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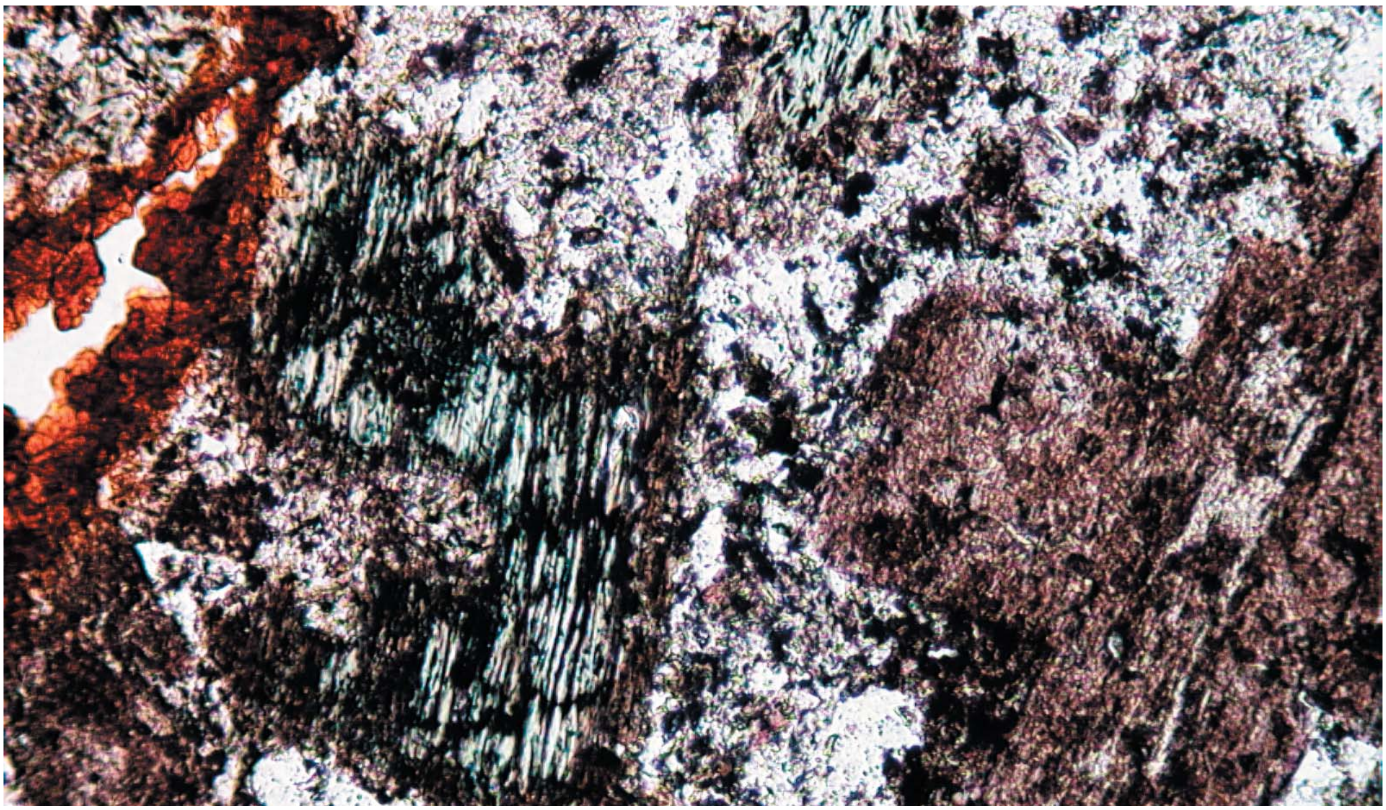

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Questa baseline and pre-mining ground-water quality investigation. 13. Mineral microscopy and chemistry of mined and unmined porphyry molybdenum mineralization along the Red River, New Mexico: Implications for ground- and surface-water quality.

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Introduction

This report is one in a series presenting results of an interdisciplinary U.S. Geological Survey (USGS) study of ground-water quality in the lower Red River watershed prior to open-pit and underground molybdenite mining at Molycorp's Questa mine. The stretch of the Red River watershed that extends from just upstream of the town of Red River to just above the town of Questa (fig. 1) includes several mineralized areas in addition to the one mined by Molycorp. Natural erosion and weathering of pyrite-rich rocks in the mineralized areas has created a series of erosional scars along this stretch of the Red River that contribute acidic waters, as well as mineralized alluvial material and sediments, to the river (fig. 2). The overall goal of the USGS study is to infer the pre-mining ground-water quality at the Molycorp mine site. An integrated geologic, hydrologic, and geochemical model for ground water in the mineralized but unmined Straight Creek drainage is being used as an analogue for the geologic, geochemical, and hydrologic conditions

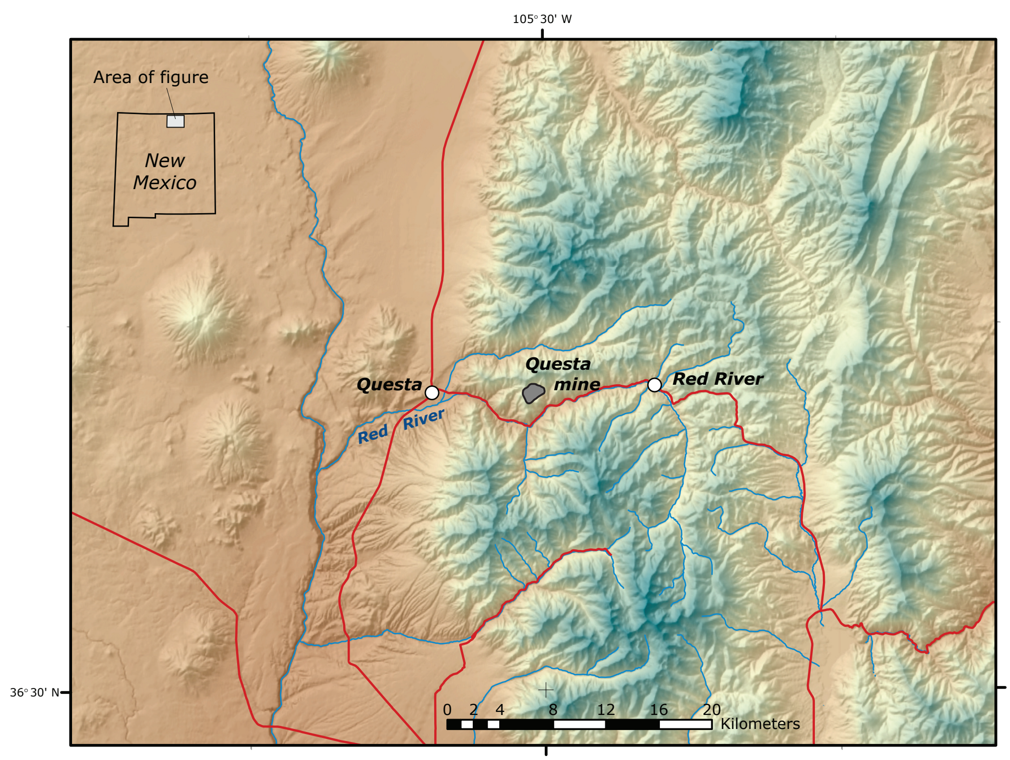
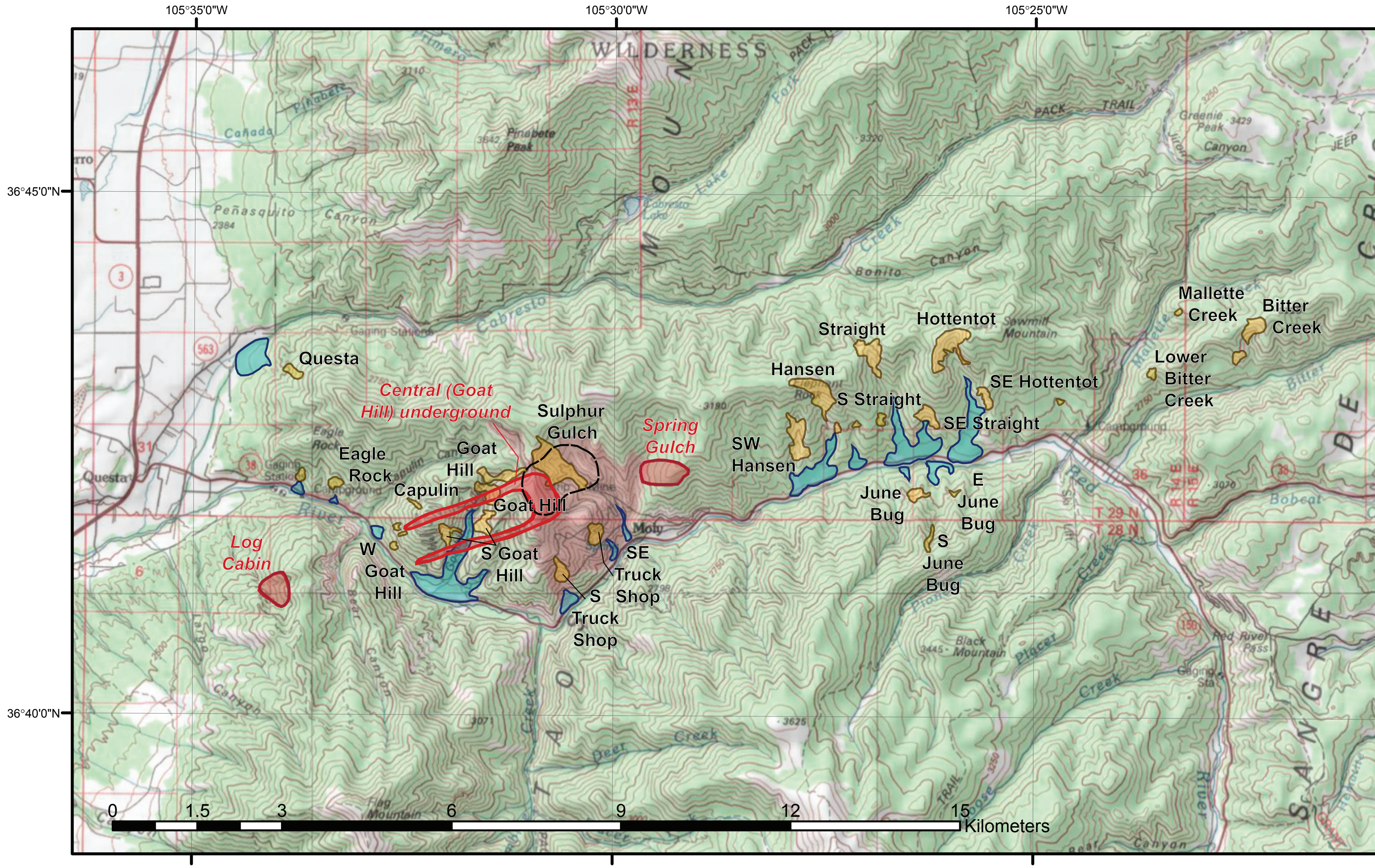


Figure 1. Index map of study area.



Scale 1:100,000. Map projection is UTM, zone 13N
Geographic coordinate system is North American datum of 1927

Figure 2. Topographic map of the study area showing erosional scars (yellow), debris fans (light blue), mineral deposits (red), and the Molycorp open pit (black dashed line).

that influenced ground-water quality and quantity at the mine site prior to mining (see project summary report by Nordstrom, 2006, in press).

Ludington and others (2004) provided an overall geologic framework for the Red River watershed between Red River and Questa and summarized key aspects of the regional and local geology, host rocks, hydrothermal alteration and mineralization, and weathering features of the various mineralized areas (and their associated erosional scars and debris fans) that likely influence ground- and surface-water quality and hydrology.

In this report, we summarize results of reconnaissance mineralogical and chemical characterization studies of rock samples collected from the various scars and the Molycorp open pit, and of drill cuttings or drill core from bedrock beneath the scars and adjacent debris fans. Although a substantial number of samples spanning many of the major scar areas were examined, funding and time constraints precluded us from being able to do an exhaustive characterization of all samples available, and from being able to develop a detailed understanding of hydrothermal mineralization timing and zoning relationships within and between the different scar areas.

The major goal of this reconnaissance characterization work is to provide constraints on the chemical composition of the ore, gangue, host-rock, and alteration minerals that are likely to be most reactive in the weathering environment within and beneath the scars. Where possible, the characterization studies also help identify important mineralogical hosts for key elements of environmental concern, such as Mn, Pb, Zn, and Cu. These results can then be used to help constrain mass-balance geochemical modeling of the weathering processes that may influence ground- and surface-water quality along the Red River.

Methods used in this study

Samples examined in this study include hand samples the report authors collected during several field seasons, drill cuttings of bedrock from USGS drill holes beneath debris fans downstream from various scar areas, and splits of drill core (access provided by Molycorp) acquired by various companies during mineral exploration along the Red River during the 1970's.

Polished thin sections prepared from the samples were examined using transmitted light, reflected light, and scanning electron microscopy. Chemical analyses of individual minerals at microscopic scales were carried out using qualitative to semi-quantitative energy-dispersive x-ray analysis on the scanning electron microscope (SEM), and quantitative wavelength-dispersive energy analysis using the electron microprobe.

Quantitative electron-probe microanalysis (EPMA) of polished thin sections was performed using a five-wavelength spectrometer (WDS), fully automated, JEOL 8900 scanning electron microprobe, at the USGS in Denver. Spot size (spatial resolution) of each analysis was approximately 10 microns. Analytical conditions varied for each mineral group analyzed. As a result, X-ray lines and background positions were chosen to prevent overlap, especially for analyses of minerals with abundant rare-earth elements. In addition, calibration was performed using well-characterized silicate, oxide, and metal standards. Analytical precision for major and minor elements based on replicate analysis of standards was ±2% relative concentration for major and minor elements and equal to counting statistics for trace (<1 wt%) elements. Matrix corrections were performed with the JEOL 8900 ZAF software.

Representative splits of hand samples, drill cuttings, and drill core samples were ground using standard methods, and splits of the ground material were analyzed for bulk inorganic chemical composition using Inductively Coupled Plasma - Atomic Emission Spectroscopy (ICP-AES) following methods described in Taggart (2002).

Laser ablation ICP-MS (LA-ICP-MS) of polished thin sections and mineral slabs provided qualitative estimates of the concentration of up to 40 elements simultaneously in minerals or mineral mixtures at a spot size (spatial resolution) of approximately 100 microns. In this technique, a pulsed laser is used to ablate material from a spot (selected by optical microscope) into an argonhelium carrier gas. The ablated material is then transformed into a plasma at 1200°F and the plasma then fed into a standard ICP-MS system optimized for laser work (see ICP-MS method described in Taggart, 2002). With detailed use of appropriate standard reference materials, the technique can provide semi-quantititative to quantitative element concentration information for single minerals such as silicates and sulfides. For this reconnaissance study, we used the technique in a qualitative manner to identify potential mineralogic hosts for elements that occur in concentrations below those detectable with electron-probe microanalysis. The elements Li and Be were of particular interest, because they have been detected in many of the surface and ground waters analyzed from the Red River area (D.K. Nordstrom, oral comm., 2004).

