WALLROCK ALTERATION IN DRILL CORE

FROM THE

KING JACK RESOURCES LTD PROPERTY

by

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REPORT ON WALL-ROCK ALTERATION, KING JACK RESOURCES LTD PROPERTY

Contents

Summary

Chlorite, carbonate-sericite, and silicification with brecciation are present on the King Jack Resources property as types of hydrothermal alteration of a biotite-muscovite granite. The alteration types result either from a single combined CO_2, K, and SiO_2 metasomatism or from a number of individual metasomatic stages. These alteration types are commonly associated with a variety of gold orebodies worldwide.

The King Jack Resources property suite is an example of a sub-volcanic, porphyry copper-molybdenite environment. The alterations and the possibility of associated gold mineralization can be expected to extend to depths in excess of 8 km into a region of ductile shear.

The presence of economic concentrations of gold at depth on the King Jack property is a distinct possibility on the basis of the evidence available to me from the property and on my knowledge of similar alterations in gold districts elsewhere. The altered shear zones at depth can only be tested by means of a deep drilling program.

Recommendations

It would be unwise to recommend a deep and expensive drilling program at this time with the information available to me. However, there is some evidence from the sections that the Main and Second breccia zones widen at depth. I could make a recommendation for a deep drilling program if the intensity and width of the alteration zones increase and if gold values increase with increasing depth.

I recommend that a search be made for wider zones of carbonate-sericite and silicic alteration and for breccia zones with higher gold values on the surface of the King Jack Resources property area.

Also, I recommend that the geology of the adjacent gold-rich property be carefully examined. If the adjacent property is at an erosion level slightly deeper than that of the King Jack property but is geologically similar in other respects, then a stronger justification for a deep drilling program on the King Jack property could be made.

Extent of Investigation

A total of 15 specimens from two diamond drill holes were supplied for my examination. A location plan and two geological cross sections of the diamond drill holes were also provided.

All 15 core specimens were examined by means of a hand lens and a binocular scope.

Thirteen of the core specimens were selected for thin sections and petrographic analyses. Two specimens, 68534 and 68535, appeared to be too oxidized to warrant petrographic work.

X-ray diffraction analyses of phyllosilicates were made on five samples: 68527, 68529, 68530, 68531, and 68538.

Observations

Most of the core specimens are a fine- to medium grained, two-mica granite (or microgranite), which is slightly porphyritic. Specimen 68540 is the least altered granite. Microcline is the dominant feldspar, plagioclase feldspar is subordinate. Biotite is the only ferromagnesian mineral present. Large flakes of muscovite are almost equal in volume to biotite and at least some muscovite replaces biotite. Some muscovite replaces quartz and feldspars. Zircon, monazite, and apatite are accessory minerals. The conversion of biotite to muscovite is a common deuteric (autometasomatic) alteration in many granites associated with Sn-W-Cu-Mo-Bi-Au metallogenic associations.

Other alteration types present in the suite are related. They are in order of intensity and probable emplacement: a chloritic alteration, a carbonate-sericite alteration and a silicic (silicification) alteration. The latter is generally accompanied by brecciation and veining.

There is an early, low-intensity, selectively pervasive chloritic alteration. The most obvious mineralogical change is the partial or total replacement of biotite by chlorite. A single specimen, 68539, has a very minor amount of epidote replacing biotite.

More intensive carbonate-sericite alteration overprints the low-intensity chloritic alteration and is, in turn, brecciated and overprinted by the silicic alteration.

The carbonate-sericite alteration varies in intensity from low to high. It is pervasive and veinlet controlled in style. The carbonate has not been identified but is probably calcite. Note that wherever "sericite" is used in this report it is a synonym for the group of minerals known as white mica. Sericite, consequently, may include a number of closely related species. Of these latter, muscovite and illite were positively identified during my examination. Sulfide minerals are part of the mineral assemblage in the carbonate-sericite alteration. The sulfides are mostly pyrite with minor amounts of chalcopyrite and molybdenite.

The silicic alteration appears to overprint all earlier alteration types It consists of quartz and minor chalcedony. The alteration styles are open-space fillings and veinlet controlled. Minor amounts of carbonate and sericite accompany the quartz. In one specimen, 68532, the quartz veinlets and pyrite veinlets constitute a stockworks. Quartz-sericite veinlets are present in some specimens. Most of the silicified specimens have pyrite as the only sulfide mineral present.

All silicified specimens are brecciated. Fragments are carbonate-sericite and chloritic altered granite, and quartz or chalcedony. The matrix consists of quartz and minor carbonate of both open-space filling and replacement origins. One specimen, 68526, appears to be a protomylonite or crush breccia. An approximate order of increasing intensity of alteration, from low to high, displayed by the thin sections is given in Table 1.

Table 1. Intensity of alteration.

Alteration types	Specimen numbers
Low-intensity chloritic	68540
Low-intensity carbonate-sericite partly overprinting chloritic	68534, 68539
Moderate-intensity carbonate-sericite partly overprinting chloritic	68527, 68529, 68536
High-intensity carbonate-sericite (?) totally obscuring chloritic	68528, 68530, 68538
High-intensity silicic and brecciation	68526, 68531, 68532, 68533, 68535, 68537.

Some grains and fragments of chalcedony are present in some of the quartz veins and breccia specimens.

The five specimens selected for X-ray diffraction analysis of their phyllosilicate minerals in order of increasing intensity of alteration are:

Moderate intensity, carbonate-sericite alteration: 68527, 68529.
Intense carbonate-sericite alteration: 68530, 68538.
Silicification and brecciation: 68531.

The print-outs from all five specimens are similar and confirm most of the petrographic identifications.

The chlorite is positively identified as ferroan clinochlore, an iron-rich member of the amesite-antigorite series. The muscovite, with one exception, consists of two polytypes, 2M1 and 2M2. A third polytype, muscovite 3T, occurs in 68527. At least some of the sericite identified in 68529 and 68538 is the mixed-layer clay: illite 2M1 polytype. Sericite and illite are identical species under the microscope and X-ray diffraction analysis is required in order to differentiate these two minerals.

Discussion and Conclusions

Chloritic alteration is a fringe type commonly occurring at the margins of wallrocks affected by carbonate metasomatism. In granitic rocks the outer chloritic zone is succeeded commonly inward by firstly, an intermediate zone of carbonate-sericite alteration and secondly, by a central zone of silicification.

