PETROGRAPHIC STUDY OF THE COLDSTREAM GOLD PROPERTY IN THE SHEBANDOWAN BELT OF NORTHWESTERN ONTARIO

Prepared For:
Michael Koziol
Vice President Exploration
ALTO VENTURES LTD.

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109883-A. Gold in chlorite vein with fine-grained rutile (dk. gray).
Width of photo: 0.45mm. Refl. light.

Prepared by:
Eva S. Schandl Ph.D.

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION &amp; OBJECTIVES</td>
<td>2</td>
</tr>
<tr>
<td>DISCUSSION AND CONCLUSIONS</td>
<td>2</td>
</tr>
<tr>
<td>TABLE 1. ROCK TYPES</td>
<td>2</td>
</tr>
<tr>
<td>TABLE 2. VISUALLY ESTIMATED % MINERALS</td>
<td>5-56</td>
</tr>
<tr>
<td>DETAILED PETROGRAPHY</td>
<td></td>
</tr>
</tbody>
</table>
INTRODUCTION AND OBJECTIVES

The suite of sixteen drill cores described in the present petrographic study, were selected from four drill holes in the Coldstream Gold property of Alto Ventures Ltd (K-38, K-39, K-41 & K-44) in the Shebandowan belt of northwestern Ontario. Gold assays obtained on the drill core samples range from 22.0 g/t/m to 0.2 g/t/m.

The objectives of the study were:

1. To identify the host lithologies, where possible
2. To identify the hydrothermal alteration types and styles in the rocks
3. To determine the paragenetic sequence of veins, sulfides and gold, and
4. To determine the style of mineralization

DISCUSSION AND CONCLUSIONS

(1) The major lithological units in the suite of rocks are mostly quartz-feldspar porphyries or feldspar porphyries. They are variably altered (silicification, carbonate sericite, and albite alteration), sheared, granulated and recrystallized. The type of rocks as identified on the basis of mineralogy and texture, are listed in Table 1 below.

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Rock Type</th>
<th>Major alteration</th>
</tr>
</thead>
<tbody>
<tr>
<td>74677</td>
<td>sheared qtz-carb. rock</td>
<td>quartz, carbonate</td>
</tr>
<tr>
<td>74688</td>
<td>feldspar porphyry</td>
<td>carbonate, sericite</td>
</tr>
<tr>
<td>74885*</td>
<td>felsic intrusive</td>
<td>carbonate</td>
</tr>
<tr>
<td>74910</td>
<td>feldspar porphyry</td>
<td>carbonate, sericite</td>
</tr>
<tr>
<td>74929*</td>
<td>feldspar porphyry</td>
<td>quartz, carbonate</td>
</tr>
<tr>
<td>74395*</td>
<td>feldspar porphyry</td>
<td>carbonate</td>
</tr>
<tr>
<td>74968*</td>
<td>QFP</td>
<td>quartz, sericite, carbonate</td>
</tr>
<tr>
<td>109512</td>
<td>QFP</td>
<td>sericite, carbonate</td>
</tr>
<tr>
<td>109516</td>
<td>fragmental</td>
<td>quartz, carbonate</td>
</tr>
<tr>
<td>109530 (Au)*</td>
<td>QFP?</td>
<td>albite, carbonate, quartz</td>
</tr>
<tr>
<td>109531*</td>
<td>QFP?</td>
<td>albite, quartz, carbonate</td>
</tr>
<tr>
<td>109534*</td>
<td>QFP?</td>
<td>albite, carbonate, quartz</td>
</tr>
</tbody>
</table>
(2) Four major alteration types were identified in the rocks: quartz, carbonate, albite and sericite. Carbonate and secondary quartz are ubiquitous in most samples, sericite alteration is variable, and secondary albite is important in four of the recrystallized quartz-feldspar porphyries. Gold was identified in two of the albitized rocks.

Shearing, granulation and recrystallization of primary minerals are common in several of the rocks, and the most extensively granulated samples are marked by * in Table 1. The hydrothermal evolution of the rocks is complex. Some secondary minerals pre-dated or were contemporaneous with shearing and granulation, whereas others post-dated shearing and deformation.

Silicification (where present) represents the earliest hydrothermal event in the rocks. The quartz aggregates show evidence of strain, deformation and stretching, suggesting their presence prior to shearing. The quartz veins and aggregates were partly replaced by carbonates, and sericite veins boudinage the carbonates. Deformation of the sericite veins suggests that the carbonates and the sericite crystallized prior to shearing and deformation.

Albite is an important secondary mineral in several of the rocks. It is apparent from the well-formed and undeformed grains that albite post-dated shearing and deformation in the rocks. The albite veins have no particular orientation, and appear to fill fractures. Although carbonates are present in some of the albite-rich domains, they are not abundant. Late pyrite poikiloblasts over-grow the albites, and some contain gold. This suggests that at least some of the pyrite post-dated shearing, and that sulfidation represents a late hydrothermal event.

(3) Several vein types were identified in the suite of samples: quartz, carbonate, sericite, albite, chlorite, pyrite and magnetite. Because not all veins are represented in any given sample, interpretation of their paragenetic sequence is difficult. Some of the quartz and carbonate veins and the sericite have a pre-deformation origin, whereas albite veins, minor second generation carbonates that over-print the albite, represent a
late hydrothermal event. Pyrite poikiloblasts that over-grow the albite, also crystallized during such late hydrothermal event. Gold occur as inclusions in such late pyrite, or they fill fractures in pyrite in two albitized rocks, and also occur within pyrite poikiloblasts in the recrystallized quartz-feldspar porphyry.

