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Mining District File Summary Sheet

DISTRICT	Rosebud
DIST_NO	4010
COUNTY If different from written on document	Pershing
TITLE If not obvious	Petrographic Examination of selected samples from the Rosebud mine area (Rosebud Petrographic Report #7) 7 July 2000
AUTHOR	Clark, J; Allen, K
DATE OF DOC(S)	2000
MULTI_DIST Y / N? Additional Dist_Nos:	
QUAD_NAME	Sulphur 7½'
P_M_C_NAME (mine, claim & company names)	Rosebud Mine; Rosebud Mining Co. LLC; Applied Petrographics
COMMODITY If not obvious	gold; silver
NOTES	Petrographic report; geology; photographs; mineral list 14 p.

Keep docs at about 250 pages if no oversized maps attached (for every 1 oversized page (>11x17) with text reduce the amount of pages by ~25)

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SS:	DP	7/30/08
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Revised: 1/22/08

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PETROGRAPHIC EXAMINATION OF SELECTED SAMPLES FROM THE ROSEBUD MINE AREA

(Rosebud Petrographic Report #7)

By

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APPLIED PETROGRAPHICS
Tucson, Arizona

7 July 2000

Prepared for

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INTRODUCTION

Applied Petrographics was requested to conduct detailed petrographic analyses on two samples from the Rosebud mine area. According to Kurt Allen, chief geologist for the Rosebud Mining Company, the samples represent dike rocks that intrude the host rock lithology package for the Rosebud vein mineralization. The objective of the petrographic analyses is to characterize the lithology of the dike rocks and the attendant alteration. Specifically in question is whether the dikes represent either a basaltic or intermediate to silicic intrusive phase.

METHODOLOGY

Two polished thin sections were prepared by Quality Thin Sections of Tucson, Arizona from samples provided by Kurt Allen, chief geologist for the Rosebud Mining Company LLC. The samples were given the same sample number (378C), presumably because they were collected from the same igneous body. This report refers to the two samples as follows:

378C-1	Tan to brown, very fine-grained intrusive rock
378C-2	Tan to brown, oxidized breccia

Each polished thin section was examined subsequently in transmitted and reflected light using an Olympus BX60 polarizing microscope, and under cathodoluminescence using a Nuclide ELM-2b Luminoscope mounted on a Nikon SMZ-1 stereo microscope with polarizing capability. Results are documented on photomicrographs taken with an Olympus OM-2 photographic system. The photomicrographs accompany this report as Figures 1 - 7. Results from the study are presented in the following section.

Abbreviations used in the text for standard petrographic observations are:

TLX	-	transmitted light, crossed polars
TLP	-	transmitted light, plane polarized
RL	-	reflected light
RLX	-	reflected light, crossed polars
CL	-	cathodoluminescence

RESULTS

Sample 378C-1

Sample 378C-1 is a light brown to tan, very fine-grained, seriate to microporphyritic intrusive rock (texturally, it could be permissively a lava). It shows a propylitic alteration assemblage of moderate intensity. The protolith appears to have been a dacite or andesite. The rock consists of a fine seriate mesh of plagioclase and chloritized mafics, minor intergranular quartz, and disseminated opaques. Microphenocryst phases are plagioclase and chloritized mafics (primary biotite and possibly pyroxene). The feldspar shows partial to complete alteration to calcite and clay, while most of the mafics are completely altered to chlorite±calcite. Scattered through the matrix are several cognate lithic inclusions containing a similar assemblage to that of the host. The rock is cut by narrow, sometimes discontinuous veinlets consisting of quartz or FeOx-chlorite-quartz. A visual estimate of mineral phase abundances is given below:

Plagioclase (pre-alteration)	65 - 75%
Mafics (chloritized biotite and pyroxene?)	10 - 15%
Quartz (groundmass)	5 - 8%
Quartz (veinlet)	< 1%
Disseminated and veinlet opaques	0.5 - 1%
Disseminated rutile(?)	<0.5%
Calcite	10 - 15%
Clay	8 - 10%
Apatite	trace

Plagioclase was the dominant primary mineral component in the sample. The plagioclase forms a seriate mesh of narrow laths that range from <0.04 - 0.4mm in length. Aspect ratios range from about 3:1 to 16:1. The larger crystals impart a microporphyritic texture to the sample. The plagioclase laths show moderate to strong alteration to an assemblage of calcite±clay. Locally, some of the plagioclase microphenocrysts appear to be completely altered to clay, although it may be possible that feldspars pseudomorphed completely by clay were originally K feldspars, rather than plagioclase. Relict plagioclase shows characteristic albite twinning (010). Extinction angles against 010 are nearly parallel, consistent with a composition in the oligoclase range (method of Michel Levy).

Mafic phases show nearly complete alteration to chlorite±calcite. Only a trace of unaltered biotite was noted. Crystal morphologies are generally subhedral to anhedral. Many of the crystals of chloritized mafics are prismatic with preferred cleavage parallel to the long dimension (crystals cut parallel, or nearly so, to the c-axis). Some of the chloritized pseudomorphs have the hexagonal cross-section characteristic of biotite, although some of the pseudomorphs are equant and resemble pyroxene cross-sections cut perpendicular to the c-axis. Crystal sizes range from <0.05 - 0.45mm in length/diameter, with most of the crystals present tending toward the smaller crystal sizes. Chloritized mafics (biotite, pyroxene?) occur also as glomerocrystic aggregates of three or more crystals. The glomerocrystic aggregates reach 1mm in diameter.

Quartz is present as fine, irregular pools intergranular to the seriate feldspathic mesh. The intergranular quartz patches are generally < 0.05mm in diameter and have a tendency to enclose parts of the plagioclase crystals in subophitic fashion. Some portions of the slide have a higher density of intergranular quartz patches than others.

