

King Prospect 841308
m-490



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Samples: 12 samples from King Suite (field description: limy sandstones and argillites; possible low-grade gold environment)

The samples are a variable suite of tuffs and tuffaceous mudstones, some with a major limy component. They are grouped into three main types as follows (with gradations between groups):

- 1) Andesitic Tuff: abundant fragments, mainly of plagioclase and andesite, commonly minor calcite.
79C-1190, 79C-1191, 79C-1223
- 2) Muddy Andesitic Tuff: scattered fragments in a muddy groundmass, no calcite
79C-1186, 79C-1201, 79C-1234, 79C-1244
- 3) Limy Tuffaceous Mudstone to Limy Tuff: abundant calcite, variable ratio of fragments to muddy groundmass.
 - a) abundant fragments: 79C-1203, 79C-1211, 79C-1217
 - b) less abundant fragments: 79C-1182, 79C-1241

The extremely fine grain size of the groundmass makes mineral identification impossible. In many samples, the groundmass is described as andesite mud, reflecting my interpretation of the composition as suggested by other features in the sample: andesite fragments, plagioclase laths in groundmass, abundance of opaque. Its composition is probably mainly plagioclase, more or less altered to clay? minerals (possibly montmorillonite in some samples) with lesser opaque and possibly chlorite (none recognized except in patches).

Four samples were selected for study of sulfides, one from each group or subgroup above. Pyrite is the only sulfide recognized in three of these (1190, 1244, 1182 - one grain of chalcopyrite), and pyrite with pyrrotite occurs in the other (1217). Pyrite is concentrated in certain fragments in all samples, mainly as very fine grained disseminated to intergrown grains. It forms spherical aggregates of very fine grains in all samples; these are best developed in sample 1190. It occurs as scattered grains throughout all samples.

A medium grey, isotropic mineral with low hardness occurs in samples 1244 and 1182; the grains could not be identified positively, but one mineral which fits these properties is chalcocite.

No explanation can be made for the correlation with an arsenic-mercury anomaly, except to suggest that the samples probably represent debris from a volcanic center. The presence of abundant pyrite suggests that hydrothermal activity may be important in the area, probably associated genetically with the volcanic event. This and the presence of a few chert fragments suggests solutions of exhalative origin.

John Payne John Payne, January, 1980

In samples 1203, 1211, 1217, 1234, and 1244, alteration produced irregular patches to dendritic veinlike zones with a darker brownish or greyish color than the main rock. In thin section, these zones contain more abundant extremely fine grained patches of a mineral with a light brown color (possibly montmorillonite). This is probably the same mineral as that which is abundant in samples 1182 (dark grey) and 1186 (medium brownish grey).

Many of the samples are deeply weathered, with pervasive development of limonite, and commonly with limonite concentrated in a thin rim along the border between weathered and fresh rock. Pyrite in the weathered zone is completely altered to limonite.

The sample is slightly foliated, with foliation defined by banding and subparallel orientation of brown montmorillonite?

fragments

calcite	15-20%	
plagioclase	7-10	
andesite	5- 7	
opaque	2- 2½	
quartz	1- 2	
leucoxene	minor	(probably includes some Ti-oxide)

groundmass

andesite mud	35-40
montmorillonite?	
opaque	15-20
	2- 3

Calcite forms rounded to subangular patches from 0.05-0.2 mm in size. Some appear to be fragments, and others appear to be alteration of the groundmass or of fragments, particularly of andesite.

Plagioclase forms angular to subangular crystal fragments averaging 0.1-0.15 mm in size. Many are slightly to moderately altered to extremely fine grained sericite, and a few are almost completely altered.

Andesite contains very fine grained laths of plagioclase in a matrix of extremely fine grained plagioclase? and opaque. The fragments commonly are difficult to distinguish from the groundmass andesite, which has essentially the same texture, but commonly has fewer plagioclase laths.

Quartz forms scattered angular grains averaging 0.1-0.2 mm in size.

Leucoxene or Ti-oxide form a few fragments up to 0.15 mm across.