(4) Minute (ca. 10-20\(\mu\)m) grains of gold occur as inclusions in pyrite and in fractures of pyrite. The pyrite post-dated most hydrothermal alteration and occur as poikiloblasts or form rims on albite and carbonate. The style of mineralization at the Coldstream property is best described as shear-zone related. Although the gold is hosted by granulated, recrystallized and hydrothermally altered porphyry, the type and intensity of alteration in the rocks is inconsistent with a typical porphyry-style mineralization.
<table>
<thead>
<tr>
<th>Sample #</th>
<th>74677</th>
<th>74688</th>
<th>74885</th>
<th>74910</th>
<th>74929</th>
<th>74395</th>
<th>74968</th>
<th>109512</th>
<th>109516</th>
<th>109530 A&amp;B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock type</td>
<td>?</td>
<td>FP</td>
<td>*felsic int.</td>
<td>FP</td>
<td>*FP</td>
<td>*FP</td>
<td>*QFP</td>
<td>QFP</td>
<td>fragmental</td>
<td>*QFP</td>
</tr>
<tr>
<td>Gold assay (g/T)/1.0m</td>
<td>5.5</td>
<td>4.3</td>
<td>5.0</td>
<td>10.0</td>
<td>3.2</td>
<td>6.2</td>
<td>2.7</td>
<td>0.2</td>
<td>3.3</td>
<td>22.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gold</th>
<th>GOLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz</td>
<td>75</td>
</tr>
<tr>
<td>Plagioclase</td>
<td>x</td>
</tr>
<tr>
<td>Albite (secondary)</td>
<td>20</td>
</tr>
<tr>
<td>K-feldspar</td>
<td></td>
</tr>
<tr>
<td>Sericite</td>
<td>2</td>
</tr>
<tr>
<td>Carbonate</td>
<td>15</td>
</tr>
<tr>
<td>Chlortie</td>
<td>x</td>
</tr>
<tr>
<td>Tourmaline</td>
<td></td>
</tr>
<tr>
<td>Zircon</td>
<td>x</td>
</tr>
<tr>
<td>Apatite</td>
<td>x</td>
</tr>
<tr>
<td>Monazite</td>
<td></td>
</tr>
<tr>
<td>Pyrite</td>
<td>8</td>
</tr>
<tr>
<td>Pyrrhotite</td>
<td></td>
</tr>
<tr>
<td>Chalcopyrite</td>
<td></td>
</tr>
<tr>
<td>Magnetite</td>
<td>5</td>
</tr>
<tr>
<td>Haematite</td>
<td></td>
</tr>
<tr>
<td>Rutile</td>
<td>x</td>
</tr>
</tbody>
</table>

FP=feldspar porphyry, QFP=quartz-feldspar porphyry, *=sheared, granulated, x=trace amount, felsic int.=felsic intrusive, felsic volc.=felsic volcanic
### TABLE 1. VISUAL ESTIMATION OF % MINERALS FROM THE COLDSTREAM PROJECT

<table>
<thead>
<tr>
<th>Sample #</th>
<th>109531</th>
<th>109534</th>
<th>109539</th>
<th>109836</th>
<th>109872</th>
<th>109883 A&amp;B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock type</td>
<td>*QFP?</td>
<td>*QFP?</td>
<td>QFP</td>
<td>*QFP?</td>
<td>QFP</td>
<td>?</td>
</tr>
<tr>
<td>Drill Hole</td>
<td>K-41</td>
<td>K-41</td>
<td>K-41</td>
<td>K-44</td>
<td>K-44</td>
<td>K-44</td>
</tr>
<tr>
<td>Gold assay (g/T)/1.0m</td>
<td>8.5</td>
<td>1.6</td>
<td>1.4</td>
<td>3.0</td>
<td>2.5</td>
<td>12.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mineral</th>
<th>109531</th>
<th>109534</th>
<th>109539</th>
<th>109836</th>
<th>109872</th>
<th>109883 A&amp;B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold</td>
<td>GOLD</td>
<td>GOLD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quartz</td>
<td>65</td>
<td>45</td>
<td>52</td>
<td>50</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Plagioclase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Albite (secondary)</td>
<td>20</td>
<td>35</td>
<td></td>
<td>25</td>
<td>5</td>
<td>x</td>
</tr>
<tr>
<td>K-feldspar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Sericite</td>
<td>x</td>
<td>x</td>
<td>10</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Carbonate</td>
<td>12</td>
<td>15</td>
<td>8</td>
<td>15</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>Chlorite</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Tourmaline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Zircon</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Apatite</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Monazite</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pyrite</td>
<td>1</td>
<td>3</td>
<td>x</td>
<td>10</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Pyrrhotite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalcopyrite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnetite</td>
<td>2</td>
<td>2</td>
<td>x</td>
<td>8</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Haematite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rutile</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
PETROGRAPHY

Ppl = plane polarized light
XN = crossed nicols
Refl. light = reflected light
Petrographic Description:

A sheared, laminated and silicified rock. Due to extensive silicification, it is not possible to identify the protolith. Lamination is indicated by the changes in grain size within the quartz bands and by the parallel alignment of the bands. Some of the more coarse-grained quartz-rich bands are partly albitized. The rock consists predominantly of partially recrystallized quartz, replacement carbonates, minor interstitial sericite, and sericite veins. The quartz are stretched and deformed.

Carbonate alteration post-dated silicification as suggested by the replacement of some quartz by carbonate aggregates in the bands. Carbonate also occurs in veins that parallel the rock fabric, and late sericite veinlets boudinage the carbonates. Amoeba-like pyrite occur within quartz and carbonate bands, and they are aligned parallel to the rock fabric.

Detailed mineralogy

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size(mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz</td>
<td>75</td>
<td>&lt;0.2-0.8</td>
<td>Fine-grained, microcrystalline quartz alternate with the more coarse-grained quartz-rich bands. The fine-grained quartz-rich domains contain interstitial carbonate, minor sericite and fine-grained pyrite. The quartz have undulose extinction.</td>
</tr>
<tr>
<td>Carbonate</td>
<td>15</td>
<td>Variable</td>
<td>Anhedral carbonate occur as replacement after quartz. They are interstitial to quartz, and partly replace the quartz in the more coarse-grained quartz bands. Late narrow carbonate veins cross-cut the rock fabric.</td>
</tr>
<tr>
<td>Pyrite</td>
<td>8</td>
<td>&lt;0.3-0.8</td>
<td>Fine-grained pyrite is disseminated through the rock. The anhedral to subhedral grains occur in bands that partly replace the quartz. Fine-grained pyrite also occurs as seams interstitial to the fine and medium-grained bands.</td>
</tr>
<tr>
<td>Sericite</td>
<td>2</td>
<td></td>
<td>Sericite occurs in veins and the disseminated aggregates are interstitial to the quartz and carbonates.</td>
</tr>
</tbody>
</table>

Accessory minerals: secondary albite, chlorite, rutile
74677-A. Silicified rock. Width of photo: 2.3mm. XN.

74677-B. Carbonate (C) over-prints quartz in silicified rock. Width of photo: 2.3mm. XN.
Sample Number: 74688  
Rock Type: Altered Feldspar Porphyry

Petrographic Description:

Carbonate-altered and sericitized feldspar porphyry. The rock is granulated and partly recrystallized. The fine-grained cherty matrix contains randomly oriented plagioclase clasts, most of which are sericitized and partly replaced by fine-grained carbonate. The rock was originally cross-cut by a few quartz veins (silicification?), and the veins were subsequently partly replaced by coarse-grained carbonate. Plagioclase and some K-feldspar phenocrysts in the matrix show evidence of partial recrystallization as some of the relict grains are replaced by chessboard albite. Granulation is apparent from the rock fabric and from the texture of the individual phenocrysts. Small stringers of sericite boudinage the feldspar phenocrysts, the carbonates and some of the sulfides.