Quartz is present also as scattered, narrow, sinuous, discontinuous veinlets, either alone or accompanied by chlorite, opaques, and brown, nearly amorphous iron oxides. The veinlets range from < 0.1mm up to 0.5mm in width. Most of the veinlets appear to have narrow selvages of hydrous FeOx material.

A very fine-grained, reddish brown disseminated phase is present throughout the section. Birefringence is masked by the color and internal reflections. Crystal morphology is generally irregular to equant, and the average crystal size is on the order of 0.005mm diameter. This phase is identified tentatively as rutile. The rutile may have been derived from alteration of primary Fe-Ti oxide phases.

The sample contains scattered lithic xenoliths that appear to be cognate. The xenoliths have an assemblage of calcite-clay-altered plagioclase, chloritized mafics, and quartz ± opaques. They reach 2.5mm in diameter and are irregularly-shaped. The texture is xenomorphic- to hypidiomorphic-granular, and crystal sizes are roughly those of the coarsest microphenocryst phases. The abundance of chloritized mafics in the xenolithis is greater than that of the host rock.

RL: The sample contains approximately one percent opaque minerals. There is significant disseminated rutile. The rutile is very fine-grained (average ±0.005mm diameter) and characterized by gray color, low reflectance, and whitish-yellow to yellowish-brown internal reflections. The coarser disseminated opaques are predominantly goethite, possibly after pyrite. The disseminated goethite pseudomorphs are up to 0.2mm in diameter, while those contained within the veinlets reach 0.5mm in length. The goethite pseudomorphs tend to be anhedral and irregularly shaped, although some of the smaller crystals have rectangular morphology. The narrow veinlet selvages and some fractures contain significant earthy goethite with bright orange internal reflections.

CL: There is about 10-15% calcite (bright orange CL), primarily as replacement of plagioclase feldspar and, less commonly, biotite. Most of the matrix has dull reddish brown CL. The quartz veinlets are non-luminescent. There is only a trace of apatite with lemon yellow CL.

Representative photomicrographs from sample 378C-1 appear in Figures 1 - 4.

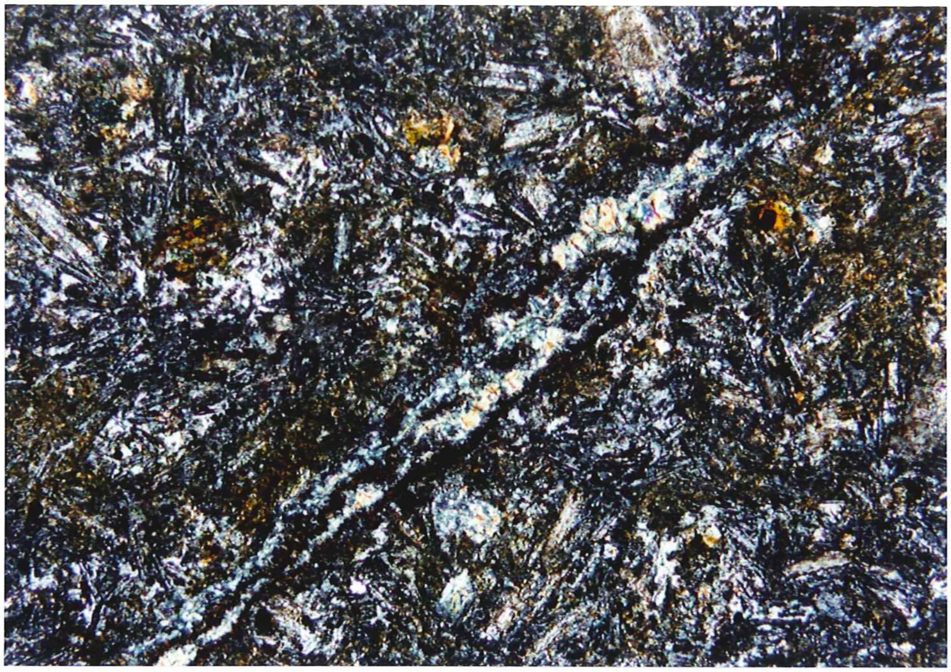

Figure 1a. 378C-1/dacite. A quartz-chlorite-FeOx veinlet cuts the dacite. The dacitic host contains microphenocrysts of plagioclase altered to calcite and clay and biotite altered to chlorite±calcite in a seriate mesh of altered plagioclase, chloritized biotite, and intergranular quartz. TLX; 1cm on the photo= 0.106mm.