Opaque occurs in some fragments as very fine grained disseminated or locally intergrown grains, and forms up to 30% of the fragments. Grain size of opaque in these is 0.01-0.03 mm. Opaque also forms a few individual grains (fragments?) averaging 0.05-0.1 mm in size.

Much of the groundmass is composed of extremely fine grained andesite, probably largely plagioclase. This contains scattered to locally abundant plagioclase laths and irregular grains, and patches to disseminated grains of calcite and of opaque.

Patches and lenses in the groundmass consist of an extremely fine grained mineral, possibly montmorillonite and less probably biotite. Perhaps both minerals are present. The mineral forms aggregates with subparallel extinction. The mineral has a light brown color but appears to be nonpleochroic. Identification is hampered by the extremely fine grain size.

The section is thicker than normal because of the very friable nature of the sample. Because of the thickness of the sample, identification of the very fine grained material is more difficult.

fragments

plagioclase	15-20%
quartz	3- 5
andesite	3- 5
chlorite	½- 1
cherty andesite	trace

groundmass

Mineral X	60-65	(possibly montmorillonite)
limonite	2- 3	
opaque	2- 3	

Plagioclase and quartz form angular fragments averaging 0.05-0.25 mm in size. Most are fresh to slightly altered (plagioclase to sericite).

Andesite forms rounded fragments averaging 0.2-0.4 mm in size. Most consist of very fine grained laths of plagioclase in an extremely fine grained groundmass.

Chlorite forms rounded patches up to 0.5 mm across; these are composed of very fine grained, medium green irregular grains in random orientation.

Cherty andesite forms a few extremely fine grained fragments up to 0.2 mm across.

These occur in a well foliated matrix composed of extremely fine grained Mineral X pseudomorphing a sheet silicate, or just as coarse grains with a well developed cleavage. Mineral X has a light to medium brown color in thin section (possibly partly due to limonite), and appears to have a R.I. less than those of quartz or plagioclase. Because of the crumbly nature of the hand sample, it is suggested that this mineral might be montmorillonite. It is length-slow and has 1st order yellow interference color.

Limonite probably occurs with Mineral X and masks the color of the mineral. It also is concentrated along the weathered parts of the sample. Opaque forms scattered grains up to 0.05 mm across and numerous much finer grained aggregates associated with Mineral X.

The average size of fragments is greater in this sample than in most of the other samples; calcite occurs as fragments and is rare in the groundmass.

fragments	
plagioclase	20-25%
calcite	10-12
andesite	10-12
sericite-opaque	3- 4
opaque	1½-2
quartz	1½-2
limonite-rich frags.	1- 1½
chert	½- 1
apatite	trace
Mineral X	trace
chlorite patches	0.5
groundmass	
andesite mud?	35-40
plagioclase laths	5- 7
opaque	1- 2
Ti-oxide	0.2-0.5
veinlets	
calcite	0.5

Plagioclase forms crystal fragments and some subhedral grains averaging 0.2-0.5 mm in size. They show slight to moderate alteration to sericite and locally to calcite.

Calcite forms irregular to angular patches up to 0.5 mm in size scattered in the rock.

Andesite forms rounded fragments averaging 0.2-0.3 mm in size; they contain plagioclase laths in a groundmass of plagioclase? and opaque.

Sericite-opaque form rounded patches averaging 0.2-0.3 mm in size; they consist of light green, very fine grained sericite with irregular very fine grained patches and networks of opaque scattered through the fragments.

Opaque also forms scattered grains averaging 0.03-0.05 mm in size, and a few coarser grains, the largest being an aggregate 1.2 mm across.

Quartz forms angular grains from 0.3-0.5 mm in size.

Limonite-rich fragments are up to 1 mm across; they contain abundant limonite and/or Ti-oxide? in an extremely fine grained rock of unknown composition, possibly a mudstone.

Cherty quartz with grain size 0.005-0.02 mm occurs in a few fragments up to 0.8 mm across.

Apatite forms a few grains up to 0.12 mm long.

Mineral X (light brown, prismatic grains from 0.1-0.2 mm long, isotropic, moderate relief) forms a few broken crystal fragments.

Chlorite forms patches up to 0.2 mm across composed of anhedral aggregates of grains 0.02-0.05 mm in size.

