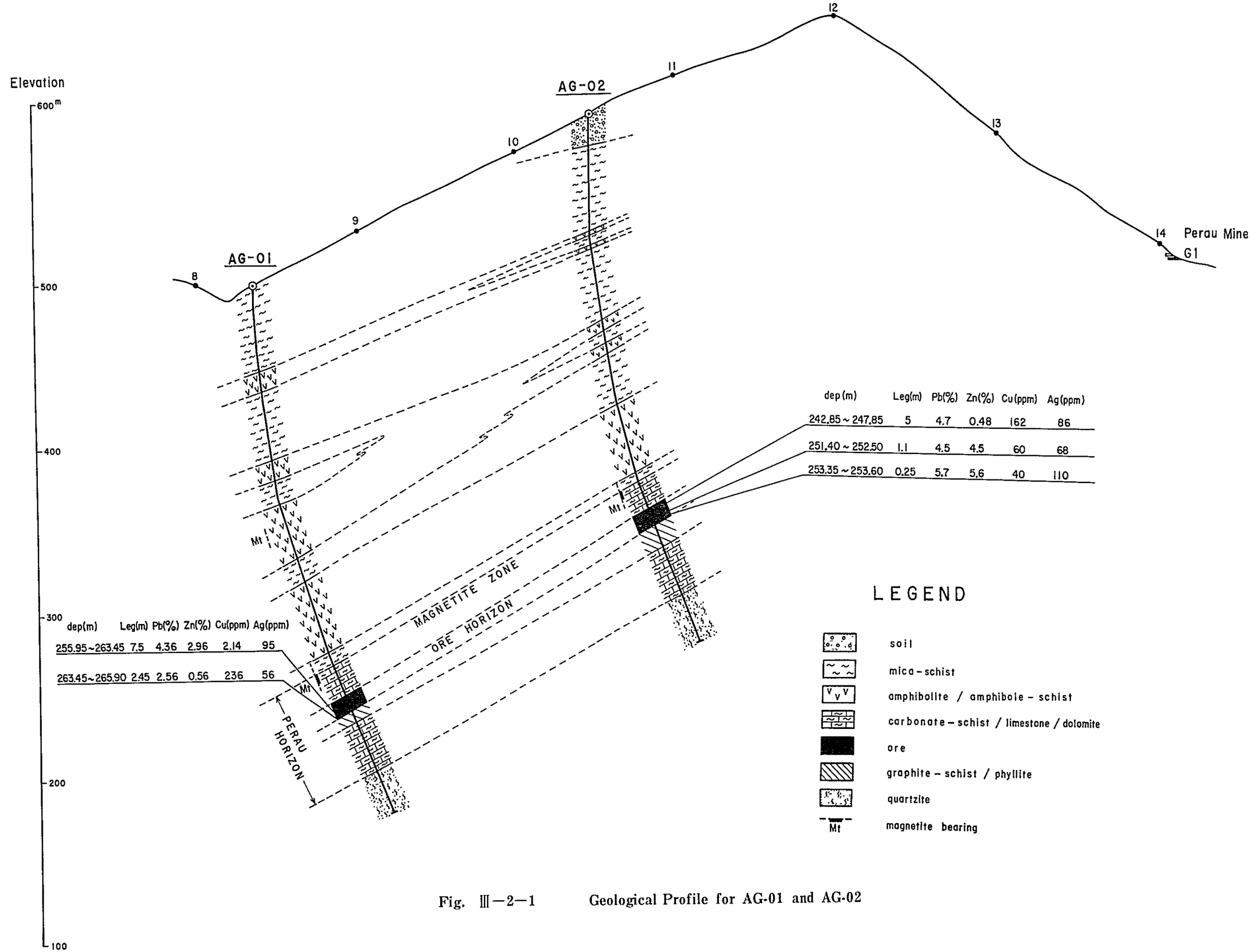


Fig. Ⅲ−2−1 Geological Profile for AG-01 and AG-02

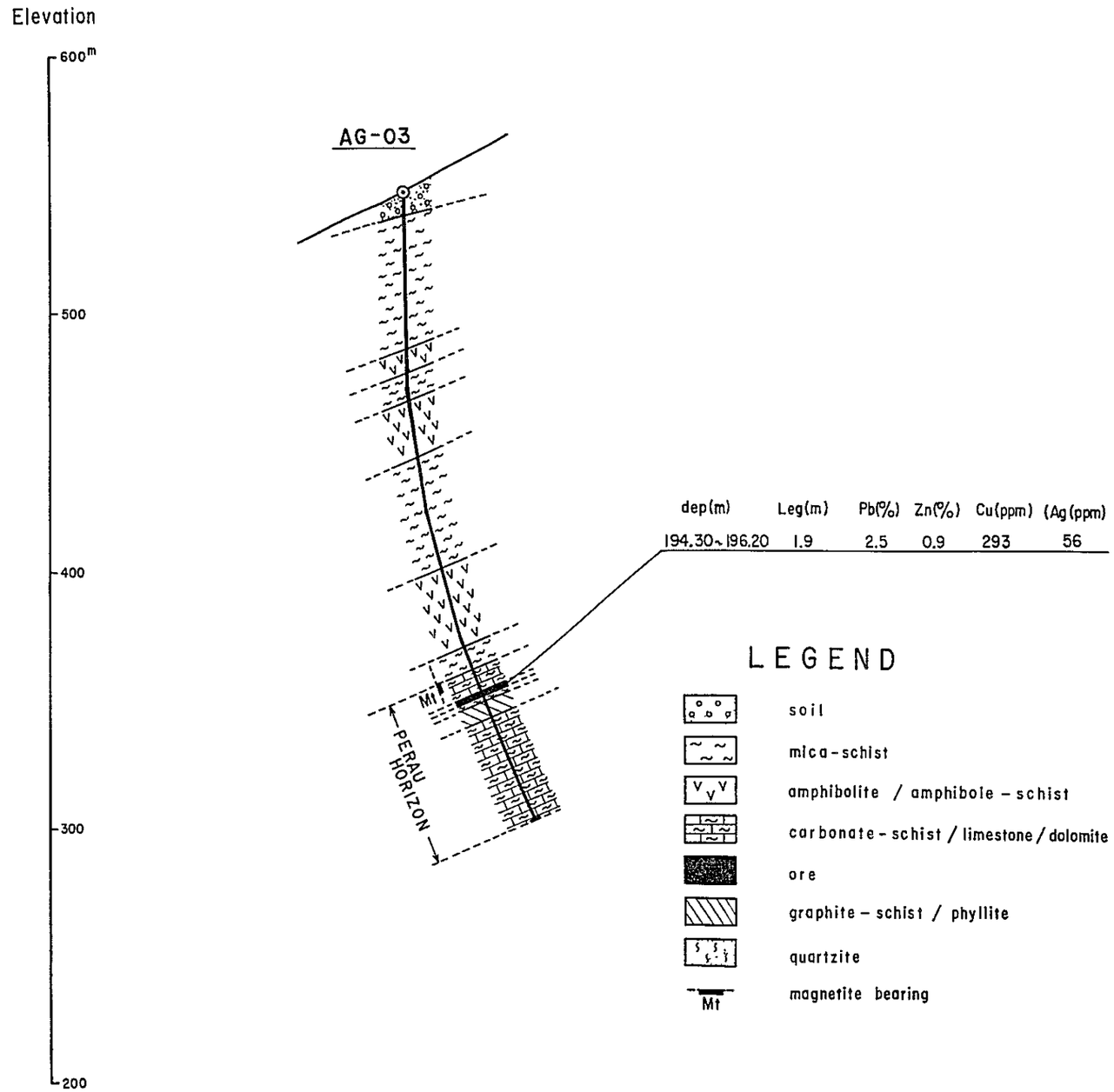


Fig. Ⅲ—2—2 Geological Profile for AG-03

深　度（m）	間隔（m）	サンプル数	Pb %	Zn %	Cu ppm	Ag ppm	CaO %	MgO %	SiO_2 %	BaO %
255.95～263.45	7.5	8	4.36	2.96	214	95	11.36	8.91	5.62	15.20
263.45～265.90	2.45	3	2.56	0.56	236	56	12.5	8.85	33.06	4.44

本鉱石部は，上記分析値および研磨片の検鏡結果に示されるように重晶石－硫化鉱物の鉱化作用の特徴を示す。鉱石鉱物は方鉛鉱，閃亜鉛鉱，黄鉄鉱を主とし．少量の黄銅鉱を伴い，稀に磁硫鉄鉱を伴う。

２５５.９５m～２６３.４５m間の鉱石部は重晶石帯中に方鉛鉱，閃亜鉛鉱および黄鉄鉱が鉱染状に胚胎する。この鉱石部ではZn品位が高いことが特徴である。

２６３.４５m～２６５.９０mの鉱石部では，鉱石鉱物の組合せは変わらないが，重晶石の含有量が非常に少なくSiO_2（チャート質）が多くなる。また，Zn 品位は非常に低くなり稼行中のPerau鉱床の鉱石に似る。

3－2　AG－02

(1) 目的：AG－01同様IP，SIP異常帯の状況解明と地質構造解明のため，AG－02が実施された。

(2) 位置：IP測線G－Line の測点№10～11の中間付近

経　距　　701.49E

緯　距　　7,251.21N

標　高　　592m

(3) 岩質：19.00mにて着岩，226.30mまで雲母片岩を主とし角閃岩～角閃片岩を挟在する。雲母片岩はしばしば石墨質母片岩を挟在し，片理面に沿って黄鉄鉱がフィルム状に発達する。しばしば石英セグレゲーションが片理に平行，またはブーディン状に分布する。角閃岩中では石英細脈のほかに方解石細脈が発達する。

226.30m～298.60m間は〝Perau Horizon〃の炭酸塩岩片岩，鉱化帯，石墨片岩などから成る。

〝Magnetite zone〃は228.10m～231.05m間に発達する。242.85m～252.5m間で重晶石－硫化鉱物帯の鉛，亜鉛鉱石部を捕捉した。

256.20m～267.00m間で鉱床下盤のKey bed の石墨片岩層を捕捉した。

298.60m～330.55m間は石灰岩，珪岩互層帯で，地質層序学的には珪岩層準に入ったので掘進を終了した。

(4) 鉱化作用および品位：鉱石部の分析値は下記のとおりである。主な鉱石部は３ケ所捕捉されている。

深　度（m）	間隔（m）	サンプル数	Pb %	Zn %	Cu ppm	Ag ppm	CaO %	MgO %	SiO_2 %	BaO %
242.85～247.85	5	5	4.7	0.48	162	86	12.6	6.2	9.0	20.5
251.40～252.50	1.1	1	4.5	4.5	60	68	12.2	7.5	4.3	17.9
253.35～253.60	0.25	1	5.7	5.6	40	110	13.2	6.9	7.6	12.3

本鉱石部は重晶石ー硫化鉱物の鉱化作用の特徴を示しており，ＡＧ－０１孔で着鉱した鉱石部に連続すると考えられる。

鉱石鉱物は重晶石帯中に方鉛鉱，閃亜鉛鉱および黄鉄鉱が鉱染状に胚胎する。

２４２.８５ｍ～２４７.８５ｍ間ではＺｎ品位が非常に低く，細～中粒の方鉛鉱主体の鉱石である。これより下位の２層は，方鉛鉱，閃亜鉛鉱がほゞ等量に胚胎している。

３－３　ＡＧ－０３

(1) 目的：ＡＧ－０１孔で着鉱した鉱化帯の南方の広がりを確認するためにＡＧ－０３孔が実施された。

(2) 位置：ＩＰ測線Ｇ－ＨＬine の中間で，測点№１０付近

経　距　　７０１.５０Ｅ

緯　距　　7,２５１.０３Ｎ

標　高　　５４８ｍ

(3) 岩質：９.００ｍで着岩，１８５.８０ｍまで雲母片岩を主とし，角閃岩～角閃片岩を挟在する。雲母片岩はＡＧ－０１およびＡＧ－０２孔に比べて石墨雲母片岩を挟在する割合が多く，また黄鉄鉱の鉱化作用も多い。

１８５.８０ｍ～２５０.５０ｍ間は〝Perau Horizon〃の炭酸塩岩片岩，〝Magnetite zone〃，鉱石部および石墨片岩層から成る。

〝Magnetite zone〃は１８５.８０ｍ～１８７.６０ｍ間で捕捉した。

１９４.３０ｍ～１９６.２０ｍ間で鉛，亜鉛鉱石部を捕捉した。しかし，ここではＡＧ－０１，ＡＧ－０２の鉱化帯に比べ規模および鉱化作用も劣化して，鉱床末端部の様相を示している。鉱床下盤のKey bed となる石墨片岩は１９８.２５ｍ～２０５.０５ｍで捕捉した。

(4) 鉱化作用および品位：鉱石部の分析値は下記のとおりである。

深　度（m）	間隔（m）	サンプル数	Pb %	Zn %	Cu ppm	Ag ppm	CaO %	MgO %	SiO_2 %	BaO %
194.30～196.20	1.9	2	2.5	0.9	293	35	8.3	3.1	40.4	4.7

本鉱石部はPb，Zn共に品位が低く，かつ重晶石も少ない。鉱石の見掛けはチャート質片岩と炭酸塩片岩中に方鉛鉱が上盤側に層状～網状に濃集し，下盤側には閃亜鉛鉱が比較的多く認められる。方鉛鉱濃集部には重晶石も認められ，重晶石－硫化鉱物の端末部を示している。

3－4　ボーリング実施結果の考察

ＩＰおよびＳＩＰでPerau 鉱床胚胎層準の異常帯に実施した３本のボーリング調査の結果，この地域に重晶石－硫化鉱物の層状鉱床の賦存が確認された。鉱石部は常に〝Perau Horizon〃の炭酸塩岩片岩中に胚胎し，その上盤には〝Magnetite zone〃が分布し，下盤には石墨片岩層が分布する。このMagnetite zone および石墨片岩層は本地域では鉱床の位置を捕捉するために非常に有効なKey bedである。

この結果各孔の鉱化帯は地質学的に同一層準に胚胎する層状鉱床であることが確認された。分析値および鏡下の観察結果，これらの重晶石－硫化鉱物の鉱化作用はＡＧ－０１孔およびＡＧ－０２孔で優勢でＡＧ－０３孔で劣化する。また，Pb，Zn鉱化作用はＡＧ－０１孔で優勢で，ＡＧ－０２孔およびＡＧ－０３孔に向ってZn品位が低下する傾向を示す。

以上〝Perau Horizon〃中の鉱化作用を検出したＩＰ・ＳＩＰ異常帯のほかに本地域から南部に向って広く分布するＩＰ異常帯の分布が知られているが，これは雲母片岩中の石墨質雲母片岩とこれに胚胎する黄鉄鉱の鉱化作用による異常帯であることがボーリングで確認された。