Key geologic characteristics of the Red River mineralized areas

Details of the geology and mineralization pertinent to this study are presented by Ludington and others (2004), Ross and others (2002), Meyer and Leonardson (1990), Molling (1989), Martineau and others (1977), Loucks and others (1977), and Schilling (1956), so only a summary is presented here. The mineralized and altered rocks that are exposed in erosional scars along the Red River mineralized trend (fig. 2) are part of a complex of multiple but geologically similar, multi-stage, mineralized intrusive centers that formed as cupolas along the roof of a single batholith at depth. It is unclear how many intrusive centers are actually present along the trend.

There are many similarities in host-rock types, intrusive-rock types, and styles of alteration and mineralization between the various scar areas (fig. 3). The intrusive centers were generally introduced into the same suite of predominantly andesitic volcanic and subvolcanic host rocks, although there are some differences in the actual rock types present and their proportions between the various scar areas. Hydrothermal alteration and mineralization is typically zoned around the intrusive centers that were responsible for mineralization (fig. 3). Molybdenite-quartz-fluorite-carbonate-±pyrite, stockwork vein, and disseminated mineralization occurs predominantly within (but also extends outward from) the source intrusions. This molybdenum-rich mineralization is generally coincident with a central zone of fluorine-rich potassic alteration.

Stockwork magnetite-hematite veining occurs in a shell overlapping the outer portions of the potassic alteration zone. Above the potassic alteration and the known mineralized rocks, Quartz-sericite-pyrite (QSP) alteration is generally encountered. As the name implies, the rocks are altered to a mixture of quartz, pyrite, and sericite[1]. In addition, the QSP-altered rocks are crosscut by a complex network of intersecting veinlets up to 1 cm wide, called stockwork veinlets; quartz and pyrite, with lesser calcite, are the dominant veinlet-filling minerals and were deposited directly from the hydrothermal fluids. At Questa, the most pyrite-rich QSP alteration (with as much as 8-10 weight % pyrite) occurs in the andesite volcanic rocks and apparently resulted from the reaction of abundant iron-bearing silicates and iron-titanium oxides with the sulfur-rich hydrothermal fluids. In contrast, in more silicic host rocks such as the rhyolite porphyries and the Amalia Tuff, the QSP alteration is well-developed only in areas relatively close to the source intrusions for the mineralization. With increasing distance away from the source intrusions in these silicic rock types, the amount of hydrothermal pyrite decreases from several weight % to the point where the alteration is predominantly quartz-sericite (QS) with less than a % total pyrite.

In the mined ore bodies at Questa, chalcopyrite and galena veins are noted to occur in a zone overlapping but within the QSP zone (Martineau and others, 1977). To date, we have observed a galena-sphalerite-quartz vein in only one sample of drill core from beneath the Hottentot scar area.

In the mined ore bodies, generally late-stage veins containing manganiferous calcite, dolomite,

[1]Sericite is a petrographic or field term for fine-grained muscovite that typically has x-ray diffraction patterns characteristic of illite.

A

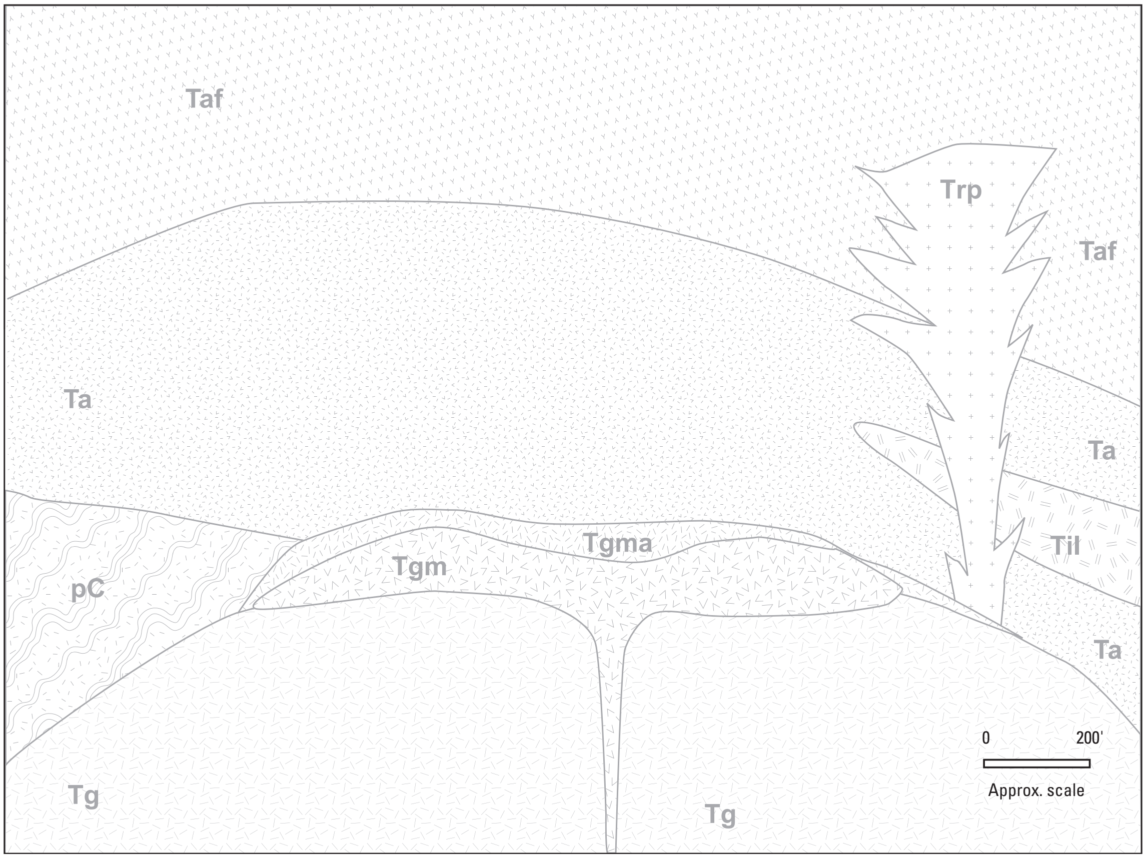


Figure 3. Cross sections from Ludington and others (2004) showing inferred spatial distributions of rock types (A), hydrothermal alteration types (B), and scar area erosion levels (C) around an idealized intrusion/mineralization center at Questa. The scar area erosion levels (C) are not to scale horizontally or vertically, nor are they meant to imply that all the scar areas are developed around a single intrusive center; rather, they are meant to convey information about the types of alteration exposed in each of the scar areas.

Hydrothermal Alteration
(listed in order of increasing proximity to source intrusion)

- Alunite and kaolinite of unknown age as veins and partial alteration of Amalia Tuff.
- Propylitic alteration, primarily of andesite and quartz latite porphyry rocks, to chlorite, sodium plagioclase, epidote, and calcite.
- Quartz-sericite (QS) alteration (orange): Distal, sulfide-poor facies of QSP alteration in rhyolitic intrusions and Amalia Tuff.
- Quartz-sericite-pyrite (QSP) alteration (brown): Generally incomplete alteration of rock to quartz, pyrite, and illite, with stockwork veins containing quartz, pyrite, and lesser chalcopyrite, pyrrhotite, carbonates, fluorite, barite, phosphates, Fe-Ti oxides. Intensity of alteration and veining diminishes away from source intrusions. Typically overprints propylitic alteration.
- Late-stage fluorite-carbonate veins.
- Magnetite-hematite-quartz stockwork veining
- Molybdenite (± quartz, pyrite, phlogopite) veins in rock potassically altered to contain phlogopite, potassium feldpsar, topaz, and other minerals

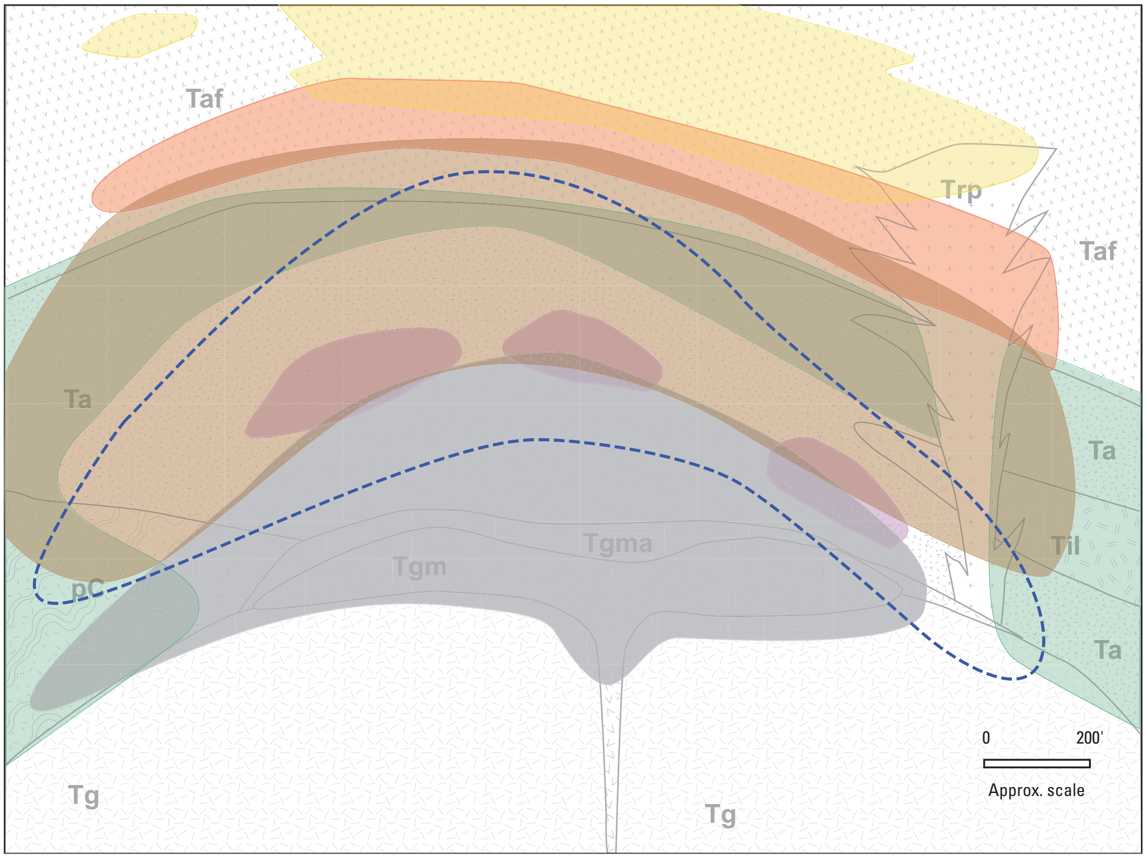
Rocks
(listed in order of increasing age)

- Source intrusion for mineralization (Tgm)
- Early aplites (Tgma)
- Early granites (Tg)
- Early rhyolite porphyry intrusions (Trp)
- Amalia Tuff (Taf)
- Quartz latite porphyry intrusions (Til)
- Andesites and associated volcaniclastic rocks (Ta)
- Precambrian (pC)

Mallette — **Schematic erosion levels in different scar areas**

Figure 6, cont.

B



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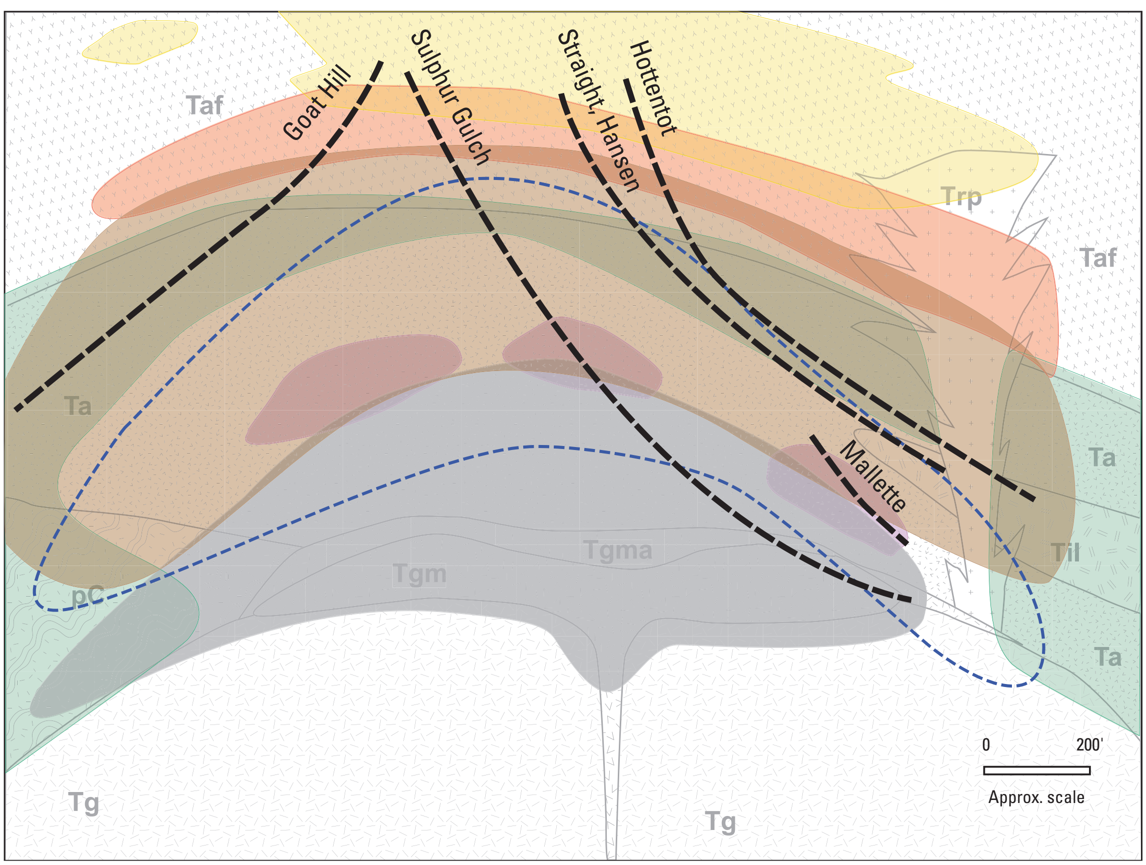


and fluorite occur spatially between but overlap both the molybdenite-bearing potassic alteration and the higher-level QSP alteration. Microscopic carbonate minerals are commonly present in veins and disseminations in QSP-altered rocks in all of the mineralized areas. Late-stage fluorite and/or carbonate veins are also present in several of the scar areas.