The groundmass is dominated by extremely fine grained plagioclase? with scattered coarser plagioclase laths up to 0.05 mm long, and moderately abundant opaque and limonite. Ti-oxide forms scattered grains averaging 0.02-0.05 mm in size.

One fragment consists of a very fine grained aggregate of quartz with interstitial calcite and minor opaque.

The rock is cut by discontinuous vein-like zones up to 0.05 mm wide composed of calcite, in which grains are intergrown in chevron-like aggregates.

The rock contains deeply weathered zones containing abundant limonite, especially at the border of the weathered zone and fresh rock.

fragments

plagioclase	30-35%
andesite	7-10
quartz	2- 3
chlorite	1½-2
opaque	1½-2
apatite	½- 1
Ti-oxide	minor

groundmass

andesite mud	40-45
plagioclase	5- 7
opaque	1- 1½

Plagioclase forms irregular angular fragments averaging 0.05-0.15 mm in size; they are slightly altered to sericite.

Andesite fragments average 0.3-0.5 mm in size; they consist of lathy plagioclase with lesser opaque and extremely fine grained groundmass. In some, groundmass is absent.

Quartz forms angular fragments from 0.05 to 0.15 mm in size.

Chlorite forms rounded patches up to 0.2 mm across composed of very fine grained aggregates; they are light brown in color, possibly from limonite.

Opaque forms abundant grains and clusters averaging 0.02 mm in size.

Apatite forms scattered prismatic to acicular grains up to 0.15 mm long.

Ti-oxide forms a few patches of grains up to 0.2 mm across.

The groundmass is dominated by extremely fine grained plagioclase? with scattered opaque. Plagioclase forms irregular laths up to 0.05 mm long in the groundmass.

79C - 1201

Tuffaceous Siltstone-Mudstone

fragments

plagioclase	20-25%
opaque	2- 3
andesite	2- 3
apatite	minor
quartz	minor

groundmass

lathy plagioclase	7-10
extremely fine	
plagioclase?	55-60
opaque	3- 5
limonite	2- 3

Plagioclase forms crystals and crystal fragments averaging 0.05 to 0.2 mm in size, with a few up to 0.5 mm across. A few contain abundant disseminated opaque, and many are slightly altered to sericite.

Opaque forms subhedral to anhedral grains averaging 0.05-0.15 mm in size. It also occurs as concentrations in opaque-rich fragments of similar size.

Andesite fragments are up to 0.25 mm across and consist of lathy plagioclase in a groundmass of opaque and extremely fine grained plagioclase?.

Apatite forms a few subhedral prismatic grains from 0.1-0.15 mm long.

Quartz forms a few angular grains 0.1 mm across.

The groundmass consists mainly of extremely fine grained plagioclase (possibly in part altered to clay). Scattered through the groundmass are patches and single grains of plagioclase averaging 0.03-0.05 mm long. Opaque forms an abundant dissemination throughout the groundmass.

Limonite is particularly abundant in the weathered zone as a dusty alteration of opaque.

79C - 1203 Silty Dacite-Andesite Tuff with Calcite alteration

FRAGMENTS

plagioclase	25-30%
andesite	3- 4
quartz	1- 2
apatite	0.3
opaque	minor
groundmass	
plagioclase	35-40
calcite	15-20
opaque	2- 3
limonite	1

Plagioclase forms angular to subhedral fragments and crystals from 0.05 to 0.2 mm in size, with a few coarser grains up to 0.5 mm across. Most grains are slightly to moderately altered to sericite.

Andesite forms a few rounded to subangular fragments up to 0.8 mm long; they contain lathy plagioclase in a groundmass of extremely fine grained plagioclase and chlorite?, and with patches and disseminated grains of opaque.

Quartz forms scattered angular grains from 0.1-0.2 mm in size.

Apatite forms one euhedral cross section 0.15 mm across, and several smaller angular grains averaging 0.03-0.05 mm in size.

Opaque forms a few anhedral grains from 0.05-0.2 mm in size.