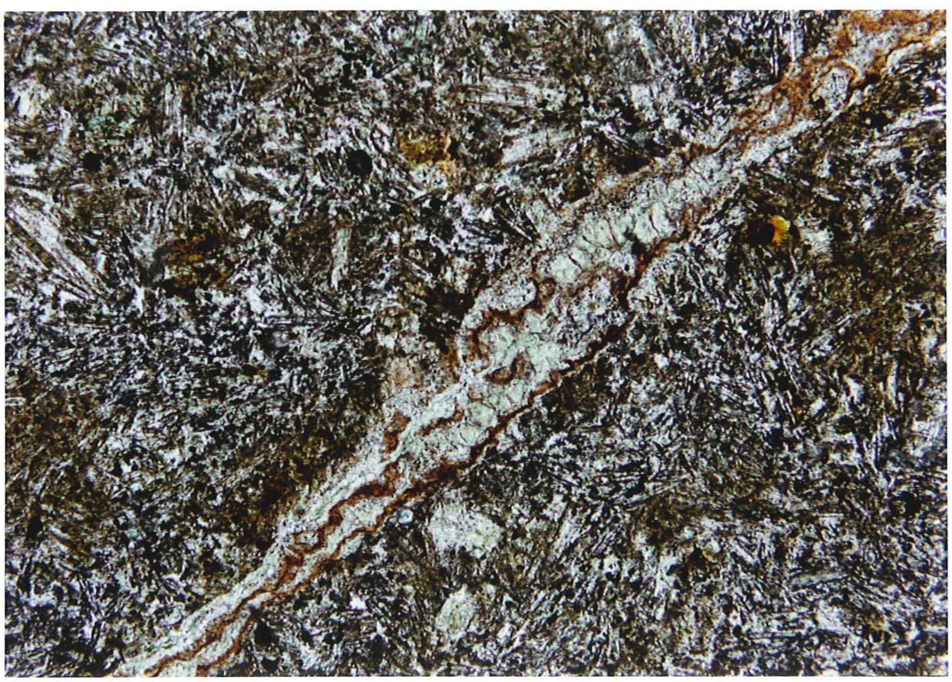

Figure 1b. 378C-1/dacite. Same view and scale as Figure 1a. TLP; 1cm on the photo= 0.106mm.

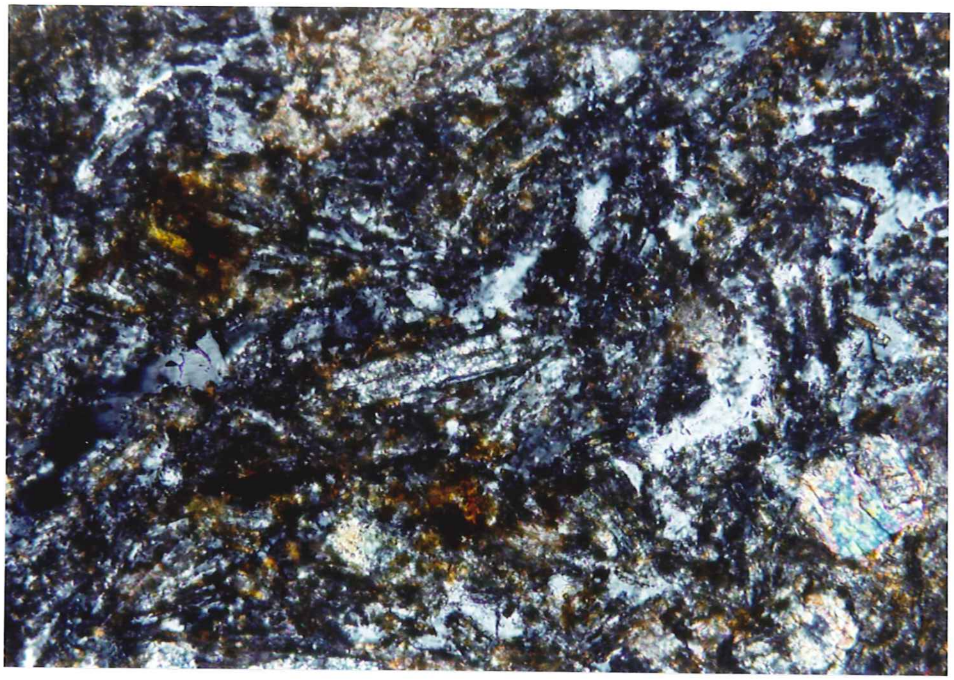

Figure 2a. 378C-1/dacite. A narrow quartz veinlet cuts the dacitic host. The dacite has seriate-microporphyritic texture imparted primarily by calcite-clay altered plagioclase. mafics are altered to chlorite and calcite. Most of the mafics were probably biotite, but the equant, chlorite-altered crystals in the lower right photo quadrant may be derived from primary pyroxene. TLX; 1cm on the photo= 0.053mm.

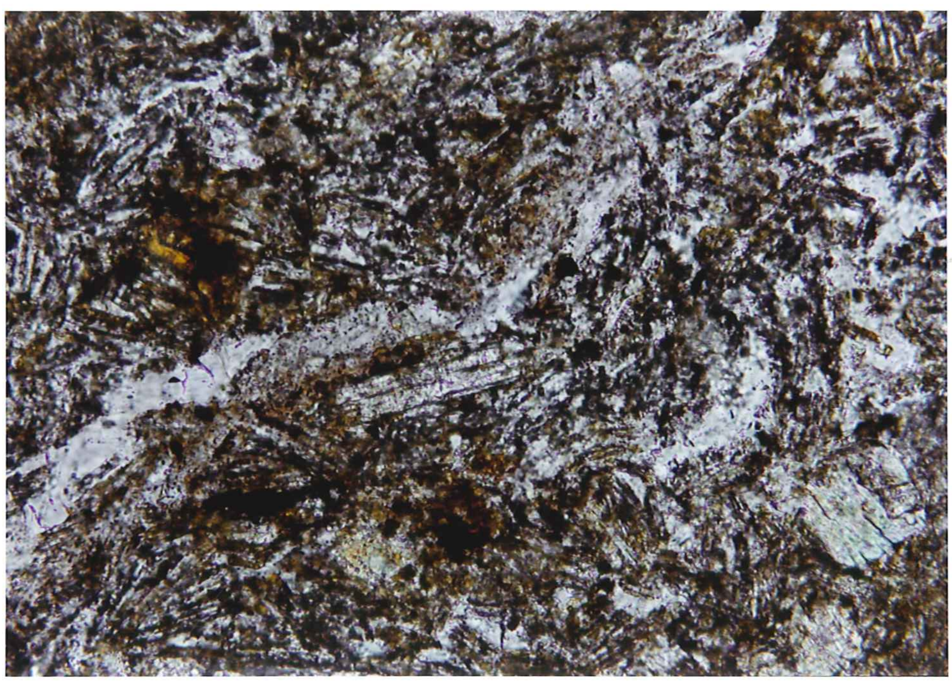

Figure 2b. 378C-1/dacite. Same view and scale as Figure 2a. TLP; 1cm on the photo= 0.053mm.