Propylitic alteration associated with the molybdenite ore deposits both spatially overlaps and occurs peripheral to QSP alteration. Propylitically altered rocks contain chlorite, epidote, albite, and calcite, and are typically greenish in color. The propylitic alteration is best developed in the andesites and quartz latite porphyries, and is relatively poorly developed in the Amalia Tuff and rhyolite porphyries.

An older propylitic alteration not linked to the molybdenite mineralization regionally affected the volcanic rocks of the Latir field. This regional propylitic alteration especially affected the more mafic pre-caldera volcanics. It can be difficult to distinguish propylitic alteration that is distal to the magmatic hydrothermal molybdenum deposits from the regional propylitization.

QSP alteration associated with the molybdenite mineralization very commonly overprinted or partially replaced minerals formed during previous propylitic alteration of the andesites. As a result, most mineralized and altered andesites peripheral to the main ore zones typically contain mixed QSP-propylitic alteration assemblages.

Optical microscopy, SEM, and electron-probe microanalytical characterization results

A summary of reconnaissance hand sample, polished thin section, and SEM mineralogical characterization results for samples from many of the major scar areas is presented in table 1. Electron-probe microanalytical data are presented in tables 2 (sulfides), 3 (carbonates), 4 (REE carbonates), and 5 (chlorites, illites, biotites). The following discussion of results is organized by mineral to show similarities or differences in occurrence for a given mineral within and between different scar areas.

Pyrite

Pyrite is by far the most common and abundant sulfide mineral found in unweathered mineralized rocks in all the Red River scar areas. It is readily apparent in both hand sample and microscopic views of most mineralized and altered rocks. The only exceptions are QS-altered Amalia Tuff and rhyolite porphyry rocks that occur away from the source intrusives responsible for mineralization, and propylitically altered rocks (such as those that crop out near the La Bobita picnic area) that have not been overprinted by later QSP alteration. Where present, the pyrite typically occurs both as disseminations in the altered rocks and in veinlets with quartz and carbonates crosscutting the altered rock (fig. 4).

Electron-probe (EP) and laser-ablation ICP-MS measurements indicate that pyrite, regardless of its location relative to the source mineralizing intrusions and its occurrence among the different scar areas, is generally very low in trace elements. With the exception of cobalt (which is noted by EP in concentrations up to 0.15 weight % in many samples), nickel (which is noted in a few EP analyses at levels as high as 0.18 weight %), lead (noted in one EP analysis), and Te (noted in one EP analysis), a wide variety of elements (Cu, Fe, As, Pb, Zn, Ni, As, Se, Mo, Ag, Bi, Te, Sb, Cd, and Au) were not detected in the pyrite using EMP with a cutoff of 0.01 weight %. Laser-ablation ICP-MS analyses of the pyrite found similarly low levels of a wide variety of elements. No consistent Co or Ni enrichments of the pyrite with respect to alteration zone or scar area are discernible.

Molybdenite

As would be expected, both megascopic and microscopic molybdenite is most abundant in the granitic intrusive rocks in the Molycorp open pit and in the underground ore bodies currently being mined at Questa. A detailed discussion of the nature

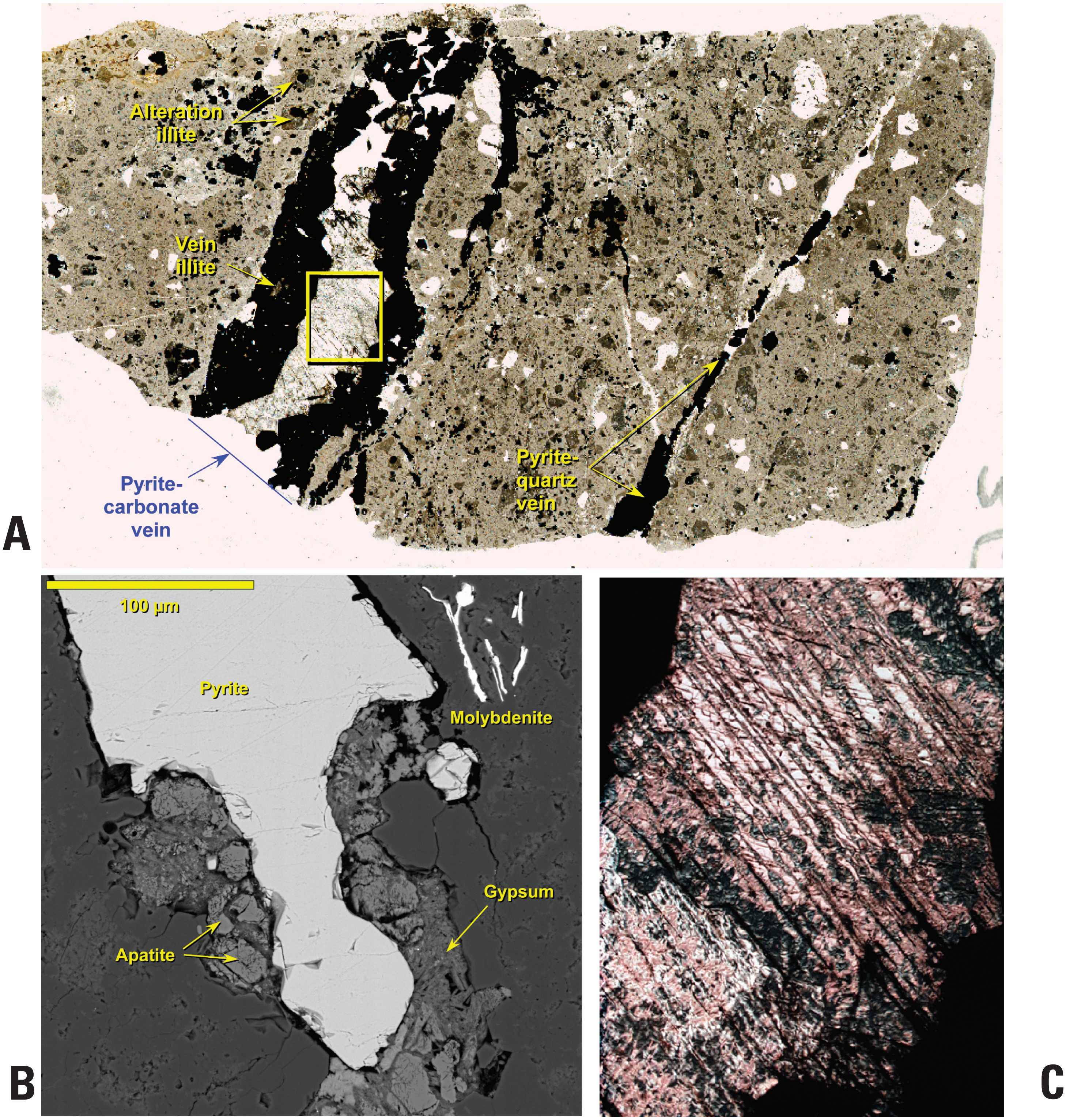


Figure 4. A. Transmitted light photograph of a thin section of sample Q02-18 from Upper Sulphur Gulch. Opaque areas are predominantly pyrite. Darker tan areas are plagioclase phenocrysts that have been partially altered to illite. The yellow square is the area of the transmitted light photograph shown in Figure 4B, where late-stage calcite filling the middle of a pyrite vein has been partly weathered to gypsum. Section is approximately 3 cm lengthwise. **B.** Backscatter electron SEM image of pyrite from sample Q02-18. **C.** Transmitted light photomicrograph of calcite (bright pink) that has been preferentially weathered along cleavage planes to gypsum (darker mottled tan). Pyrite is opaque. Field of view is approximately 0.5 cm lengthwise.

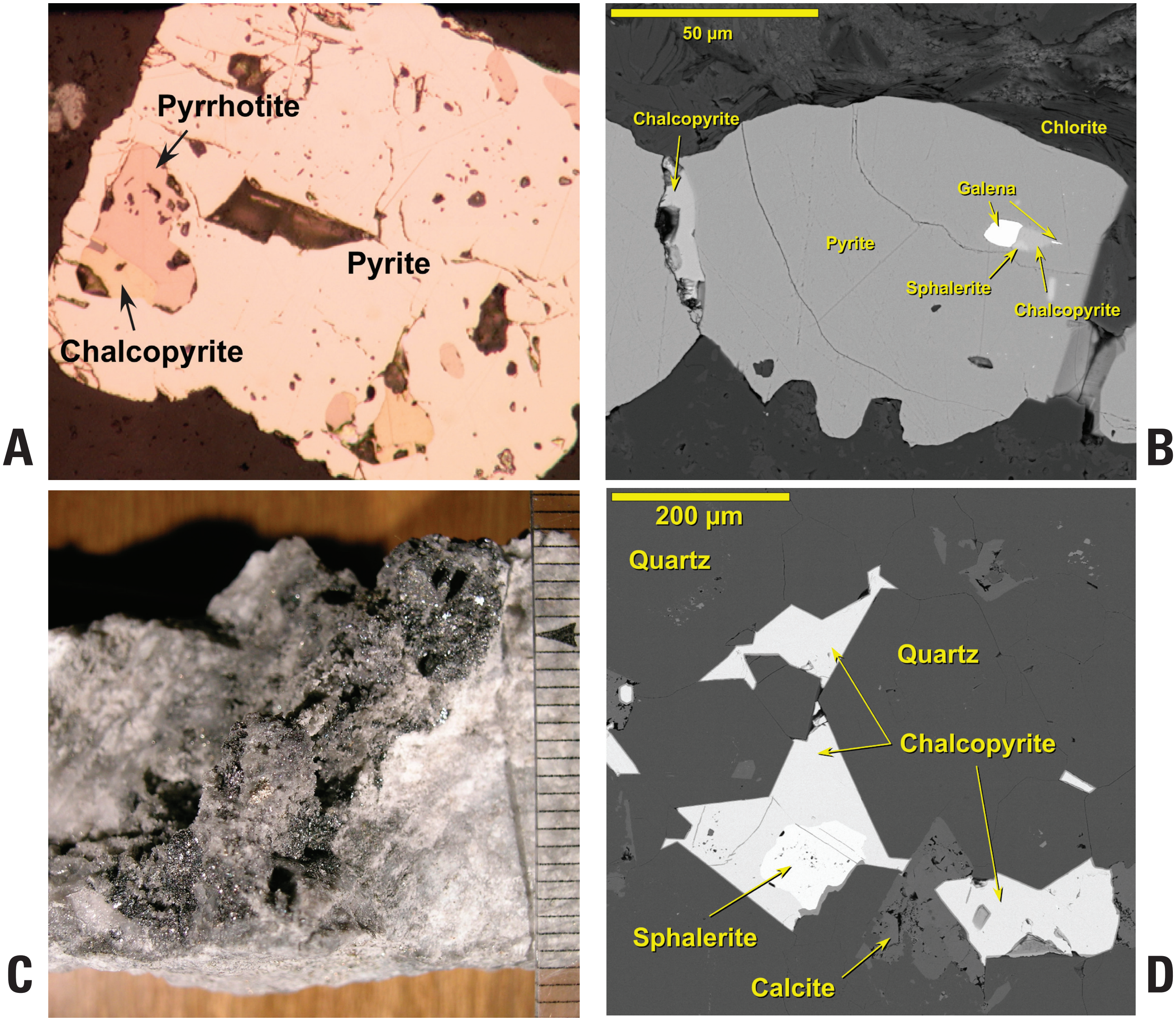
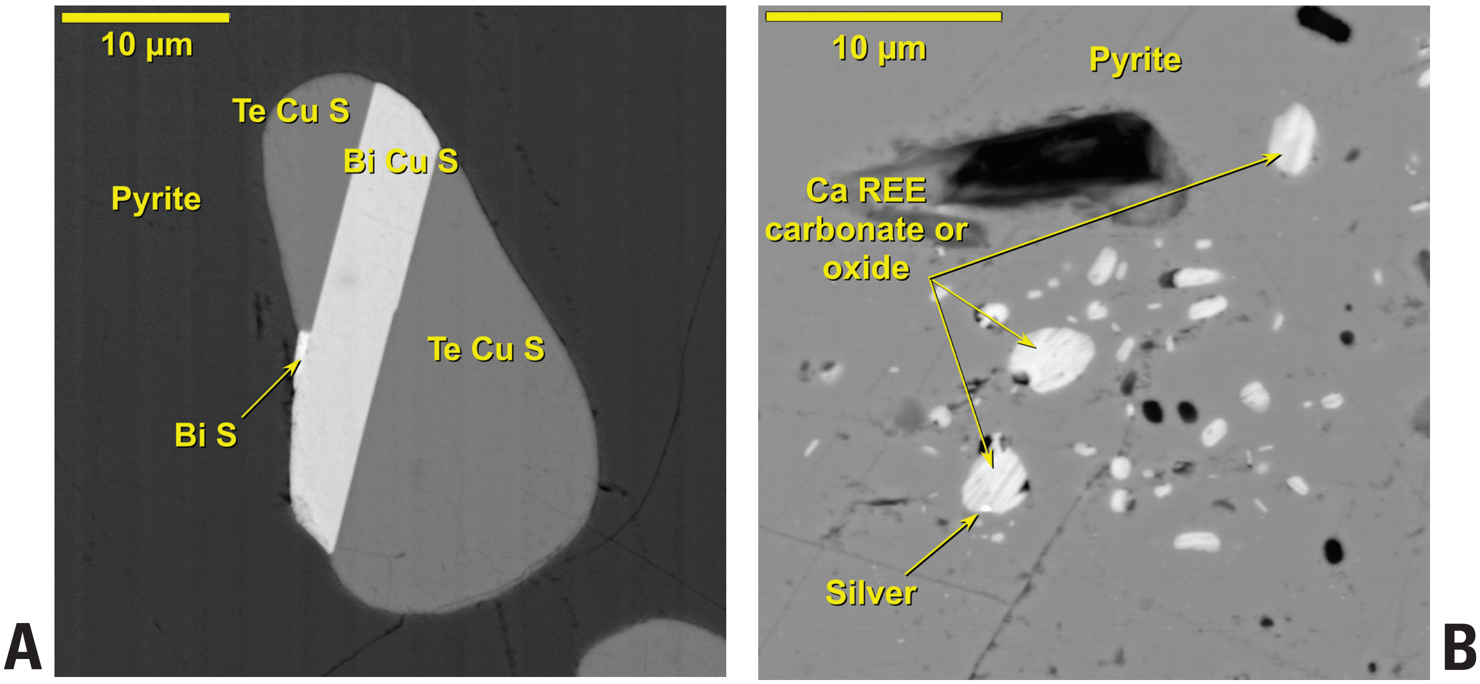