The groundmass consists of irregular to lathy plagioclase grains averaging 0.01-0.05 mm in size. Calcite forms replacement patches of grains averaging 0.01-0.05 mm in size; they are concentrated in certain parts of the section where alteration is intense. Opaque occurs as disseminated to locally concentrated patches of extremely to very fine grains.

Limonite forms dusty to very fine grained patchy alteration which gives the rock a mottled appearance.

One fragment 1 mm long contains very abundant extremely fine grained limonite, probably as an alteration of a mudstone with scattered plagioclase crystals.

79C - 1211

Silty Andesitic Tuff (Limy groundmass)

fragments	
plagioclase	25-30%
andesite	5- 7
opaque grains	1- 1½
opaque-rich	
fragments	1½-2
quartz	½- 1
apatite	minor
groundmass	
calcite	30-35
andesite	20-25
opaque	2- 3
chlorite	0.5
veinlets	
calcite	0.5

Plagioclase forms prismatic grains and fragments averaging 0.05-0.25 mm in size, with a few up to 0.7 mm in length. Most are slightly altered to very fine grained sericite.

Andesite forms several fragments averaging 0.15-0.25 mm in size, with a few about 1 mm across. They contain lathy plagioclase averaging 0.03-0.05 mm, but up to 0.2 mm long in coarser fragments. The plagioclase laths are enclosed in an extremely fine grained groundmass of plagioclase with scattered patches of fine grained opaque. The coarsest fragment is associated with a patch about 1 mm long containing abundant opaque.

Opaque forms scattered anhedral grains from 0.1-0.2 mm in size. It also occurs in fragments of similar size as very fine grained aggregates associated with extremely fine grained groundmass.

Quartz forms a few grains and patches of grains up to 0.15 mm across.

Apatite forms scattered prismatic grains up to 0.1 mm long.

The groundmass consists in part of very fine grained andesite with scattered laths of plagioclase up to 0.05 mm long and dusty to fine grained disseminated opaque. It is partly altered to fine grained to very fine grained patches of calcite with scattered opaque grains. Parts of the sample are free of calcite, whereas others are very strongly altered with little of the primary texture remaining.

Chlorite forms a few light brown patches of very fine grained aggregates; patches average 0.05-0.15 mm across.

The rock is cut by discontinuous veinlets of calcite up to 0.1 mm wide.

Limonite occurs as dusty dendritic alteration along fractures and is concentrated along the edge of the weathered zone in the hand sample.

79C - 1217

Limy Siltstone - Silty Tuff

fragments	
plagioclase	30-35%
andesite?	5- 7
quartz	2- 3
opaque	minor
groundmass	
calcite	30-35
andesite?	20-25
veinlets	
calcite	minor

The siltstone is probably in large part derived from volcanic rocks, probably andesite as judged from the abundant plagioclase fragments and the fine grained andesite? in fragments and groundmass.

Plagioclase forms equant to slightly elongate fragments averaging 0.1-0.25 mm in size, with a few up to 0.7 mm across. Many are slightly altered to sericite.

Some patches of andesite? appear to be fragments, averaging 0.1-0.2 mm in size. These consist of scattered to locally abundant lathy plagioclase averaging 0.05-0.1 mm long in an extremely fine grained groundmass.

Quartz forms equant to slightly elongate fragments from 0.1-0.5 mm in length.

Opaque grains occur with andesite fragments and locally alone as very fine grained irregular aggregates.

The groundmass consists mainly of very fine grained (0.01-0.04 mm) calcite spots and patches in a matrix of extremely fine grained andesite containing scattered plagioclase laths. In places the andesitic groundmass grades into andesitic fragments, and it is probable that both textures represent the same original material.

The rock is cut by a few discontinuous vein-like zones composed of fine to medium grained calcite; grains are elongate and oriented in a chevron-like texture.

fragments	
plagioclase	35-40%
andesite	7-10
quartz	1- 1½
opaque	1- 1½
biotite	minor
apatite	minor
chert	minor
actinolite?	minor
groundmass	
andesite	35-40
calcite	7-10
opaque	1½-2
chlorite patches	1- 1½
veinlets	
calcite	½- 1

Plagioclase forms abundant fragments and crystals from 0.1-0.3 mm in size, and a few up to 1 mm long. Most are slightly altered to sericite and locally to calcite.