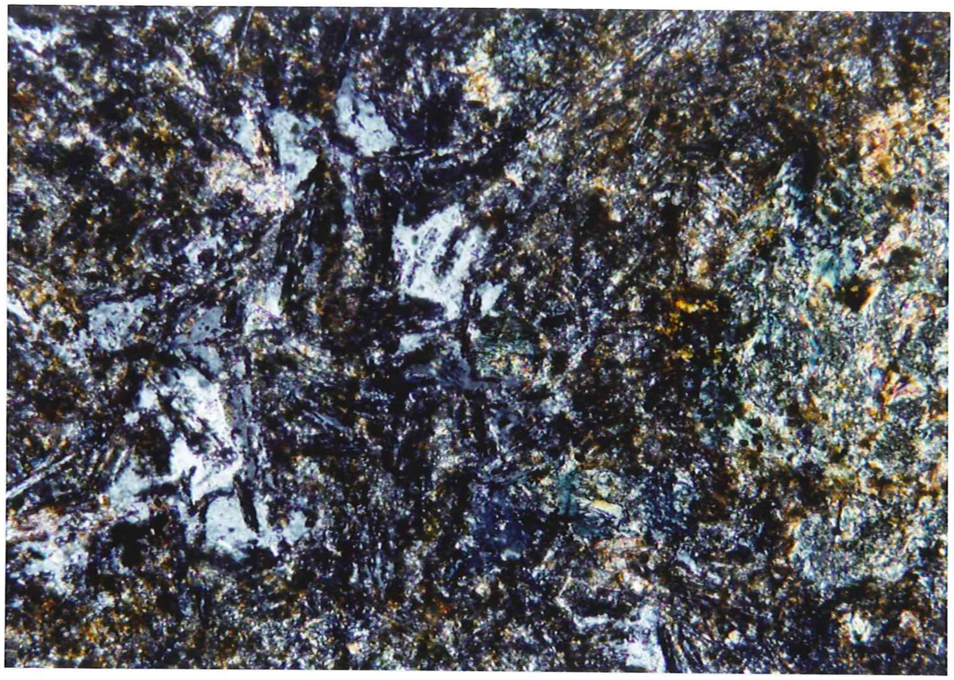

Figure 3a. 378C-1/dacite. Pools of quartz reside intergranular to the plagioclase laths predominantly in the left half of the photo. Present near the right photo edge is a cognate lithic xenolith composed of chloritized biotite and clay-calcite altered plagioclase. TLX; 1cm on the photo= 0.053mm.

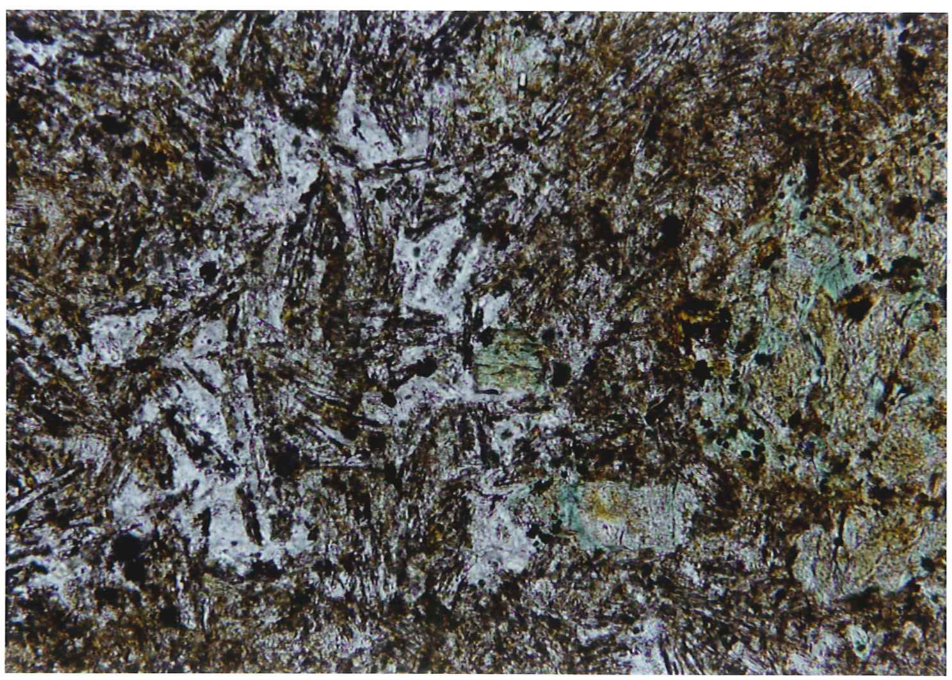

Figure 3b. 378C-1/dacite. Same view and scale as figure 3a. TLP; 1cm on the photo= 0.053mm.