Figure 5. A. Reflected light photomicrograph of sample ULHansen9125, from the upper part of the SW Hansen scar. Pyrite grain is approximately 100 µm wide. Blebs of pyrrhotite and chalcopyrite occur within the pyrite. This type of microscopic intergrowth within pyrite is common in QSP-altered rocks from most of the scar areas. **B.** SEM backscatter electron image of chalcopyrite, sphalerite, and galena blebs in a pyrite grain, sample Q10-17-02-03, upper Straight Creek scar. **C.** Hand-sample photo of quartz-pyrite-galena-sphalerite vein in QSP-altered rocks from a deep drill hole beneath Hottentot scar. Note 1 mm increments on ruler for scale. **D.** SEM backscatter electron image of chalcopyrite, sphalerite, and calcite filling microscopic vug in quartz, sample Q10-18-02-4a, SE Straight scar.

and occurrences of molybdenite in the mined ore bodies is beyond the scope of this study, and is presented by Ross and others (2002), Meyer and Leonardson (1990), Molling (1989), Martineau and others (1977) and Schilling (1956). Molybdenite was observed in this study to occur in veins and veinlets, as thin “paint” on fracture surfaces, and as disseminations in the mineralized granites. Rare microscopic molybdenite was also observed in altered rocks from the Hottentot, June Bug, and Upper Sulphur Gulch scars (table 1). Two electron-probe analyses of molybdenite (table 2) from a late-stage fluorite-carbonate vein cutting mineralized granite in the Molycorp open pit revealed small



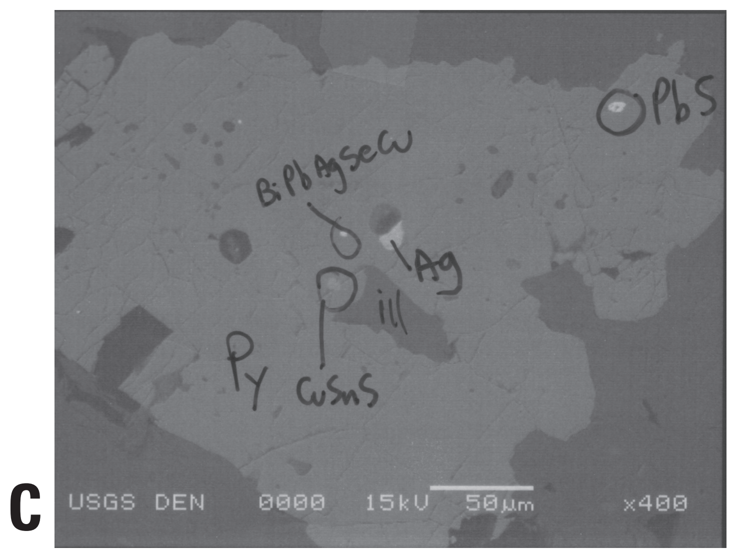


Figure 6. A. SEM backscatter electron image showing Te, Bi, and Cu sulfide blebs within a pyrite crystal. Sample Q02-21 from the Goat Hill Gulch scar west of the Molycorp open pit. **B.** SEM backscatter electron image showing a bleb of native silver and multiple blebs of a calcium-REE carbonate or oxide within a pyrite crystal. Sample Q02-21, Goat Hill Gulch scar. **C.** SEM backscatter electron image of a pyrite grain (py) containing blebs of galena (PbS), illite (ill), native silver (Ag), a copper-tin sulfide of undetermined stoichiometry, and a phase containing Bi, Pb, Ag, Se, and Cu. The pyrite grain occurs within QSP-propylitically altered quartz latite porphyry. Sample (SC3B 195-200) from Straight Creek bedrock drill hole SC3B, depth 195-200 feet below ground surface.

amounts of iron and zinc (less than 0.5 weight %).

Other common but less abundant sulfides

Chalcopyrite, pyrrhotite, sphalerite, and galena are nearly always visible only microscopically, in samples from nearly all scars (figs. 5, 6). Most commonly, these sulfides occur as 10 to 50 micron-wide blebs within pyrite (figs. 6A, B). Less commonly, they occur as discrete blebs within altered rocks or filling small voids in veinlet centers (fig. 6C) . One exception is a galena-sphalerite vein cutting QSP-altered andesite in a sample of drill core from a deep drill hole beneath the Hottentot scar (fig. 5C).

Limited electron-probe analyses (table 2) of pyrrhotite and chalcopyrite reveal occasional Co in levels around 0.1 weight %. In contrast, sphalerite commonly contains measureable amounts of Cu, Cd, and Fe (around 0.2 %, 0.2 - 0.7 %, and 1 - 4.55 %, respectively). Limited analyses suggest that sphalerite from the Molycorp open pit may contain higher levels of Fe than sphalerite from higher-level QSP alteration zones in the various scar areas. One electron-probe analysis of galena measured 0.25 weight % Fe and 0.3 % Se.

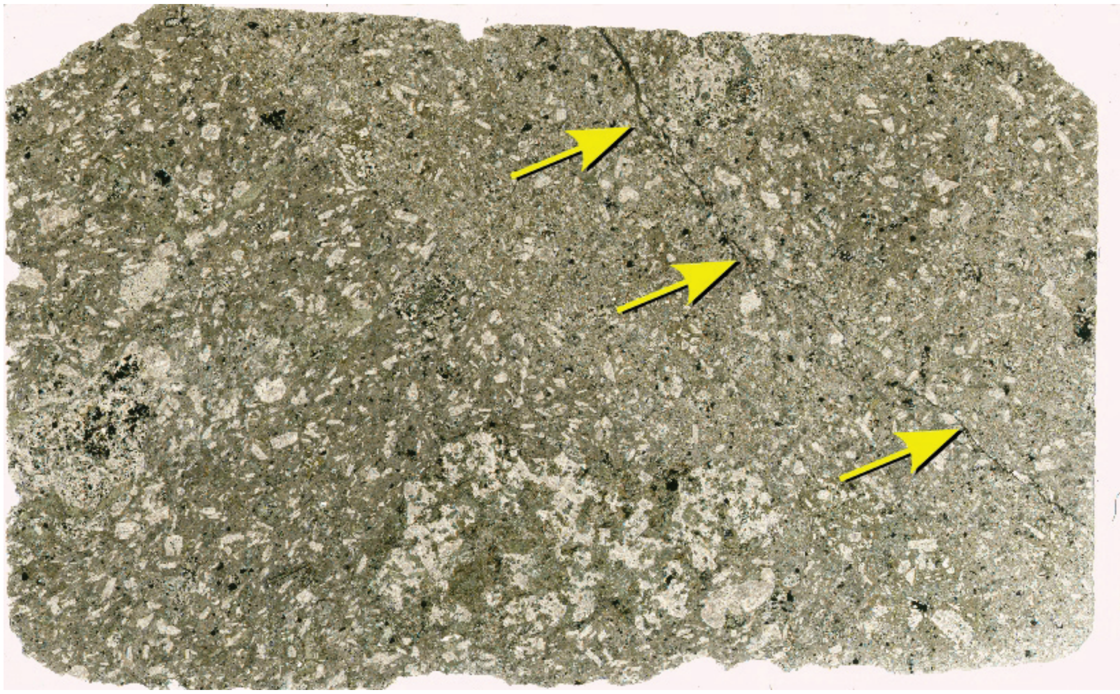


Figure 7. Transmitted light thin section photo of propylitically altered andesite from near the La Bobita picnic area, Sample Q10-18-02-6b. The opaque phases are ilmenite and magnetite. The rock has undergone very little QSP alteration. The yellow arrows point at a small veinlet containing quartz, ilmenite, magnetite, epidote, Na- and K- feldspar, sphene, and apatite.

Other phases containing ore metals

Reconnaissance SEM characterization encountered a number of different phases containing more exotic metals such as Ag, Bi, Te, and Sn (table 1, fig. 6). In addition to native silver, phases with the following element combinations were identified: Bi and S; Te, Cu, and S; Bi, Cu, and S; Cu, Sn, and S; and Bi, Pb, Ag, Se, and Cu. As with the more common sulfides such as chalcopyrite, these exotic phases typically occur as microscopic blebs within pyrite grains in veins and disseminations in QSP-altered rocks. They are substantially less common and less abundant than chalcopyrite, pyrrhotite, galena, and sphalerite. Based on our reconnaissance characterization, these phases occur in only two general areas: in the Goat Hill Gulch, S Goat Hill, and Sulphur Gulch scars overlying the high-grade molybdenite ore zones, and in the SE Straight scar and deep Straight Creek drill holes to the west of the SE Straight scar. As will be discussed in a later section, these areas are also those in which rare-earth carbonates and other phases rich in REE are most common.

Fe-, Fe-Ti-, and Ti-oxides

Iron-, Fe-Ti-, and Ti-oxides are quite common in altered rocks throughout the scar areas and Molycorp open pit. However, there are several different types of occurrences, each with characteristic Fe-Ti oxide minerals and trace element enrichments.

Based on a sample collected near La Bobita picnic area east of the mine site and west of Hansen Creek (fig. 7), it can be inferred that magnetite and ilmenite are abundant in propylitically altered andesite that has not been overprinted by later QSP alteration. Some of the magnetite and ilmenite may be primary magmatic phases disseminated through the andesite. However, both also occur with quartz, epidote, Na- and K-feldspar, sphene, and apatite in small veins cross-cutting the andesite, indicative of a hydrothermal origin. This indicates that some portion of the disseminated magnetite and ilmenite may have resulted from hydrothermal alteration.

As shown in fig. 3, a zone of hematite-magnetite-quartz stockwork veining was noted by Martineau and others (1977) to occur outward from the high-grade molybdenite ores and potassically

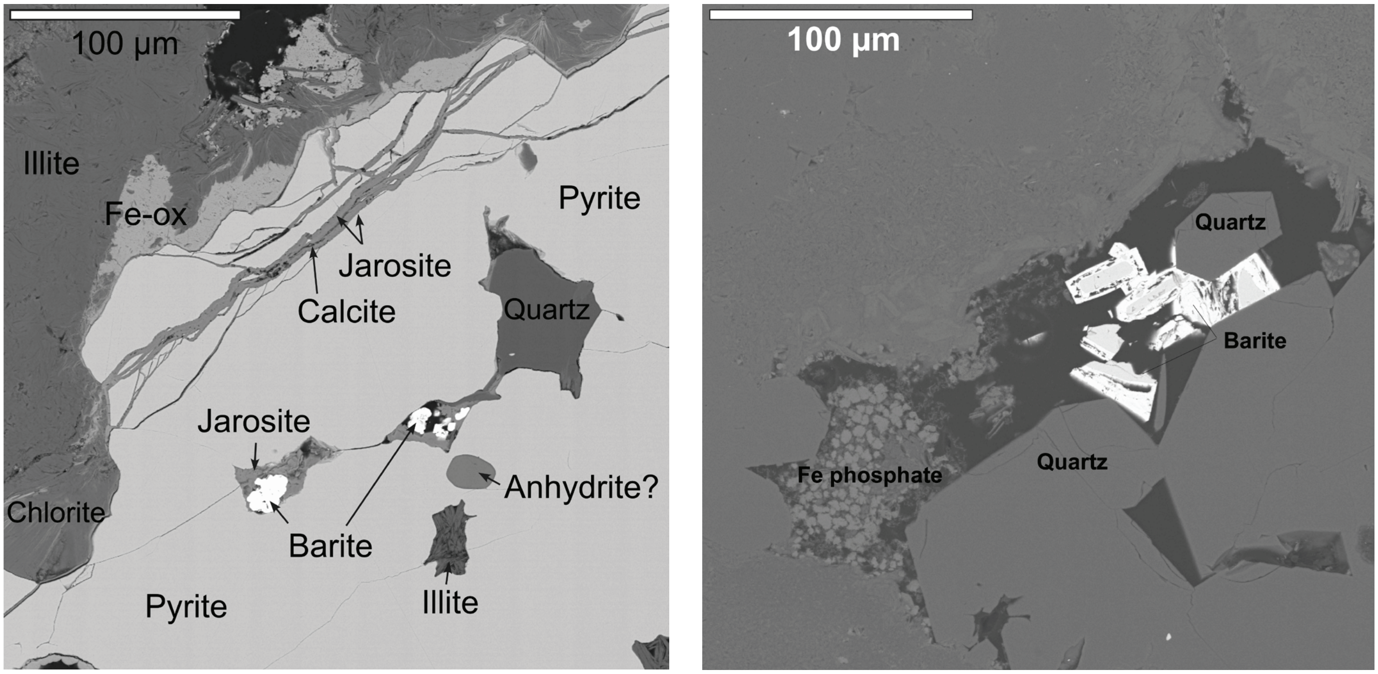


Figure 8 A. SEM backscattered electron image of hydrothermal pyrite, quartz, illite, chlorite, barite, and possible anhydrite cross-cut by secondary jarosite. The sample is of QSP-altered (and minor propylitically altered) Amalia Tuff, sample Q02-18, from the Upper Sulphur Gulch scar. **Figure 8 B.** SEM backscattered electron image of microscopic Sr-rich barite crystals (lighter rims are more Sr-rich) with quartz crystals in a vug in QSP-altered quartz latite porphyry, sample Q10-15-02-2, June Bug scar. It is not clear if the Fe phosphate is hydrothermal or supergene.

altered rocks. We have noted similar stockwork veining in rocks exposed in the Mallette scar east of the town of Red River.

In rocks with even relatively small amounts of QSP alteration, it appears that most if not all of the magnetite and ilmenite were completely converted to pyrite by sulfidation. QSP-altered rocks are marked by abundant Ti-oxides, however, which may have in part formed from Ti released by the sulfidation of ilmenite and magnetite to pyrite.

Qualitative SEM energy-dispersive analysis indicates that Ti-oxides from the Goat Hill Gulch scar and the Straight Creek drill holes are typically enriched in rare-earth elements and yttrium, and are occasionally enriched in tungsten (table 1). Ti-oxides from the lower Straight Creek drill holes can also contain elevated U and Th. These areas are the same as those noted in the previous section of this report, in which the exotic ore metals are found.

Phosphate minerals

A Ca-phosphate mineral, most likely apatite, is commonly found in QSP-altered rocks from most of the scar areas. A microsocopic Ce- and La-phosphate mineral (monazite?) is somewhat common in QSP-altered rocks of the SE Straight, Straight Creek, Upper Sulphur Gulch, Goat Hill, and South Goat Hill scars, the Molycorp open pit, and the Straight Creek drill holes. As noted previously, apatite is also common in quartz veins and disseminations in propylitically altered andesite that has not been overprinted by QSP alteration. The common occurrence of phosphates in quartz veins in both QSP- and propylitically-altered rocks indicates that these phosphates are at least partially hydrothermal in origin.

Sulfate minerals

Primary hydrothermal anhydrite has been noted by several previous workers at Questa. Our reconnaissance SEM characterization studies encountered relatively common microscopic calcium sulfate minerals in altered rocks from nearly all samples examined; however, most of these occurrences are likely to be secondary gypsum based on their occurrence with abundant iron-oxides or jarosite, or replacing calcite (fig. 4C). What may be hydrothermal anhydrite, based on its occurrence as microscopic blebs within unweathered pyrite, was only noted in a small number of samples from the SE Straight and South Goat Hill scars.