Late pyrite occurs in veinlets that parallel the rock fabric. They often replace some of the plagioclase phenocrysts or the fine-grained, anhedral magnetite. Fine-grained, anhedral-euhedral magnetite are disseminated through the matrix, they occur in veinlets, and they are interstitial to pyrite. Fine-grained aggregates of rutile occur in veinlets and as replacement after titanomagnetite.

Detailed mineralogy

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size(mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagioclase</td>
<td>35</td>
<td>&lt;0.5-2.5</td>
<td>Plagioclase occur as fragmented and partly recrystallized phenocrysts. Some of the phenocrysts are bent and deformed. They are commonly altered by carbonate and sericite. Aggregates of phenocrysts are ‘engulfed’ by carbonates, which are rimmed by sericite veinlets.</td>
</tr>
<tr>
<td>Quartz</td>
<td>15</td>
<td>Variable</td>
<td>Fine-grained quartz is part of the matrix, and also occurs in veins that cross-cut the rock fabric. They all have undulose extinction, except for the recrystallized granoblastic quartz in some veins.</td>
</tr>
<tr>
<td>Carbonate</td>
<td>35</td>
<td>&lt;0.2-2.0</td>
<td>Anhedral, fine-grained carbonate partly replaced some of the matrix. The coarse-grained carbonates occur as replacement after the plagioclase phenocrysts, and also form veins. They are partly deformed.</td>
</tr>
<tr>
<td>Mineral</td>
<td>Size</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Sericite</td>
<td>5</td>
<td>Sericite is interstitial to the fine-grained matrix, and also occurs as small veinlets that boudinage the feldspar phenocrysts and the coarse-grained carbonates.</td>
<td></td>
</tr>
<tr>
<td>Pyrite</td>
<td>5 &lt;0.3-1.5</td>
<td>Anhedral-subhedral pyrite is disseminated through the matrix. Some also occur in veinlets.</td>
<td></td>
</tr>
<tr>
<td>Magnetite</td>
<td>5 &lt;0.3-1.0</td>
<td>Fine-grained, anhedral magnetite is disseminated through the matrix, and the subhedral grains occur in veins or as aggregates with the pyrite.</td>
<td></td>
</tr>
</tbody>
</table>

Accessory minerals: albite, chlorite, rutile, zircon
74688-A. Plagioclase phenocrysts (light) in carbonate altered feldspar porphyry. Width of photo: 2.3mm. XN.

74688-B. As above.
Sample Number: 74885  
Rock Type: Altered felsic intrusive

Petrographic Description:

Fine-grained albite-rich rock. It consists predominantly of albite, quartz, magnetite-haematite, carbonate and pyrite. Although the rock is extensively altered, it has a typical igneous texture indicative of a felsic intrusion (albitite?). It may represent either a contact zone between the felsspar porphyry and the country rock, or it is a fragmental consisting predominantly of fragments derived from the felspar porphyry. The feldspars are generally more fine-grained than in the previous porphyry (74688), they are strained, partly deformed and recrystallized at the grain boundaries. Quartz is interstitial to the albite, and both minerals are partly carbonatized. Very fine-grained, anhedral carbonate are disseminated through the rock, but they also occur as more coarse-grained subhedral aggregates and veins. Magnetite and haematite are abundant. Subhedral / anhedral titanomagnetite are partly replaced by haematite.

Pyrite is relatively abundant in the rock. It occurs in fine-grained aggregates that partly replace the magnetite, and as large, anhedral / subhedral grains that form boudins on feldspar aggregates. The coarse-grained pyrite post-dated or was contemporaneous with deformation and granulation in the rock.

Detailed mineralogy

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size(mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagioclase</td>
<td>50</td>
<td>minute-2.5</td>
<td>The feldspars are probably albite, as suggested by the extinction angles in some of the relict grains. They occur in clusters, aggregates and as granulated grains partly replaced by fine-grained quartz and sericite. The orientation and distribution of the grains suggest that the rock may be a fragmental.</td>
</tr>
<tr>
<td>Quartz</td>
<td>20</td>
<td>&lt;0.2-1.0</td>
<td>Quartz are anhedral, interstitial grains associated with the feldspars. They are partly recrystallized and have embayed, ragged grain boundaries.</td>
</tr>
<tr>
<td>Carbonate</td>
<td>20</td>
<td>&lt;0.2-2.0</td>
<td>Fine-grained carbonate is disseminated in the rock. It partly replaced some of the plagioclase. Carbonate veins are parallel to the rock fabric.</td>
</tr>
<tr>
<td>Pyrite</td>
<td>5</td>
<td>Variable, up to.</td>
<td>Fine-grained pyrite occur as small</td>
</tr>
<tr>
<td></td>
<td>1.5mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>----------------</td>
<td>----------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>stringers, and often parallel the carbonate veins. The texture</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>of fine-grained stringers implies a sedimentary origin, whereas</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>the coarse-grained pyrite over-grow the albite phenocrysts.</td>
<td></td>
</tr>
</tbody>
</table>

| Magnetite /    | 5              | Variable |
| haematite      |                |          |
|                |                | Fine-grained, magnetite / haematite occur as aggregates and as  |
|                |                | veins. They are relatively abundant and have granular texture.  |
|                |                | Euhedral and subhedral blocky magnetite are disseminated through  |
|                |                | the rock, and are partly replaced by the fine-grained magnetite  |
|                |                | / haematite.                                                  |

Accessory minerals: chlorite, sericite, apatite, rutile
74885-A. Fragmented plagioclase phenocrysts in carbonate altered felsic intrusion. Width of photo: 2.3mm. XN.

74885-B. Magnetite is replaced by haematite. Width of photo: 0.45mm. Refl. light.
74885-C. Pyrite (black) poikiloblasts over-grow carbonates and secondary albite. Width of photo: 0.45mm. XN.
Sample Number: 74910  Rock Type: Altered feldspar porphyry

Petrographic Description:

An extensively carbonatized sheared and granulated feldspar porphyry. The rock consists of plagioclase phenocrysts set in a matrix of fine-grained carbonate and quartz. Numerous small veinlets (muscovite and chlorite) form a network, and they are interstitial to the carbonate altered feldspars. Sericite alteration of the feldspars is common, and the micas occur as inclusions or rims on the feldspar phenocrysts. The rock is fractured and the twin lamellae in the feldspars are bent, fractured and displaced. The fractures are filled by fine-grained carbonate. The composition of the feldspars, as determined from the extinction angle of the twin lamellae (Levy method) is generally in the range of oligoclase. The carbonates locally form fine-grained domains interstitial to and replacing the granulated quartz-feldspar grains. Carbonate also occurs as coarse-grained aggregates and veins that cross-cut the rock fabric.