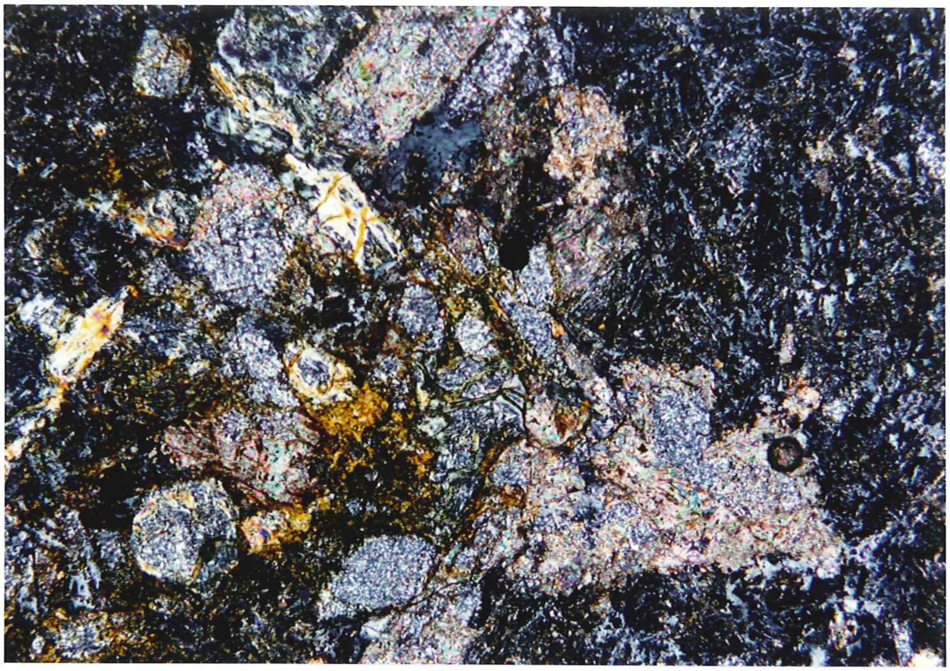

Figure 4a. 378C-1/dacite. Coarser-grained cognate lithic xenolith in the dacite is composed of clay-calcite altered plagioclase, chloritized biotite, and intergranular quartz. TLX; 1cm on the photo= 0.106mm.

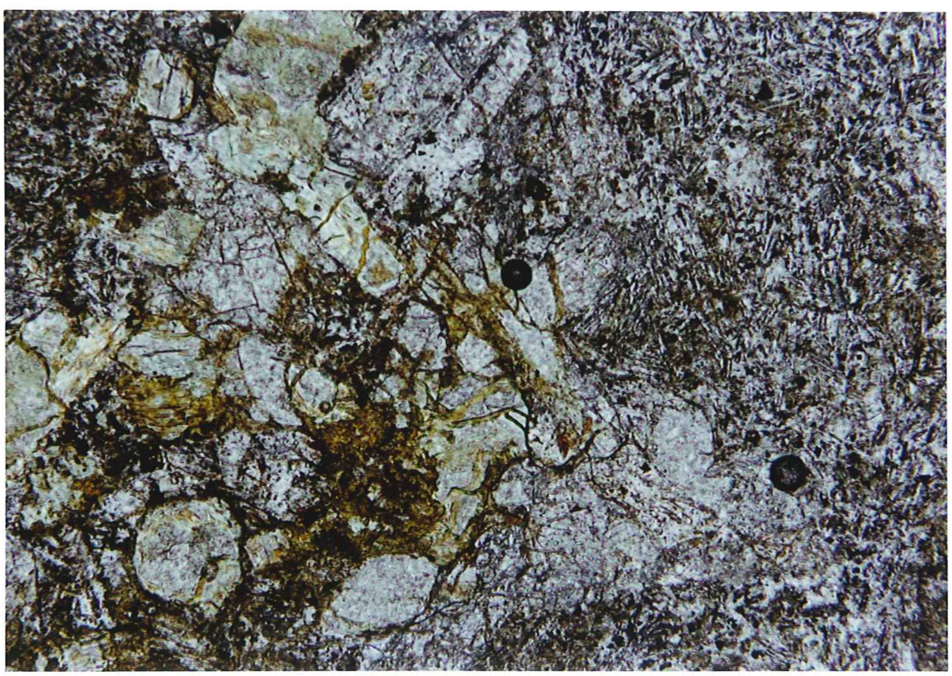

Figure 4b. 378C-1/dacite. Same view and scale as Figure 4a. TLP; 1cm on the photo= 0.106mm.

Sample 378C-2

Sample 378C-2 is a breccia. The breccia is poorly-sorted, closely packed, and ranges between fragment support and matrix support on the scale of the thin section. Locally it has the characteristics of a crackle breccia. The breccia contains subangular to subround clasts of microporphyritic to seriate-textured hypabyssal intrusive rock with dacitic to andesitic affinity (similar to sample 378C-1) set in a very fine-grained, highly oxidized matrix composed of hydrous iron oxides, very fine fragmental material derived from the igneous fragment lithology, and subordinate microcrystalline quartz and calcite.

The igneous fragment lithology appears identical to that described above for sample 378C-1, except that the breccia clasts are more strongly replaced by calcite. The carbonate alteration affects primarily the plagioclase, but it also affects the mafics to a lesser extent. The alteration obscures the details of the groundmass texture. The groundmass consists of a mesh of calcite-altered plagioclase laths, intergranular quartz, fine, equant chloritized biotite, disseminated, very fine, yellowish brown rutile, and scattered opaques that appear to be limonitic iron oxides. Average groundmass crystal size is about 0.03mm length/diameter. The groundmass contains microphenocrysts of altered plagioclase and biotite. The lath-shaped plagioclase microphenocrysts reach nearly 0.5mm in length. Maximum biotite microphenocryst sizes are slightly less. The plagioclase is strongly altered to an assemblage of calcite±clay±quartz, and the biotite shows nearly complete alteration to chlorite±calcite. Irregular patches of calcite to nearly 1mm in diameter are in places replacing glomerocrysts of multiple plagioclase microphenocrysts. Individual fragments contain wispy, often discontinuous veinlets or fracture fill of quartz, quartz-calcite, and/or calcite. The veinlet quartz is very fine-grained to microcrystalline. The veinlets range up to 0.15mm width, and they do not propagate into the matrix.

The dacitic lithic clasts make up 50 - 60 % of the sample. The clasts are subround to subangular with a size range from < 0.2mm to > 15mm in diameter. The fragments are tightly packed, although locally some fragments are completely free-floating in the matrix. In some areas of the slide the sample has a crackle breccia appearance. Several of the larger fragments contain abundant wispy quartz-calcite veinlets that also impart a crackle breccia appearance. Some of the fragments have narrow partial rims of earthy, limonitic iron oxides.