This distribution of alteration zones is very characteristic of numerous gold-mining districts around the world. The occurrences belong to three different classes of gold deposits. The first is gold-silver telluride deposits hosted by alkalic or alkalic-calcic volcanic rocks in anorogenic environments. The best examples of these are Cripple Creek, Colorado (Lindgren and Ransome, 1906); the Emperor mine, Fiji (Ahmad and others, 1987); and, at a slightly deeper subvolcanic level of erosion, Zortman-Landusky, Montana. The second deposit class includes the gold-rich porphyry molybdenite (and sometimes copper) deposits which are hosted by quartz monzonitic to high-silica, alkali-rich granitic plutons. A recently described example is the Salave deposit, northwest Spain (Harris, 1985). The third and largest class is the well-known quartz-carbonate-lode gold deposits in ductile-flow shear zones of the greenstone belts of Precambrian age and in melange shear zones of Phanerozoic age. Examples of this last class are Red Lake and Timmins, Ontario, and the Mother Lode-Grass Valley region, California (Johnston, 1940).

The presence of breccia zones in the King Jack Resources property indicates a relatively shallow level, probably less than 2 km, in the hydrothermal system. Other indications of shallow depth are the presence of crustiform textures in veins and the presence of chalcedony in some quartz veins, breccias, and as replacements of wallrock. The King Jack property environment appears to be intermediate between the first and second classes of gold deposits. Similarities to both Zortman-Landusky and Salave deposits are present in the King Jack specimens and geological sections.

The zones of carbonate-sericite alteration on the King Jack property are relatively narrow in width (possibly about 20 ft as indicated in the samples I examined) compared to other gold-bearing districts. However, many of the latter have ultramafic or mafic igneous wallrocks which are much more susceptible to carbonate metasomatism than the granitoids on the King Jack property.

Gold ore in many gold-mining districts occupies most of the brecciated quartz zones, and occupies a significant proportion of the carbonate-sericite alteration zones. These types of hydrothermal alteration are both spatially and genetically associated with gold ore in numerous deposits.

There should be a good potential for extensions of the sericite-carbonate and silicic alterations favorable for gold mineralization to continue to great depth. In other districts, there is circumstantial evidence which suggests that the alterations extend from near-surface volcanic sequences and subvolcanic, hypabyssal environments to porphyry plutonic environments, and to deep mesozonal shear zones. The environments range from environments of brittle failure down into environments of ductile flow at depths in excess of 10 km.

It is unfortunate for the present study that there is no information from other gold districts that indicates the presence of a vertical sequence of alteration and mineralization zones associated with carbonate metasomatism. The limited evidence supports the model of continuous chlorite + carbonate-sericite + silicic alteration zones + quartz-carbonate-gold lodes with increasing depth. Widths of alteration zones and intensity of alteration increase with increasing depth.

From the relatively small number of samples made available to me, I am unable to tell if the intensity and width of the alterations favorable for gold mineralization increase with increasing depth. The geological sections indicate that, at least, the widths of the Main and Second breccia zones increase with depth. Close examination of the available diamond-drill core should disclose if the width and intensity of alteration similarly increase with depth.

References

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Appendix 1. Hand Specimen and Thin Section Descriptions

68526 HAND-SPECIMEN DESCRIPTION

Color: Medium gray, patchy greenish gray and white.

Texture: Mosaic, sugary, and sparse open-space filling.

Grain size: Variable, very fine to fine grained.

Fabric: Variable.

Homogeneity: Sparse vugs. Some veinlets.

Color Index: Unknown.

Primary Mineralogy: None. Protolith was probably a silicic, medium-grained rock.

Alteration Mineralogy:

1. Pervasive Alteration:
   Quartz, fine to medium grained, colorless.
   Chalcedony, very fine grained, light gray, appears to be replacing wallrock.
   Sericite, colorless, fine grained.
   Clay(?), dark green-gray, white streak, in aggregates.
   Pyrite, very fine grained, disseminated, rare.

Pervasive silicification (flooding) of the wallrock.

2. Open-space Fillings:
   (1) Some small vugs and irregular areas partly or wholly occupied by colorless, transparent, terminated quartz crystals.

3. Veinlet-controlled Alteration:
   (1) Sericite(?) or clay veinlet.

68526 THIN-SECTION DESCRIPTION

Alteration Type: Silicification and brecciation.

Style: Open-space filling
Intensity: Intense
Extent: 75%

Protolith: Clasts of carbonate-sericite altered granite

Protolith Minerals: Quartz, microcline, plagioclase

Alteration Minerals: Quartz in matrix; sericite and ferroan carbonate in clasts of altered granite.

Remarks: Much of the fine-grained quartz matrix is sheared and granulated. The rock resembles a protomylonite.

68527 HAND-SPECIMEN DESCRIPTION

Color: White, speckled gray.

Texture: Phaneritic.

Grain size: Medium grained.

Fabric: Equigranular, subhedral.

Homogeneity: Vuggy. Some veinlets.

Color index: 10%, leucocratic.

Primary Mineralogy: Quartz, clear and slightly smoky.
Feldspar, remnant, much altered, pale pink and cream. Outlines are slightly diffuse due to alteration.

Alteration Mineralogy:

1. Pervasive Alteration: Muscovite, fine-grained, replacing feldspars.
Clays(?), cream-colored, replacing feldspars.
Pyrite, relatively abundant, fine-grained, pale-colored, disseminated.
Chlorite, green, minor, replaced by clay(?)
Clay, yellow-green, replacing chlorite(?)
Limonite and hematite, replacing biotite.

2. Veinlet-controlled Alteration:

(1) White carbonate(?); undulating, parallel walls.

XRD analysis completed.

68527 THIN-SECTION DESCRIPTION

Alteration Type: Early Deuteric Chlorite overprinted by Carbonate-sericite.

Style: Pervasive and Veinlet-controlled.
Intensity: Moderate.
Extent: Pervasive is about 25%.

Protolith: Muscovite-biotite granite.

Protolith Minerals: Quartz, microcline, plagioclase, muscovite, biotite, apatite.

Pervasive Alteration Minerals: Chloritic replacement of biotite is almost complete. Chlorite, in turn, is bleached and partly replaced by carbonate. Sericite replaces feldspars and is overprinted by carbonate alteration. Disseminated pyrite.

Veinlet-controlled Alteration: Early stage of quartz and sericite. Succeeded by intense fracturing of quartz and feldspars healed by a late stage of carbonate and sericite.

Remarks: Mosaic areas of muscovite and carbonate are present.
Vein-like areas of fine-grained quartz and feldspar are overprinted by carbonate-sericite alteration.

X-ray Diffraction Analysis: Muscovite, 2M1 and 3T polytypes.
Ferroan clinochlore IIB polytype.