Barite is a far more common hydrothermal sulfate mineral than anhydrite in the samples examined in this study. Microscopic barite is readily encountered in QSP-altered samples from nearly all scar areas, where it occurs as intergrowths with pyrite and quartz (fig. 8A), in veinlets, as isolated blebs within other minerals, and as fillings within microscopic voids. A number of the barites contain relatively high levels of strontium (fig. 8B).

There are isolated occurrences of lead-rich sulfates, which typically also contain Ca and Sr. It is unclear whether these lead sulfates are secondary or hyrothermal.

As noted in the section of the report on alteration zoning patterns, and as reported by Ludington and others (2004), alunite occurs primarily in veins in Amalia Tuff distant from the source intrusions (fig. 3); the vein-filling textures and lack of nearby sulfide mineralization suggest that this alunite is hypogene rather than supergene. It is also present as an alteration product in the groundmass of the Amalia Tuff in the same samples.

Secondary jarosite is common in partially weathered samples from several of the scars. It typically occurs as veinlets crosscutting pyrite (fig. 8A) and it also replaces pyrite.

Carbonate minerals

Calcite is the predominant carbonate mineral identified by this study in QSP-altered rocks from all scar areas, and in late-stage veins with fluorite that cut potassically altered rocks in the Molycorp open pit. In the QSP-altered rocks, the calcite occurs as microscopic disseminations, as vein material with intergrown quartz (fig. 9B), and as late-stage vein fill (figs. 4 and 9).

Results of electron-probe microanalyses of the carbonates are listed in table 3, and depicted graphically in figure 10. Most of the calcite has up to several weight % MnO. The highest manganese concentrations measured in our samples (over 5 weight % MnO) occur in late microscopic rims on calcite-fluorite veins that cut the deep ore bodies in the Molycorp open pit (fig. 9A). A variety of previous studies have noted the presence of manganese-rich calcite and rhodochrosite from the mined ore bodies, but our limited sampling of these ore bodies did not encounter any rhodochrosite. Of all the scars, the SE Straight Creek scar calcite is generally highest in MnO (2-3 weight % MnO), although samples from the Straight Creek scar have some elevated MnO in this range as well.

The only dolomite found in this study occurs as late microscopic rims on calcite from the SE Straight scar (figs. 9B and 9C). Dolomite has been noted in the late veins and breccias at Molycorp (Ross and others, 2002), but our limited sampling has not encountered any dolomite in samples from the pit area. Calcite with elevated magnesium contents from 0.1 to 0.6 weight % is noted in samples from the Molycorp pit and the SW Hansen, Upper Sulphur Gulch, and SE Straight scars.

The highest iron contents (as high as 2.5 weight %) are in the SE Straight and Straight Creek calcites, with some enrichment in the late-stage Molycorp pit carbonates. The highest Sr contents (as high as 0.6 weight %, but generally less than 0.2 weight %) are in the Straight Creek drill hole (sample SC-5B) and, to a lesser extent, in upper Sulphur Gulch. The highest Y contents (generally less than 0.1 weight %) are in the SC5-B (Straight Creek drill hole), Straight Creek, and SE Straight samples.

As noted in our previous report (Ludington et al., 2004), an unusual Ca-REE-F carbonate, synchisite, is quite common in samples from the Upper Sulphur Gulch, Goat Hill Gulch, and SE Straight Creek scars, as well as the Straight Creek drill holes. The synchisite commonly occurs as microscopic blebs within pyrite (fig. 6B), quartz, or fluorite, or as disseminations within the QSP-altered rocks. In one sample, the synchisite appears to be intergrown with REE oxides (fig. 11). Electron-

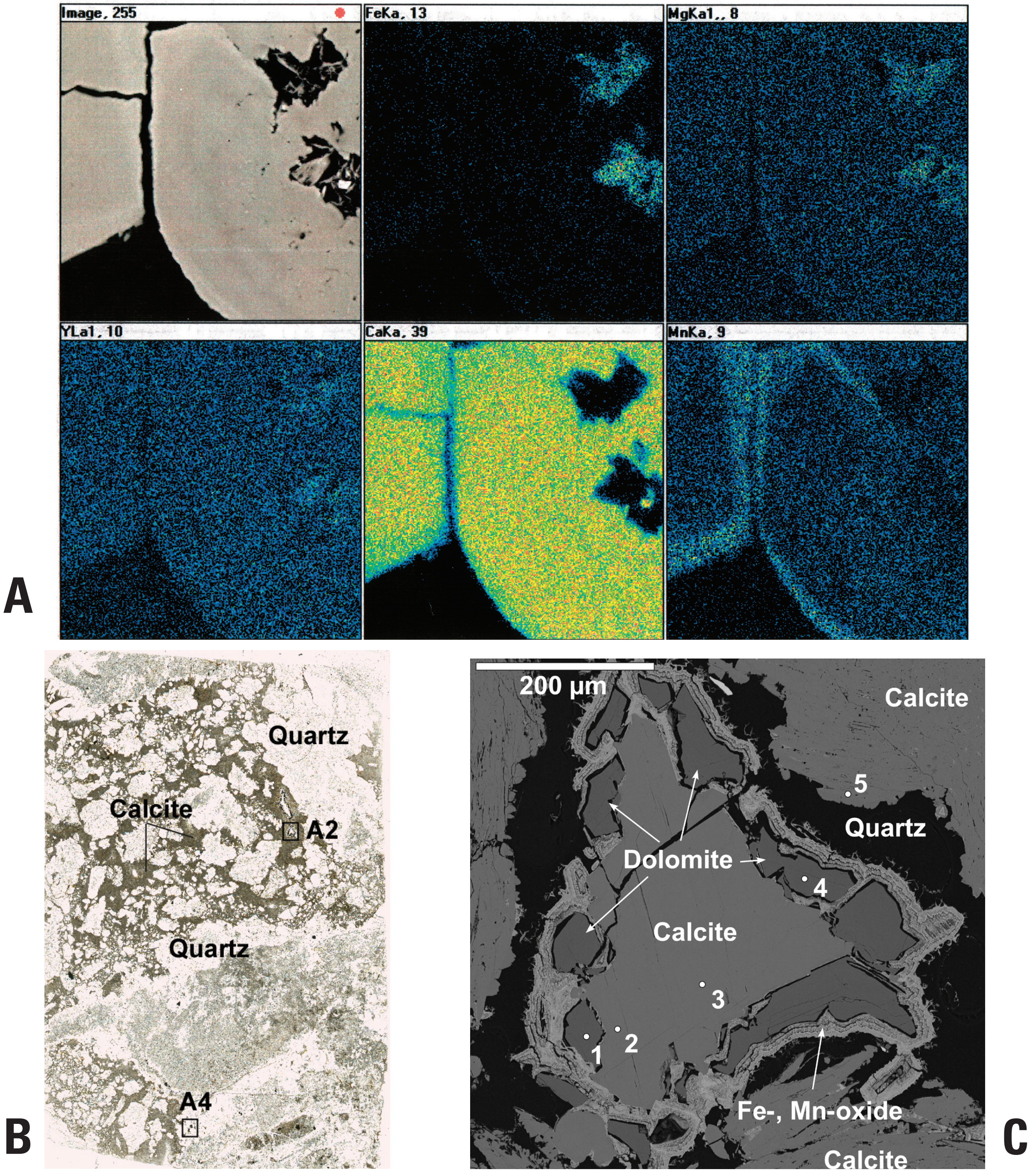


Figure 9. A. SEM maps of sample Q02-19B, Molycorp open pit, showing chlorite blades coated by calcite with Mn-rich outer rims. The calcite occurs in a late-stage vein with fluorite, quartz, and minor sulfides. The maps are approximately 200 µm wide each. Note the generally uniform distribution of Y through the calcite, and the slight enrichment of Mg and Fe in the Mn-rich growth zones. **B.** Transmitted light photograph (~3 cm field of view) of a late-stage carbonate-quartz vein from the SE Straight scar, sample Q10-18-02-4A. Box A2 shows the location of the SEM shown to the right in Figure 9C. Box A4 shows the location of the SEM image shown in Figure 5D. **C.** SEM backscattered electron image of microscopic late-stage quartz, dolomite, and calcite from the thin section shown in B. The carbonates are cut by secondary Fe- and Mn-oxides. Points 1-5 show the location of probe analyses Q10-18-02-4A-A2 1 through 5 from Table 3.

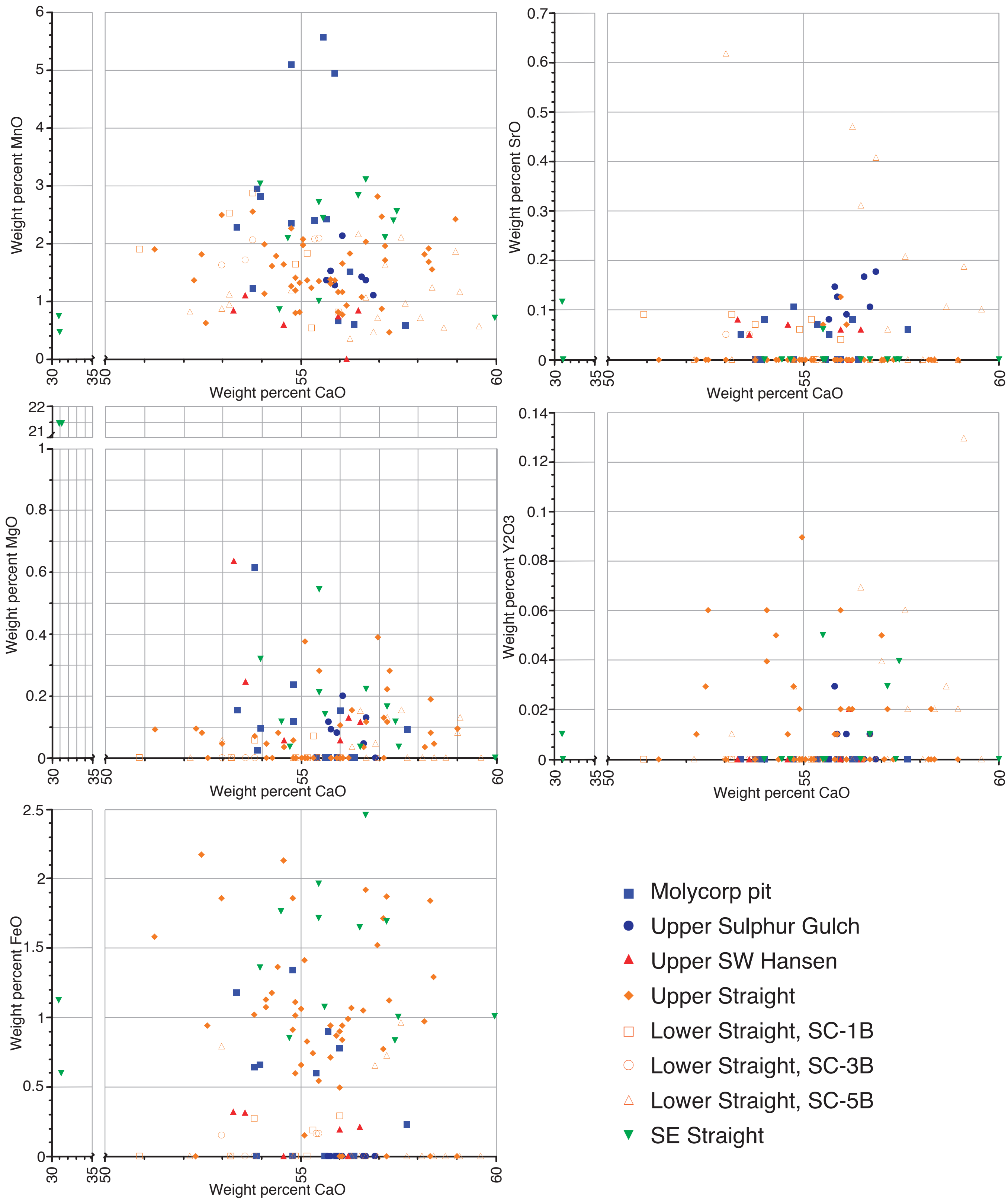


Figure 10. Plots showing compositional variations in calcite and dolomite from the Red River scar areas and Molycorp open pit, as determined by electron probe microanalysis. The data are presented in Table 3.

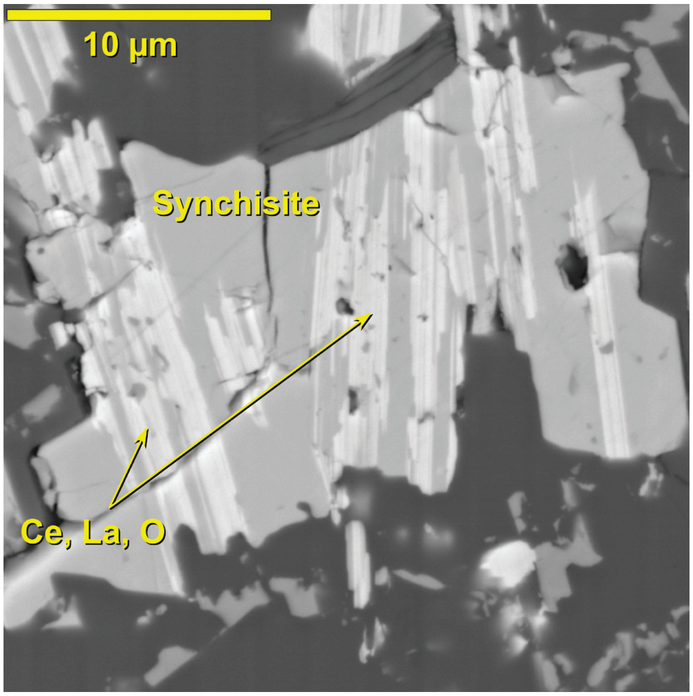


Figure 11. SEM backscatter electron image of intergrown synchisite and a Ce-La oxide mineral. The surrounding darker gray minerals are illite and quartz.