Fine-grained magnetite are disseminated through the rock, it occurs in aggregates in veins, and they are commonly intergrown with rutile. Minor pyrite occur as anhedral to euhedral grains and aggregates.

Detailed mineralogy

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size(mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagioclase</td>
<td>43</td>
<td>&lt;0.3-2.5</td>
<td>Plagioclase phenocrysts are fractured, fragmented and deformed. Their composition (as determined on 4 grains) is oligoclase. There is evidence of partial recrystallization of some grains. Most plagioclase are weakly sericitized, granulated and partly or completely replaced by fine-grained carbonates.</td>
</tr>
<tr>
<td>Quartz</td>
<td>24</td>
<td>&lt;0.3-2.0</td>
<td>Quartz is interstitial to the plagioclase phenocrysts. The grains are anhedral, have undulose extinction, and ragged grain boundaries.</td>
</tr>
<tr>
<td>Carbonate</td>
<td>25</td>
<td>&lt;0.3-2.5</td>
<td>Carbonates occur as minute grains that locally form aggregates, as veins that cross-cut the rock fabric, and as coarse-grained aggregates. They are cross-cut by some of the sericite veins.</td>
</tr>
<tr>
<td>Sericite</td>
<td>5</td>
<td></td>
<td>Fine-grained sericite occur as inclusions in the feldspars, and as veinlets that form a</td>
</tr>
</tbody>
</table>
Magnetite 2 <0.3 Fine-grained magnetite is disseminated through the matrix.

Rutile 1 Fine-grained aggregates of rutile are associated with the magnetite veins and aggregates.

Accessory minerals: chlorite, pyrite, rutile, apatite, zircon
74910-A. Plagioclase phenocrysts in feldspar porphyry are replaced by carbonate. Width of photo: 2.3mm. XN.

74910-B. Fragmented and carbonate altered plagioclase in feldspar porphyry. Width of photo: 2.3mm. XN.
Sample Number: 74929  
Rock Type: Recrystallized feldspar porphyry

Petrographic Description:

The rock is extensively recrystallized, silicified and partly carbonatized. The fine-grained matrix consists of chert, microcrystalline quartz, and very fine-grained carbonate. Several quartz veins cross-cut the present rock fabric. Relict fragments of small, granulated feldspars are also part of the matrix. As the twin lamellae of feldspars have been destroyed, it is not possible to visually estimate their composition. Microcrystalline and fine-grained magnetite are interstitial to quartz and the feldspars in the matrix. The anhedral grains are skeletal and partly fragmented. Fine-grained quartz veins cross-cut the rock matrix and occur in parallel bands. Anhedral to euhedral pyrite are locally abundant as aggregates, veins or single grains. Fine-grained carbonate veinlets cross-cut the quartz veins and also occur as replacement after the vein quartz.

Detailed mineralogy

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size(mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz</td>
<td>65</td>
<td>&lt;0.1-1.0</td>
<td>Anhedral, fine-grained quartz makes up a significant part of the rock. Quartz occur as anhedral, granulated grains that are part of the matrix, and as veins that consist of equigranular, granoblastic and semi-granoblastic aggregates. Most grains in the veins are sutured, embayed and stretched, and in the matrix they have poorly defined grain boundaries. All have undulose extinction.</td>
</tr>
<tr>
<td>Carbonate</td>
<td>18</td>
<td>&lt;0.1-&lt;0.5</td>
<td>Very fine-grained carbonate is interstitial to the quartz-rich matrix, and also form veinlets that partly replace the quartz. Carbonate alteration in the rock post-dated silicification, as the carbonate veins cross-cut the vein quartz.</td>
</tr>
<tr>
<td>Plagioclase</td>
<td>10</td>
<td>&lt;0.5</td>
<td>Plagioclase phenocrysts are fragmented and granulated. Fine-grained matrix feldspars are interstitial to quartz. They are difficult to identify.</td>
</tr>
<tr>
<td>Pyrite</td>
<td>3</td>
<td>minute-0.5</td>
<td>Anhedral / euhedral pyrite occur in veinlets that more or less parallel the rock fabric. A relatively coarse pyrite vein however, is</td>
</tr>
</tbody>
</table>
perpendicular to the other veins.

Sericite 2
Fine-grained sericite is interstitial to the matrix quartz and the feldspars.

Magnetite 2 <0.3
Very fine-grained magnetite is disseminated through the matrix. The larger grains are skeletal.

Accessory minerals: chlorite, apatite, rutile
74395-A. Relict plagioclase in granulated and altered feldspar porphyry. Width of photo: 2.3mm. XN.

74395-B. Silicified and carbonate-altered feldspar porphyry. Carbonate replaces quartz (white). Width of photo: 2.3mm XN.
74395-C. Pyrite poikiloblast (black) over-grows quartz and carbonate.
Width of photo: 2.3mm. XN.
Sample Number: 74968   Rock Type: Recrystallized QFP

Petrographic Description:

An extensively recrystallized quartz-feldspar porphyry. The rock consists of fine-grained quartz-rich matrix, relict quartz phenocrysts, granulated ghosts of plagioclase phenocrysts, and replacement minerals such as, carbonate, sericite and chlorite. The rock is partly silicified, and contains small quartz veinlets and secondary quartz aggregates. Sericite veinlets are common and form a network in the rock, carbonate occurs in fine-grained aggregates within some domains, and very fine-grained chlorite needles are interstitial to the sericite. Carbonate replacement is less extensive than in the previous samples, and sericite is a more important secondary mineral than carbonate. The rock is sheared and granulated, the sericite veinlets are deformed and wrap-around some quartz phenocrysts and aggregates.

Magnetite is rare, and pyrite is relatively abundant in some domains. The pyrite are anhedral to euhedral grains and are most abundant in the sericite-veins.