68528 HAND-SPECIMEN DESCRIPTION

Color: Variable; wallrock is white to light tan. Vein-controlled alteration envelope is greenish gray

Texture: Wallrock and alteration envelope are phaneritic.

Grain size: Medium grained.

Fabric: Wallrock is equigranular, subhedral.

Homogeneity: Vuggy. One vein and vein-controlled alteration envelope.

Color index: Wallrock was probably leucocratic.

Primary Mineralogy: Quartz, clear and slightly smoky.
Feldspar, remnant, much altered, pale pink and white.

Alteration Mineralogy:

1. Pervasive Alteration: Muscovite, abundant, pale green, fine to medium grained, replacing feldspars.
Clays(?), replacing feldspars.
Pyrite, relatively abundant, fine-grained, brass-colored, disseminated.
Molybdenite, fine-grained, sparse.
Limonite and hematite, replacing biotite.

2. Veinlet-controlled Alteration:
(1) Pyrite veinlet. Not straight - undulating, unparallel walls. Replacement texture not open-space filling. The alteration envelope consists of:
Quartz, fine to medium grained.
Sericite, fine to medium grained.
Pyrite, fine-grained, brass-colored.
Molybdenite, fine-grained, less abundant than pyrite.
K-feldspar, cream, mostly replaced by sericite.

68528 THIN-SECTION DESCRIPTION

Alteration Type: Carbonate-sericite overprints an earlier deuteric chloritic alteration

Style: Pervasive and veinlet-controlled
Intensity: Intense
Extent: 30% pervasive

Protolith: Granite

Protolith Minerals: Quartz, microcline, plagioclase

Alteration Minerals: Chlorite (selectively pervasive); muscovite and fine-grained sericite (pervasive replacing K-spar and chlorite); pyrite (pervasive); carbonate (veinlets and pervasive replacing chlorite).

Remarks: Muscovite patches in this specimen are larger and more numerous than in 68527 and 68529.

68529 HAND-SPECIMEN DESCRIPTION

Color: Variable, white to light tan, speckled green.

Texture: Phaneritic.

Grain size: Medium grained.

Fabric: Equigranular, sparsely porphyritic, subhedral.

Homogeneity: Vuggy. Numerous veins.

Color index: 10%, leucocratic.

Primary Mineralogy: Quartz, clear and slightly smoky.
Feldspar, remnant, much altered, pale pink and white.

Alteration Mineralogy:

1. Pervasive Alteration: Muscovite, fine-grained, replacing feldspars.
Clays, replacing feldspars.
Chlorite, green, mostly replacing biotite.
Pyrite, relatively abundant, fine-grained, pale-colored, disseminated.
Limonite and hematite, replacing biotite.

2. Veinlet-controlled Alteration:
(1) Pyrite + K-feldspar + sericite(?) veinlets.
Not straight - undulating, unparallel walls, Chlorite is largely destroyed within 2-3 mm of the veinlet. One veinlet is asymmetrical with one side filled with very fine-grained aggregate of quartz + albite(?) + prismatic dark mineral.
Pyrite, fine-grained, pale-colored.
K-feldspar, pale pink, in part replaced by sericite(?).
Sericite, very fine-grained.

(2) White carbonate(?), straight, parallel walls.

Remarks: Presence of carbonate confirmed by dilute acid.

XRD analysis completed.

68529 THIN-SECTION DESCRIPTION

Alteration Type: Early Deuteric Chlorite overprinted by Carbonate-sericite.

Style: Pervasive and veinlet-controlled.
Intensity: Weak to Moderate.
Extent: Pervasive is about 20%.

Protolith: Muscovite-biotite granite.

Protolith Minerals: Quartz, microcline, plagioclase, muscovite, apatite.

Pervasive Alteration Minerals: Chloritic replacement of biotite is complete.

Veinlet-controlled Alteration: Early stage of crustiform quartz, tourmaline, pyrite, and quartz.
Late stage of carbonate and sericite.

X-ray Diffraction Analysis: Muscovite 2M2 polytype.
Ferroan clinochlore IIB polytype.
Illite 2M1 polytype.

68530 HAND-SPECIMEN DESCRIPTION

Color: Light yellowish tan, speckled green.

Texture: Phaneritic.

Grain size: Medium grained.

Fabric: Equigranular, sparsely porphyritic, subhedral.

Homogeneity: Sparse vugs. Numerous veins.

Color index: Originally probably leucocratic.

Primary Mineralogy: Quartz, gray and slightly smoky.
Feldspar, remnant, much altered, pale tan.

Minerals have diffuse boundaries.

Alteration Mineralogy:

1. Pervasive Alteration: Sericite(?), bright green, fine-grained.
Clays, white, replacing feldspars.
Pyrite, pyritohedrons, abundant, fine-grained, brass-colored, disseminated.
Limonite and hematite, replacing biotite.

2. Veinlet-controlled Alteration:
(1) Quartz + sericite(?) veinlets.
Not straight - undulating, unparallel walls,
Quartz, light gray and white.
Sericite or clay, white, occurs as discontinuous, asymmetrical selvages and fillings.

XRD analysis completed.

68530 THIN-SECTION DESCRIPTION

Alteration Type: Carbonate-sericite and Silicification

Style: Pervasive and veinlet-controlled
Intensity: Intense
Extent: 70% pervasive

Protolith: Granite

Protolith Minerals: Quartz, microcline

Pervasive Alteration Minerals: Ferroan carbonate, sericite, pyrite, quartz

Veinlet Alteration Minerals: Quartz-sericite (early stage); carbonate (late stage)

Remarks: All chlorite and plagioclase of the granite is replaced.
An early quartz-sericite veinlet is cut by a younger carbonate veinlet.

X-ray Diffraction Analysis: Muscovite 2M1 and(or) 2M2 polytypes.
Ferroan clinochlore IIB polytype.

68531 HAND-SPECIMEN DESCRIPTION

Color: Light gray.

Texture: Phaneritic.

Grain size: Medium grained

Fabric: Equigranular and subhedral.

Homogeneity: Numerous vugs

Color index: Originally probably leucocratic.

Primary Mineralogy:
- Quartz, clear and slightly smoky.
- Feldspar, cream, slightly altered.
- Albite(?), white.
- Muscovite,

Alteration Mineralogy:

1. Pervasive Alteration:
   - Sericite, colorless and green, fine grained, replacing feldspars.
   - Quartz, medium grained, some overgrowths.
   - Kaolin(?), yellow and white, replacing feldspar.
   - Pyrite, fine grained, abundant, disseminated, brass-colored.
   - Chalcopyrite, fine grained, disseminated.
   - Hematite, red-brown.