The breccia matrix is a reddish-brown, very fine-grained mixture of earthy limonitic iron oxides (±40-45%) and very fine fragmental material derived from the same lithology as the breccia clasts (50-55%), with subordinate microcrystalline quartz and calcite.

It is difficult to determine the ultimate derivation of this breccia from examination of a thin section size sample. The breccia may be a very shallow level intrusion breccia formed along the contact zone with the wall rocks. Alternatively, if the major lithology is extrusive, the breccia may be an autoclastic flow breccia. Determination of unit geometry would greatly aid in the geological interpretation of the sample lithology.

RL: Scattered irregularly-shaped goethite, possibly after pyrite (or magnetite?) is disseminated in both breccia clasts and matrix (<0.25%). Maximum crystal size is about 0.3mm in length/diameter. Earthy goethite takes a poor polish, but is identified by abundant yellow-orange internal reflections. It composes a significant proportion of the breccia matrix. A trace of magnetite was noted within a lithic clast. The magnetite forms a subhedral rectangular crystal with dimensions of about 0.07 by 0.05mm. Disseminated rutile is common within the lithic clasts. The rutile has whitish yellow internal reflections. It forms very fine-grained, generally irregular crystals that average about 0.002mm in diameter. Overall abundance is approximately 0.1 - 0.2 percent. The rutile may have been derived from alteration of primary disseminated FeTi oxide phases.

CL: There is about 15 - 20% calcite with bright orange CL. Calcite makes up as much as 30-40% of individual breccia clasts. The calcite replaces plagioclase and biotite to a lesser extent. Only a trace of apatite is present (lemon yellow CL; Mn^{2+} activation).

Photomicrographs representative of sample 378C-2 are illustrated in Figures 5 - 7.

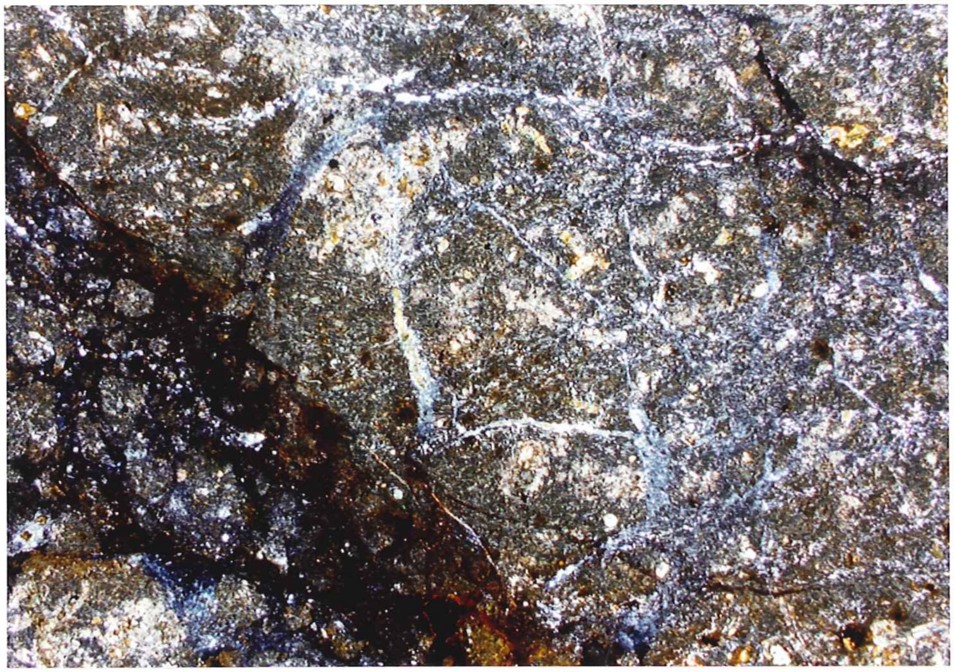

Figure 5a. 378C-2/dacitic breccia. Dacitic breccia clasts are strongly calcite-altered and sit in a matrix of limonitic iron oxides, pulverized dacitic material, and minor calcite and quartz. The breccia clast in the photo contains abundant wispy calcite veinlets that do not propagate into the breccia matrix. TLX; 1cm on the photo= 0.532mm.

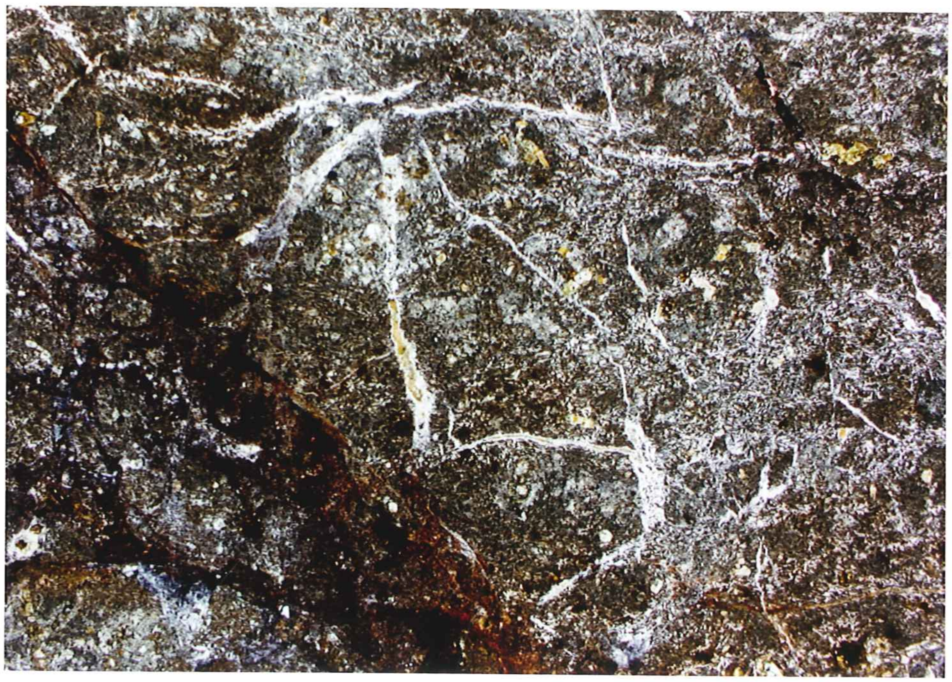

Figure 5b. 378C-2/dacitic breccia. Same view and scale as figure 5a. TLP; 1cm on the photo= 0.532mm.