Andesite fragments are up to 1.5 mm in size. They contain plagioclase laths from 0.1-0.15 mm in size in a sparse to moderately abundant extremely fine grained groundmass of plagioclase. Fine grained opaque commonly is abundant.

Quartz forms angular grains from 0.1-0.15 mm in size.

Opaque forms ragged patches up to 0.5 mm in size. These are mainly very fine grained aggregates, and grade into opaque-rich fragments with abundant disseminated opaque in an extremely fine grained groundmass, probably of andesite or cherty quartz.

Biotite forms scattered laths up to 0.15 mm long; pleochroism is from light to medium brown.

Apatite forms a few prismatic to acicular grains up to 0.1 mm long.

Chert forms a few extremely fine grained fragments averaging 0.3-0.5 mm in size.

Actinolite? forms a few parallel aggregates up to 0.4 mm across; the mineral has moderate relief, 1st order white interference color, slightly inclined extinction (10-15°), and is length slow.

The groundmass consists mainly of extremely fine grained andesite? containing moderately abundant laths of plagioclase up to 0.05 mm long and scattered to abundant very fine grained opaque. It is partly replaced by very fine grained (0.01-0.03 mm) patches of calcite; the intensity of alteration ranges widely in different parts of the section from unaltered to moderately to strongly altered. Opaque forms disseminated to locally concentrated very fine grains. Limonite is probably associated with weathering of the rock, and forms irregular patches.

Chlorite with minor limonite forms light brown patches up to 0.3 mm across composed of very fine grained random aggregates.

The rock is cut by a few discontinuous veinlets of calcite up to 0.1 mm wide; they have chevron textures as in sample 1217. One oval patch 1.7 mm long consists of very fine grained calcite.

The rock contains a strong limonitic alteration on the weathered surface; which extends up to 1.5 cm into the rock. It is superimposed on a dendritic hematite-limonite alteration along irregular fractures.

fragments

plagioclase	10-15%	
opaque	2- 2½	
andesite	1½-2	(chlorite-plagioclase)
biotite	trace	

groundmass

andesitic mud	60-65
plagioclase	15-20
opaque	2- 3
limonite	2- 3

Plagioclase forms equant to lathy grains averaging 0.03-0.1 mm in size. These are slightly altered to sericite. Opaque forms scattered irregular grains averaging 0.03-0.1 mm in size. Andesite fragments consist of aggregates of plagioclase laths and interstitial chlorite; fragments are up to 0.2 mm across, and grains average 0.02-0.05 mm in size. Biotite forms a few laths up to 0.15 mm long; pleochroism is from light to medium reddish brown.

The groundmass is dominated by extremely fine grained andesitic mud composed mainly of plagioclase? with disseminated opaque and limonite grains. Scattered grains and patches of plagioclase as irregular to lathy grains average 0.02-0.03 mm in size.

fragments		
plagioclase	10-15%	
quartz	1- 1½	
chlorite	½- 1	
chert	trace	
opaque-bearing	2- 3	(with abundant opaque)
groundmass		
calcite	30-40	(patchy replacement)
andesite mud	30-40	
opaque	3- 5	
veinlets		
calcite		

Plagioclase forms angular equant to elongate fragments averaging 0.03-0.08 mm in size. Quartz forms angular fragments averaging 0.05 mm across. Chlorite forms a few angular patches composed of very fine grained aggregates; patches are up to 0.5 mm long. One fragment consists of a very fine grained aggregate of cherty quartz with grain size averaging 0.03 mm, and fragment size 0.15 mm across. Numerous fragments of extremely fine grained material contain abundant (over 30% opaque) as extremely fine to very fine grains.

The groundmass consists of extremely fine grained plagioclase? and lesser chlorite? with scattered plagioclase laths up to 0.05 mm in size. It is partly replaced by calcite which occurs as irregular patches with average grain size 0.03-0.07 mm. Much of the groundmass contains extremely fine grained disseminated opaque.

Calcite appears to replace some plagioclase fragments in regions of the sample where calcite is abundant in the groundmass. Here calcite grains and patches have outlines similar to those of angular plagioclase grains and fragments elsewhere in the sample.