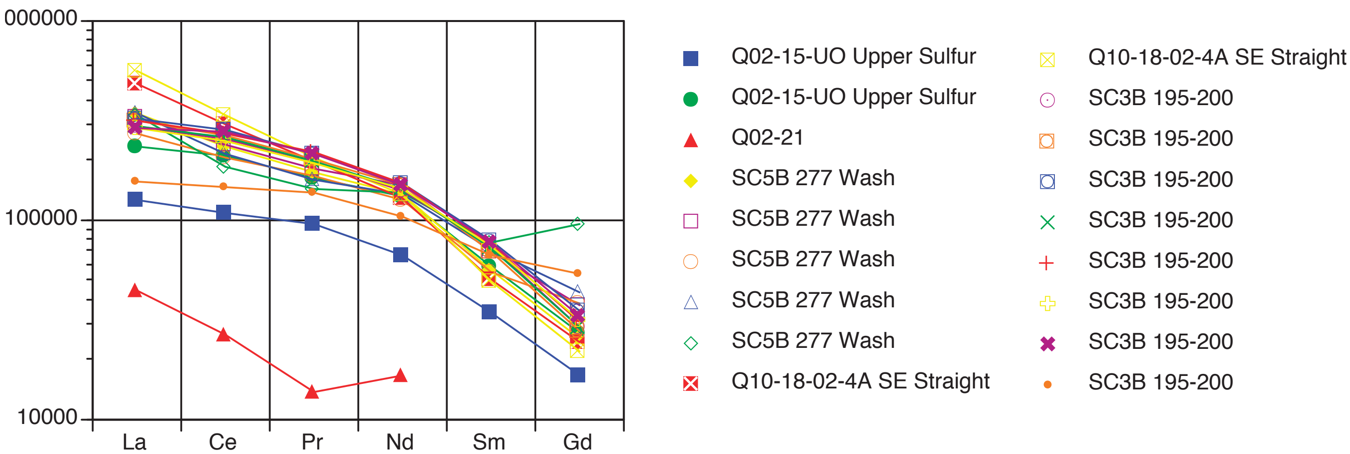


Figure 12. Plot showing the relative enrichment of Questa synchisite in REE, normalized to chondrite values. The Y-axis is [REE in sample]/[REE in chondrite]. The Q02-15 -UO Upper Sulfur analyses (blue squares, green circles), as well as those for Q02-21 (red triangles) and the last SC3B 195-200 listed in the legend (small orange circles), are likely diluted by contributions from other minerals. If these analyses are excluded from consideration, the measured enrichments and patterns are relatively similar between the different analyses.

probe analyses (table 4) indicate that the synchisite is most enriched in Ce (18.8 - 34.3 weight % Ce_2O_3), La (11.2 - 21.5 weight % La_2O_3), and Nd (9.4 - 10.7 % Nd_2O_3), but also can contain up to nearly 5 % Y_2O_3, and 1 - 2 % Sm_2O_3 and Gd_2O_3. A plot of the synchisite REE concentrations normalized to chondrite concentrations indicates each of the grains shows a fairly similar enrichment pattern relative to chondrites, with the light REE enriched more than the heavy REE (fig. 12).

Similar REE carbonates have also been noted as microscopic intergrowths with late-stage fluorite from breccia ore bodies at the Molycorp mine site, but their compositions have not been measured to date (S. Church, oral comm., 2004).

Chlorite, biotite, and illite

Chlorite is present in all of the scar areas, where it occurs primarily as a hydrothermal alteration

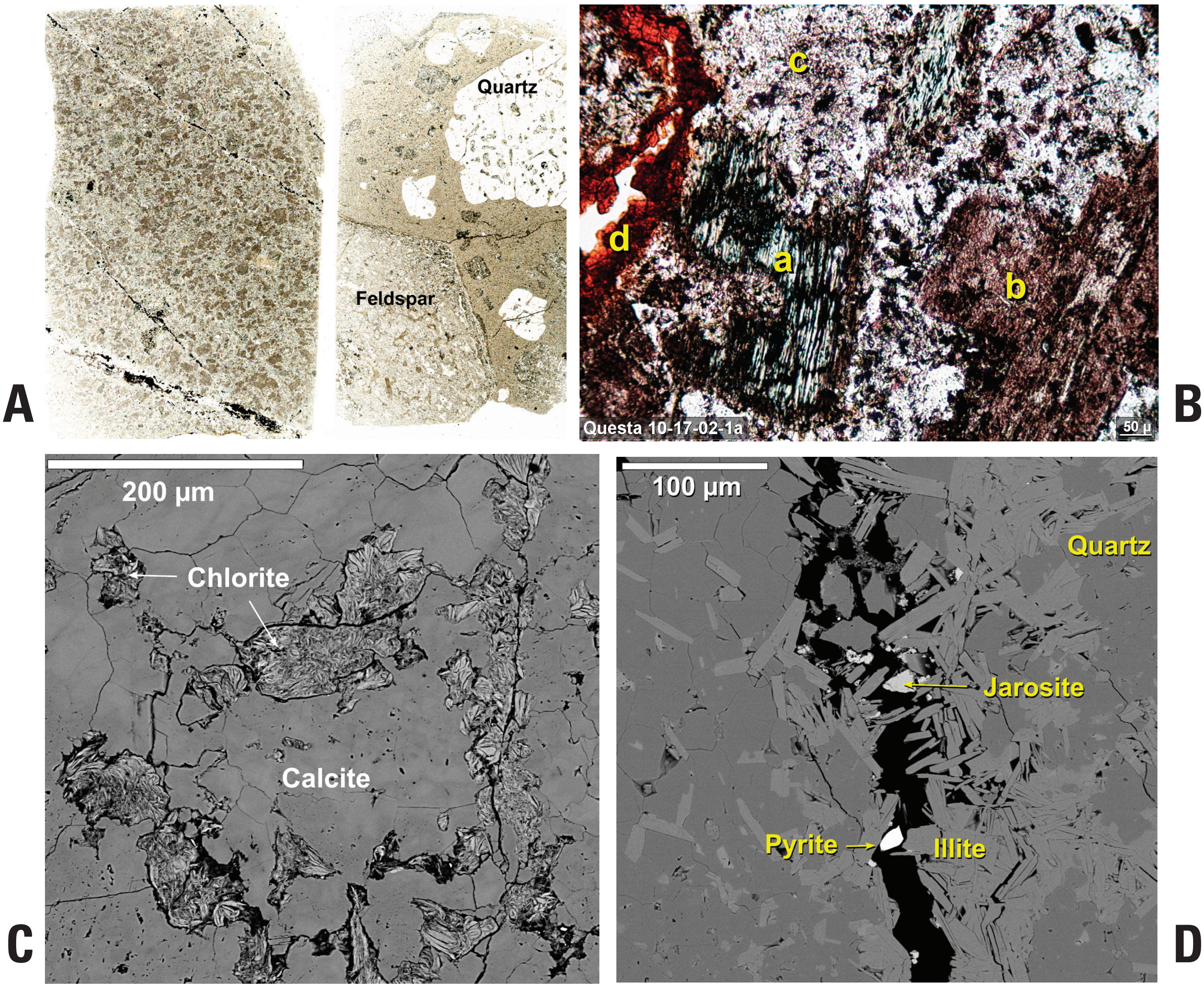


Figure 13. A. Transmitted light thin section images (each approx. 3 cm lengthwise) showing the occurrences of alteration chlorite and illite. Left - QSP-propylitically altered andesite, sample Q10-17-02-1c, Straight Creek Scar. Brown patches are plagioclase feldspars altered to illite from the QSP alteration event, while the green-tinted areas are chlorite-rich alteration products of pyroxenes and other silicates. Several quartz (white) and pyrite (black) veins crosscut the section. Right - QSP-altered quartz latite porphyry, sample Q10-16-02-1, SE Hottentot scar. Quartz phenocrysts in the rock are white. The groundmass, a large sanidine feldspar phenocryst, and other phenocrysts are tinted brown due to partial alteration to illite. **B.** Transmitted light thin section of QSP-propylitically altered andesite, sample Q10-17-02-1a, Straight Creek scar. In area labeled “a”, remnant dark green pyroxene in the andesite was partially altered to green chlorite, and the chlorite was then partially QSP-altered around the grain edges to brown illite and/or smectite. QSP alteration also led to partial alteration of plagioclase crystals (such as in area “b”) and groundmass (area “c”) to brown illite and/or smectite. An orange secondary goethite vein crosscutting the sample in area “d” formed during weathering of the rock. **C.** SEM backscatter image of vein chlorite clots within calcite from a late-stage calcite-fluorite vein, sample Q02-19B, Molycorp open pit. **D.** SEM backscatter electron image of vein illite and pyrite cutting aplite rock, sample Q02-19c, Molycorp open pit. Potassic alteration of the rock was overprinted by later QSP alteration, which produced the illite-pyrite vein. Secondary jarosite formed during weathering of the rock.

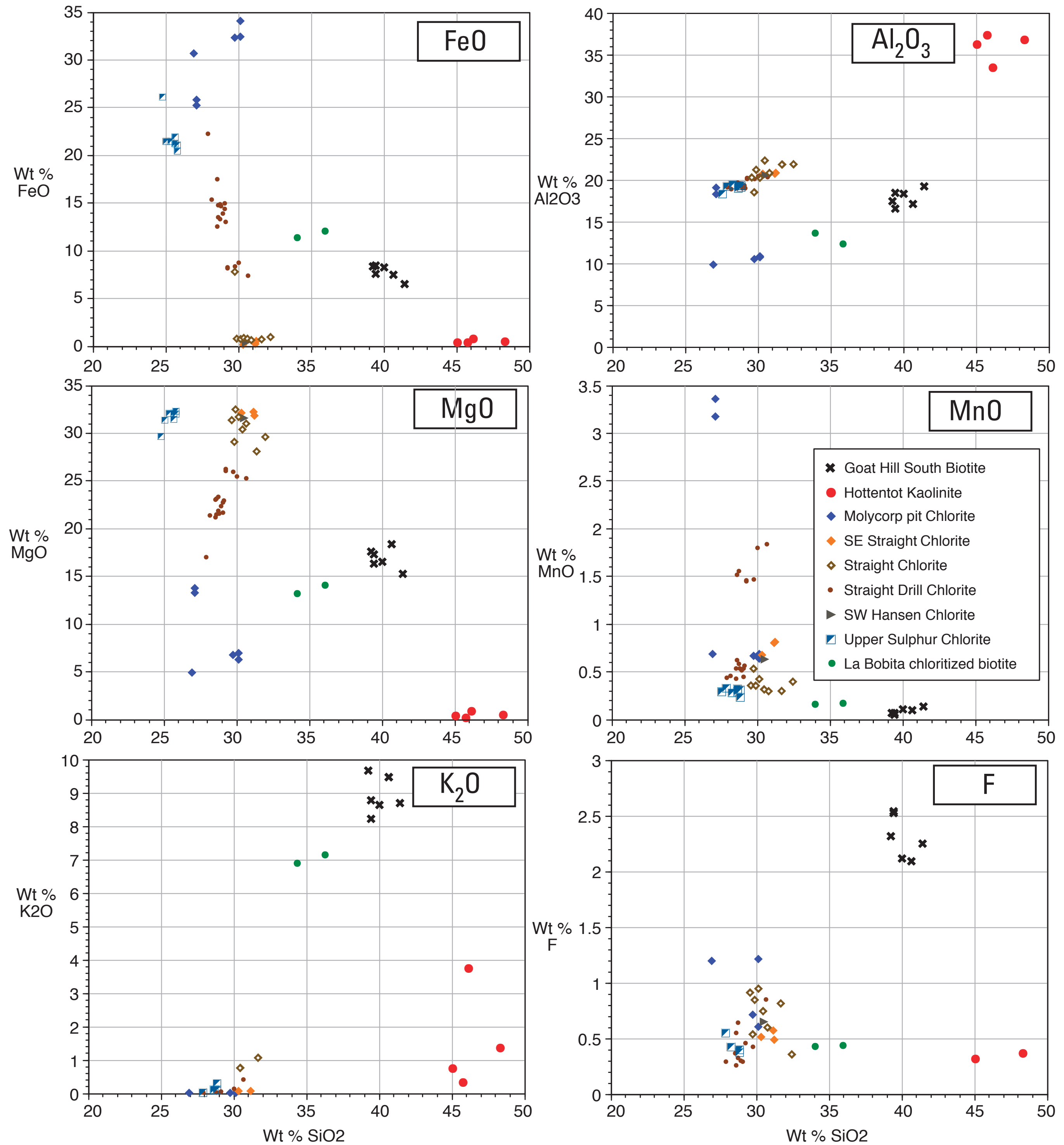


Figure 14. Plots showing compositional variations in chlorite and biotite from Questa, as measured by electron-probe microanalysis. Also shown are analyses of kaolinite-like phases in QSP-altered andesite from the Hottentot scar area and two analyses of choritized biotite from propylitically altered andesite collected from La Bobita picnic ground.

phase in andesites and quartz latite porphyries (figs. 13 A, B), and to a lesser extent as a microscopic vein phase. Small amounts of chlorite are also present as alteration and vein phases within the Amalia Tuff and rhyolite porphyries, and within the late-stage carbonate-fluorite veins cutting the high-grade ores in the Molycorp open pit (fig. 13C).

Electron-probe microanalyses of the chlorite (fig. 14, table 5) indicate a wide range in co-varying Fe and Mg contents, but relatively little variation in silica content. The highest Fe concentrations (near 35 weight % FeO) and lowest Mg concentrations (5-7 weight % MgO) occur in chlorites in late-stage calcite-fluorite veins from the Molycorp open pit. The lowest Fe concentrations (less than 1 % FeO) and highest Mg concentrations (near 33 % MgO) occur in disseminated chlorite from the Straight Creek and SE Straight scars. Samples from the Sulphur Gulch scar and Straight Creek drill holes have Fe and Mg concentrations intermediate between these two end-members. The Fe-rich, Mg-poor chlorites tend to have slightly less (2-5 %) silica than the Mg-rich, Fe-poor chlorites. The chlorites all generally have from 18-21 % Al_2O_3, with the exception of several analyses from the open pit vein chlorite with approximately 10 % Al_2O_3. Mn contents may correlate somewhat with Fe content; chlorites from the open pit sample have the highest Mn (3.2 - 3.4 % MnO), whereas the bulk of the analyses have low Mn (0.3 - 0.8 % MnO), and several analyses from Straight Creek drill hole samples have intermediate values from 1.5 - 1.7 % MnO. The chlorites can also have somewhat elevated F contents, as high as 1.2 %. Although the highest F contents are found in open pit chlorites, there is no other obvious parallel correlation of F content with occurrence in the different scar areas, as is present with Fe, Mg, and, to a lesser extent, Mn.

Biotite (phlogopite) examined in this study was collected from potassically altered rocks associated with high-grade molybdenite mineralization. It occurs as an alteration mineral and in veins and breccia fillings (Ross and others, 2002). Limited electron-probe analyses of disseminated biotite from QSP-potassically altered andesites near the Molycorp mine entrance (below the Goat Hill South scar) show that these biotites are generally enriched in F (concentrations from 2 - 2.5 weight %) and Cl (concentrations up to 0.15 weight %) compared to other mineralization-related phyllosilicates from the Red River trend (figs. 14 and 15, table 5). Concentrations of Ti in the biotite (up to 1.4 %) are also high compared to those measured in chlorites and most illites (table 5, fig. 15).

Based on optical properties in thin section, we originally interpreted that a sample of propylitized andesite lacking later QSP alteration overprint (Sample 10-16-02-6b, La Bobita; fig. 7) has abundant green chlorite. Limited electron-probe analyses indicate the presence of biotite that has been partially altered to chlorite (fig. 14).