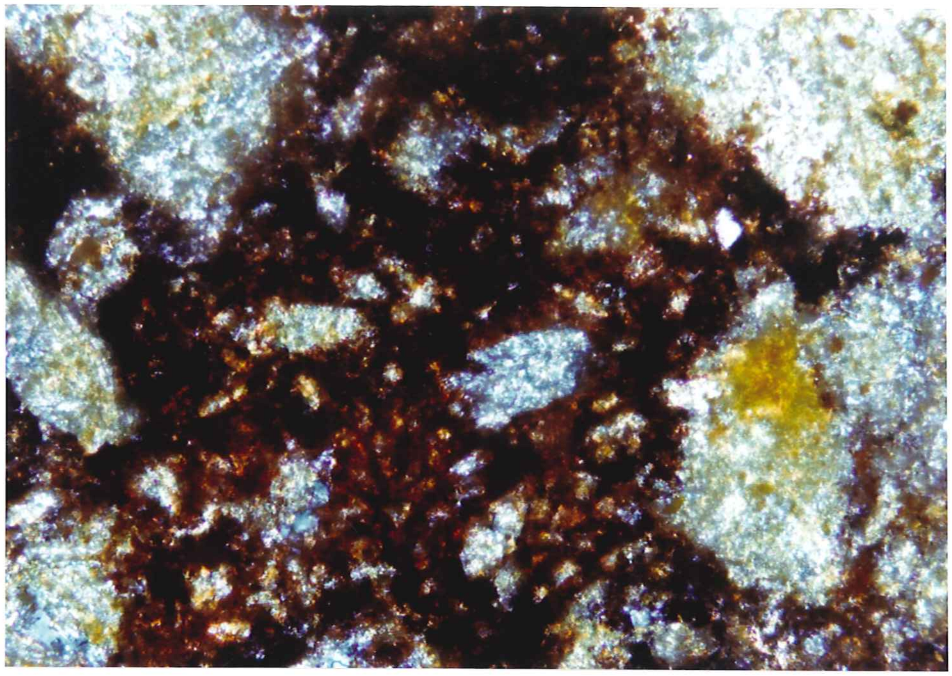

Figure 6a. 378C-2/dacitic breccia. The breccia matrix consists of limonitic iron oxides and very fine pieces of the dacitic lithology that makes up the larger fragments. Present also in the matrix are minor calcite and microcrystalline quartz. TLX; 1cm on the photo= 0.053mm.

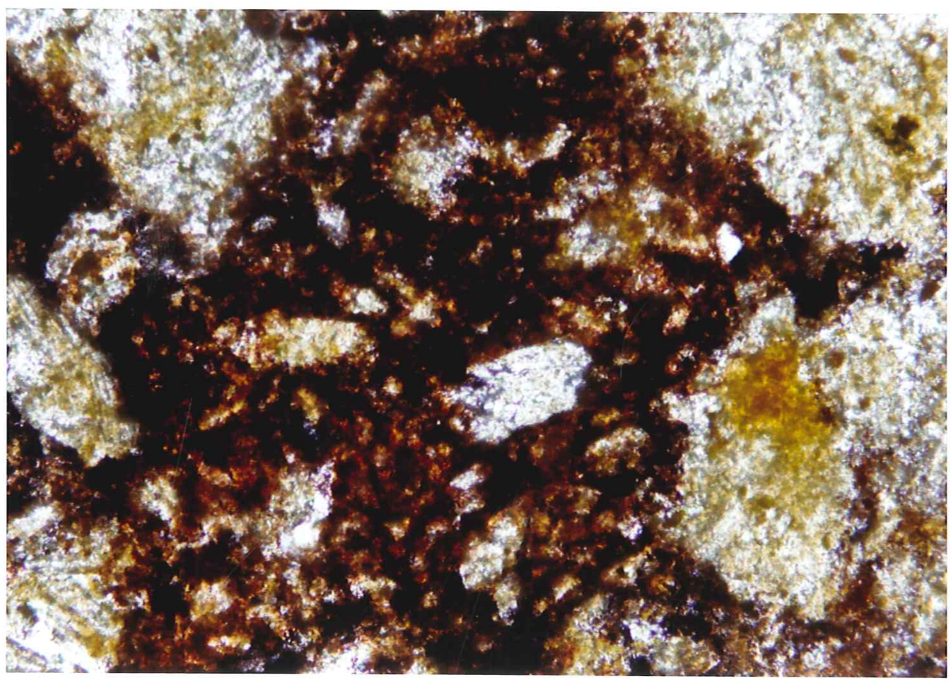

Figure 6b. 378C-2/dacitic breccia. Same view and scale as Figure 6a. TLP; 1cm on the photo= 0.053mm.