The rock contains a few discontinuous veinlets up to 0.05 mm thick composed of calcite.

fragments	
plagioclase	20-25%
andesite	2- 2½
leucoxene	minor
apatite	one grain
groundmass	
andesitic mud	60-65
opaque	5- 7
sericite patches	minor
limonite	3- 5 (concentrated in certain layers)

Plagioclase forms fragments averaging 0.03-0.1 mm in size, with a few up to 0.2 mm long. They are fresh to slightly altered to sericite.

Andesite (possibly same as groundmass) forms a few discrete fragments from 0.1-0.15 mm in size. It is extremely fine grained and contains scattered coarser plagioclase laths.

Leucoxene forms a few grains from 0.1-0.15 mm in size.

Apatite forms one prismatic grain 0.1 mm long.

The groundmass is predominantly an extremely fine grained mud probably composed of plagioclase, with scattered plagioclase laths up to 0.05 mm long. It contains abundant disseminated opaque, which also is concentrated in certain patches and fragments. Grain size of opaque averages 0.005-0.02 mm.

Sericite forms a few patches up to 0.1 mm across composed of radiating flakes.

Limonite is concentrated near one end of the section as a dusty alteration, which gives the fine grained groundmass a yellow-brown color, and which obscures the optical properties of the groundmass minerals.

Polished Section Study

79C - 1190

Almost all the reflective grains are of pyrite, which occurs in three main modes:

- 1) as individual equant anhedral grains up to 0.1 mm in size
- 2) as clusters of grains averaging 0.01-0.02 mm in size concentrated in a large number of fragments; in some of these pyrite comprises up to 50% of the fragment.
- 3) as spherical growths of thinly layered pyrite and non-reflective minerals, with grain size up to 0.4 mm. Individual layers probably average 0.02 mm thick. Some fragments consist of angular fragments of these spherical growths.

A few grains of hematite are present; these are up to 0.2 mm in size, and generally consist of fine grained intergrowths of reflective and non-reflective hematite.

79C - 1244

Almost all reflective grains are of pyrite, which occurs in two main modes:

- 1) as extremely fine to very fine grains (0.01-0.02 mm) scattered through the rock, and locally concentrated in certain fragments.
- 2) as fine grained (0.03-0.05 mm) spherical aggregates of extremely fine to very fine grains, in part intergrown with minor non-reflective minerals.
- 3) one cluster of three grains 0.02-0.03 mm across appears to be either secondary pyrite or recrystallized pyrite; grains have subhedral outlines.

A few grains consist of a medium grey, isotropic mineral with low hardness. It is not an oxide mineral, and possibly may be chalcocite. These grains range from 0.05-0.15 mm in size.

79C - 1182

Almost all reflective grains are of pyrite. It occurs mainly as very fine grains (0.005-0.02 mm) with rounded to irregular outlines. These are moderately to strongly concentrated in certain fragments. A few spherical grains are up to 0.05 mm across and are as in the second type of texture described above for sample 1244.

One grain 0.03 mm across may be chalcopyrite, it is a deeper yellow than pyrite and appears to be softer.

Several grains of Ti-oxide up to 0.25 mm across are present; they form rims surrounding non-reflective material of similar internal reflection, probably leucoxene.

A few grains and clusters of grains are of a soft, light to medium grey mineral with low to moderate reflectivity and isotropic character. It is probably the same mineral as that described in sample 1244.

Polished Section Study (continued)

79C-1217

Pyrite forms grains mainly as in sample 79C-1182, with average grain size 0.01-0.02 mm. In some fragments up to 0.2 mm across, pyrite is concentrated and forms up to 50% of the fragment as rounded to elongated grains averaging 0.02 mm in size.

Pyrrhotite forms scattered grains and clusters of a few grains with average grain size 0.02-0.03 mm, and a few patches up to 0.1 mm across.

Ti-oxide and hematite form a few scattered patches averaging 0.05-0.1 mm across. Some are extremely fine grained aggregates and others are coarser grains up to 0.05 mm across. One patch of hematite appears to be an aggregate of poorly defined subparallel flakes up to 0.1 mm long.