2. Open-space Fillings:
   (1) Numerous vugs and irregular areas partly or wholly occupied by colorless, transparent, terminated quartz crystals.

XRD analysis completed.

68531 THIN-SECTION DESCRIPTION

Alteration Type: Silicification and Brecciation

Style: Open-space filling
Intensity: Intense
Extent: 90%

Protolith: Minor small clasts of carbonate-sericite altered granite

Protolith Minerals: Quartz, microcline, plagioclase in clasts

Pervasive Alteration Minerals: Quartz, carbonate, pyrite, chalcopyrite,

Veinlet Alteration Minerals: Quartz, minor sericite and chalcedony in matrix

Remarks: Breccia with a matrix of crustiform quartz matrix

X-ray Diffraction Analysis: Muscovite 2M1 polytype.
Ferroan clinochlore IIB polytype.

68532 HAND-SPECIMEN DESCRIPTION

Color: Light gray.

Texture: Phaneritic.

Gráin size: Medium grained

Fabric: Equigranular and subhedral.

Homogeneity: Vuggy. Numerous veins form a stockworks. Some veinlets are en echelon.

Color index: Originally probably leucocratic.

Primary Mineralogy: Quartz, clear and slightly smoky.
Feldspar, cream, slightly altered.
Albite(?), white.
Muscovite,

Alteration Mineralogy:

1. Pervasive Alteration:
Sericite, fine grained, replacing feldspars.
Quartz, medium grained.
Pyrite, fine grained, abundant, disseminated, brass-colored.

3. Veinlet-controlled Alteration:
(1) Pyrite veinlet. Cut by the quartz + sericite veinlets.

(2) Quartz + Sericite(?) veinlets. At least 2 generations present. Earlier is curved, bifurcating. Later is straight with parallel walls.
Sericite(?), very fine-grained.
Quartz, gray,
Pyrite, very sparse, very fine grained.

68532 THIN-SECTION DESCRIPTION

Alteration Type: Sericite, overprinted by carbonate and silicification

Style: Sericite - pervasive;
Carbonate - pervasive and veinlet control.
Silicification - pervasive and open-space fracture filling

Intensity: Intense
Extent: 25% pervasive of granitic feldspars.

Protolith: Granite

Protolith Minerals: Quartz, cloudy microcline and plagioclase

Pervasive Alteration Minerals: Quartz, sericite, carbonate

Veinlet Alteration Minerals: Quartz, carbonate, pyrite

Remarks: Chlorite is not present

68533 HAND-SPECIMEN DESCRIPTION

Color: Light yellow-brown, white veins.

Texture: Mosaic, sugary, and sparse open-space filling.

Grain size: Variable, very fine to fine grained.

Fabric: Variable.

Homogeneity: Numerous vugs. Some veinlets.

Color index: Unknown.

Primary Mineralogy: Quartz, medium gray.
Protolith was probably a silicic, medium-grained rock.

Alteration Mineralogy:

1. Pervasive Alteration:
   Quartz, fine to medium grained, colorless.
   Chalcedony, very fine grained, light gray, appears to be replacing wallrock.
   Sericite(?) or clay, white, very fine grained.

Some pervasive silicification (flooding) of the wallrock.

2. Open-space Fillings:
   (1) Some small vugs and irregular areas partly or wholly occupied by colorless, transparent, terminated quartz crystals.

3. Veinlet-controlled Alteration:
   (1) Sugary quartz + sericite(?) or clay veinlet.

4. Oxidation: Limonitic staining of the sericite(?).
   Limonite and hematite replacement of a micaceous mineral (chlorite?).

A thin section was not made because of the weathered and oxidized nature of the specimen.

68534 HAND-SPECIMEN DESCRIPTION

Color: Light to medium brown, speckled medium gray.

Texture: Phaneritic.

Grain size: Medium grained.

Fabric: Equigranular, very sparsely porphyritic, subhedral.

Homogeneity: Some veins.

Color index: 10%, leucocratic.

Primary Mineralogy: Quartz, clear and slightly smoky.
Feldspar, pale pink or tan.
Biotite, black, mostly chloritised.
Muscovite, almost as abundant as biotite.

Pervasive Alteration Mineralogy:
Pyrite, brass-colored, partly oxidized, disseminated.
Chlorite, green, mostly replacing biotite.
Muscovite, minor.

Veinlet-controlled Mineralogy:
(1) Pyrite veinlets, irregular, unparallel walls, fine aggregates of pyrite cubes. Very oxidized to limonite and jarosite.

(2) Sericite(?) or clay(?) veinlets. Straight, parallel walls, en echelon.

Supergene Mineralogy: Limonite, abundant, heavy stain on joints, also replacing chlorite, pervasive stain in places.
Azurite, blue, very fine grained, rare.

A thin section was not made because of the weathered and oxidized nature of the specimen.

68535 HAND-SPECIMEN DESCRIPTION

Color: Light gray.

Texture: Mosaic and open-space filling.

Grain size: Variable.

Fabric: Variable.

Homogeneity: Numerous vugs. A vein and numerous veinlets.

Color index: Unknown.

Primary Mineralogy: None.

Alteration Mineralogy:

1. Pervasive Alteration:
   Quartz, fine to medium grained, colorless.
   Chalcedony, very fine grained, light gray, appears to be replacing wallrock.
   Sericite, colorless, fine grained.

Pervasive silicification (flooding) of the wallrock.

2. Open-space Fillings:
   (1) Some vugs and irregular areas partly or wholly occupied by colorless, transparent, terminated quartz crystals.

3. Veinlet-controlled Alteration:
   (1) Quartz vein. 3.0 mm wide, of colorless, transparent, terminated quartz crystals.

68535 THIN-SECTION DESCRIPTION

Alteration Type: Silicification

Style: Open-space filling
Intensity: Intense
Extent: 100%

Protolith: Unknown

Pervasive Alteration Minerals: Quartz, sericite

Vein-controlled Alteration Minerals: Quartz, minor sericite, minor late chalcedony,

Protolith Minerals: None

Remarks: Early stage of fine-grained quartz veins;
Late stage of coarse-grained quartz in the same veins.
Notable absence of carbonate.

68536 HAND-SPECIMEN DESCRIPTION

Color: Variable, white to light tan, speckled green.

Texture: Phaneritic.

Grain size: Medium grained.

Fabric: Equigranular, subhedral.

Homogeneity: Vuggy. Slight flow banding. Some veins.