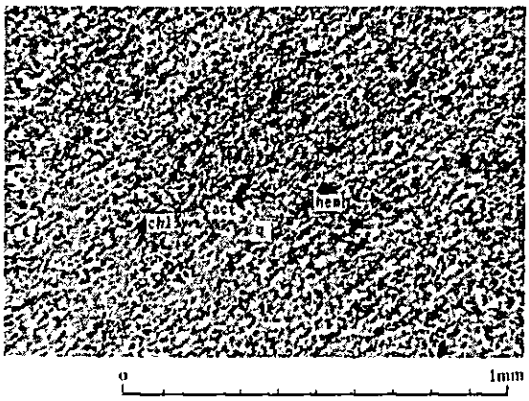
今後の探鉱余地としては，今回のボーリング調査で確認された鉱化帯の西方および北方への広がりを確認する必要があり，ボーリング調査の実施が望ましい。

APPENDICES

Photo A—1 Microphotograph of Thin Section

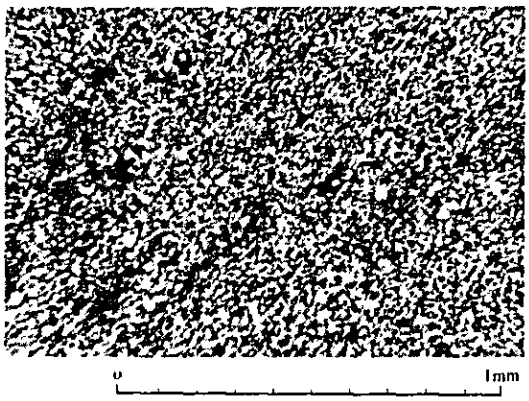
Abbreviations

q : quartz
pl : plagioclase
K—F : potash felspar
bt : biotite
mus : muscovite
hb : hornblende
chl : chlorite
cpx : clinopyroxene
act : actinolite
myr : myrmekite
diop : diopside
spn : sphane
zir : zircon
ep : epidote
hem : hematite
grp : graphite
cor : cordierite
And : andalusite
chlori : chloritoide

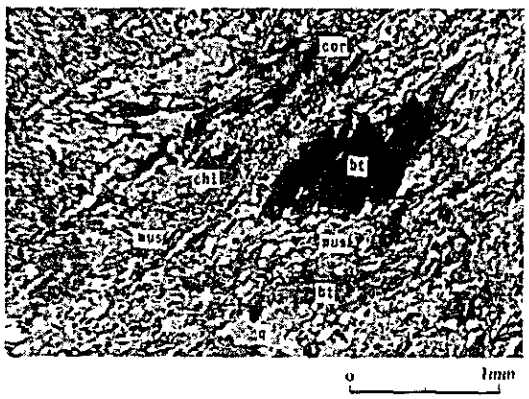


Sample No. : E–578
Rock name : phyllite (Açungui I F)
Location . Morro do Mouro
Texture : lepidoblastic

(only lower polar)

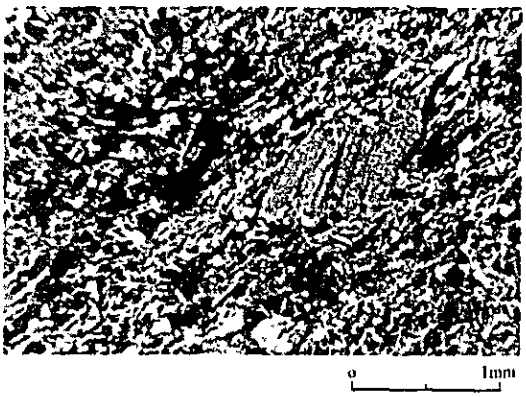


(crossed polars)

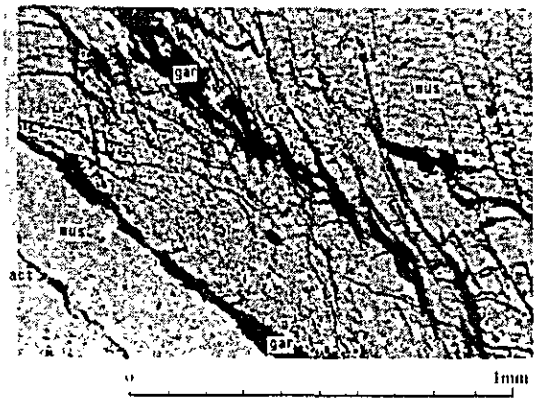


Sample No. : B-602
Rock name : chl–bt-schist (Açungui II F)
Location : Ressaca
Texture : lepidoblastic

(only lower polar)

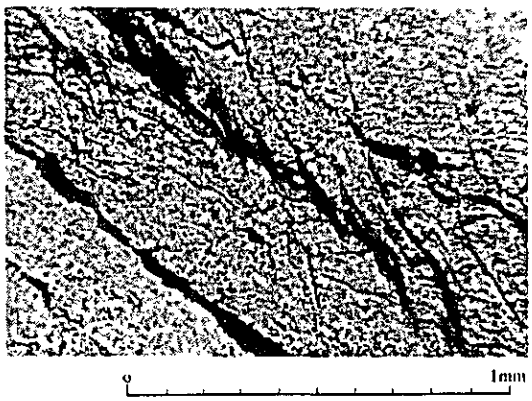


(crossed polars)

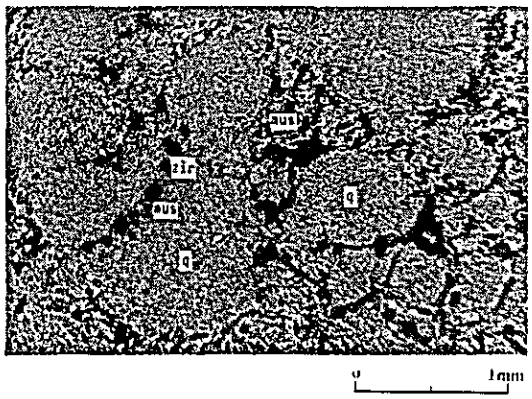


Sample No. : D–528
Rock name : meta conglomerate (Açungui II F)
Location : Iporanga
Texture : lepidoblastic

(only lower polar)

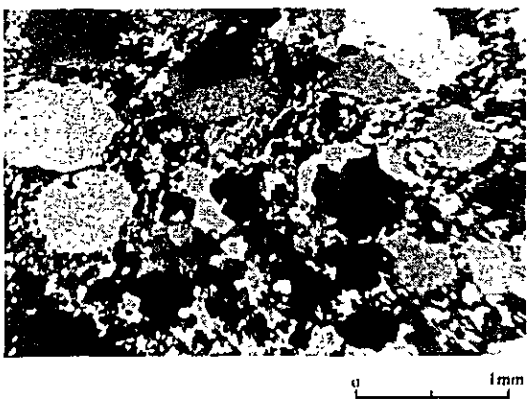


(crossed polars)

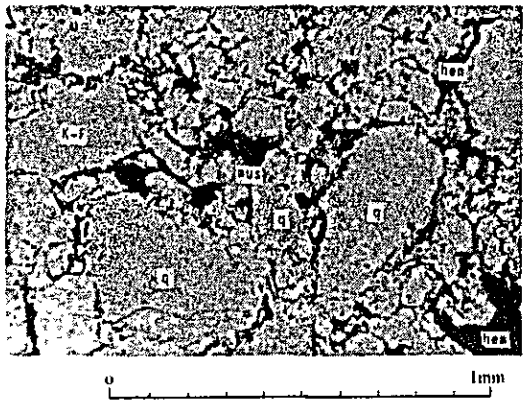


Sample No. : I–546
Rock name : meta conglomerate (Açungui III F)
Location : Betari
Texture : granoblastic

(only lower polar)

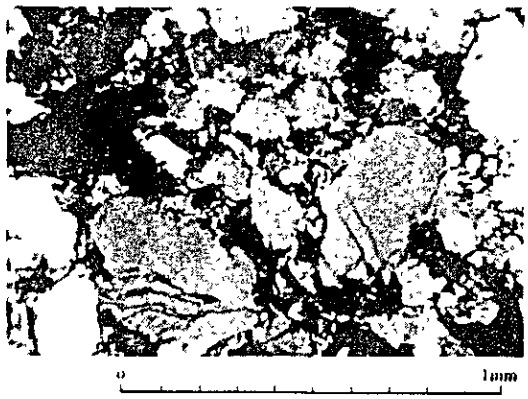


(crossed polars)

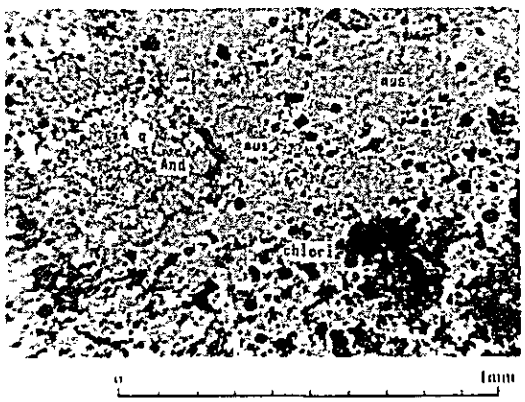


Sample No. : A–525
Rock name : meta-q-sandstone (Açungui III F)
Location : Furnas
Texture : granoblastic

(only lower polar)

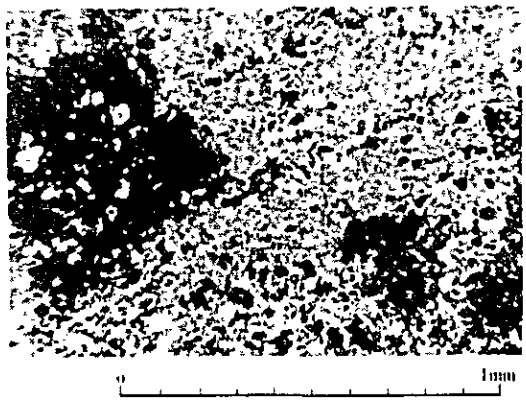


(crossed polars)



Sample No. : B–544
Rock name : metasiltstone (Açungui III F)
Location : Gurutuva
Texture : lepidoblastic

(only lower polar)

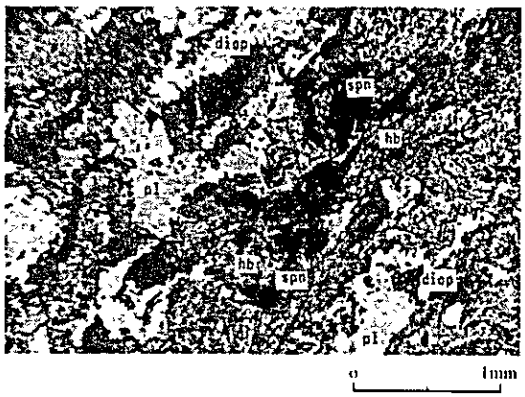


(crossed polars)

Sample No. : H–516
Rock name : gabbro
Location : Faz da Cachimba
Texture : ophitic

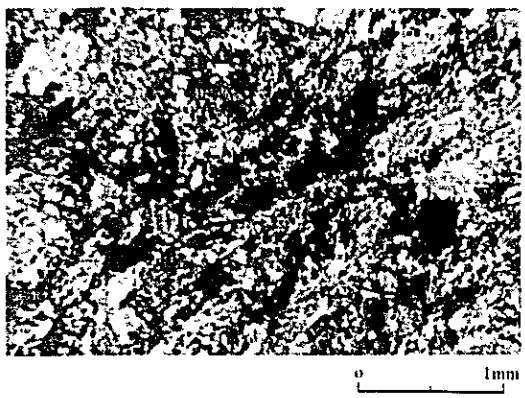
(only lower polar)

(crossed polars)

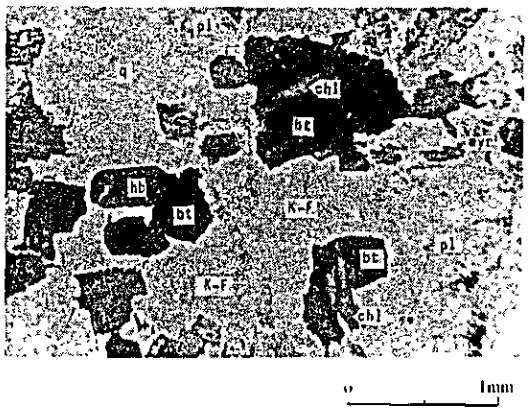


Sample No. : E–583
Rock name : meta basalt
Location : Faz Bachada Grande
Texture : subophitic

(only lower polar)



(crossed polars)



Sample No. : C–685
Rock name : granite
Location : Esprito Santo
Texture : granular

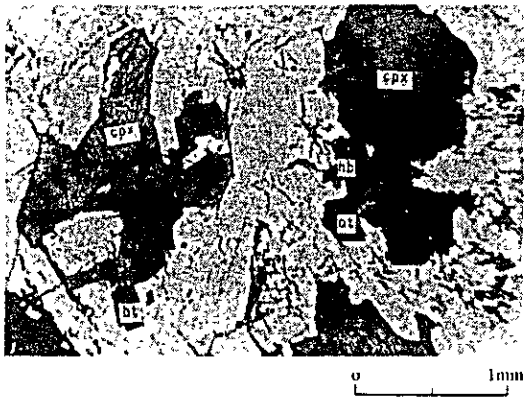
(only lower polar)

(crossed polars)

Sample No. : I–558
Rock name : granite
Location : Apiai
Texture : granular

(only lower polar)

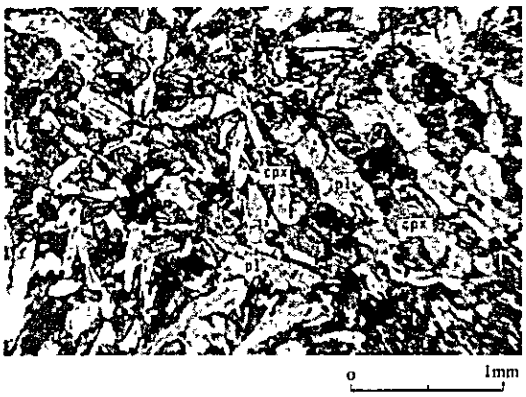
(crossed polars)



Sample No. : C–501
Rock name : gabbro
Location : Faz Bachada Grande
Texture : ophitic

(only lower polar)

(crossed polars)



Sample No. : C–681
Rock name : diabase
Location : Bairro da Cachimba
Texture : ophitic

(only lower polar)

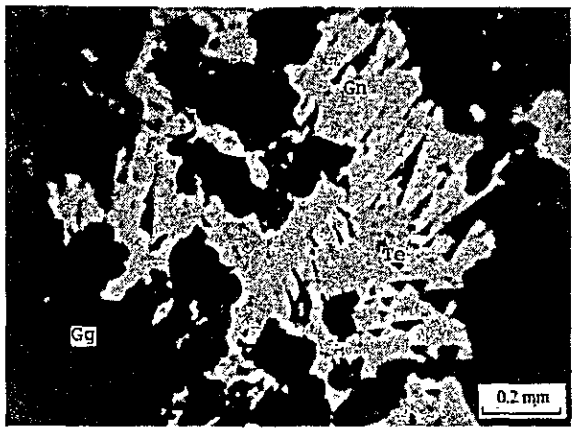
(crossed polars)