Similarly, several mineral grains thought to be chlorite in QSP-propylitically altered andesite from the Hottentot scar are compositionally similar to kaolinite (fig. 14, table 5), with substantially higher silica and alumina contents than the chlorite. It is uncertain whether these kaolinite-like compositions resulted from hydrothermal alteration or secondary weathering phases, or whether they are poor elemental analyses of fine-grained phases or phase mixtures.

Based on electron-probe data coupled with SEM characterization, illite has been identified as both an alteration product and a vein mineral in QSP-altered rocks (fig. 13). It most commonly replaces plagioclase, other feldspars, and groundmass in all rock types, where it helps impart a brown tint to the minerals as viewed in thin section. Based on textures observed in thin sections, illite also appears to replace chlorite (fig. 13), epidote, and biotite. It is possible that smectite may be present in at least some of the material identified in thin section as illite (D. Bove, oral comm., 2005).

Electron-probe analyses (fig. 15, table 5) indicate that the Questa illites vary most substantially in their contents of silica (43 - 55 weight %) and alumina (24 - 37 weight %). These illites also contain 7 - 11 % K_2O, up to 5 % of FeO, and up to 5 % MgO. Fluorine contents are generally from 0.3 to 0.8 %; however, alteration illites from granites in the Molycorp open pit can have fluorine concentrations as high as 2.3 weight %. Manganese contents of the illites are generally low (less than 0.1 %) compared to those of chlorites (most less than 2 %); however, alteration illites within or close to Mo mineralization (i.e., from granites in the Molycorp open pit and Amalia ash-flow tuff from the Sulphur Gulch scar) can have somewhat elevated manganese concentrations (as high as 0.2 %) compared to illites from other scar areas more distant to the molybdenite mineralization.

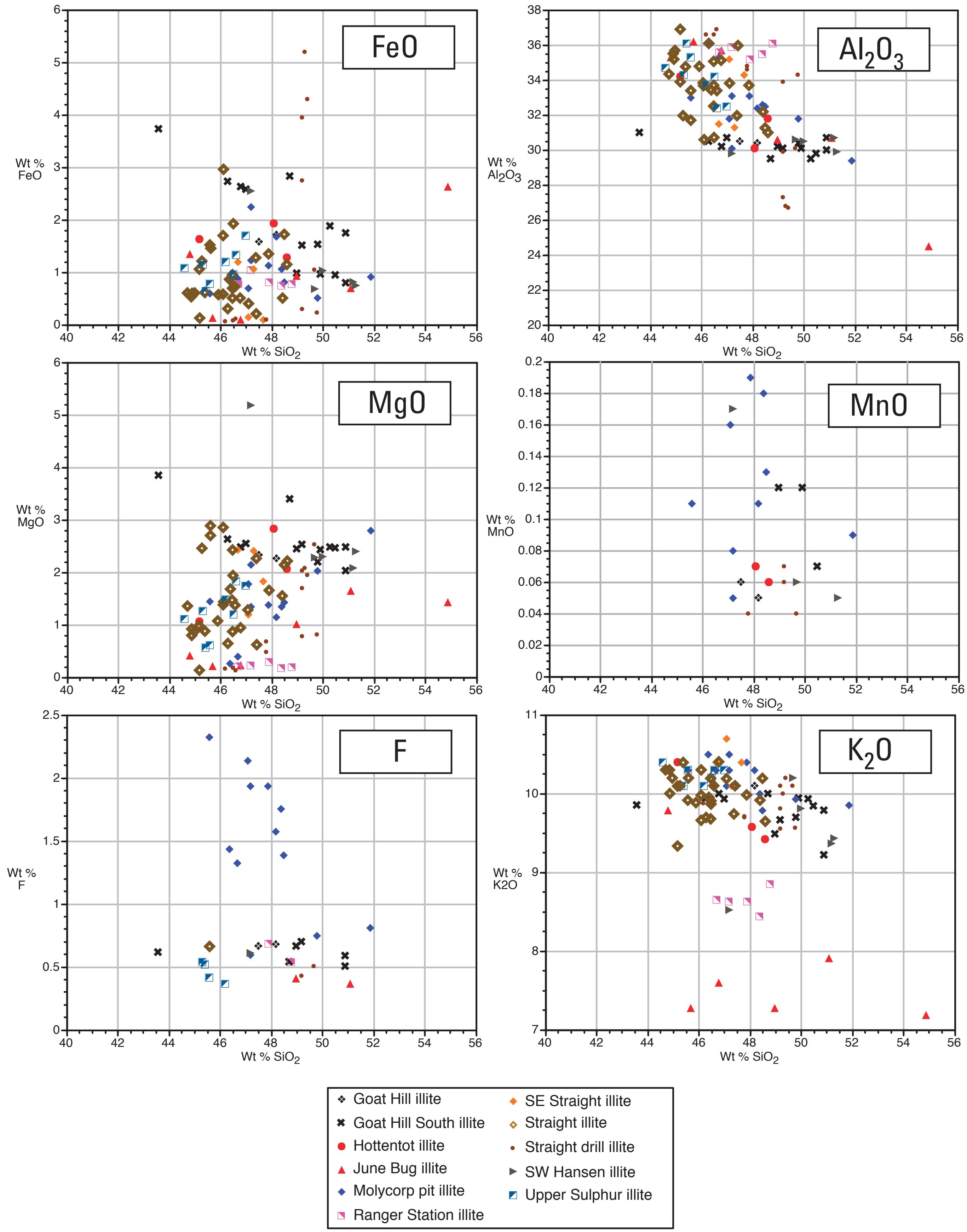


Figure 15. Plots showing compositional variations in illite from Questa, as measured by electron probe microanalysis.

Epidote

Epidote primarily occurs as a propylitic-stage alteration mineral and more rarely as a vein-filling mineral. It is most readily apparent in hand sample as a megascopic alteration product of plagioclase phenocrysts in quartz latite porphyries, but it also is observed microscopically in QSP-propylitically altered andesites from several of the scar areas (table 1). Compositional information on the epidote is not available. Schilling (1956) did note the occasional occurrence of a pink Mn-rich epidote in rocks from the Molycorp mine, so it is possible that epidote from the scar areas may contain some Mn.

Trace elements in silicates determined by LA-ICP-MS

The chlorite and illite grains from mineralized and altered rocks from the Red River scars are not ideal for characterization using LA-ICP-MS, given their fine grain size less than 50 microns and their common occurrence as fine intergrowths with other minerals. Nonetheless, LA-ICP-MS provides some indications of the relative abundances of trace elements among chlorites, illites, feldspars, and altered groundmass phases (figs. 16 and 17).

Two elements of interest due to their elevated abundances in waters from the the ground and surface waters from the Molycorp mine site are Li and Be (Nordstrom, 2006, in press). Qualitative LA-ICP-MS results indicate that the concentrations of these elements in illites from the Molycorp open pit (samples Q02-19B, C) are somewhat higher than their concentrations in illites from other scar areas and those in chlorite, feldspars, and fine-grained groundmass (fig. 16).

Several elements are enriched in the silicates compared to Li and Be (fig. 17). Most notably, Mn and Rb appear to be consistently elevated in most silicates, with their concentration ratios relative to silica some 5-10 times greater than those for Li and Be. In addition, illites from the open pit (sample Q02-19C) have elevated Mn and Rb concentrations compared to illites and silicates from scar areas. These enrichments are consistent with the elevated levels of these elements measured in the granites associated with the porphyry-Mo mineralization (Li, Be, Rb) or the mineralization itself (Mn).

In contrast, chromium is elevated in illites from June Bug, Hottentot, and Straight Creek scars, and in the limited number of chlorites analyzed, with concentration ratios similar to or slightly less than those for Mn and Rb. Arsenic is also generally elevated in the same samples as those in which Cr is elevated. It is possible that these As and Cr enrichments reflect enrichments in the original quartz latite porphyry and andesite rocks compared to the granites and Mo mineralization.

Several elements are enriched in only a few analyses (fig. 17), which we interpret to result from the inclusion of multiple phases in the material analyzed.

Bulk chemical compositions of rock samples

Bulk ICP-AES chemical analyses of a number of samples from Questa are summarized in table 6 and figure 18. This study focused on unweathered rocks, and the samples we analyzed include unweathered hand samples and drill cuttings taken from the various scars, Molycorp open pit, and USGS drill holes.

For comparison, ICP-AES analytical results from Smith and others (2006, in press) are also included in table 6 and figure 18. Smith and others (2006, in press) analyzed composites of samples collected at regular intervals on traverses along each of the scar areas, the various Molycorp mine waste piles, and the drainage near La Bobita picnic ground. They also analyzed a sample of tailings remaining in a replaced section of the Molycorp tailings pipeline. In contrast to the unweathered rock samples collected in our study, the scar area composite samples contain both weathered and unweathered material. The mine waste composites include material from two piles dominated by weathered and unweathered scar material (Capulin and Sugar Sack West). The other waste piles contain less weathered material from below the scars but above the high grade ore bodies. The La

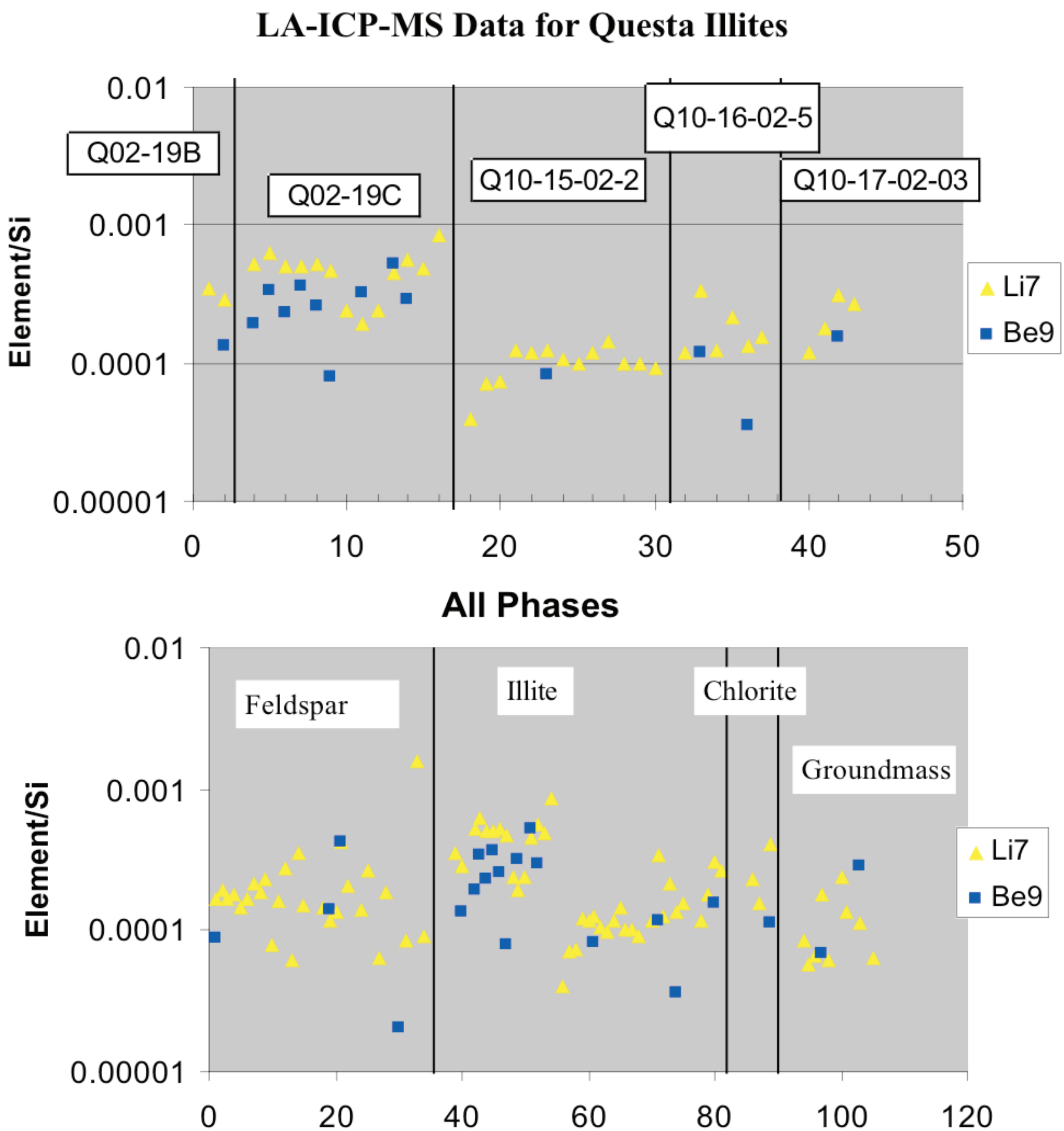


Figure 16. Upper Plot — Reconnaissance qualitative LA-ICP-MS results for Li and Be in illites from the Molycorp open pit and several Red River scar areas. Q02-19B - illite from late-stage calcite-fluorite vein, Molycorp open pit; Q0219C - illite from potassically-altered aplite with QSP overprint, Molycorp open pit; Q10-15-02-2 - illite from QSP-propylitically altered quartz latite porphyry, June Bug scar; Q10-16-02-5 - illite from QSP-propylitically altered andesite, Hottentot scar; Q10-17-02-3 - illite from QSP-propylitically altered andesite, Straight Creek scar. **Lower Plot** — The Li and Be concentrations in illites compared to Li and Be concentrations in chlorites, feldspars, and rock groundmass from the same samples. In both plots, the element concentrations are presented as a ratio compared to silica in the sample. X-axis is sample analysis number. The approximate detection limit for Li in a silicate glass standard (NIST612) was ~ 5 ppm. The approximate detection limit for Be in the silicate glass standard (NIST612) was ~ 20 ppm. The values plotted are all above the approximate detection limits for each element. Based on comparison to standards, and based on SiO_2 contents measured with electron probe, it is estimated that Be concentrations range from 5 - 150 ppm, and Li concentrations range from 15 - 250 ppm.