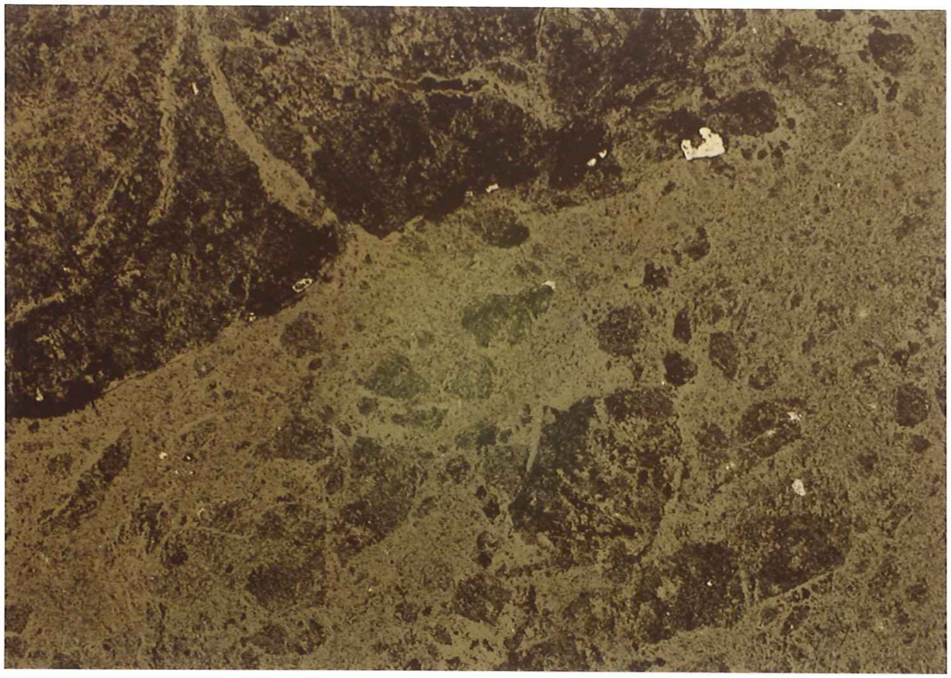

Figure 7a. 378C-2/dacitic breccia. Dacitic fragments dispersed in FeOx-rich matrix. The coarser, grayish white crystal in the upper right photo quadrant is goethite after pyrite (?). The earthy limonitic material takes a poor polish. RL; 1cm on the photo= 0.532mm.

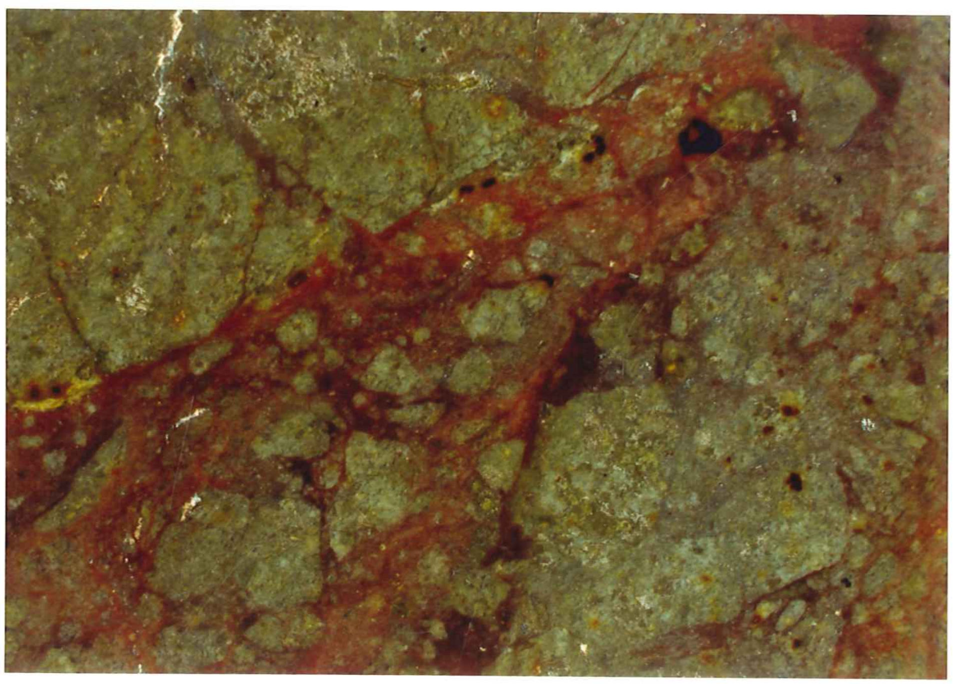

Figure 7b. 378C-2/dacitic breccia. Earthy goethite of the breccia matrix has reddish orange internal reflections. Same view and scale as Figure 7a. RLX; 1cm on the photo= 0.532mm.

CONCLUSIONS

Petrographic characteristics of the dike rocks (samples 378C-1 and 378C-2) indicate that they do not represent an intrusive phase of basaltic magma. Although alteration somewhat obscures the texture and primary mineralogy, it appears that the rocks in question are of intermediate composition (dacitic to andesitic). major characteristics leading to this conclusion are:

1. Where present, unaltered plagioclase, both groundmass and microphenocryst phases, appears to be of oligoclase composition and insufficiently calcic to be stable in a liquid of basaltic composition. It may also be possible, however, that the sodic composition of the plagioclase is a product of the propylitic alteration that the sample has undergone.

2. The major primary mafic phases appear to have been biotite (definitely) and pyroxene (possibly). Minor relict biotite was noted in both samples. Biotite is commonly a stable mafic phase in intermediate and silicic igneous rocks, but is rare in those of basaltic composition.

3. Significant modal quartz is present in the groundmass as irregular patches intergranular to the seriate palgioclase mesh. The presence of modal quartz is consistent with a bulk composition in the intermediate to silicic range.

If the rocks examined are, in fact, of dike origin, the breccia (sample 378C-2) is most likely an intrusion breccia formed near the wall rock contact. The abundance of fine, disaggregated fragmental material in the oxidized matrix suggests that there may have been an explosive component to the breccia. The fine material appears to be derived from a lithology similar to that of the larger breccia clasts and identical in many ways to that of sample 378C-1.