Photo A—2 Microphotograph of Polished Section

Abbreviation

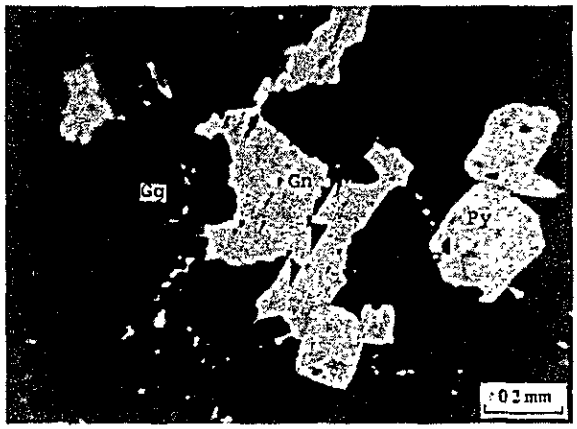
Gn : galena
Py : pyrite
Te : tetrahedrite
Sp : sphalerite
Cp : chalcopyrite
Po : pyrrhotite
Mt : magnetite
Hm : hematite
Cr : cerussite
Ge : goethite
Cc : chalcocite
Dg : digenite

(Geological Survey)



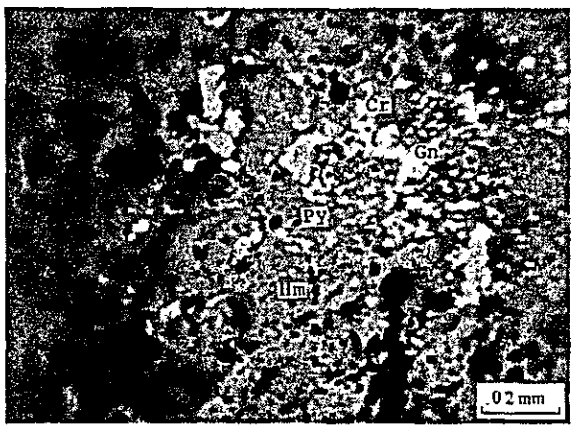
only lower polar

Sample No. : A–576
Location : Barrinha Mine
Ore name : Pyrite-Galena Ore



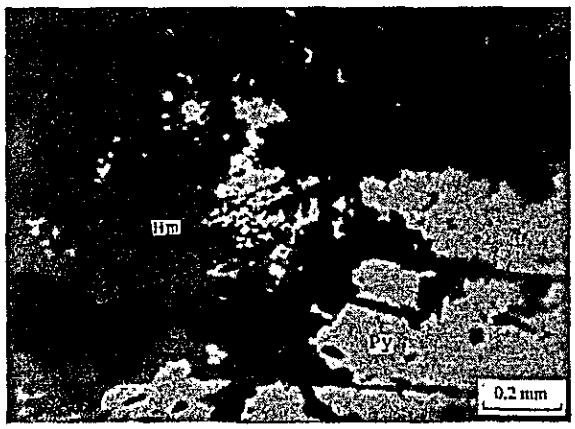
only lower polar

Sample No. : A–578
Location : Barrinha Mine
Ore name : Galena-Pyrite Ore



only lower polar

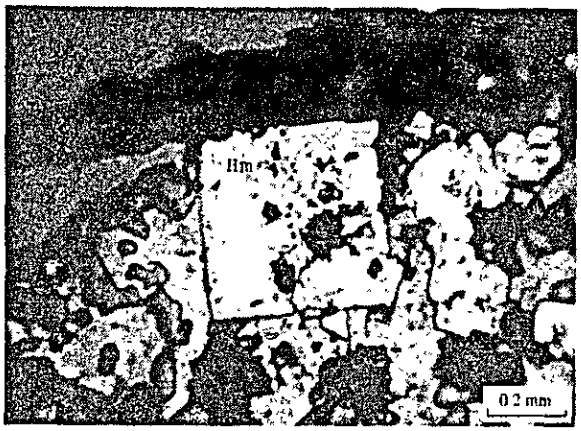
Sample No. : C–518
Location : Esprito Santo Mine
Ore name : Hematite-Galena Ore



only lower polar

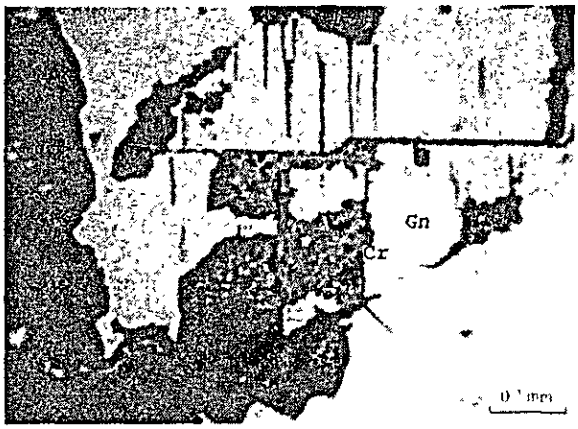
Sample No. : D–542
Location : west of Furnas
Ore name : Hematite-Pyrite Ore

(Geological Survey)



only lower polar

Sample No. : D–581a
Location : Lageado (Boa Ventura)
Ore name : Cerussite Ore

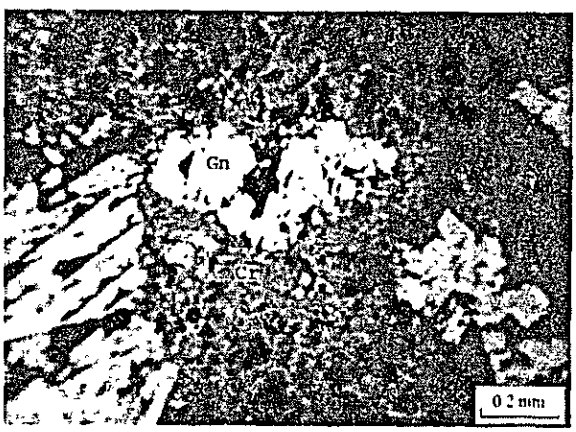


only lower polar

Sample No. : D–583
Location : Lageado (Boa Ventura)
Ore name : Cerussite-Galena Ore

only lower polar

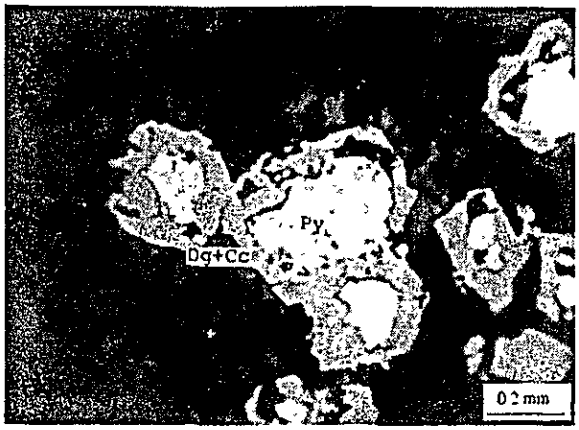
Sample No. : D–584
Location : Lageado (São Vicente)
Ore name : Galena Ore



only lower polar

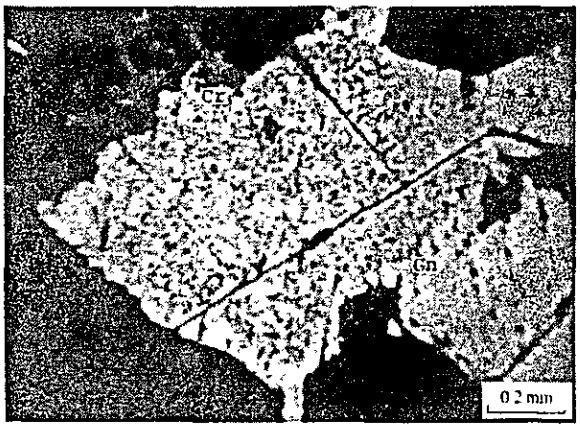
Sample No. : D–586
Location : Legeado (Jardim G2)
Ore name : Galena Ore

(Geological Survey)



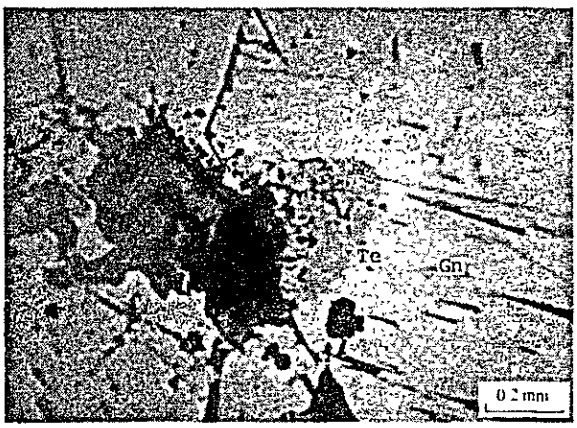
only lower polar

Sample No. : D–592
Location : Lageado (Copper Showing)
Ore name : Pyrite-Ore



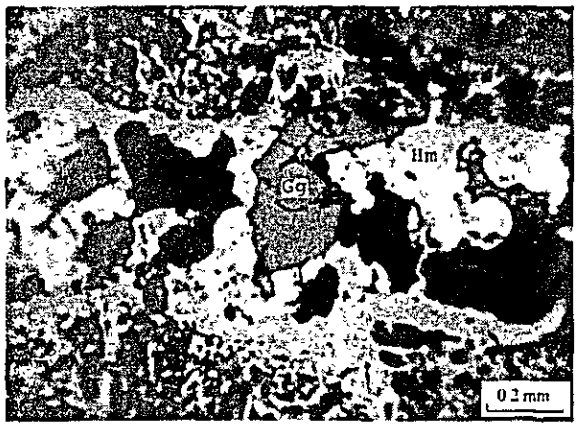
only lower polar

Sample No. : D–593
Location : Lageado (Copper Showing)
Ore name : Galena Ore



only lower polar

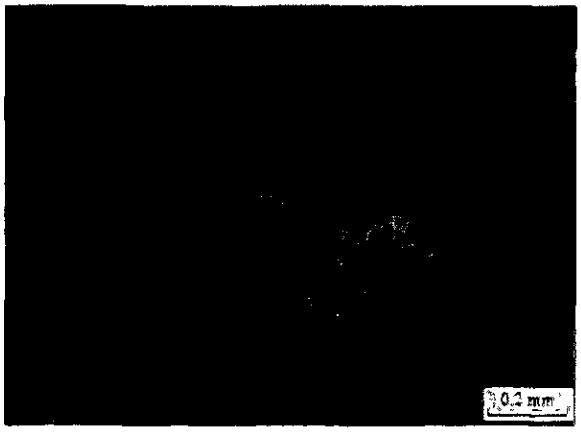
Sample No. : D–595a
Location : Serra (Jaguatiria)
Ore name : Cerussite-Galena Ore



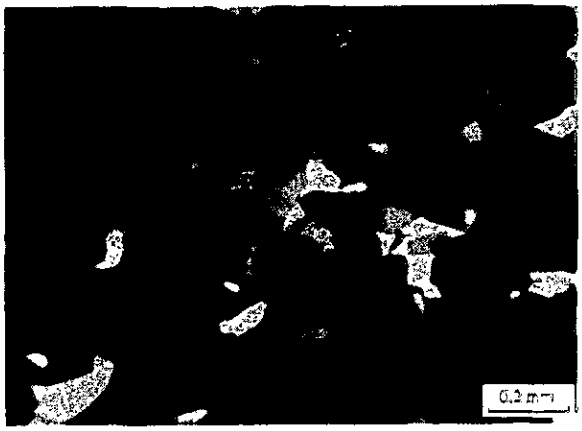
only lower polar

Sample No. : E–548
Location : Agua Suja
Ore name : Hematite Ore

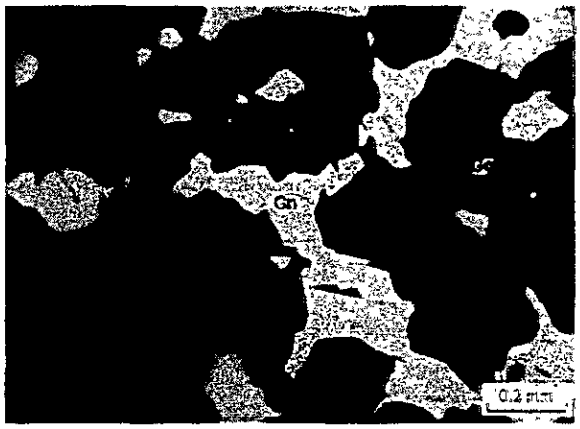
(Logging Core)