Color index: 10%, leucocratic.

Primary Mineralogy: Quartz, clear and slightly smoky.
Feldspar, remnant, much altered, white and pale pink,
Muscovite,

Alteration Mineralogy:

1. Pervasive Alteration: Chalky white feldspars
Chlorite, green, mostly replacing biotite.
Pyrite, sparse, very fine-grained, pale-colored, disseminated.
Muscovite, minor, some replacing feldspar.
Limonite and hematite, possibly replacing biotite.

2. Veinlets: White carbonate, straight, cross-cutting, parallel walls.

68536 THIN-SECTION DESCRIPTION

Alteration Type: Deuteric sericitic and chloritic overprinted by carbonate.

Style: Miarolitic cavity fillings, pervasive, and veinlet-controlled.

Intensity: Weak to Moderate

Extent: Pervasive is about 15%

Protolith: Muscovite-biotite granite.

Protolith Minerals: Quartz, microcline, plagioclase, muscovite, zircon, monazite, apatite.

Pervasive Alteration Minerals: Some muscovite after biotite and quartz.
Considerable sericite and carbonate after plagioclase and microcline.
Chlorite and pyrite totally replace biotite.

Open-space Filling Minerals: Carbonate is dominant, minor chlorite and muscovite.

Veinlet-controlled Alteration: Carbonate.

Remarks: Both pervasive and cavity-filling styles of alteration are early and possibly of deuteric origin, not necessarily associated with epigenetic mineralization.
Carbonate alteration is both early and late.
This rock is more altered than 68540 and 68539.

68537 HAND-SPECIMEN DESCRIPTION

Color: Light pinkish-tan, speckled green.

Texture: Phaneritic, in general, but some areas are aphanitic.

Grain size: Medium to fine grained.

Fabric: Equigranular and subhedral in phaneritic parts. Otherwise microporphyritic and anhedral to subhedral.

Homogeneity: Vuggy. Brecciated. Numerous veins.

Color index: 15%, leucocratic.

Primary Mineralogy:

Where phaneritic - Quartz, clear and slightly smoky.
K-Feldspar, pale pink, slightly altered.
Chlorite, green,
Albite(?), white.
Muscovite,

Where aphanitic and porphyritic - K-feldpar phenocrysts.

Alteration Mineralogy:

1. Pervasive Alteration in the Phaneritic areas:
Muscovite, fine-grained, replacing feldspars.
Clays(?), replacing feldspars.
Chlorite, green, probably replacing biotite.
Pyrite, fine grained, disseminated, brass-colored.

2. Pervasive Alteration in the Aphanitic areas:
Quartz, dark gray, microphenocrysts.
Feldspar, pale pink, microphenocrysts, possibly K-feldspar.
Sericite, white.
Carbonate(?), light green.

The aphanitic areas are parallel with the sericitic veining and are probably thin breccia dikes with parallel and nonparallel walls emplaced by a fluidization process.

3. Veinlet-controlled Alteration:
(1) Sericite(?) + quartz veinlets.
Straight, parallel walls,
Sericite(?), very fine-grained.
Quartz, gray,
Pyrite, very sparse, very fine grained.
Clay(?), light green.

68537 THIN-SECTION DESCRIPTION

Alteration Type: Carbonate-sericite and Brecciation

Style: Veinlet-controlled, minor pervasive, and open-space fillings

Intensity: Moderate

Extent: 15% pervasive in granites

Protolith: Granite

Protolith Minerals: Quartz, microcline, plagioclase.

Alteration Minerals: Carbonate and muscovite in patches; sericite in veinlets; pyrite disseminated and in veinlets; early pervasive chlorite

Open-space Filling Minerals: Quartz, fine-grained

Remarks: Specimen appears to be from a shear or shatter zone. "Pull-apart" or exploded textures without rotation of fragments are common.

68538 HAND-SPECIMEN DESCRIPTION

Color: Light gray, speckled pink.

Texture: Phaneritic, in general, but some areas are aphanitic.

Grain size: Medium to fine grained.

Fabric: Equigranular and subhedral in phaneritic parts. Otherwise porphyritic and subhedral.

Homogeneity: Vuggy. Numerous veins which form a stockworks.

Color index: 10%, leucocratic.

Primary Mineralogy:
Where phaneritic - Quartz, clear and slightly smoky.
K-Feldspar, remnant, much altered, pale pink.
Albite(?), white.
Muscovite,

Where aphanitic and porphyritic - K-feldpar phenocrysts.

Alteration Mineralogy:

1. Pervasive Alteration in the Phaneritic areas:
Muscovite, fine-grained, replacing feldspars.
Clays(?), replacing feldspars.
Chlorite, green, minor, mostly replacing biotite and now mostly replaced by muscovite.

2. Pervasive Alteration in the Aphanitic areas:
Quartz, dark gray
Feldspar, cream-colored, possibly albite, but now mostly replaced by sericite.

The aphanitic areas are associated with the stockwork veining and are probably an alteration fabric.

3. Veinlet-controlled Alteration:
(1) Sericite(?) + quartz veinlet stockworks.
Straight, parallel walls,
Sericite(?), very fine-grained.
Quartz, gray,
Pyrite, very sparse, very fine grained.

Remarks: Presence of carbonate confirmed by dilute acid.

XRD analysis completed.

68538 THIN-SECTION DESCRIPTION

Alteration Type: Carbonate-sericite and Brecciation

Style: Pervasive, veinlet-controlled, and open-space filling

Intensity: Intense

Extent: 40%

Protolith: Microclasts of chloritized granite

Protolith Minerals: Quartz, microcline, plagioclase, minor chlorite in clasts

Alteration Minerals: Carbonate, sericite

Remarks: This specimen is a microbreccia with chloritized granite clasts and a quartz-feldspar matrix

XRD analysis completed. X-ray Diffraction Analysis: Illite 2M1 polytype.
Ferroan clinochlore IIB polytype.
Muscovite 2M1 and(or) 2M2 polytypes are possibly present.

68539 HAND-SPECIMEN DESCRIPTION

Color: Light gray, speckled green and white.

Texture: Phaneritic.

Grain size: Medium grained.

Fabric: Equigranular, very sparsely porphyritic, subhedral.

Homogeneity: Slight flow banding. Some veins.

Color index: 10%, leucocratic.

Primary Mineralogy: Quartz, clear and slightly smoky.
Feldspar, white and pale pink.
Biotite, black

Alteration Mineralogy: Pyrite, pale-colored, disseminated.
Chlorite, green, mostly replacing biotite.
? Muscovite, minor

Veinlet-controlled Mineralogy:
Discontinous, pale pink or white feldspar, with fine aggregates of pyrite cubes, and minor epidote.