Detailed mineralogy

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size(mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz</td>
<td>65</td>
<td>&lt;0.2-2.0</td>
<td>Fine-grained quartz makes up most of the rock matrix. Some matrix quartz are secondary and represent silicification of the rock. Quartz phenocrysts and clasts are up to 2.0mm, and occur as subhedral to anhedral grains. Several phenocrysts have resorbed grain boundaries that were inherent in the original rock. Some phenocrysts are fractured, fragmented, and most have undulose extinction.</td>
</tr>
<tr>
<td>Plagioclase</td>
<td>10</td>
<td>&lt;0.5</td>
<td>Plagioclase are mostly recrystallized and the present assemblage is not representative of its original abundance. As the twin lamellae have been destroyed, their composition cannot be estimated.</td>
</tr>
<tr>
<td>Sericite</td>
<td>12</td>
<td></td>
<td>Sericite occurs mostly as contorted veinlets that form a network within the silicified rock. Some boudinage the quartz phenocrysts. Fine-grained sericite is also interstitial to the matrix quartz.</td>
</tr>
<tr>
<td>Carbonate</td>
<td>8</td>
<td>Variable</td>
<td>Fine-grained carbonate is interstitial to the</td>
</tr>
</tbody>
</table>
matrix quartz, it occurs in aggregates that partly replace some of the feldspars, and as small veinlets.

Pyrite 5 <0.2-1.0 Fine-grained pyrite is disseminated through some domains in the rock. The subhedral-euhedral grains are often associated with the sericite.

Accessory minerals: magnetite, rutile, apatite
74968-A. Wide sericite vein in granulated quartz-feldspar porphyry.
Width of photo: 2.3mm. XN.

74968-B. Quartz phenocrysts in altered quartz-feldspar porphyry.
Width of photo: 2.3mm. XN.
Sample Number: 109512

Rock Type: Quartz-feldspar porphyry

Petrographic Description:

A moderately altered quartz-feldspar porphyry. The rock consists of partly sericitized, fractured and fragmented plagioclase, sericitized and fragmented K-feldspars, and quartz phenocrysts within a very fine-grained matrix of equigranular quartz and feldspars. The matrix contains a few grains of magnetite, fine-grained leucoxene (after titanomagnetite) and small grains of anhedral pyrite. The secondary minerals are predominantly sercite, and fine-grained carbonate. Secondary quartz occurs as small veins, as fine-grained aggregates within some of the sercite-altered domains, and as coarse-grained aggregates, which evidently represent recrystallized quartz phenocrysts. Most feldspar phenocrysts are altered (sercite+carbonate), fractured, and some are fragmented. The fragmented grains are boudinaged by sercite veinlets. Sercite occurs as replacement after the feldspars, but also as anastomosing veins that cross-cut the rock fabric. A few grains of fragmented tourmaline occurs in the matrix. Their texture suggests that they pre-dated sercite and carbonate alteration.

Detailed mineralogy

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size(mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagioclase</td>
<td>25</td>
<td>0.5-2.5</td>
<td>Plagioclase occurs as large, altered and fragmented phenocrysts. The composition of the feldspars cannot be determined due to extensive alteration – they are probably oligoclase-albite. Most grains are sericitized and partly replaced by fine-grained carbonate. Their twin lamellae are bent or offset.</td>
</tr>
<tr>
<td>Quartz</td>
<td>45</td>
<td>minute-2.0</td>
<td>Quartz occurs as very fine-grained matrix, as phenocrysts and as secondary aggregates and veins that represent silicification. Some of the phenocrysts are completely recrystallized to granoblastic aggregates, and others are strained, fractured and fragmented.</td>
</tr>
<tr>
<td>K-feldspar</td>
<td>5</td>
<td>0.5-1.5</td>
<td>The % of K-feldspars in the rock is probably under-estimated, as several of the grains are fragmented and partly replaced by sercite. They were identified by their single twinning (Carlsbad) and –ve interference figure.</td>
</tr>
<tr>
<td>Mineral</td>
<td>Value</td>
<td>Size</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>-------</td>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>Sericite</td>
<td>15</td>
<td>&lt;0.2-2.0</td>
<td>Sericite alteration effected all feldspars. Sericite occurs as inclusions in the feldspars, as well as sericite-rich domains that partly replaced the feldspars. Sericite also occurs as veins that boudinage some phenocrysts, and as veins that cross-cut the rock fabric.</td>
</tr>
<tr>
<td>Carbonate</td>
<td>10</td>
<td>&lt;0.2-2.0</td>
<td>Carbonate is randomly distributed in the rock. It appears to have pre-dated sericite that forms rims on some of the carbonates.</td>
</tr>
</tbody>
</table>

Accessory minerals: magnetite, leucoxene, pyrite, tourmaline, apatite, chlorite
109512-A. Sericite veins rim plagioclase phenocrysts in quartz-feldspar porphyry. Width of photo: 2.3mm. XN.

109512-B. Carbonate vein in QFP. Width of photo: 2.3mm. XN.
Sample Number: 109516  
Rock Type: Fragmental

Petrographic Description:

An extensively altered and granulated rock. Although a few relict fragments of feldspar and quartz phenocrysts were identified, much of the rock consists of fine-grained quartz + carbonate + magnetite + sericite. The texture of the matrix quartz does not resemble the previous sample (109512), and the abundance of subhedral-euhedral magnetite in the rock suggests a protolith that was different from the quartz-feldspar porphyry. Sericite veins boudinage the relict quartz and feldspar phenocrysts, and carbonate is relatively abundant in some domains. They pre-dated the sericite veins, as the veins boudinage some of the carbonates.

Pyrite occur as subhedral-euhedral grains and broken fragments. They are disseminated through the matrix and also occur as veins. Magnetite is abundant in some domains – but they are generally not associated with the relict feldspar-quartz phenocrysts, only with the fine-grained quartz and carbonate. Some magnetite occur in veins, suggesting a secondary origin. Fine-grained rutile is part of the matrix. It occurs in small domains (0.2-0.2mm) as aggregates. They appear to have crystallized from the breakdown of titanomagnetite or ilmenite.

Detailed mineralogy

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size (mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz</td>
<td>45</td>
<td>Minute-2.0</td>
<td>Anhedral quartz makes up part of the matrix. The fine-grained matrix consists of inequigranular quartz and carbonate. The texture of quartz suggests granulation and deformation. Relict quartz phenocrysts and quartz clasts occur in the matrix. They are partly fragmented, and several of the grains are rimmed by secondary quartz coronas. Late quartz veinlets intrude the matrix. All quartz grains are strained and have undulose extinction.</td>
</tr>
<tr>
<td>Plagioclase</td>
<td>20</td>
<td>&lt;0.3-1.5</td>
<td>Plagioclase phenocrysts are fragmented and they occur only as broken clasts. Their composition cannot be determined as the twin lamellae has been partly destroyed.</td>
</tr>
<tr>
<td>Sericite</td>
<td>15</td>
<td></td>
<td>Sericite occurs as veins and as aggregates interstitial to the fragmented feldspars. Most veins are anastomosing,</td>
</tr>
</tbody>
</table>
Carbonate 10 Variable

Fine-grained carbonate is interstitial to the granulated quartz-rich matrix. Large, anhedral carbonates also occur as replacement after the feldspars, and as relatively coarse-grained veins.