Sample No. : F-627
Depth : AG-02, 228.70m
Ore name : Magnetite Ore



Sample No. : F-637b
Depth : AG-02, 243.70m
Ore name : Pyrite-Galena Ore



Sample No. : F-640a
Depth : AG-02, 246.05m
Ore name : Galena Ore

Sample No. : F-675a
Depth : AG-03, 191.10m
Ore name : Chalcopyrite-Pyrite Ore

Table A—1 List of Mines and Showings in Survey Area

No.		Name of Mine & Showing	Kind of Ore	Type	Status	Location	Host Rock	Ore Deposits				Grade					Ore Mineral	Remarks
								Strike & dip	Lateral Extension	Longitudinal Extension	Average Width	Au g/t	Ag g/t	Cu %	Pb %	Zn %		
1		Braço da Pescaria	Pb	Vein	closed	Areia Branca	Açungui III F L_3 limestone	–	–	–	–	–	–	–	–	–	Gn	
2		Agua da Limeira	Pb	do	do	East of Espinto Santo	Açungui III F L_2 limestone	N40°~60°W, 30°~70°SW	1,200m	–	0 005 ~0.20 m	0.4	554.0	0.06	12.09	0.00	Gn, Cp, Py, Cc, Cv	
3		Monjolinho de Sebastião	Pb	do	do	do	Açungui III F L_3 dolomite	N40°E,80°SE	10	–	network 0.03~0.10	0.8	204 0	0.00	7.70	0.00	Gn, Py, Cp	production several tons
4		Espirito Santo	Pb	do	do	Espirito Santo	Açungui III F L_3 limestone	N50°E,80°NW	250	100	0 30	0.0	85.9	0.05	8.57	0.66	Gn, Hm, Cer, Py, Cv	production several hundred tons
5		Figueira	Pb	do	do	Southwest of Espirito Santo	do	N50°E, 55°NW	–	–	0.15~0 20	–	–	–	–	–	Sp, Ga, Py, Cp	production several hundred kilograms
6		Paciencia	Zn, Pb	do	do	do	do	N60°E,50°SE	–	–	0.80~1.50	–	–	–	–	–	Gn, Sp, Py, Cp	production Galena 200kg
7		Furnas	Pb, Ag, Zn	Vein and pipe-like	operating	Furnas	do	N60°W,80°SW N40°E,45°NW	800	100	–	0.2	2586.0	0.11	12 60	3.82	Gn, Sp, Py, Tt, Cer	production (1981) 500T/M Pb:7%, Ag: 3,000g/T
8		Gruta de Santana	Pb	Vein	closed	East of Furnas	Açungui III F L_2 limestone	–	–	–	network 0.01~0.05	0.0	7.9	0.02	5.92	2.79	Gn, Sp	production 10 tons
9		Agua Suja	(Pb)	(Vein)	do	Northeast of Furnas	Açungui III F L_3 limestone	–	–	–	(0.02~0.04)	11.8	2.0	0.01	0 12	0.01	Hm, Gt	
10	Lageado Deposits	Occorençia de Cobre	Cu,Zn	Vein	do	Lageado	Açungui III F L_2 dolomite	N55°E, 50°SE	1.5	30	network 0.02	1.5	100.7	1.33	0.50	11.50	Gn, Cv, Py, Hm, Cer	
11		Lourenço Velho (São Lourenço)	Pb	do	do	do	Açungui III F L_2 limestone	N45°E, 75°SE	20~30	–	1.00	–	–	–	–	–	Gn, Cer	production 10 tons
12		Santana Velha	Pb	do	do	do	do	N75°E, 70°SE	5	250	0.50	–	–	–	–	–	Gn, Sp	production 1,000 tons
13		Porco ou Porco do Mato	Pb, Zn	do	do	do	do	N70°E, 70°SE	–	–	0.60~0.80	–	–	–	–	–	Gn, Sp, Py	production Gn: 2 tons
14		Mamangava	Pb	do	do	do	do	N65°E, 70°S E	500	100	0.80	0	215	0.0	11.1	0.01	Gn, Sp, Py, Cer	by JICA(1981), production several thousand tons
15		Santana Nova	Pb, Ag	do	do	do	do	N50°E, 75°SE	600	200		0.3	1874.0	0.08	12.24	0.01	Gn, Py, Cer, Cv	production severalthousand tons Pb:5~50%
16		Santana F	Pb	do	do	do	do	N50°E, 60°SE	–	100+	1.00~2.00	–	–	–	–	–	Gn, Py, Cer	production Gn: 20~30 tons
17		Nova Esperança	Pb, Ag	do	do	do	do	N80°E, 70°SE	20	80+	0.50	0 5	1891.0	0.08	12.04	0.01	Gn, Cer, Py, Cp, Cv	production 40 tons Pb: 40%
18		São Vicente	Pb	do	do	do	do	N50°E, 50°SE	–	50	0 60	0.5	496.0	0.08	12.04	0.22	Gn, Hm, Cer	production 40 tons
19		Coqueiro	Pb	do	do	do	do	N60°E, 80°SE	–	6+	0.20	–	–	–	–	–	Gn, Py, Cer	production 5 tons
20		Bugios	Pb	do	do	do	do	N50°E, 70°SE	–	150	0.30	–	–	–	–	–	Gn, Py	production 500 tons
21		Jardim I II	Pb, Ag	do	do	do	do	N50°~60°E, 60°SE	20	250	0.70	0.4	2150 0	0.58	12.14	0.08	Gn, Py, Hm, Cer	production 1,000 tons(I), 80 tons Pb. 50% (II)
22		São Rafael I-II-III	Pb	do	do	do	do	N70°E, 60°SE	–	150+	1.00	–	–	–	–	–	Gn, Py	by Sudelpa, production 500~1,000 tons
23		Boa Ventura	Pb	do	do	do	do	N70°E, 60°SE	5~10	80m (py-vein: 1,000m)	1.00~1.50	0.1	1073.0	0.05	11.84	0.27	Gn, Py, Hm, Cer	production 85 tons
24	Serra Deposits	Macaquinho	Pb	do	do	do	do	E-W, 65°S	–	–	0.10	–	–	–	–	–	Gn, Sp, Hm, Cer	production several hundred tons
25		Jaguatirica	Pb, Zn	do	do	do	do	N50°E, 65°SE	–	50+	0.10~0.50	0.1	835.0	0.16	10.56	5.37	Gn, Cer, Sp, Py, Mt, Hm, Cv	production 80 tons
26		Sete Alqueires	Pb	do	do	do	do	N70°E, 75°SE	–	–	?	–	–	–	–	–	Gn, Hm	
27		Berta Funda I-II-III-IV	Pb	do	do	do	do	N30°E, 40°SE	–	–	0.20~0.30	–	–	–	–	–	Gn, Sp	
28		Alto do Bento (Descanso I-II)	Pb	do	do	do	do	N70°E, 70°SE	–	–	0.30~0.40	–	–	–	–	–	Gn, Sp, Py	by Sudelpa, production Gn:15 tons
29		Casa Velha	Pb	do	do	do	do	N60°E, 80°SE	–	200	0.10~0.40	tr	265	–	9.48	n.d.	Gn, Sp, Py, Hm, Cer	by Sudelpa
30		Sitio Noro	Pb	do	do	do	do	N80°E, 60°SE	–	–	0 20~0.30	–	–	–	–	–	Gn	
31		Berta do Leão	Pb, Ag	do	do	do	do	N45°E, 60°SE	–	60	0.20~0.30	0.0	1131.0	0.01	12.86	0.27	Gn, Sp, Py	
32		Santo Antonio do Pavão	Pb	do	do	Pavão	do	N60°W, 30°~80°NE	300	130+	0.15	0.0	51.9	0.00	4.29	0.06	Py, Gn	by Sudelpa, production 70 tons

Table A—2—1—1 Microscopic Observations (Thin Section) (Geological Survey)

Metamorphic rocks

Formation	Sample No.	Location	Rock Name	Texture	quartz	plagioclase	K-feldspar	apatite	zircon	sphene	calcite	dolomite	magnetite	hematite	sericite	graphite	tourmaline	tremolite	actinolite	chloritoid	andalusite	garnet	chlorite	staurolite	phlogopite	biotite	muscovite	epidote	zoisite	clinozoisite	anthophyllite	hornblende	clinopyroxine	Remarks
Açungui I Formation	C – 659	Bairro Maria Rosa	phyllite	lepidoblastic	•									•		○							◎				•							qtz-opq-mus vein
	C – 661	Bairro Maria Rosa	metabasalt	clastic	○	•					◎			•	•	•							◎											
	E – 577	Morro do Mouro	phyllite	lepidoblastic	○									•		○							○				○							
	E – 578	Morro do Mouro	phyllite	lepidoblastic	○									◎					○				•				◎							
	G – 556	Bicas	meta conglomerate	clastic and lepidoblastic	○	•								•		○							•				◎							
	J – 532	Morro do Mouro	phyllite	lepidoblastic	○									•									•				◎							
	J – 555	Bairro Maria Rosa	metadiabase	subophitic		○				•									○				•					○				○		
Açungui II Formation	B – 588	Ressaca	amph sch.	nematoblastic	○	○																	•						•		◎		
	B – 589	Ressaca	meta qtz sandstone	granoblastic	◎	○								•									•											
	B – 602	Ressaca	chl-bt sch.	lepidoblastic	○	○							•										○			○	○	•						cordierite •
	B – 603	Ressaca	ep-act sch.	granoblastic	◎	•													◎				○					○						
	C – 653	Ribeirão Farto	meta siltstone	lepidoblastic	○	○	•							•		•							○				○							
	D – 528	Iporanga	meta conglomerate	lepidoblastic	○	○										○			○				○				◎							
	G – 552	Bicas	meta conglomerate	porphyroblastic and clastic	◎	○	○							•	○												•							
	G – 554	Bicas	meta conglomerate	porphyroblastic and clastic	○	○	○							•	○											•	•							
	G – 594	Serra do Monte Negro	meta siltstone	lepidoblastic		•								•									◎				•							
	I – 522	Corrego da Cotia	meta sandstone	lepidoblastic	○	○								•		•											◎					•		
	J – 547	Corrego Pedra de Amolar	meta arkose sandstone	clastic (partly lepidoblastic)	◎	○	○							•	○	•											•							
	J – 548	Corrego Pedra de Amolar	meta conglomerate	clastic	◎	○	○							•	○	•																		
	J – 549	Corrego Pedra de Amolar	dolomite	micromosaic	•	•						◎				•																		clay mineral •
Açungui III Formation	A – 525	Furnas	meta qtz sandstone	granoblastic	◎		○						•	○									○				○							
	B – 514	Caracol	calc sch.	granoblastic	○	○					◎			•													•							cal vein
	B – 517	Pouso Triste	calc sch.	nematoblastic	○	○	○			•	•			•														○				◎		allanite •
	B – 531	Itaoca	hornfels	granoblastic and porphyroblastic	◎																													tourmaline ◎
	B – 544	Gurutuva	metasiltstone	lepidoblastic	○					•										•	•		○				◎							opq ○
	B – 553	Gurutuva	mus-bt sch.	porhyroblastic	○	•								•	•						◎		•			◎	○							
	B – 611	Foqouilha	bt-ser sch.	porphyroblastic	◎	○		•						•	○											•								
	B – 624	Gurutuva	bt sch.	nematoblastic	○	○				•				•												○	○					○	○	
	C – 573	Bairro da Cachimba	meta siltstone	nematoblastic	○	○								•					○				○			○	○							
	C – 682	Bairro da Cachimba	meta siltstone	lepidoblastic	○	•																	○			○	○							
	D – 553	Cachoeira	meta siltstone	lepidoblastic	○											•							•			◎	○							
	D – 558	Betari	calc schist	lepidoblastic	○						◎												•				○							
	D – 564	Funil	meta sandstone	lepidoblastic	○	○		•								•	•			○			○			◎	○	•						
	D – 566	Funil	meta qtz sandstone	granoblastic	◎	•		(•)	(•)					(•)		•							•			•								
	D – 592	Lageado	brecciated dolomite	allotriomorphic and granular	◎	○									•	•																		
	E – 513	Lambari	meta siltstone	lepidoblastic	•	○										•			◎				○				○							
	E – 540	Serra	mus sch.	lepidoblastic	○	•								•	•				○				○				○							
	G – 506	Lambari	meta siltstone	lepidoblastic											○								•				◎	○						
	G – 533	Serra da Onça Panda	meta sandstone	clastic	○	○									○				○				◎											
	I – 519	Corrego da Cotia	brecciated silicified limestone	clastic	◎										•	•																		qtz veinlet
	I – 546	Betari	meta conglomerate	granoblastic	◎	○				•					•								○				○							
	I – 551	Apiai	bt-mus sch.	lepidoblastic	◎	○									•											○	◎							
	I – 552	Apiai	mus-bt sch	lepidoblastic	◎	○		•	•						•		•				○		•			◎	○							
	I – 555	Apiai	meta qtz sandstone	granoblastic	◎			•	•														•					○	○					
	I – 556	Apiai	bt-bearing metasandstone	lepidoblastic	◎	•									○	•										○								
	I – 565	Barrinha	meta conglomerate	clastic and lepidoblastic	◎	○	○	•						○		•	•											○							
Meta Igneous Rocks	B – 548	Gurutuva	gabbro	ophitic		◎								•	•								•						○		•	○	
	C – 538	Faz Bachada Grande	meta basalt	subophitic		◎				•				•					◎				○					○		•				stilpnomelane vein
	C – 631	Bairro da Cachimba	meta gabbro	ophitic	•	◎									•				◎							•	•				○			
	D – 600	Cachoeira	meta gabbro	ophitic		◎								•					○								•				○	○		stilpnomelane •
	E – 583	Faz da Cachimba	meta gabbro	ophitic	○	○				•									○								•				○			
	G – 561	Faz da Cachimba	meta gabbro	ophitic		◎								•					•				•			•						◎		
	H – 516	Pamital	gabbro	ophitic		◎								•					•							•						◎		orthopyroxene ○

Table A—2—1—2 Microscopic Observations (Thin Section) (Geological Survey)

Igneous Rocks

Rock Group		Sample No.	Location	Rock Name	Texture	Constituent mineral												Secondary mineral								Remarks
						quartz	K-feldspar	plagioclase	biotite	muscovite	hornblende	augite	hypersthene	olivine	garnet	zircon	rutile	calcite	sericite	chlorite	epidote	sphene	actinolite	idingsite	serpentin	
Granite	Apiai mass	B – 508	Apiai	granite	granular	○	◎	○	•							•						•	•				partly mylonitic
		I – 558	Apiai	granite	granular	◎	○	◎	○		○					•			•	•	•	•					apatite • allanite •
	Itaoca mass	B – 623	Itaoca	granite	equigranular	○	◎	○	○		○					•			•		•	•					apatite •
	E. Santo mass	C – 685	Espirito Santo	granite	granular	○	◎	◎	○		○					•			•	•	•	•					myrmekite • apatite •
	Vardim Grande mass	G – 570	Serra de Vargem Grande	granite	equigranular	○	◎	◎	○		(•)					(•)			•			•					apatite (•)
	small mass	D – 533	Serra do João Ferreira	granite porphyry	porphyritic	○	○	○	○																	hematite •
		G – 618	Furnas	granite	porphyritic	○	◎	○	○		○								•	•	•	•				magnetite •
diabase dyke		C – 501	Fa$_2$ Bachada Grande	gabbro	ophitic			◎	•			◎											•			
		C – 681	Bairro da Cachimba	diabase	ophitic			◎				◎								•						magnetite ○
andesite ~ porphyrite dyke		C – 553	Espirito Santo	porphyrite	porphyritic	•		◎	○		○								•	○	•	•				apatite •
		C – 641	Ribeirão Farto	porphyrite	porphyritic			◎	•			○							•	•	•					magnetite •

Table A—2—2 Microscopic Observations (Thin Section) (Logging Core)

Formation	Sample No.		Depth (m)	Rock Name	Texture	quartz	plagioclase	K-feldspar	apatite	zircon	sphene	calcite	dolomite	magnetite	hematite	sericite	graphite	tourmaline	tremolite	actinolite	chloritoid	andalusite	garnet	chlorite	staurolite	phlogopite	biotite	muscovite	epidote	zoisite	clinozoisite	anthophyllite	hornblende	clinopyroxine	Remarks
Aqungui 1 Formation	F— 525	AG—01	15.55	mus-bt sch	lapidoblastic	◎	○	•		•						•	•	•					○	•			○	○							
	530		64.40	act sch	nematoblastic	•	○					•								◎						•									
	537		87.90	graph-mus sch	nematoblastic	○	•										○							•				○	◎						
	544		137.20	act sch	nematoblastic		○					•								◎										•					
	548		184.00	bt-mus sch	lapidoblastic	◎	•											•									○	◎							
	560		240.20	mt-bearing calc-silicate rock	granoblastic	○	○					◎		•					◎					•			○						○		
	562		254.30	bt-carbonate sch	nematoblastic							◎		○													○						○		
	575		256.50	graph-mus sch	lepidoblastic	○	○					•		•			○										•	◎							
	578		280.50	carbonate sch	nematoblastic	○	•	•	•		•	○		•													•								
	580		292.00	limestone	granoblastic							◎							◎								○								
	583		323.15	quartzite	granoblastic	◎	○					•													•				•						
	F— 588	AG—02	52.10	bt-mus sch	granoblastic	◎	•		•			•					•	•					•				○	○						cal vein
	597		75.20	bt-mus sch	lepidoblastic	○	○		•								•										○	◎						
	606		113.80	bt-mus sch	lepidoblastic	◎									•	•	•							•	•		○	◎						
	610		128.60	bt-act sch	nematoblastic	○	○		•											◎							○		•					
	612		137.80	bt-mus sch	lepidoblastic	◎	•		•	•													•				○	◎						
	617		167.30	garnet-bt-mus sch	lepidoblastic	◎	•		•	•							•	•					○				○	◎						
	621		195.50	amphibolite	nematoblastic	○	○			•				•						•									•			◎		
	623		214.40	amphibolite	nematoblastic	•	○			•	•				•					•	○				•				•			◎		
	626		225.70	bt-mus sch	lepidoblastic	◎											•					○					○	◎						
	627		228.70	bt-carbonate-mt sch	granoblastic	○	•					○	◎						○					•			○		○					
	636		240.30	tre-phlo-carbonate sch	mosaic and lepidoblastic	○	○					◎					•		◎				•			◎								
	651		260.50	graph-bt-mus sch	lepidoblastic	◎			•					•		○								•			○	○						
	654		271.75	phlo-carbonate sch	granoblastic	○	○		•			◎		•					○							◎								
	659		299.20	quartzite	granoblastic	◎	•	•			•	○														○								
	662		328.10	quartzite	granoblastic	○	○					○		•					○							○								