68539 THIN-SECTION DESCRIPTION

Alteration Type: Deuteric sericitic and chloritic.

Style: Miarolitic cavity fillings and pervasive.
Intensity: Weak.
Extent: Pervasive is about 20%.

Protolith: Muscovite-biotite granite.

Protolith Minerals: Quartz, microcline, plagioclase, biotite, muscovite, zircon, monazite, apatite. cassiterite (a single grain).

Pervasive Alteration Minerals: Some muscovite after biotite and quartz.
A little sericite after plagioclase and microcline.
Considerable chlorite and very minor epidote after biotite,

Open-space Filling Minerals: Chlorite, muscovite, monazite, carbonate.

Remarks: Both styles of alteration are early and deuteric, probably not associated with epigenetic mineralization.
Deuteric alteration is stronger than in thin section 68540.

68540 HAND-SPECIMEN DESCRIPTION

Color: Light gray, speckled black.

Texture: Aphanitic

Grain size: Fine grained.

Fabric: Equigranular, very sparsely porphyritic, subhedral.

Homogeneity: Slightly miarolitic.

Color index: 10-15%, leucocratic.

Primary Mineralogy: Quartz, clear and slightly smoky.
Feldspar, white and pale pink,
Biotite, black
? Muscovite, minor.

68540 THIN-SECTION DESCRIPTION

Alteration Type: Deuteric sericitic and chloritic.

Style: Miarolitic cavity fillings and pervasive.
Intensity: Weak.
Extent: Pervasive is less than 10%.

Protolith: Muscovite-biotite granite.

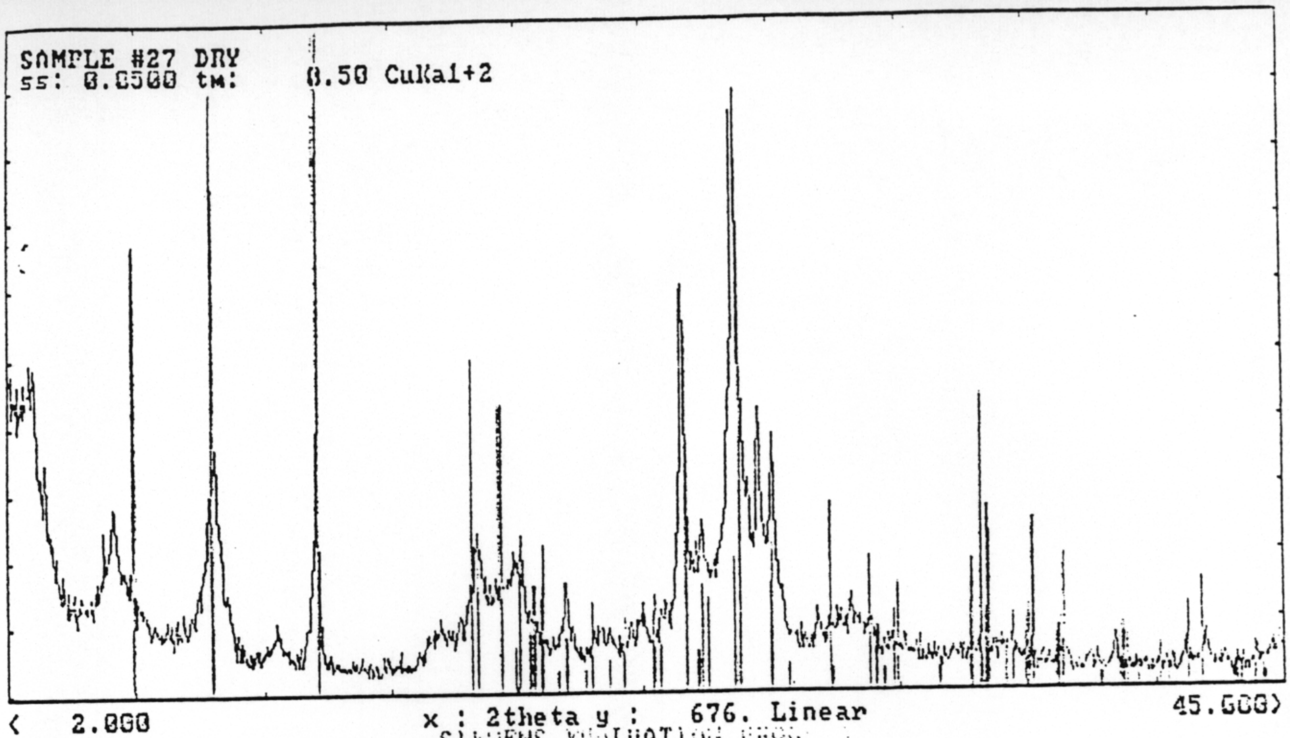
Protolith Minerals: Quartz, microcline, plagioclase, biotite, muscovite, zircon, monazite.

Pervasive Alteration Minerals: Some muscovite after biotite and quartz.
A little sericite after plagioclase and microcline.
Some chlorite after biotite,