Magnetite 7 Av. 0.3

Anhedral-subhedral magnetite occur in aggregates within the matrix, as well as veins that consist of aggregates. They could not have been derived from the porphyry, which was magnetite poor (109512).

Pyrite 3 <0.3-1.0

Pyrite are subhedral-euhedral single grains, they also occur in aggregates or in veins.

Accessory minerals: chlorite, apatite, rutile
109516-A. Sericite and carbonate altered fragmented plagioclase in a fragmental (?). Width of photo: 2.3mm. XN.

109516-B. Sericite altered fragmental (?). Width of photo: 2.3mm. XN.
Petrographic Description:

GOLD occurs as inclusion in pyrite poikiloblast (within secondary albite+quartz aggregates), and it also infills fractures in pyrite.

A fine-grained, sheared, silicified and albitized rock. The matrix consists of fine-grained quartz, minor carbonate and feldspars. Relict quartz phenocrysts are overgrown by secondary quartz coronas, some are fractured and fragmented. The rock contains numerous albite veins. The albite are secondary, and in some domains they are intergrown with quartz. Some grains are chessboard albite. Silicification of the rock is evident from the presence of quartz veins, quartz-rich domains, and the secondary quartz over-growth on quartz phenocrysts. The quartz are sheared and stretched, suggesting shearing and deformation in the rock. Minor carbonate alteration overprinted the albite, as carbonate are interstitial to or partly replace the albite.

Pyrite is relatively abundant. Most anhedral-euhedral grains are randomly oriented, and some occur as veinlets. Magnetite is relatively sparse and it occurs as small grains with haematite over-growth.

### Detailed mineralogy

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size(mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz</td>
<td>50</td>
<td>Minute-2.5</td>
<td>Fine-grained quartz is part of the matrix. Quartz also occur as subhedral/anhedral phenocrysts, and as overgrowth on quartz phenocrysts. Most have undulose extinction. Some quartz are intergrown with albite in the veins. They are often plumose.</td>
</tr>
<tr>
<td>Albite</td>
<td>20</td>
<td>Up to 2.0</td>
<td>Fine to coarse-grained albite occurs in veins and as aggregates within the matrix. They are secondary, as suggested by the common occurrence of chessboard albite within the veins. Albite grains are relatively fresh and the only alteration within the grains is, partial replacement by carbonates.</td>
</tr>
<tr>
<td>Carbonate</td>
<td>15</td>
<td>Variable, up to 3.0</td>
<td>Fine-grained carbonates are commonly disseminated within the quartz-rich matrix. They also occur as coarse-grained aggregates partly replacing the albite.</td>
</tr>
<tr>
<td>Mineral</td>
<td>Code</td>
<td>Abundance</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
<td>-----------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Pyrite</td>
<td>10</td>
<td>Variable</td>
<td>Subhedral-anhedral pyrite occurs as single grains, as veins and as aggregates. Some are poikiloblasts that over-grow the quartz and carbonates. Some pyrite contains <strong>GOLD</strong> inclusions and gold also occurs in the fractures.</td>
</tr>
<tr>
<td>Sericite</td>
<td>5</td>
<td></td>
<td>Fine-grained sericite occur in anastomosing veins that define the rock fabric. It is also interstitial to the matrix.</td>
</tr>
</tbody>
</table>

*Accessory minerals: magnetite, apatite, tourmaline, **GOLD***
109530-A. Albitized QFP. Width of photo: 2.3mm. XN.

109530-B. Sericite vein in granulated quartz-feldspar porphyry. Width of photo: 2.3mm. XN.
Petrographic Description:

The rock is granulated, silicified and recrystallized. The matrix consists of fine-grained quartz and plagioclase – mostly secondary albite. The presence of small quartz clasts that may have been phenocrysts, and shadows of recrystallized plagioclase suggest that the rock may be a sheared and granulated quartz-feldspar porphyry. The rock is cross-cut by several quartz veins, some of which contain secondary albite interstitial to vein quartz. The matrix contains minute grains and aggregates of carbonates that are interstitial to quartz. Some of the quartz veins are partly replaced by carbonates, suggesting that silicification pre-dated carbonate alteration.

Pyrite is disseminated throughout the rock. It consists of anhedral aggregates, and also occur as single grains. Some of the large grains are poikiloblasts that over-grow replacement carbonates in quartz aggregates. Relict, euhedral magnetite are partly replaced by haematite, and the siliceous matrix also contains fine-grained anhedral haematite and secondary magnetite.

**Detailed mineralogy**

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size(mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz</td>
<td>65</td>
<td>minute-2.0</td>
<td>Most of the matrix consists of fine-grained, anhedral quartz. Quartz also occurs as corroded and fragmented phenocrysts, and as veins that cross-cut the rock fabric. Most quartz in the matrix and in the veins have sutured, embayed grain boundaries, and all have undulose extinction. The latter suggests deformation and strain, and the former suggests disequilibrium crystallization.</td>
</tr>
<tr>
<td>Carbonate</td>
<td>12</td>
<td>Minute-2.0</td>
<td>Fine-grained carbonate is interstitial to the matrix quartz. Coarse-grained carbonate over-prints and replace some of the coarse-grained vein quartz and the albite.</td>
</tr>
<tr>
<td>Albite</td>
<td>20</td>
<td>Av. 1.0</td>
<td>Fine-grained albite and chessboard albite are intergrown with the matrix quartz, and they also occur within the quartz veins. The feldspar laths in the veins are interstitial to quartz.</td>
</tr>
<tr>
<td>Pyrite</td>
<td>1</td>
<td>&lt;0.3-2.0</td>
<td>Anhedral-subhedral pyrite is most</td>
</tr>
</tbody>
</table>
Magnetite / 2 <0.2-0.6

common in the carbonate-altered quartz-albite veins. They are poikiloblasts in the veins and over-grow the carbonates.

Haematite occur as small, anhedral grains interstitial to the matrix.

Accessory minerals: sericite, apatite, monazite, chlorite

Only a few grains of primary anhedral-euhedral magnetite were identified. They are partly replaced by haematite. Haematite occur as small, anhedral grains interstitial to the matrix.
109531-A. Quartz phenocrysts in granulated and altered QFP. Width of photo: 2.3mm. XN.