Table A–3–1 Microscopic Observations (Polished Section)

(Geological Survey)

No	Sample No	Location	Ore Name	Galena	Sphalerite	Pyrite	Pyrrhotite	Chalcopyrite	Tetrahedrite	Chalcocite (second)	Covelline (second)	Magnetite	Hematite (second)	Cerussite	Goethite	Others
1	A–572	Panelas Mine 110 + 26mL	Galena-Pyrrhotite Ore	○	•	•	○	•								
2	A–573	Panelas Mine 110 + 34mL	Galena Ore	◎		●	•	•								
3	A–574	Perau Mine G2 + 8 – S	Pyrite-Cerussite Ore	•		●					•			●		
4	A–575	Perau Mine G2 + 8 – N	Galena Pyrite Ore	●	•	●		•			•		•			Bor
5	A–576	Barrinha Mine	Pyrite-Galena Ore	○	•	●		•	•			•	•			
6	A–577	do	Pyrite-Galena Ore	○		•										
7	A–578	do	Galena Pyrite Ore	•		○			•							
8	A–579	do	Galena-Pyrite Ore	●	•	●			•							
9	A–580	Perau Mine G2 + 8 – S	Galena-Pyrite Ore	●		●								●		
10	A–581	Panelas Mine 110 + 34mL	Pyrite Ore			◎		•								
11	A–582	UNIGEO	Galena-Magnetite Ore	●		•		•				○	•			
12	B–622	Santo Antonio do Pavão Mine	Pyrite-Galena Ore	◎		◎										
13	C–518	Espirito Santo Mine	Hematite-Galena Ore	○		•					•		○	●		
14	C–591	Agua da Limeira	Galena Ore	●												
15	C–592	do	Chalcopyrite Ore			•		●		•	•					Dg
16	C–596	SW of Espirito Santo Mine	Pyrite Ore			•										
17	D–542	West of Furnas	Hematite-Pyrite Ore			◎		•			•		●			
18	D–581a	Lageado Boa Ventura	Cerussite-Ore										•	◎	•	
19	D–581b	do	Galena Ore	◎									•	•		
20	D–583	do	Cerussite-Galena Ore	◎		•							●	○	•	
21	D–584	Lageado São Vicente	Galena Ore	◎									●	●		
22	D–586	Lageado Jardim G2	Galena Ore	○		•							•	•		
23	D–588	Legeado Nova Esperança	Pyrite-Galena Ore	◎		●		•			•			●		
24	D–590	Lageado Santana Nova G5	Pyrite-Galena Ore	◎		●					•			•		
25	D–592	Lageado Copper Showing	Pyrite Ore			●							•		•	
26	D–593	do	Galena Ore	○		•					•		•	•	•	
27	D–595a	Serra Jaguaturica	Cerussite-Galena Ore	◎	•	•						•	•	●		
28	D–595b	do	Cerussite-Galena Ore	◎	•	•					•			●		
29	D–597	do	Galena Cerussite Ore	●	•	•					•			◎		
30	E–544a	Gruta de Santana	Galena-Sphalerite Ore	●	●											
31	E–548	Agua Suja	Hematite Ore										◎		●	
32	E–643	Furnas Mine	Pyrite-Galena Ore	◎	•	○										
33	E–644	do	Galena Ore	◎	●	●			•					•		
34	E–645	do	Galena-Sphalerite Ore	◎	◎	•			•					•		
35	E–646	Diogo Lopes Mine	Cerussite-Galena Ore	○		•								●		
36	E–647	Paqueiro Mine	Galena Ore	○	•	•					•			•		
37	E–648	Bueno Mine	Galena Ore	●		•		•			•			•		
38	E–649	Onça II	Galena Ore	○		•								•		
39	I –508	Serra	Galena Ore	●	•	•										
40	G–610	Aberta do Leão Barrinha Mine	Galena Ore	•												

Remarks ◎ abundant ○ common ● little • rare Dg . Digenite Bor . Bornite

1. A-572

Massive pyrrhotite occupies more than 30 % and disseminated galena occupies about 20 % of the area. Galena, pyrrhotite and a small amount of chalcopyrite occur with mutual boundary. No indication of the temporal difference in the deposition of them was observed microscopically. These sulfide minerals fill the interstices of carbonate and quartz grains. Pyrite grains occur rarely between pyrrhotite and chalcopyrite grains. Few sphalerite grains occur in chalcopyrite.

2. A-573

Galena occupies nearly 80 % and pyrite about 20 % of the area. Large grains of pyrite occur in galena. The shape of grain is mostly irregular and the boundary is partly coroded. A small amount of galena, pyrrhotite and chalcopyrite occur in pyrite grains. Small grains of pyrrhotite occur sporadically in galena and the shape of them is quite irregular being coroded by galena. Sphalerite occurs also in galena as small irregular grains or with pyrrhotite grains. From the texture, galena seems to have replaced pyrite, sphalerite and pyrrhotite.

3. A-574

Pyrite and galena occupy several per cent of the area totally. A small amount of covellite, sphalerite and cerussite are observed. Galena fills the interstices of carbonate and quartz grains. Cerussite replaces galena along the boundary forming thin films. In the case of small grain, cerussite replaces almost of the galena grain leaving minute relict of galena in the cerussite aggregate. Pyrite occurs as isolated grains or with galena in carbonate gangue. Round grains of pyrite (500 μm - 1200 μm) are often found in carbonate aggregates. Covellite is observed in cerussite.

4. A-575

Pyrite occupies 10 % and galena 10 % of the area totally. Galena fills the interstices of ganuge minerals and round grains of pyrite distributed radomly in gangue. Small round grains of sphalerite occur in galena. Bornite occurs with chalcocite and covellite as veinlets and films along the boundary of chalcopyrite which contacts with galena. The assemblage also occurs in cerussite aggregates. A small amount of fine-grained covellite also occurs in cerussite. Hematite occasionally occurs along the boundary of galena.

5. A-576

Galena occupies 30 % and pyrite about 10 % of the area. Galena fills the interstices of carbonate and quartz grains, and pyrite occur as coroded euhedral grains with galena. Fine grains of sulfides disseminated in gangue, mostly of carbonate. Pyrite grains often contain fine blebs of sphalerite and galena. Few grains of magnetite are replaced by hematite along their margin. Irregular form of tetrahedrite occurs in galena. A few amount of cerussite is formed in galena.

6. A-577

Galena and pyrite occur in carbonate and quartz gangue. Galena occupies 20 % and pyrite is much less. Galena fills the interstices of gangue or disseminates finely (less than 10 μm) along the grain boundary or cleavage cracks of carbonate grains. Pyrite occurs as coroded round form in gangue isolated from or with galena.

7. A-578

Pyrite and galena occupy 20 % of the area. Euhedral or coroded large grains of pyrite (200 μm - 800 μm) occur in carbonate. The grains include small blebs of galena, chalcopyrite and tetrahedrite. Galena fills the interstices of gangue grains, and also finely disseminated in or along the grains of carbonate. A small amount of tetrahedrite occurs in galena.

8. A-579

10 % of galena and 10 % of pyrite disseminate in gangue. Galena fills the interstices of ganuge minerals and distributes randomly. Pyrite occurs as round grains in galena or as isolated in gangue. Sphalerite grains of irregular shape occur occasionally surrounded by galena thin film and tetrahedrite film at the outside. A trace amount of sphalerite is observed.

9. A-580

Pyrite occupies several per cent of the area. Pyrite grains of round shape (less than 1 mm) distribute in gangue minerals. Galena grains which fill the interstices of gangue minerals are replaced by cerussite partly along the rim or completely.

10. A-581

95 % of the area is occupied by pyrite. Large subangular grains of pyrite compose the most part of ore. The interstices of large pyrite grains are filled with the aggregates of small framboidal pyrite grains and irregularly shaped chalcopyrite.

11. A-582

Magnetite occupies about 40 % of the area. Sulfides including galena, pyrite and chalcopyrite, occupy only less than 10 %. Magnetite forms a band and it consists of grains ranging from 100 μm to 300 μm. The rim and cracks are partly replaced by hematite. Galena fills the interstices of gangue minerals but they show roughly the distribution along a direction. Sphalerite generally occurs with galena. Chalcopyrite occurs with pyrite and sphalerite, filling the interstices of them, but it occurs with galena with mutual boundary.

12. B-622

Pyrite is the major sulfide mineral. Galena is quite few. Large anhedral grains of pyrite occupy the most part. The size of grain ranges from 300 μm to 1000 μm. Pyrite grains contain small grains of gangue minerals as well as blebs of galena. Cracks filled with gangue minerals penetrate irregularly the pyrite grains.

13. C-518

Opaque minerals consist mostly of galena and hematite. Less amount of cerussite and minor amount of pyrite and covellite were observed. Cerussite replaces the rim of galena grains and also fills up the cleavage cracks of galena. Hematite replaces galena and pyrite grains forming fine bands or partly as aggregates of oolitic texture. Tiny relicts of galena of irregular shapes were observed everywhere in the aggregates of cerussite and hematite. A small amount of covellite occurs as small grains (less than 10 μm) in cerussite aggregates. Slightly eroded euhedral or anhedral grains of pyrite occur in galena grains, or in the aggregates of cerussite and hematite. Quartz grains also occur in the aggregates of cerussite and hematite.

14. C-591

A small amount of galena fills up the interstices of grains of gangue minerals and also occur as small aggregates having very rugged surface.

15. C-592

Chalcopyrite predominates in the sulfide minerals. Chalcopyrite fills the interstices of gangue minerals, and show very rugged surface. Few round grains of pyrite occur in chalcopyrite grains. Mixture of chalcocite and digenite replaces irregularly the chalcopyrite grains. Covellite is rarely found on the boundary of the mixture of digenite and chalcocite.

16. C-596

A small amount of pyrite (less than 1%) occurs in gangue minerals as irregularly coroded grains. Besides pyrite, no other sulfide minerals were observed.

17. D-542

Pyrite occupies nearly 50% of the area of the polished surface and hematite does about 35%. A small amount of chalcopyrite and covellite were observed. Massive aggregates of pyrite occupy the most part of sulfide minerals. Chalcopyrite fills the interstices of pyrite grains. The size of pyrite grain ranges from 100 μm to 2 mm, and chalcopyrite about 10-20 μm. Pyrite grains are partly replaced by hematite, especially along the rim of grain. Hematite occurs as flaky aggregates surrounding the massive pyrite. The size of hematite was

between 100 μm and 500 μm. Covellite occurs as small aggregates in the hematite aggregates.

18. D-581-a

Sulfides, probably galena, are completely replaced by the fine-grain aggregates of cerussite leaving quartz grains in them. Hematite pseudomorph after pyrite crystal is rarely obaserved.

19. D-581-b

Galena occupies the most part of the sample. Large grains of galena (4 mm - 6 mm) form a compact mass. Fine grains of cerussite occur along cleavage cracks or partly replacing galena. Hematite occurs with cerussite forming the center part of the cerussite veinlets along cleavage cracks.

20. D-583

Galena occupies 60 % and cerussite 30 % of the area. Mixture of hematite and geothite is leaa than 5 %. Galena grains are large (500 μm - 2 mm). Cerussite occurs along cleavage cracks or replacing galena grains. Aggregates of fine grain cerussite occasionally contain many irregular grains of galena (less than 2 μm) as the relicts of replacement of galena by cerussite. Hematite and goethite mixtures occur in the cerussite aggregates and they also include galena relicts. Two grains of pyrite (about 100 μm) occur in galena.

21. D-584

The sample is occupied exclusively by galena. A small amount of cerussite and hematite were observed. Cerussite occurs along cleavage cracks forming veinlets which have hematite aggregates in the center.

22. D-586

Galena predominates over the other sulfide minerals. Galena is remarkably replaced by fine-grain aggregates of cerussite which include fine irregular relicts of galena, mostly along cleavage cracks. The galena grains are surrounded by the mixture of cerussite, hematite and goethite with the irregular boundary. These secondary mixtures form fine banding texture along the boundary, and sporadically contain covellite. Few pyrite grains were observed.

23. D-588

Galena occupies more than 90 % of the area. Cerussite succeeds galena but much less. A small amount of pyrite, chalcopyrite and covellite were found. Large grains of galena (1 mm - 3 mm) are scarcely replaced by cerussite, except partly on the boundary. In smaller grains of galena, cerussite occurs replacing galena and filling cleavage cracks. Eroded grains of pyrite contain few blebs of chalcopyrite and galena. A small amount of covellite occurs in cerussite aggregates. Mixture of hematite and goethite forms pseudomorph after pyrite crystal in the assemblage of cerussite, carbonate and quartz. Pyrite relicts were often observed in these hematite and goethite mixture.

24. D-590

Galena occupies about 75 % and pyrite about 25 % of the area. Galena grains are partly replaced by cerussite aggregates along the grain boundary and cleavage cracks. Pyrite grains are eroded by galena in various states. Some grains show slightly eroded euhedral shape and others show quite irregular shapes cut by cracks filled with gangue minerals. A very few amount of covellite was observed.

25. D-592

Less than 5 % of the area is occupied by pyrite. The other part is gangue. The rim of pyrite grain is strikingly replaced by the mixture of chalcocite and digenite. Larger grain consists of pyrite core and secondary envelop but smaller one is completely replaced.

26. D-593

Galena occupies the most part of sulfides. Galena fills the interstices of gangue minerals, mostly of carbonate and quartz. Galena also occurs with quartz as veinlets cutting gangue. Galena grain is often replaced by cerussite aggregates along cleavage cracks or as selvages of them. Covellite is found in the aggregate. A finely crushed pyrite grain, the interstices of which is filled with the mixture of chalcocite and digenite, is found.