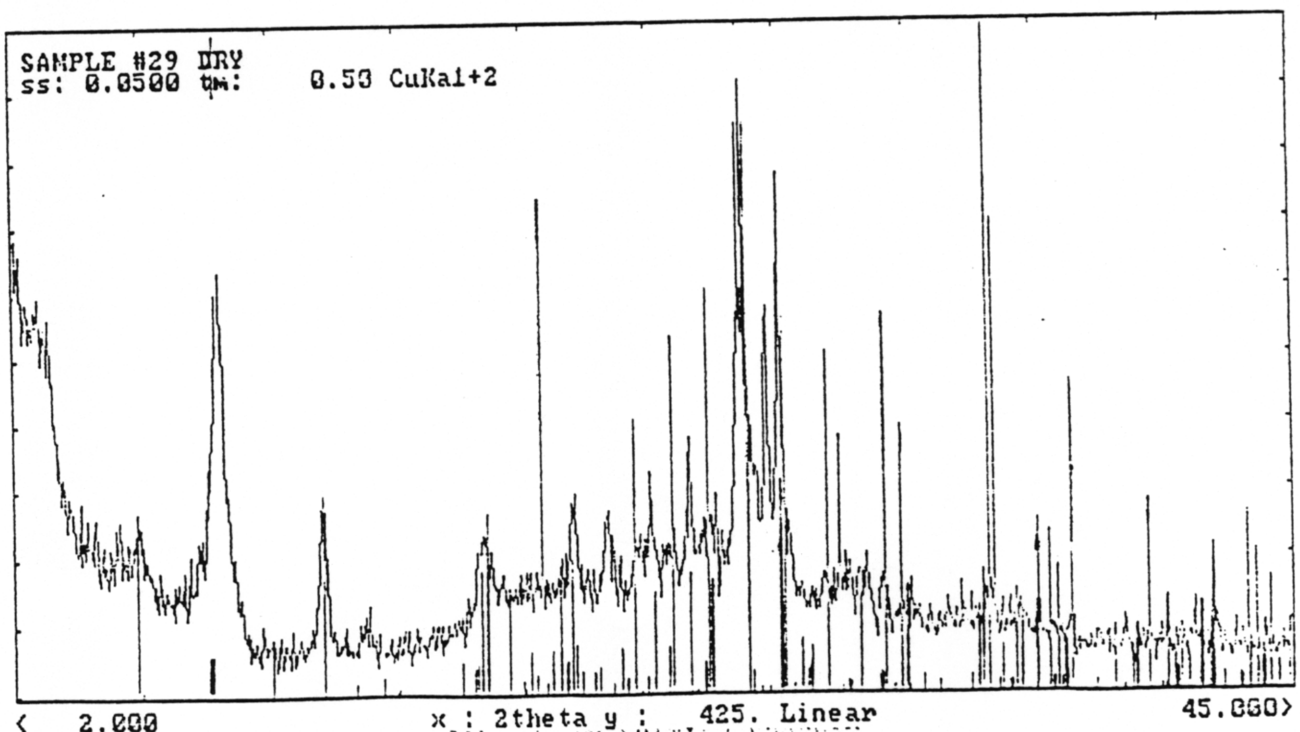
Open-space Filling Minerals: Chlorite, muscovite, monazite, carbonate.

Remarks: Both styles of alteration are early and deuteric, probably not associated with epigenetic mineralization.
This rock is very little altered.

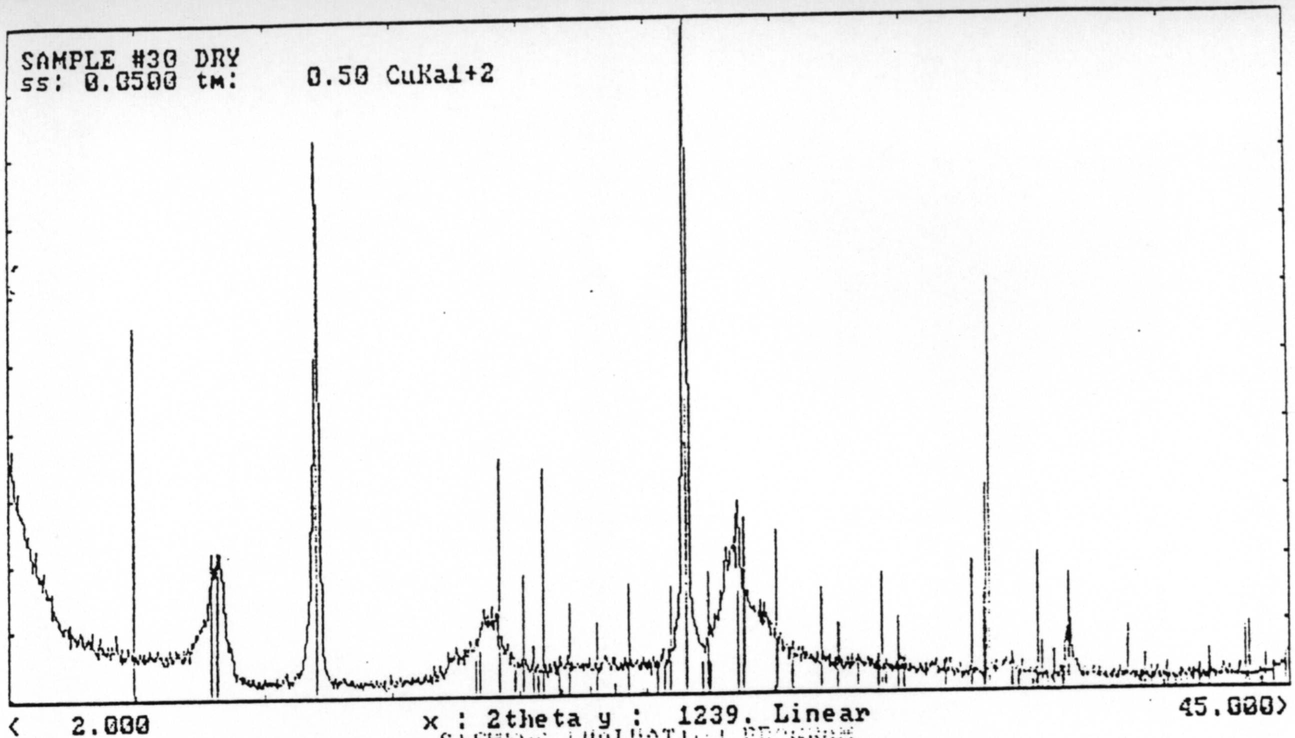
Appendix 2. X-ray Diffractograms for Phyllosilicate Analysis