109531-B. Silicified QFP. Width of photo: 2.3mm. XN.
Sample Number: 109534
Rock Type: Recrystallized QFP

Petrographic Description:

The mineralogy of the rock is comparable to the previous sample, 109531. However, matrix albite occurs in small laths, and magnetite / haematite, as well as pyrite, are more abundant. It appears that the rock is partly granulated and sheared and the matrix consists of fine-grained quartz and feldspars. Phenocrysts of subhedral / anhedral quartz, up to 1.5 mm diameter are rimmed by secondary quartz coronas. Some are fractured and fragmented. The texture of the rock resembles a recrystallized and granulated quartz-feldspar porphyry. Although the feldspar phenocrysts have recrystallized to fine-grained aggregates, the outline of the aggregates suggests a plagioclase precursor. Fine-grained carbonate occurs in veins and is also interstitial to the matrix. Quartz veins and albite veins are also common.

Subhedral magnetite is disseminated through the matrix, and some are partly or completely replaced by haematite. Fine-grained, anhedral haematite are disseminated in the rock.

Detailed mineralogy

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size (mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albite</td>
<td>35</td>
<td>&lt;0.3-1.5</td>
<td>Albite are secondary, as suggested by the common presence of chessboard albite in the matrix, and in the veins. Some albite and quartz aggregates outline the shape of the original plagioclase they replaced.</td>
</tr>
<tr>
<td>Quartz</td>
<td>45</td>
<td>&lt;0.2-1.5</td>
<td>The matrix quartz is fine-grained and forms interlocking aggregates with the feldspars. The vein quartz contains some albite, and the subhedral / anhedral quartz phenocrysts are rimmed by secondary quartz. They all have undulose extinction and partly sutured grain boundaries.</td>
</tr>
<tr>
<td>Carbonate</td>
<td>15</td>
<td>&lt;0.8</td>
<td>Anhedral-euhedral carbonate occurs in veins, and as single grains interstitial to the matrix. It represents a late replacement, forming rims on the feldspars and quartz.</td>
</tr>
<tr>
<td>Magnetite / haematite</td>
<td>2</td>
<td>Variable</td>
<td>Subhedral / euhedral magnetite are partly replaced by haematite. They are disseminated in the rock matrix.</td>
</tr>
</tbody>
</table>
Pyrite 3 <0.3-1.0  Anhedral / subhedral pyrite occur as single grains and as aggregates. Some are intergrown with magnetite.

Accessory minerals: apatite, chlorite, sericite, rutile
109534-A. Fragmented quartz phenocryst in granulated QFP. Width of photo: 2.3mm. XN.

109534-B. Carbonate altered QFP. Width of photo: 2.3mm. XN.
Sample Number: 109539  
Rock Type: Quartz-feldspar porphyry

Petrographic Description:

A partly recrystallized, sheared and altered quartz-feldspar porphyry. The rock consists of sericitized plagioclase, K-feldspar phenocrysts and glomerocrysts, and coarse-grained quartz phenocrysts, all in a matrix of fine-grained equigranular quartz, minor feldspars and sericite. The rock contains several quartz veins, carbonate veins and sericite veins. Deformation is apparent from the numerous anastomosing sericite veins that boudinage some of the fragmented feldspar and quartz phenocrysts. Quartz in the veins generally have granoblastic texture, and they are partly replaced by carbonates. Some of the quartz-carbonate veins are fragmented and cross-cut by sericite veins.

Pyrite and magnetite are rare. Most of the magnetite have been partly replaced by rutile, suggesting the they were originally titanomagnetite. Fine-grained secondary rutile occurs in stringers within the sericite veins. Only a few small grains of pyrite were identified.

Detailed mineralogy

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size(mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz</td>
<td>52</td>
<td>Minute-2.5</td>
<td>Microcrystalline quartz makes up most of the matrix. Quartz also occurs as phenocrysts and as part of the quartz-carbonate veins. The phenocrysts are extensively strained and some are deformed, whereas the veins quartz has semi-granoblastic texture. The matrix quartz is equigranular, microcrystalline, and it is intergrown with some feldspars.</td>
</tr>
<tr>
<td>Plagioclase</td>
<td>25</td>
<td>Av. 2.5</td>
<td>The plagioclase feldspars are albite-oligoclase. They are extensively sericitized, fractured and fragmented. Some of the grains are granulated and are boudinaged by anastomosing sericite veins.</td>
</tr>
<tr>
<td>K-feldspars</td>
<td>5</td>
<td>Av. 1.0</td>
<td>Most K-feldspars (orthoclase) phenocrysts are pervasively sericitized, and partly recrystallized. They are present as glomerocrysts intergrown with the plagioclase, and also as single grains.</td>
</tr>
<tr>
<td>Mineral</td>
<td>Size</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Carbonate</td>
<td>8</td>
<td>Anhedral carbonates mostly occur in veins and partly replace the earlier quartz veins. Several are poikiloblasts with inclusions of quartz.</td>
<td></td>
</tr>
<tr>
<td>Sericite</td>
<td>10</td>
<td>Sericite occurs as replacement after the feldspars, and most commonly as anastomosing veins that boudinage most of the quartz and feldspar phenocrysts.</td>
<td></td>
</tr>
</tbody>
</table>

Accessory minerals: rutile, magnetite, pyrite, zircon
109539-A. Sericite altered plagioclase phenocryst in QFP. Width of field: 2.3mm. XN.

109539-B. Sericite veins boudinage relict, carbonate altered quartz phenocryst. Width of photo: 2.3mm. XN.
Petrographic Description:

GOLD was identified in pyrite fractures. The pyrite occurs within secondary albite aggregates.

The rock is extensively silicified, granulated and recrystallized. The outline of relict plagioclase phenocrysts suggests that the protolith may have been a quartz-feldspar porphyry. The rock has an unusual mineralogy and texture. The present mineralogy consists predominantly of quartz, secondary albite, and carbonate. The rock is extensively silicified and contains numerous quartz veins, as well as several veins that consist of quartz and albite-chessboard albite. Albite aggregates also form small domains in the quartz-rich matrix. Pyrite is abundant and commonly occurs with very fine-grained rutile in the albite-rich domains.

Detailed mineralogy

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size(mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz</td>
<td>50</td>
<td>Minute-1 cm</td>
<td>Several quartz generations were identified in the rock. The original quartz in the matrix recrystallized to semi-granoblastic aggregates. Two quartz generations were identified. The early quartz represents silicification in the rock, and the late quartz occurs in veins. Some quartz veins are partly replaced by carbonates, and some quartz veins are composite containing several grains of albite. Very coarse-grained quartz in a vein is up to 1 cm in diameter. Most quartz are strained and have undulose extinction.</td>
</tr>
<tr>
<td>Albite</td>
<td>25</td>
<td>&lt;0.3-2.0</td>
<td>The matrix contains fine-grained albite interstitial to quartz. Secondary albite occurs in veins and in aggregates within the matrix. Several of the albite are chessboard albite and the aggregates may have crystallized as replacement after relict plagioclase phenocrysts. The albite veins are intergrown with some quartz.</td>
</tr>
<tr>
<td>Carbonate</td>
<td>15</td>
<td>&lt;0.2-1.5</td>
<td>Carbonate occurs as replacement after the quartz. They are intergrown with the quartz aggregates and form carbonate-rich</td>
</tr>
</tbody>
</table>
Pyrite 10 <0.2-1.0

Anhedral-euhedral pyrite occur in parallel bands. They are associated with the quartz and albite veins and with the carbonates. **GOLD** was identified in fractured pyrite that occurs in albite aggregates.