27. D-595-a

The sample consists of 60 % Of galena and 30 % of cerussite. In the rest, covellite, sphalerite, pyrite and some undetermined minerals. Cerussite replaces remarkably galena grains along cleavage cracks and rims, forming fine colloform or banding texture and including fine relicts of galena, especially around the replaced galena grains. Pyrite shows slightly eroded euhedral or anhedral shapes and occurs in the cerussite aggregates or in galena with sphalerite. Covellite occurs sporadically in cerussite aggregates. Sphalerite occurs as round grains in galena. Magnetite grains partly replaced by hematite occur with cerussite in cleavage cracks of galena. Two undetermined minerals occur with cerussite. The one is brownish and the other is bluish. They occur intimately making aggregates with cerussite.

28. D-595-b

Galena occupies the area more than 80 %. Galena grains (500 um - 2 mm) are partly replaced by cerussite along cleavage cracks and boundary or as spots. Near the grain boundary, cerussite aggregates form fine bands. A small amount of covellite with the undetermined brownish mineral occur in cerussite. Larger area of galena, however, is still intact by cerussite, and contains round grains of pyrite and sphalerite, and rather irregularly shaped grains of greenish undetermined mineral (tetrahedrite?). It is inferred microscopically that galena was first replaced by fine grains of cerussite along cleavage cracks, and then they grew to connect each other forming a fine grained aggregate leaving small flakes of galena in it.

29. D-597

Galena occupies 60 % of the area. Sphalerite, pyrite, covellite and cerussite occur in a much less amount. Galena is intensively replaced by cerussite which accompanies hematite and goethite aggregates in some places. The secondary aggregates show a concentric banding in somewhere. Covellite is found in the secondary aggregates. Small round grains of pyrite and sphalerite occur scarcely in galena.

31. E-548

Aggregates of hematite and goethite. Fine-grained hematite occurs associated with goethite. Hematite forms fine mesh-like texture, filling the interstices of quartz grains and veinlets, forming concentric nodules and pseudomorph after sulfide grain. The parts of rugged surface are porous with more goethite. No sulfide minerals such as sphalerite, galena, pyrite or chalcopyrite are found.

30. E-554

Stringer of galena and sphalerite in gangue minerals. Galena and sphalerite fill up the interstices of carbonate grains distributing randomly but along a direction.

32. E-643

Galena occupies about 75 % of the area, and pyrite about 20 %. A small amount of sphalerite is found. Galena fills the interstices of pyrite and gangue grains. Some parts are almost occupied by galena. The size of galena grain ranges from 100 μm to 800 μm. Some pyrite grains are coroded by galena. Pyrite grains ranges from 50 μm to 200 μm, and generally they show a slightly coroded euhedral shapes. Pyrite grains distribute evenly forming a small aggregate consisting of several grains or separately in galena, but in gangue minerals, the distribution of pyrite grains is much denser than in galena. A single large grain of sphalerite, the size of which is about 1800 μm, is observed in galena. Several small blebs of chalcopyrite and galena are observed in it.

33. E-644

Largely galena. Large well-developed crystals of galena include some round grains of pyrite and sphalerite. Irregular patches of tetrahedrite(?) occur sporadically in galena. Some parts of galena grain are sparsely replaced by cerussite.

34. E-645

50 % of the area is occupied by galena and the rest by sphalerite. A small amount of pyrite, tetrahedrite and cerussite are found. Large grains of galena and sphalerite occupy the most part. Galena aggregates consisting of grains ranging between 500 μm and 2000 μm are roughly separated from sphalerite aggregates. Galena grains include round grains of sphalerite and pyrite, and irregular patches of tetrahedrite. Pyrite and sphalerite grains show occasionally a corosion texture but tetrahedrite contacts with galena with mutual boundary. Sphalerite grains in the aggregates are as large as 100-2000 μm, and they include many tiny grains of galena (less than 50 μm) and round grains of pyrite. Veinlets consisting of fine grains of cerussite with galena relicts penetrate the sphalerite aggregates and

they extend to galena which contacts with the sphalerite, and connects with the cleavage cracks formed in galena.

35. E-646

Galena fills the interstices of carbonate grains forming irregular shapes, and it is partly replaced by cerussite. Fine grains of the undetermined brownish and bluish minerals form aggregates with hematite and goethite and occur in cerussite. Pyrite and galena relicts occur in cerussite. Coroded grains of pyrite (100-200 μm) occur sparsely in galena.

36. E-647

Galena predominates over pyrite, sphalerite and covellite. Galena occurs randomly filling the interstices of gangue minerals and the size is between 30 μm and 300 μm. Some parts of grains are slightly replaced by fine grain aggregates of cerussite. In the highly altered parts, very few galena is observed as the remnants of replacement forming very irregular shapes. Coroded grains of pyrite, ranging from 40 μm to 150 μm, occur sparsely in galena and gangue. A small amount of sphalerite also occurs in galena. Few grains of covellite are found in cerussite.

37. E-648

Sulfides occupy only about 5 % of the area. Galena fills the interstices of carbonate and quartz grains. The size ranges from 5 μm to 500 μm. Rims and smaller parts of galena grain are partly replaced by cerussite. Very few covellite occurs in cerussite. Chalcopyrite occurs in galena but very few. Several anhedral grains of pyrite, the size of which is smaller than 200 μm, occur with galena or separately in gangue.

38. E-649

Galena occupies less than 40 % of the area. Galena occurs in large grains ranging from 500 μm to 1 mm with mutual boundary. Cerussite replaces the boundary or cleavage cracks of galena, but the replacement is not intense. Pyrite grains, ranging from 40 μm to 800 μm, form aggregates in galena and gangue. The brownish and bluish undetermined minerals occur with cerussite which replace galena.

39. I-508

Galena occupies the most part. Galena occurs as mosaic aggregates of large grains of about 1-2 mm in diameter. Rounded cubic form of pyrite occurs in galena with gangue and a certain amount of sphalerite. Pyrite grains range from 10 μm to 200 μm. Cerussite and secondary minerals replace galena partly or along cleavage cracks.

40. G-610

Very few galena occurs in gangue. Galena fills the interstices of gangue minerals but very few.

Table A–3-2 Microscopic Observations (Polished Section) (Logging Core)

No.	Sample No.	Depth	Ore Name	Galena	Sphalerite	Pyrite	Chalcopyrite	Magnetite
1	F–564a	AG–01, 256.20m	Galena-Pyrite Ore	●	•	●		
2	F–567a	do. 259.10m	Galena-Sphalerite Ore	●	●	●	•	
3	F–570a	do. 262.10m	Galena-Sphalerite Ore	●	●	●	•	
4	F–627	AG–02, 228.70m	Magnetire Ore					◎
5	F–637a	do. 242.90m	Galena-Sphalerite Ore	●	●	•	•	
6	F–637b	do. 243.70m	Pyrite-Galena Ore	○	•	●	•	
7	F–640a	do. 246.05m	Galena Ore	○		•		
8	F–641a	do. 247.10m	Sphalerite-Galena Ore	○	●	●	•	
9	F–646a	do. 252.30m	Galena-Sphelerite Ore	•	○	•		
10	F–646b	do. 252.45m	Galena-Sphalerite Ore	○	○	•	•	
11	F–673a	AG–03, 190.10m	Chalcopyrite-Pyrite Ore	•	•	●	●	
12	F–675a	do. 194.60m	Pyrite-Galena Ore	○		○		
13	F–675b	do. 195.30m	Galena-Sphalerite Ore	●	●	●		

Remarks ◎ abundant ○ common ● little • rare

1. F-564-a

Sulfides consisting of pyrite, galena and sphalerite, occupy less than 10 % of the area. Sulfides distribute irregularly in the interstices of gangue minerals, mostly of carbonate. Pyrite occasionally shows euhedral form but sphalerite and galena contact with mutual boundary. Grain size varies from a few μm to 600 μm in maximum of pyrite. Rounded quartz grains distribute sparsely in carbonate.

2. F-567-a

Sulfides occupy about 15 % of the area. Galena and sphalerite contact with mutual boundary and distribute in gangue randomly or making a rough distribution. They include a small amount of chalcopyrite. Pyrite occurs in euhedral forms in galena and sphalerite or in gangue separated from the other sulfides.

3. F-570-a

Sulfides, consisting of galena, sphalerite and pyrite, occupy about 10 % of the area. Galena occurs in some parts as a slender distribution of fine grains (ca. 5 μm) along the grain boundary of carbonate or cutting them. Galena also occurs as large grains (400 μm - 1 mm) filling the interstices of gangue minerals. Sphalerite occurs mostly with galena in contact with mutual boundary or included in galena grain. Pyrite grain occurs as a single grain in gangue, or included or contact with galena and sphalerite. A small amount of chalcopyrite is observed.

4. F-627

Magnetite occupies about 40 % of the area. Very irregularly shaped grains of magnetite ranging from 30 μm to 500 μm, distribute among gangue minerals. They show very irregular shapes and heavily rugged surface. No other opaque minerals were seen.

5. F-637-a

Galena and sphalerite occupy about 20 % of the area. Galena and sphalerite disseminate in the interstices of gangue minerals. Galena especially distributes finely along the grain boundary of carbonate and also fills the interstices irregularly. Chalcopyrite occurs more intimately with sphalerite than galena. Pyrite shows euhedral forms and occurs with galena and sphalerite or separately in gangue. Flaky crystals of gangue are observed in sulfide-rich zone.

6. F-637-b

Galena and pyrite occupy about 20 % of the area. Galena occurs randomly in aggregates of flaky gangue minerals and quartz grains. It ranges from 20 μm to 500 μm in size and shows irregular forms. Sphalerite is few and mostly included in galena. Pyrite occurs in large grains, the size of which is between 200 μm and 1 mm. A very small amount of chalcopyrite is observed in gangue.

7. F-640-a

Galena occupies about 30 % and pyrite about 10 % of the area. Galena fills the interstices of carbonate grains and distributes randomly. No sharp boundary is microscopically observed between the sulfide-poor zone and the sulfide-rich zone. Round or subangular grains of pyrite distribute separately or with galena in gangue minerals.

8. F-641-a

Sulfides form bands in carbonate gangue. A band consists of only galena which occurs in the interstices of carbonate forming irregularly shaped grains of 50-350 μm diameter. Galena occupies about 20 % of the area. In the second band, sphalerite forms a mosaic texture with carbonate and it includes smaller irregular patches of chalcopyrite and galena. At some boundaries between sphalerite and galena, it seems that galena is replaced by sphalerite. Two large grains are included in this zone as round shapes ranging 800 μm and 300x600 μm. In the third part, sphalerite predominates than galena or pyrite. A large grain of pyrite partly coroded occurs in carbonate with a small amount of galena and sphalerite. The diameter is about 1 mm.

9. F-646-a

Sphalerite disseminates in the interstices of quartz and carbonate gangue, occupying about 20 % of the area. Galena and sphalerite contact each other with mutual boundary, or partly galena fills the interstices of sphalerite grains. Pyrite occurs in round irregular grains ranging from 50 μm to 800 μm.

10. F-646-b

Galena and sphalerite mixture forms irregular streaks in carbonate gangue. The mixture occupies about 15 % of the area. Galena occurs in irregular forms between the gangue grains or cutting them as irregular veinlets. The grain size is between 50 μm and 600 μm. Sphalerite occurs intimately with galena, with mutual boundaries or partly replaced by galena. Pyrite occurs sparsely in gangue as fine round grains. The grains are partly coroded and range between 20 μm and 40 μm. Very few chalcopyrite is observed.

11. F-673-a

Chalcopyrite occupies about 40 % and pyrite about 30 % of the area. Large grains (larger than 4 mm) are included in the sulfide mixture. The mixture also includes large round grains of pyrite. Besides this aggregate, chalcopyrite occurs in carbonate gangue along grain boundary or cleavage cracks forming thin veinlets. It also fills the interstices of flaky crystals of gangue. In some parts, it replaces carbonate, but it does not quartz grains. Very few sphalerite and galena occur with chalcopyrite and pyrite.

12. F-675-a

Pyrite and galena evenly disseminate in carbonate gangue. They occupy about 10 % of the area. Pyrite is coroded to round shapes or includes some gangue minerals. The grain ragnes from 60 μm to 350 μm. Galena occurs in the interstices of gangue ranging from 5 to 80 μm, but mostly between 10 and 40 μm. Quartz grains range from 100 μm to 600 μm and most of them show round shapes. No distinct orientation of distribution of sulfide minerals is observed.

13. F-675-b

Slender sreaks of sulfides show distinct orientation. Irregular and rugged grains of galena, sphalerite and pyrite disseminate along the boundary of gangue, mostly of quartz grains. The size of sulfide grains is between 20 μm and 500 μm. Very few

Table A–4–1 Assay Results of Ore (Geological Survey)

No.	Sample No.	Location	Occurrence	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)
1	A-573	Panelas Mine 110+34 mL	Galena, Pyrrhotite	0.5	610.6	0.36	17.21	0.02
2	A-574	Perau Mine G2+8-S	Galena and Sphalerite in barite zone W:150	0.0	53.0	0.074	5.50	0.12
3	A-575	do. G2+8-N	do. W:170	0.0	52.0	0.010	5.40	0.60
4	A-576	Barrinha Mine	Galena vein	0.9	480.8	0.73	15.12	0.09
5	B-622	Santo Antonio do Pavão Mine	Galena-Pyrite vein	0.0	51.9	0.00	4.29	0.06
6	C-518	Espirito Santo Mine	Galena-Quartz vein	0.0	85.9	0.05	8.57	0.66
7	C-580	Monjolinho de Sebastião	Galena-Dolomite-Quartz vein	0.8	204.0	0.00	7.70	0.00
8	C-591	Agua da Limeira	Galena-Quartz vein	0.4	554.0	0.06	12.09	0.00
9	C-592	do.	Galena-Chalcopyrite-Quartz vein	0.0	16.8	0.11	0.14	0.00
10	C-596	SW of Espirito Santo Mine	Galena(?)-Py-Quarts vein	0.0	3.2	0.01	0.15	0.00
11	D-521	Lageado Santa Nova G3	Galena vein	0.8	157.0	0.05	11.58	0.18
12	D-523	do. do. G1	Galena vein	1.1	218.0	0.04	11.28	0.29
13	D-526	do. Jardim G1	Pb oxide(?)vein	0.0	1.6	0.23	0.02	0.01
14	D-542	Furnas west	Quartz-Pyrite Vein W:5	0.1	18.0	0.02	0.12	31.48
15	D-580	Lageado Boa Ventura	Galena vein	6.4	24.8	0.16	0.26	0.08
16	D-581	do. do.	do.	0.1	1073.0	0.05	11.84	0.27
17	D-583	do. do.	Pb oxide ore - Galena vein	0.1	619.0	0.07	12.24	0.04
18	D-584	do. São Vicente	do.	0.5	496.0	0.08	12.04	0.22
19	D-586	do. Jardim G2	do.	0.4	2150.0	0.58	12.14	0.08
20	D-588	do. Nova Esperança	do.	0.5	1891.0	0.08	12.04	0.01
21	D-590	do. Santana Nova G5	Galena vein	0.3	1874.0	0.08	12.24	0.01
22	D-593	do. copper showing	Chalcopyrite and Gl impregnation	1.5	100.7	1.33	0.50	11.50
23	D-595	Serra Juguatirica	Pb oxide-Galena vein	0.0	1200.0	0.14	13.32	0.27
24	D-596	do.	do.	0.0	1054.0	0.08	11.53	0.92
25	D-597	Serra Juguatirica	Pb oxide-Galena vein	0.1	835.0	0.16	10.56	5.37
26	E-544a	Gruta de Santana	Pb-calcite network	0.0	7.9	0.02	5.92	2.79
27	E-544b	do.	Gossam with Pb oxide?	0.0	7.5	0.00	0.17	0.06
28	E-548	Agua Suja	do.	11.8	2.0	0.01	0.12	0.01
29	E-571	Rio Iporanga	Pb oxide vein	0.0	5.8	0.00	0.02	0.00
30	E-620	do.	do.	0.0	5.2	0.00	0.03	0.01
31	E-643	Furnas Mine	Pyrite-Galena vein	0.3	1540.0	0.02	12.81	0.13
32	E-644	do.	Sphalerite-Galena vein	0.2	2586.0	0.11	12.60	3.82
33	E-645	do.	do.	0.0	1891.0	0.13	11.28	17.75
34	E-646	Diogo Lopes Mine	Pb oxide-Galena vein	0.0	362.0	0.03	12.50	0.29
35	E-647	Paqueiro Mine	Pyrite-Galena vein	0.0	183.7	0.08	12.60	0.09
36	E-648	Bueno Mine	do.	0.3	1506.0	0.09	12.96	0.01
37	E-649	Onsa II	do.	3.6	904.0	1.04	7.40	0.03
38	F-685	Perau Mine	Galena in barite zone	0.0	53.0	0.076	4.60	0.15
39	F-686	do.	do.	0.0	40.0	0.11	3.40	0.13
40	F-687	do.	do.	0.0	52.0	0.01	5.3	0.90
41	I-508	Serra Aberta do Leão	Galena	0.0	1131.0	0.01	12.86	0.27
42	J-506	Monjolinho de Sebastião	Limonitized rock	0.0	11.3	0.19	0.57	0.01
43	J-507	do.	Sandstone with dissemination of manganese	0.0	2.9	0.02	0.61	0.03
44	J-574	Espirito Santo	Limonitized rock	0.0	2.2	0.16	0.16	0.16