7-0042 I (KNa)(AlMgFe)2(Si3.1Al.9) MUSCOVITE-3T



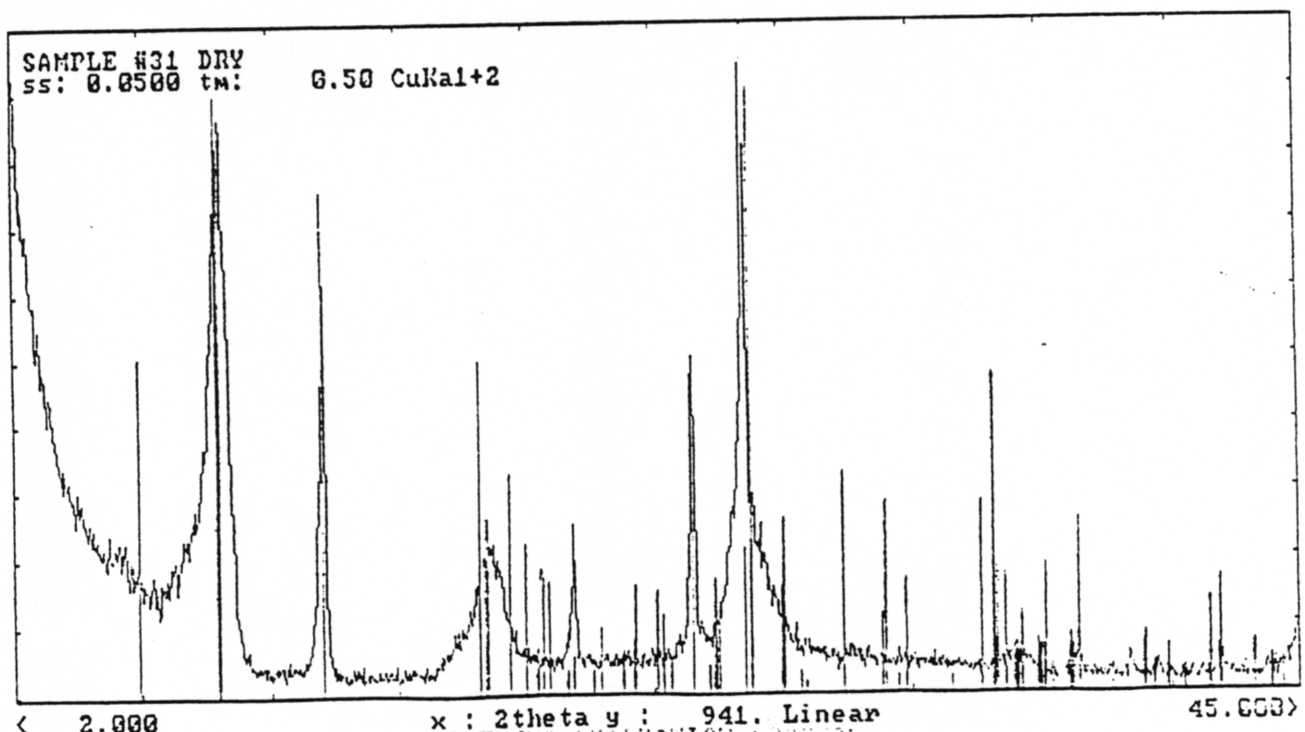
26-0911 I (KH3O)Al2Si3AlO10(OH)2 ILLITE-2M1



SIEMENS EVALUATION PROGRAM

- 24-0506 C (MgAlCrFe)5(SiAl)4O10(OH CLINOCHLORE-IIB, FERR...
- 6-0263 I KAl2(Si3Al)O10(OHF)2 MUSCOVITE-2M1
- 34-0175 C (KNa)Al2(SiAl)4O10(OH)2 MUSCOVITE-2M2

OK [Y/N/F]: Y

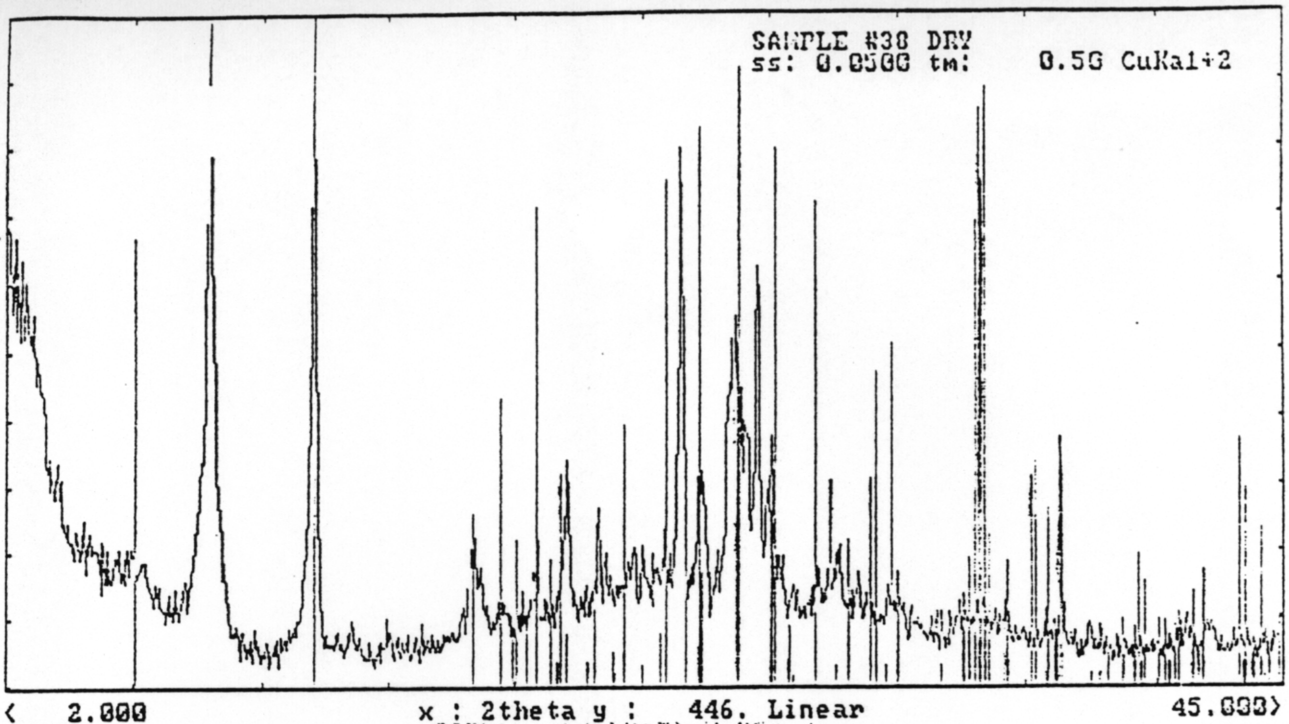


SIEMENS EVALUATION PROGRAM

- 24-0506 C (MgAlCrFe)5(SiAl)4O10(OH CLINOCHLORE-IIB, FERROAN
- 6-0263 I KAl2(Si3Al)O10(OHF)2 MUSCOVITE-2M1
- 26-0911 I (KH3O)Al2Si3Al O10(OH)2 ILLITE-2M1

7-0042 I (KNa)(AlMgFe)2(Si3.1A1.9 MUSCOVITE-3T

Test



SIEMENS EVALUATION PROGRAM

- [illegible] C (Mg,AlCrFe)5(Si,Al)4O10(OH,O)8 CLINOCHLORE-IIB, FERROAN
- 6-0263 I KAl2(Si3Al)O10(OH,F)2 MUSCOVITE-2M1
- 34-0175 C (K,Na)Al2(Si,Al)4O10(OH)2 MUSCOVITE-2M2

26-0911 I (KH3O)Al2Si3AlO10(OH)2 ILLITE-2M1

Help Zoom Match File Reset Back. K a2 Peaks Smoo. Con. [illegible] Test