Accessory minerals: sericite, zircon, apatite, chlorite, rutile, **GOLD**
109836-A. Albite-rich vein in altered QFP. Width of photo: 2.3mm. XN.

109836-B. Gold in pyrite fracture. Width of photo: 0.22mm. Refl. light
Sample Number: 109872  

Rock Type: Quartz-feldspar porphyry

Petrographic Description:

Fragmented, granulated and extensively altered quartz-feldspar porphyry. Large feldspar phenocrysts are deformed, fractured, fragmented and the fragments are offset. The quartz phenocrysts are partly recrystallized and partly granulated. Early silicification is suggested by the fine-grained quartz veins and the quartz-rich domains that are partly replaced by carbonates. The rock contains an abundance of secondary magnetite. Veins and aggregates of coarse-grained, euhedral magnetite represent ca. 10% of the rock. Carbonate alteration is extensive, and fine-grained carbonates partly replace most of the matrix. They also occur as small veinlets that fill fractures in some of the feldspar phenocrysts.

Pyrite is much less common than magnetite. It occurs as small to large, anhedral-subhedral grains interstitial to the carbonates. Some form small veins.

Detailed mineralogy

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size(mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagioclase</td>
<td>40</td>
<td>0.5-4.0</td>
<td>Coarse-grained plagioclase phenocrysts are probably oligoclase, as suggested by the extinction angles of two relict plagioclase grains. They are carbonate altered, and the fractures are filled by carbonate veins. Granulation and fragmentation of the grains are common.</td>
</tr>
<tr>
<td>Quartz</td>
<td>25</td>
<td>&lt;0.3-1.5</td>
<td>Granular quartz and recrystallized quartz were originally phenocrysts as suggested by their texture. The fine-grained quartz in the matrix and in silicified domains have semi-granoblastic texture.</td>
</tr>
<tr>
<td>Carbonate</td>
<td>25</td>
<td></td>
<td>Fine-grained, anhedral carbonates partly replaced the original mineralogy (quartz and feldspars) of the rock. Carbonate alteration represents a post deformation and brecciation event, or carbonate replacement occurred during the waning stages of deformation and shearing.</td>
</tr>
<tr>
<td>Magnetite</td>
<td>8</td>
<td>Av. 0.5</td>
<td>Euhedral / subhedral magnetite are abundant. They occur in veins, in aggregates, and as single grains. Some</td>
</tr>
</tbody>
</table>
are partly replaced by haematite and some haematite form rims on magnetite.

Anhedral-subhedral pyrite occur in aggregates and as single grains. Some are intergrown with magnetite.

Accessory minerals: sericite, zircon, apatite, rutile, pyrrhotite
109872-A. Fragmented plagioclase in QFP. Width of photo: 2.3mm. XN

109872-B. Fragmented and granulated plagioclase in QFP. Width of photo: 2.3mm. XN
Sample Number: 109883 A & B  

Rock Type: ?

Petrographic Description:

GOLD was identified as a minute inclusion in pyrite, and it also fills fractures in pyrite. The pyrite occurs in the chlorite veins, suggesting the mobilization of gold during a late, shear-related hydrothermal event.

The mineralogy of this rock is significantly different from all of the previous samples. It consists predominantly of carbonate, fine-grained quartz aggregates, and pyrite. The carbonate-altered rock is cross-cut by dark green (Fe-rich) chlorite veins that locally contain a large number of tourmaline aggregates, as well as fine-grained rutile and some magnetite. The texture of the carbonates suggests that at least in some domains the carbonates replaced large plagioclase phenocrysts. The chlorite veins are contorted, and occur in fractures. They boudinage some of the carbonate aggregates, and also occur in anastomosing veins.

### Detailed mineralogy

<table>
<thead>
<tr>
<th>Mineral</th>
<th>%</th>
<th>Grain size(mm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbonate</td>
<td>60</td>
<td>&lt;0.3-2.8</td>
<td>Carbonates occur as fine-grained aggregates intergrown with fine-grained quartz, and as coarse grained aggregates that resemble replacement after plagioclase phenocrysts. Most carbonates are anhedral, they are locally fractured and fragmented, and cross-cut by late chlorite veins.</td>
</tr>
<tr>
<td>Quartz</td>
<td>25</td>
<td>&lt;0.3-0.8</td>
<td>Quartz is interstitial to the carbonates. It occurs in granoblastic aggregates (recrystallized) and as relict veins that were partly replaced by the carbonates. Quartz evidently pre-dated carbonate alteration in the rock.</td>
</tr>
<tr>
<td>Pyrite</td>
<td>10</td>
<td>&lt;0.2-2.6</td>
<td>Most pyrite occur as anhedral grains. They are commonly associated with the carbonates and the chlorite veins. Several of the large grains are poikiloblasts that include carbonate and quartz, suggesting late-stage crystallization. Some pyrite contains minute grains of GOLD, and in some pyrite, gold occurs in fractures.</td>
</tr>
<tr>
<td>Chlorite</td>
<td>5</td>
<td>Dark green, contorted veins of chlorite cross-cut the fractured carbonates. Some chlorite veins contain numerous dark green tourmaline, fine-grained rutile, pyrite (with gold) and magnetite.</td>
<td></td>
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<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
</tbody>
</table>

Accessory minerals: magnetite, rutile, tourmaline, secondary albite, sericite, apatite, **GOLD**
109883-A. Gold in chlorite vein with fine-grained rutile (dk. gray).
Width of photo: 0.45mm. Refl. light.

109883-B. Tourmaline prisms in pyrite within chlorite vein. Width of photo: 0.45mm. XN.
109883-C. Gold inclusion in pyrite (in chlorite vein). Width of photo: 0.22mm. Refl. light.

109883-D. Chlorite vein and inclusions of pyrite (host to Au above) and rutile. Width of photo: 2.3mm. Ppl.
109883-E. Dark chlorite vein with fine-grained rutile and tourmaline inclusions (colored) cross-cuts carbonate-rich domain in a silicified and carbonate-altered rock. Width of photo: 2.3mm.XN.