Table A–4–2 Assay Results of Drilling Core

No.	Sample No.	Depth (m)	Width (m)	Rock Type	Pb (%)	Zn (%)	Cu (ppm)	Ag (ppm)	CaO (%)	MgO (%)	SiO2 (%)	BaO (%)
AG-01		254.95										
1	F-563	∿255.95	1.00	cab-sch	0.07	0.03	90	3	11.8	6.0	39.8	2.1
2	F-564	∿256.95	1.00	ore	2.1	3.3	120	100	7.7	6.6	8.0	26.1
3	F-565	∿257.95	1.00	ore	1.2	3.8	70	50	11.9	9.4	5.5	17.8
4	F-566	∿258.95	1.00	ore	3.3	3.5	170	110	11.9	9.4	6.7	16.1
5	F-567	∿259.95	1.00	ore	5.3	3.8	110	75	12.6	9.4	4.9	15.4
6	F-568	∿260.95	1.00	ore	8.9	2.2	290	150	8.4	6.9	3.4	27.1
7	F-569	∿261.95	1.00	ore	3.6	0.68	590	80	18.2	13.8	4.6	7.5
8	F-570	∿262.95	1.00	ore	7.5	2.6	330	130	11.2	8.6	4.0	18.1
9	F-571	∿263.45	0.50	ore	1.7	4.7	50	35	6.6	5.5	10.3	27.1
10	F-572	∿264.45	1.00	ore	0.19	0.84	280	12	14.0	9.4	23.0	10.9
11	F-573	∿265.45	1.00	ore	5.0	0.36	250	100	14.0	9.9	34.6	0.05
12	F-574	∿265.90	0.45	ore	2.3	0.41	110	60	3.4	5.3	52.3	0.05
AG-02		231.05										
13	F-629	∿232.05	1.00	cab-sch	0.02	0.01	230	1	11.8	5.8	41.9	0.45
14	F-630	∿233.05	1.00	cab-sch	0.32	0.02	1.2%	44	22.7	10.2	16.6	0.08
15	F-631	∿234.05	1.00	cab-sch	0.08	0.01	4200	13	24.4	8.5	16.6	0.37
16	F-632	∿235.05	1.00	cab-sch	0.02	0.01	960	5	24.0	12.0	14.0	0.3
17	F-633	∿236.05	1.00	cab-sch	0.01	0.04	1200	5.5	18.2	6.6	24.4	0.49
18	F-634	∿237.05	1.00	cab-sch	0.06	0.03	2000	11	17.4	7.7	31.7	0.71
19	F-635	∿237.80	0.75	cab-sch	0.01	0.01	2400	7.5	24.0	8.3	21.1	0.15
20	F-650	241.85 ∿242.85	1.00	cab-sch	0.03	0.02	75	2	12.6	7.3	38.6	0.94
21	F-637	∿243.85	1.00	ore	4.9	1.7	140	76	12.3	5.8	5.4	17.9
22	F-638	∿244.85	1.00	ore	6.3	0.32	480	98	13.2	6.6	6.3	22.3
23	F-639	∿245.85	1.00	ore	6.4	0.16	45	98	14.3	7.7	7.5	17.9
24	F-640	∿246.85	1.00	ore	6.0	0.09	70	86	11.2	5.6	10.2	22.3
25	F-641	∿247.85	1.00	ore	2.4	0.29	75	76	12.3	5.6	15.6	22.3
26	F-642	∿248.85	1.00	cab-sch	0.14	0.27	80	5.5	14.0	7.5	43.8	2.7
27	F-643	∿249.85	1.00	cab-sch	0.02	L	40	1.5	10.4	6.0	2.8	2.2
28	F-644	∿250.85	1.00	cab-sch	0.07	0.01	150	3.5	15.1	7.5	28.5	2.7
29	F-645	∿251.40	0.55	cab-sch	0.25	0.03	90	8.0	15.1	6.6	33.4	1.3
30	F-646	∿252.50	1.10	ore	6.0	4.5	60	68	12.2	7.5	4.3	17.9
31	F-647	∿253.35	0.85	cab-sch	0.21	0.09	70	7.0	11.8	6.4	17.5	13.4
32	F-648	∿253.60	0.25	ore	6.4	5.6	40	114	13.2	6.9	7.6	12.3
33	F-649	∿254.60	1.00	cab-sch	0.65	0.38	160	10	11.9	5.2	32.9	4.0
AG-03		188.30										
34	F-673	∿189.50	1.20	cab-sch	0.02	0.01	1200	3	9.7	4.8	53.0	1.6
35	F-674	∿190.70	1.20	cab-sch	0.24	0.03	880	5	17.0	6.0	39.6	0.89
36	F-675	194.30 ∿195.30	1.00	ore	3.3	0.39	350	38	9.5	3.7	35.0	8.5
37	F-676	∿196.20	0.90	ore	2.0	1.6	230	35	7.0	2.5	46.5	0.67

Table A–5 Result of Chemical Analysis of Carbonate Rocks in Survey Area

No	Sample No	Geol. Unit	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Co ppm	Ni ppm	Mn ppm	Ba ppm	Sr ppm	F ppm	CaO %	MgO %	Na %	K %	I.R. %
1	B510	L3	25	8	27	0.5	4	13	580	600	850	700	33.1	2.0	0.03	0.16	28.0
2	B524	L3	14	14	18	0.5	5	8	420	240	850	140	38.4	1.4	0.29	0.32	22.3
3	B536	L3	3	10	6	0.5	3	3	70	60	440	50	53.0	1.1	0.04	0.03	2.2
4	B542	L4	3	10	8	0.5	3	3	150	340	190	200	38.4	2.2	0.13	0.22	24.3
5	B547	L4	5	6	3	0.5	3	3	28	820	120	700	2.0	0.3	0.18	0.60	94.9
6	B551	L4	3	12	8	0.5	3	3	400	180	310	50	48.2	0.6	0.17	0.12	11.5
7	B571	L2	3	12	3	0.5	3	3	100	100	850	140	48.0	1.9	0.06	0.13	7.1
8	B583	L2	3	14	10	0.5	3	3	90	320	1800	325	47.7	0.8	0.12	0.30	12.6
9	B592	L2	5	12	3	0.5	3	3	150	270	1660	350	48.5	1.4	0.07	0.17	8.6
10	B599	L2	3	11	3	0.5	3	3	110	80	930	300	49.9	0.8	0.04	0.05	7.7
11	B605	L3	4	6	3	0.5	3	3	55	90	2100	160	52.5	0.4	0.04	0.05	3.3
12	B606	L2	3	10	6	0.5	3	3	90	140	1600	300	50.8	1.0	0.11	0.11	5.5
13	B609	L2	5	16	20	0.5	3	5	5200	100	800	225	48.8	0.6	0.05	0.26	8.7
14	B614	L2	3	10	3	0.5	3	3	50	120	770	120	53.0	1.1	0.05	0.05	2.3
15	B616	L3	3	30	8	0.5	3	3	140	80	350	50	46.0	6.1	0.05	0.03	3.6
16	B618	L2	30	24	24	0.5	3	3	260	40	800	170	50.1	0.6	0.17	0.16	7.9
17	B619	L2	3	14	9	0.5	3	3	320	180	680	425	46.3	2.3	0.03	0.28	10.4
18	H518	L4	19	5	40	0.5	15	29	2800	2400	55	700	5.3	5.9	0.63	0.66	63.1
19	H521	L4	35	6	15	0.5	3	3	60	80	5	50	0.1	0.3	0.03	0.09	97.1
20	C510	L3	3	12	3	0.5	3	3	18	60	2300	110	54.1	0.4	0.03	0.09	1.4
21	C517	L3	14	570	190	2.5	3	4	1000	220	600	475	30.9	3.9	0.03	0.50	33.7
22	C531	L4	3	12	3	0.5	3	3	16	40	1900	1600	54.1	0.4	0.03	0.04	2.2
23	C547	L3	20	10	20	0.5	7	14	500	160	520	500	36.7	2.5	0.30	0.70	25.5
24	C549	L3	30	12	70	0.5	17	40	3600	1000	120	375	29.2	18.2	0.05	0.40	6.5
25	C551	L3	3	10	29	0.5	4	8	520	160	240	1000	31.1	13.0	0.03	0.30	12.3
26	C554	L3	4	14	5	0.5	3	3	410	40	570	60	53.9	0.4	0.03	0.03	2.6
27	C558	L3	14	14	21	0.5	3	3	6900	100	400	325	30.7	3.6	0.03	0.35	30.5
28	C556	L3	13	10	35	0.5	6	15	1400	300	160	600	16.8	10.2	0.45	0.75	40.4
29	C577	L4	3	16	10	0.5	3	3	110	20	720	90	54.4	0.6	0.03	0.08	1.8
30	C581	L3	240	150	20	0.5	20	55	850	360	120	500	9.5	4.1	0.22	1.80	59.9
31	C590	L2	10	35	5	0.5	3	3	180	60	450	225	49.9	1.9	0.03	0.28	5.7
32	C595	L3	3	12	20	0.5	3	9	5800	20	220	80	22.9	14.6	0.03	0.04	25.3
33	C599	L3	4	10	3	0.5	3	3	840	60	830	50	50.8	1.1	0.06	0.03	4.8
34	C600	L3	24	10	40	0.5	17	35	1300	600	1200	650	27.2	2.5	0.55	0.90	40.4
35	C602	L3	30	16	20	0.5	6	16	180	380	650	900	23.0	9.1	0.03	0.85	36.0
36	C603	L3	11	8	45	0.5	7	21	420	360	470	800	14.6	10.0	0.03	0.60	48.5
37	C604	L3	3	12	3	0.5	3	3	150	20	850	70	51.6	1.8	0.03	0.05	2.9
38	C605	L3	8	10	27	0.5	5	17	550	300	320	1300	21.9	12.7	0.13	0.60	29.6
39	C672	L2	50	18	50	0.5	7	27	430	440	300	800	11.2	8.3	0.48	1.30	57.9
40	C673	L2	4	8	29	0.5	5	11	380	140	600	1000	19.9	13.8	0.11	0.40	30.4
41	J521	L3	3	6	3	0.5	3	3	30	40	55	375	30.4	19.3	0.03	0.03	0.8
42	J522	L3	3	10	3	0.5	3	3	6	40	2100	500	53.6	1.2	0.03	0.03	1.5
43	J529	L3	4	10	6	0.5	3	3	45	40	60	600	28.6	18.2	0.27	0.05	6.9
44	J524	L3	6	12	7	0.5	10	9	250	100	1000	325	49.4	0.6	0.09	0.25	7.2
45	J525	L3	4	8	18	0.5	4	9	3100	60	210	375	21.5	13.0	0.11	0.14	30.3
46	J539	L3	50	14	40	0.5	9	24	1000	240	520	900	16.1	11.3	0.38	1.00	38.6
47	J540	L3	3	10	7	0.5	3	4	110	80	900	700	45.2	4.1	0.03	0.14	7.8
48	J541	L3	3	8	3	0.5	3	3	28	20	110	160	30.9	19.3	0.06	0.03	1.0
49	J542	L3	3	10	4	0.5	3	3	50	60	770	70	54.1	0.3	0.03	0.05	1.3
50	D501	L3	3	12	6	0.5	3	4	130	360	1700	225	46.0	0.6	0.11	0.26	13.7
51	D504	L3	3	10	3	0.5	3	3	40	20	55	350	30.9	19.3	0.03	0.03	0.9
52	D506	L3	3	26	8	0.5	3	3	60	20	70	140	30.0	19.3	0.03	0.03	0.8
53	B507	L3	3	8	3	0.5	3	3	35	140	830	600	49.6	0.6	0.03	0.45	8.7
54	D508	L2	3	18	4	0.5	3	3	40	100	950	1200	52.5	1.1	0.03	0.05	3.2
55	D511	L2	8	50	16	0.5	3	6	210	1300	1600	600	46.0	1.1	0.10	0.45	14.4
56	D515	L2	3	22	7	0.5	3	3	150	80	620	140	45.7	3.3	0.07	0.19	9.7
57	D519	L2	3	26	3	0.5	3	3	22	20	1700	50	53.9	1.1	0.03	0.03	1.5
58	D522	L2	3	22	15	0.5	3	3	170	200	2200	50	53.6	0.6	0.03	0.03	2.0
59	D529	L2	3	10	3	0.5	3	3	80	40	1400	250	52.2	1.4	0.11	0.10	4.2
60	D531	L2	3	10	3	0.5	3	2	65	50	1600	50	53.3	0.8	0.03	0.03	1.7
61	D534	L2	18	50	35	0.5	4	19	460	160	580	600	19.1	13.2	0.25	0.65	31.1
62	D537	L2	5	20	4	0.5	3	3	90	60	860	250	49.1	1.7	0.08	0.06	7.4
63	D540	L2	6	16	4	0.5	3	3	85	60	1000	200	49.6	3.0	0.08	0.07	8.2
64	D543	L3	4	10	35	0.5	3	17	7400	80	180	800	24.7	15.2	0.03	0.12	17.8
65	D545	L2	4	30	5	0.5	3	3	50	10	850	200	48.7	3.0	0.03	0.11	6.0
66	D555	L3	3	28	3	0.5	3	3	6	80	2000	1000	54.1	0.8	0.03	0.03	0.5
67	D556	L3	3	12	4	0.5	3	3	26	70	160	275	30.6	18.8	0.03	0.03	0.8
68	D569	L2	3	26	5	0.5	3	3	55	60	580	275	51.3	2.2	0.03	0.04	4.2
69	D573	L3	4	22	8	0.5	3	3	140	100	2100	250	49.4	1.4	0.11	0.19	7.6
70	D582	L2	140	5400	140	12.9	3	3	4300	140	570	250	47.3	0.8	0.04	0.30	8.3
71	D585	L2	4	40	10	0.5	3	3	200	120	640	425	43.3	4.1	0.06	0.15	12.0
72	D587	L2	8	220	75	3.5	3	3	960	460	230	170	52.5	0.3	0.03	0.13	5.2
73	D589	L2	4	22	13	0.5	3	3	170	140	2000	250	50.2	1.4	0.08	0.21	6.9
74	D591	L2	3	24	3	0.5	3	3	26	60	2100	100	53.9	0.8	0.03	0.03	0.8
75	D594	L2	35	50	45	0.5	7	21	360	200	590	1400	15.4	8.8	0.75	0.55	47.7
76	D598	L2	10	280	920	0.5	3	13	440	140	630	800	33.9	4.7	0.19	0.31	25.5
77	I502	L2	16	26	22	0.5	3	3	150	300	1100	700	44.6	4.4	0.17	0.25	9.3
78	I507	L2	3	14	26	0.5	3	10	260	160	880	800	24.4	12.7	0.9	0.55	26.2
79	I509	L2	-	70	45	0.5	3	3	75	60	760	1600	48.0	3.6	0.15	0.12	6.5
80	I514	L2	3	40	7	0.5	3	3	80	60	1200	300	51.2	1.1	0.14	0.07	3.8
81	I518	L2	3	24	6	0.5	3	3	18	100	1900	100	52.7	1.1	0.04	0.07	2.9
82	I523	L2	3	26	3	0.5	3	3	16	60	1400	130	53.6	1.1	0.03	0.03	1.2
83	I525	L2	3	22	6	0.5	3	3	60	60	820	400	50.8	1.7	0.03	0.03	4.6
84	I527	L2	17	28	55	0.5	7	24	1200	980	520	2750	16.5	9.7	0.15	1.10	42.0
85	I531	L2	17	35	18	0.5	3	10	370	120	360	350	47.4	0.6	0.08	1.20	11.8
86	I538	L3	4	28	7	0.5	3	3	160	70	1500	160	47.7	2.5	0.15	0.12	7.8
87	I535	L3	20	26	28	0.5	4	13	280	640	810	800	18.4	11.1	0.30	0.75	38.1
88	I536	L3	8	16	7	0.5	3	4	310	80	620	275	45.4	3.6	0.05	0.20	9.6
89	I537	L3	30	24	22	0.5	8	15	590	500	450	1000	24.7	11.1	0.09	1.10	25.5
90	I538	L3	70	35	25	0.5	11	18	2600	620	260	600	16.8	10.2	0.20	0.90	39.2
91	I541	L3	3	30	7	0.5	3	3	45	20	120	475	31.5	18.8	0.03	0.07	0.3
92	I549	L4	7	22	11	0.5	3	4	500	110	200	120	43.1	2.8	0.13	0.21	15.4
93	I560	L3	7	18	16	0.5	3	4	90	180	1100	1000	26.6	6.8	0.04	0.50	31.9
94	I566	L4	30	12	11	0.5	4	8	220	1400	240	375	22.0	1.0	0.43	0.55	50.3
95	E505	L2	3	10	4	0.5	3	3	40	100	750	450	48.7	3.0	0.05	0.08	5.8
96	E521	L2	3	6	27	0.5	3	10	700	110	640	800	19.9	12.7	0.17	0.50	31.1
97	E522	L2	16	8	40	0.5	5	17	840	120	620	1100	18.9	12.7	0.04	0.35	33.4
98	E524	L2	18	10	35	0.5	5	23	140	240	670	1000	20.8	13.8	0.30	0.55	26.2
99	E527	L2	5	8	30	0.5	3	8	330	170	730	900	21.9	13.8	0.38	0.50	27.2
100	E530	L2	3	27	7	0.5	3	3	440	130	1800	300	52.2	1.4	0.03	0.10	4.1
101	E542	L2	4	14	6	0.5	3	3	200	220	1100	375	41.8	2.8	0.05	0.32	17.6
102	E563	L2	3	12	4	0.5	3	3	180	120	720	170	48.8	1.1	0.05	0.20	9.6
103	E564	L2	29	5	65	0.5	6	21	610	500	210	700	9.0	6.9	0.58	1.60	61.8
104	E586	L4	5	26	8	0.5	3	3	680	540	250	170	35.1	10.2	0.25	0.03	12.4
105	E595	L4	3	12	10	0.5	3	4	200	120	190	325	47.4	2.2	0.07	0.20	11.1
106	E598	L3	16	16	100	0.5	5	11	2600	340	170	130	49.1	2.8	0.03	0.10	5.1
107	E602	L4	3	14	3	0.5	3	3	110	100	2200	50	55.4	0.6	0.03	0.03	0.4
108	E605	L2	3	14	10	0.5	3	3	180	100	560	800	45.7	3.3	0.06	0.24	8.5
109	E619	L2	3	14	3	0.5	3	3	50	120	800	1000	53.3	0.8	0.03	0.06	2.9
110	E621	L2	4	16	9	0.5	3	3	80	100	800	250	46.0	5.3	0.09	0.18	4.7
111	E622	L2	3	12	7	0.5	3	3	55	60	1600	375	48.9	3.0	0.09	0.22	4.1
112	E637	L3	3	14	3	0.5	3	3	6	60	2100	100	55.0	0.3	0.03	0.03	0.8
113	E640	L3	3	35	6	0.5	3	3	50	140	700	425	46.8	4.7	0.06	0.18	5.2
114	E641	L2	3	12	5	0.5	3	3	100	140	600	700	46.7	3.9	0.18	0.21	7.4
115	E602	L4	13	12	25	0.5	3	9	700	320	90	700	29.7	11.6	0.13	0.45	16.5
116	G513	L2	3	12	4	0.5	3	3	170	80	720	1100	48.5	2.5	0.06	0.18	6.8
117	G526	L4	3	14	4	0.5	3	3	35	160	470	375	51.3	1.4	0.07	0.12	4.7
118	G531	L2	13	10	22	0.5	3	9	430	520	440	1000	31.1	8.8	0.12	0.85	21.3
119	G588	L2	3	8	19	0.5	3	4	180	440	350	2250	27.2	13.8	0.10	0.55	17.0
120	G583	L2	3	12	3	0.5	3	3	35	120	580	110	53.6	0.8	0.03	0.03	2.3

Table A–6 Result of Factor Analysis of Geochemical Date of Carbonate Rocks in Survey Area

No.	Sample No.	Geol. Unit	Factor Score			
			Factor 1	Factor 2	Factor 3	Factor 4
1	B510	L3	0.784	-0.087	-0.029	0.011
2	B524	L3	0.887	-0.132	0.195	-0.844
3	B536	L3	-1.051	-0.311	-0.256	-0.943
4	B542	L4	0.936	-0.462	-0.539	-0.428
5	B547	L4	2.267	-1.144	-1.974	-1.569
6	B551	L4	0.344	-0.212	-0.340	-1.170
7	B571	L2	0.066	-0.424	0.311	-0.617
8	B583	L2	1.058	-0.276	0.978	-0.631
9	B592	L2	0.597	-0.366	0.779	-0.719
10	B599	L2	-0.242	-0.439	0.247	-0.529
11	B605	L3	-0.315	-0.664	0.682	-1.236
12	B606	L2	0.174	-0.445	0.766	-0.521
13	B609	L2	-0.021	0.448	0.312	0.023
14	B614	L2	-0.568	-0.508	0.320	-0.855
15	B616	L3	-0.990	0.213	-0.440	-0.464
16	B618	L2	0.032	0.586	-0.041	-0.829
17	B619	L2	0.382	-0.054	0.364	0.084
18	H518	L4	1.252	-0.909	-1.748	-0.319
19	H521	L4	0.480	-0.392	-6.314	-2.915
20	C510	L3	-0.597	-0.435	1.065	-1.078
21	C517	L3	0.787	4.017	-0.087	0.284
22	C531	L4	-0.809	-0.527	0.990	0.140
23	C547	L3	0.818	-0.368	0.140	0.088
24	C549	L3	-0.401	-0.044	-0.451	0.450
25	C550	L3	-0.036	-0.184	-0.303	1.504
26	C552	L3	-1.189	0.050	-0.174	-1.041
27	C554	L3	0.461	0.573	-0.676	-0.077
28	C556	L3	0.939	-0.299	-0.851	0.724
29	C577	L4	-1.177	0.083	0.217	-0.392
30	C581	L3	-0.096	0.790	-0.499	-0.098
31	C590	L2	-0.153	0.418	0.102	-0.200
32	C595	L3	-1.057	0.186	-1.535	0.881
33	C599	L3	-0.785	-0.198	-0.155	-1.192
34	C600	L3	1.170	-0.579	0.713	-0.306
35	C602	L3	1.077	-0.080	0.067	0.376
36	C603	L3	0.865	-0.394	-0.396	0.651
37	C604	L3	-1.141	-0.239	0.045	-0.559
38	C605	L3	0.772	-0.369	-0.234	1.345
39	C672	L2	1.441	-0.065	-0.627	0.460
40	C673	L2	0.564	-0.510	-0.131	1.139
41	J521	L3	-1.956	-0.611	-1.318	0.890
42	J522	L3	-1.020	-0.640	0.869	-0.206
43	J523	L3	-0.726	-0.597	-1.495	0.961
44	J524	L3	-0.147	-0.578	0.814	-0.673
45	J525	L3	-0.171	-0.263	-1.094	1.038
46	J539	L3	0.952	-0.122	-0.250	0.457
47	J540	L3	-0.107	-0.365	0.382	0.584
48	J541	L3	-1.894	-0.642	-1.142	0.515
49	J542	L3	-0.985	-0.357	0.320	-1.146
50	D501	L3	1.037	-0.414	0.897	-0.800
51	D504	L3	[illegible]	[illegible]	[illegible]	[illegible]
52	D506	L3	[illegible]	164	[illegible]	-.42
53	D507	L3	[illegible]	[illegible]	[illegible]	[illegible]
54	D508	L2	[illegible]	[illegible]	0.451	0.260
55	D511	L2	[illegible]	[illegible]	[illegible]	[illegible]
56	D515	L2	0.110	-0.006	0.144	-0.195
57	D519	L2	-1.353	-0.065	0.551	-0.926
58	D522	L2	-0.692	0.280	0.739	-1.375
59	D529	L2	-0.335	-0.529	0.613	-0.294
60	D531	L2	-1.055	-0.387	0.448	-1.266

No.	Sample No.	Geol. Unit	Factor Score			
			Factor 1	Factor 2	Factor 3	Factor 4
61	D534	L2	0.856	0.554	-0.140	0.814
62	D537	L2	-0.265	-0.127	0.176	-0.398
63	D540	L2	-0.438	-0.169	0.276	-0.407
64	D543	L3	-0.621	0.148	-0.972	2.190
65	D545	L2	-0.804	0.125	0.157	0.224
66	D555	L3	-1.516	-0.189	1.254	0.233
67	D556	L3	-2.042	-0.375	-0.842	0.789
68	D569	L2	-0.787	-0.008	0.102	-0.021
69	D573	L3	0.327	-0.092	0.940	-0.506
70	D582	L2	0.014	7.224	-0.157	-1.020
71	D585	L2	0.155	0.341	0.219	0.253
72	D587	L2	-0.200	3.890	[illegible]	-0.798
73	D589	L2	0.342	0.148	[illegible]	-0.391
74	D591	L2	-1.278	-0.088	0.938	-0.910
75	D594	L2	0.966	0.297	[illegible]	0.838
76	D598	L2	0.447	1.923	[illegible]	1.778
77	I502	L2	0.641	0.434	0.495	-0.083
78	I507	L2	0.801	-0.183	[illegible]	1.468
79	I509	L2	0.369	0.725	[illegible]	[illegible]
80	I514	L2	-0.600	[illegible]	[illegible]	[illegible]
81	I518	L2	-0.322	-0.173	[illegible]	-0.905
82	I523	L2	-1.141	-0.134	0.718	-0.699
83	I525	L2	-0.784	-0.051	0.218	0.100
84	I527	L2	1.268	0.174	[illegible]	1.237
85	I531	L2	0.627	0.588	0.380	0.466
86	I534	L3	0.030	0.101	0.568	-0.390
87	I535	L3	1.463	0.113	-0.302	0.578
88	I536	L3	0.049	0.053	0.041	0.031
89	I537	L3	0.951	0.084	0.134	0.417
90	I538	L3	0.942	0.338	-0.498	-0.168
91	I541	L3	-2.604	0.202	-0.677	1.386
92	I549	L4	0.262	0.202	-0.608	-0.178
93	I560	L3	1.122	-0.012	[illegible]	0.428
94	I566	L4	1.946	-0.325	-0.551	-0.974
95	E505	L2	-0.153	-0.556	0.286	-0.011
96	E521	L2	0.734	-0.489	-0.188	1.448
97	E522	L2	0.445	-0.152	-0.350	1.132
98	E524	L2	0.905	-0.428	0.018	1.075
99	E527	L2	0.990	-0.395	-0.149	1.155
100	E530	L2	-0.292	-0.018	0.920	-0.398
101	E542	L2	0.854	-0.194	0.494	-0.274
102	E563	L2	0.310	-0.318	.299	-0.582
103	E564	L2	1.647	-0.559	-1.027	0.366
104	E586	L4	0.054	0.121	-0.730	-0.430
105	E595	L4	0.143	-0.243	-0.359	0.380
106	E598	L3	-0.636	0.605	-0.619	0.041
107	E602	L4	-1.475	-0.128	0.966	-1.339
108	E605	L2	0.148	-0.142	.266	0.606
109	E619	L2	-0.493	-0.379	0.609	0.070
110	E621	L2	-0.042	-0.124	0.374	0.029
111	E622	L2	-0.159	-0.199	0.842	0.145
112	E637	L3	-1.074	-0.463	0.956	-1.258
113	E640	L3	0.020	0.058	0.558	0.285
114	E641	L2	0.324	-0.466	.394	0.365
115	E602	L4	0.559	0.037	-.936	1.197
116	G513	L2	-0.025	-0.355	0.464	0.564
117	G526	L2	0.025	-0.442	309	-0.189
118	G531	L2	1.225	-0.118	0.050	0.903
119	G548	L2	0.992	-0.448	-0.002	1.239
120	G583	L2	-0.768	-0.432	0.110	-0.960