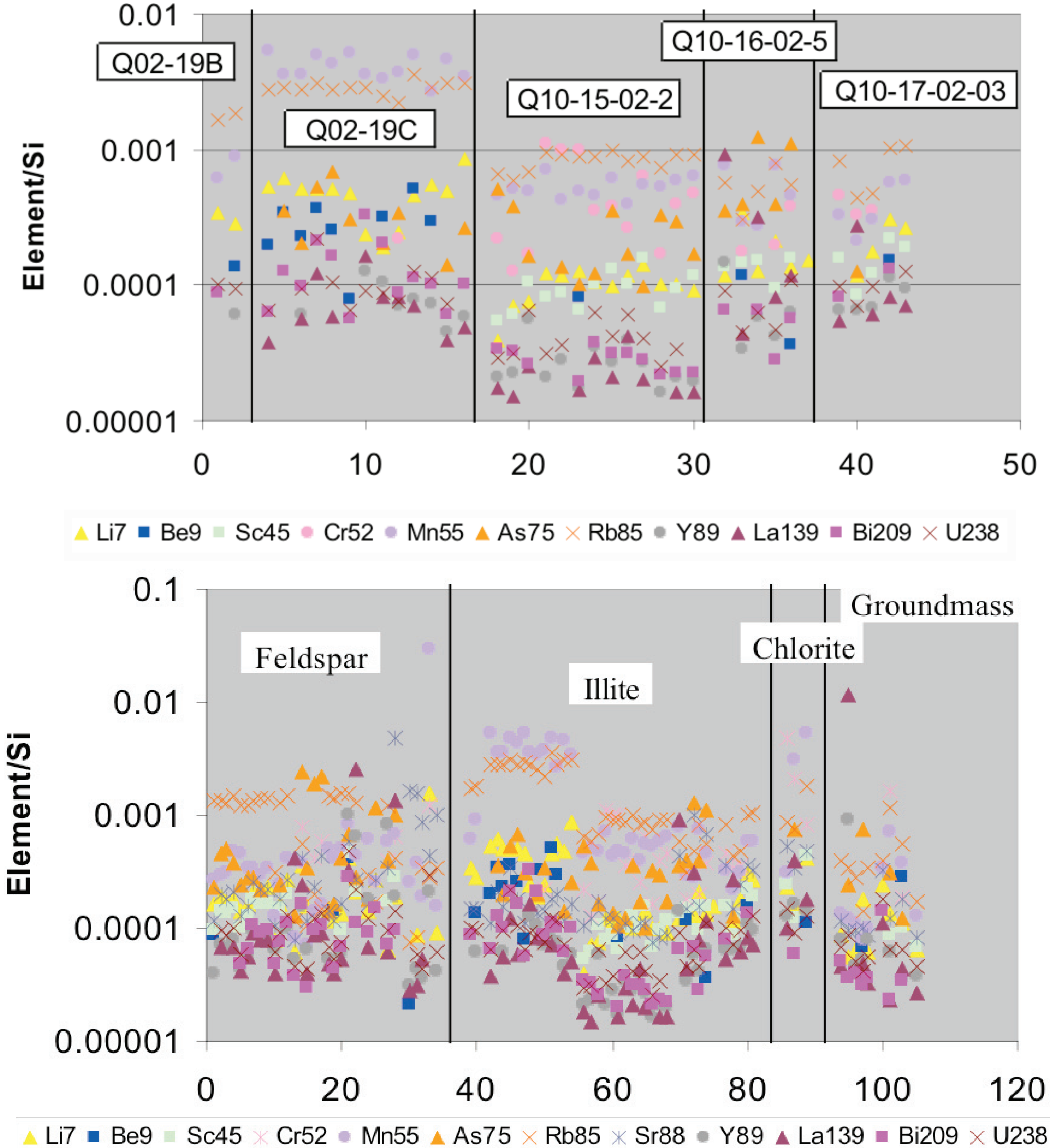


Figure 17. Plots showing reconnaissance qualitative LA-ICP-MS results for various elements in illites, chlorites, feldspars, and rock groundmass. The samples and analysis numbers are the same as those shown for Li and Be analyses depicted in figure 16. In both plots, the element concentrations are presented as a ratio compared to silica. X-axis is sample analysis number.

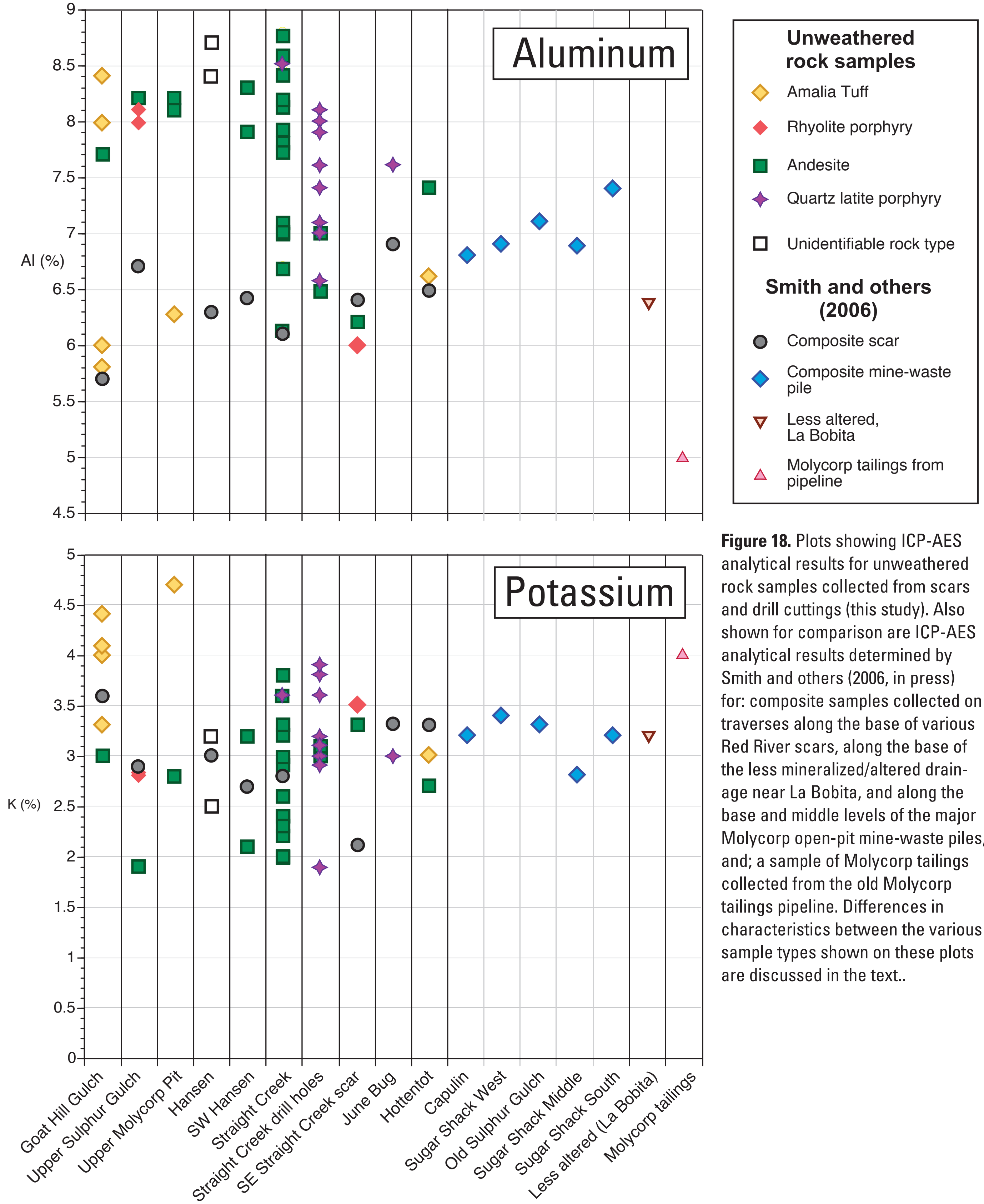
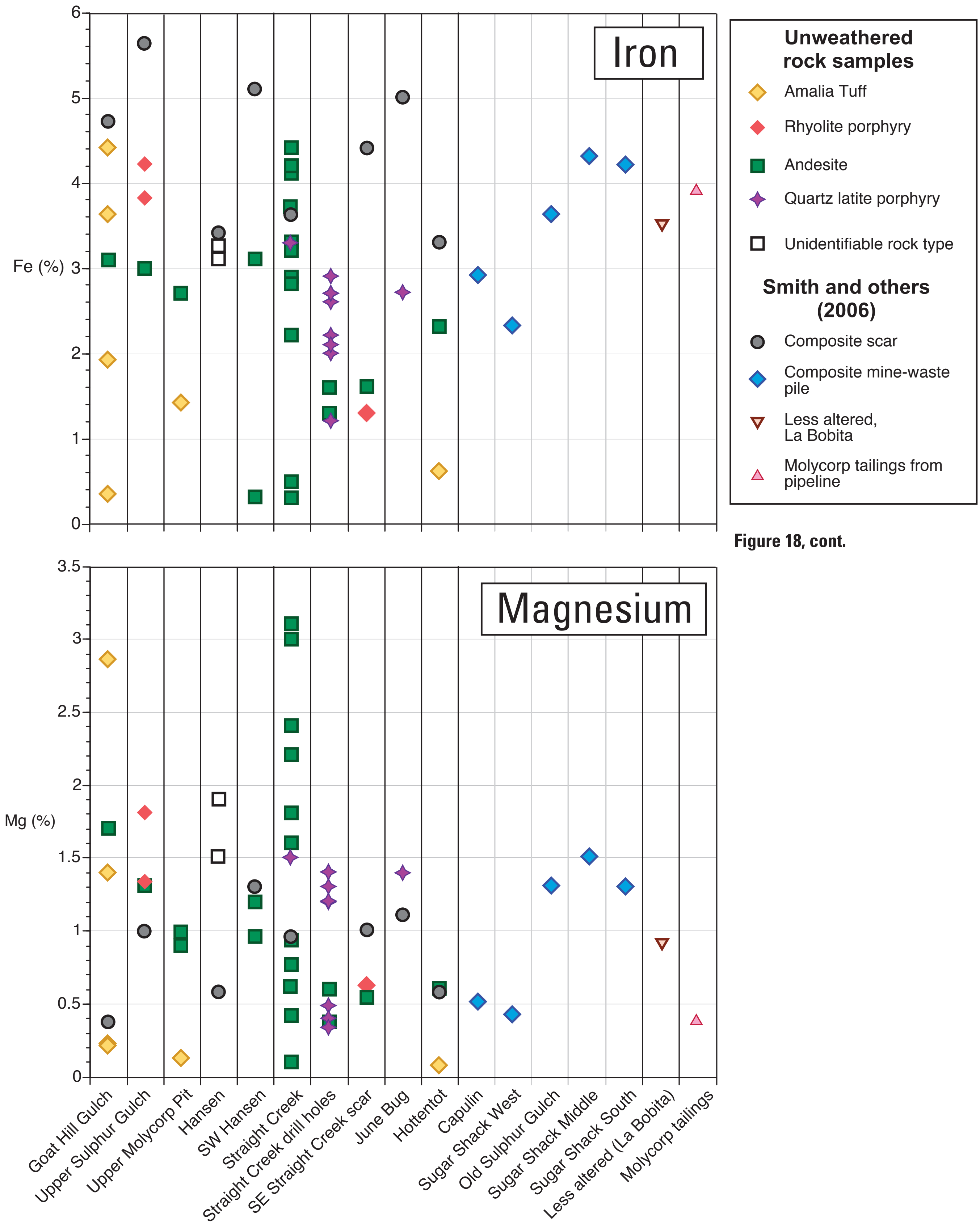


Figure 18. Plots showing ICP-AES analytical results for unweathered rock samples collected from scars and drill cuttings (this study). Also shown for comparison are ICP-AES analytical results determined by Smith and others (2006, in press) for: composite samples collected on traverses along the base of various Red River scars, along the base of the less mineralized/altered drainage near La Bobita, and along the base and middle levels of the major Molycorp open-pit mine-waste piles, and; a sample of Molycorp tailings collected from the old Molycorp tailings pipeline. Differences in characteristics between the various sample types shown on these plots are discussed in the text..



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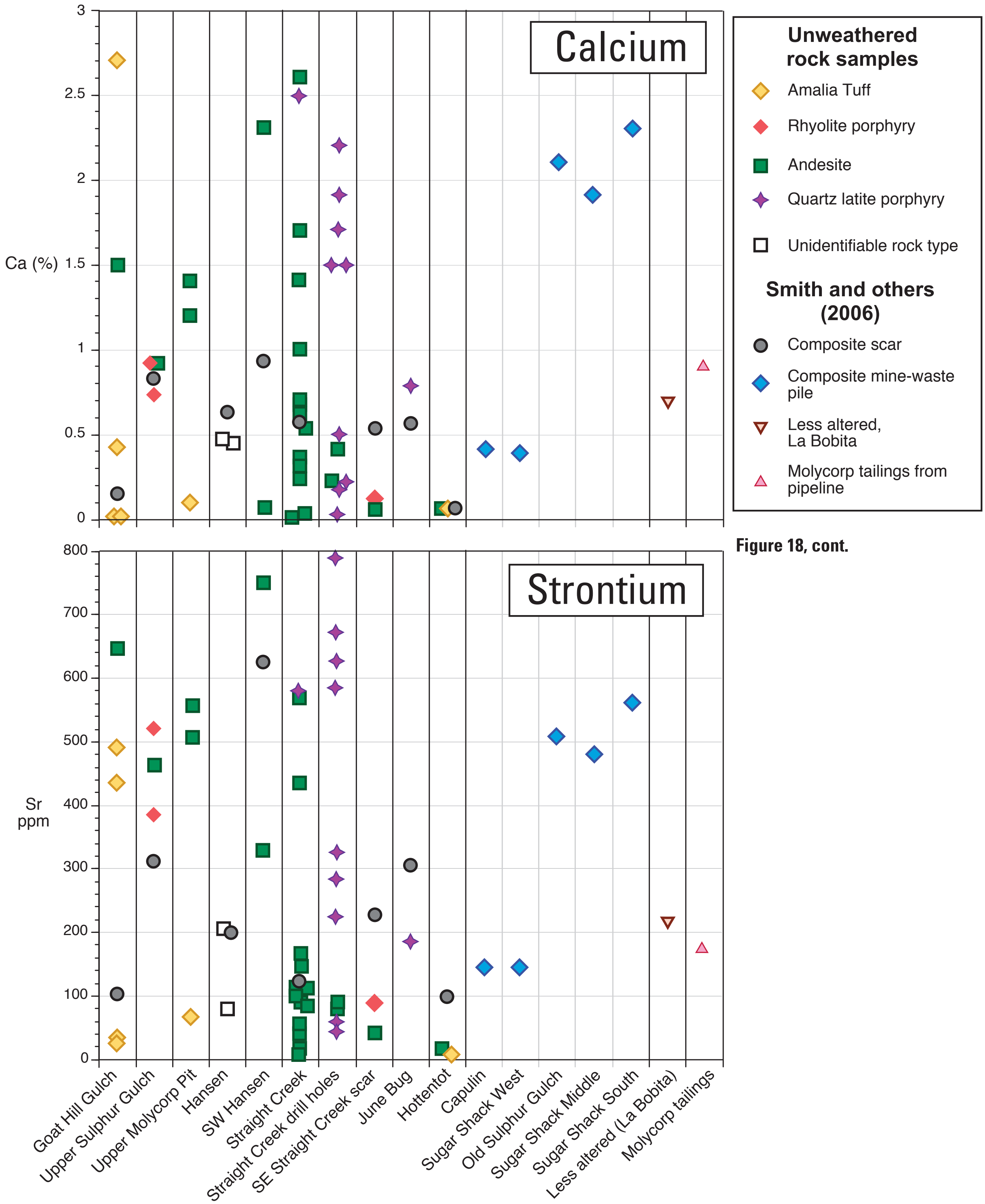

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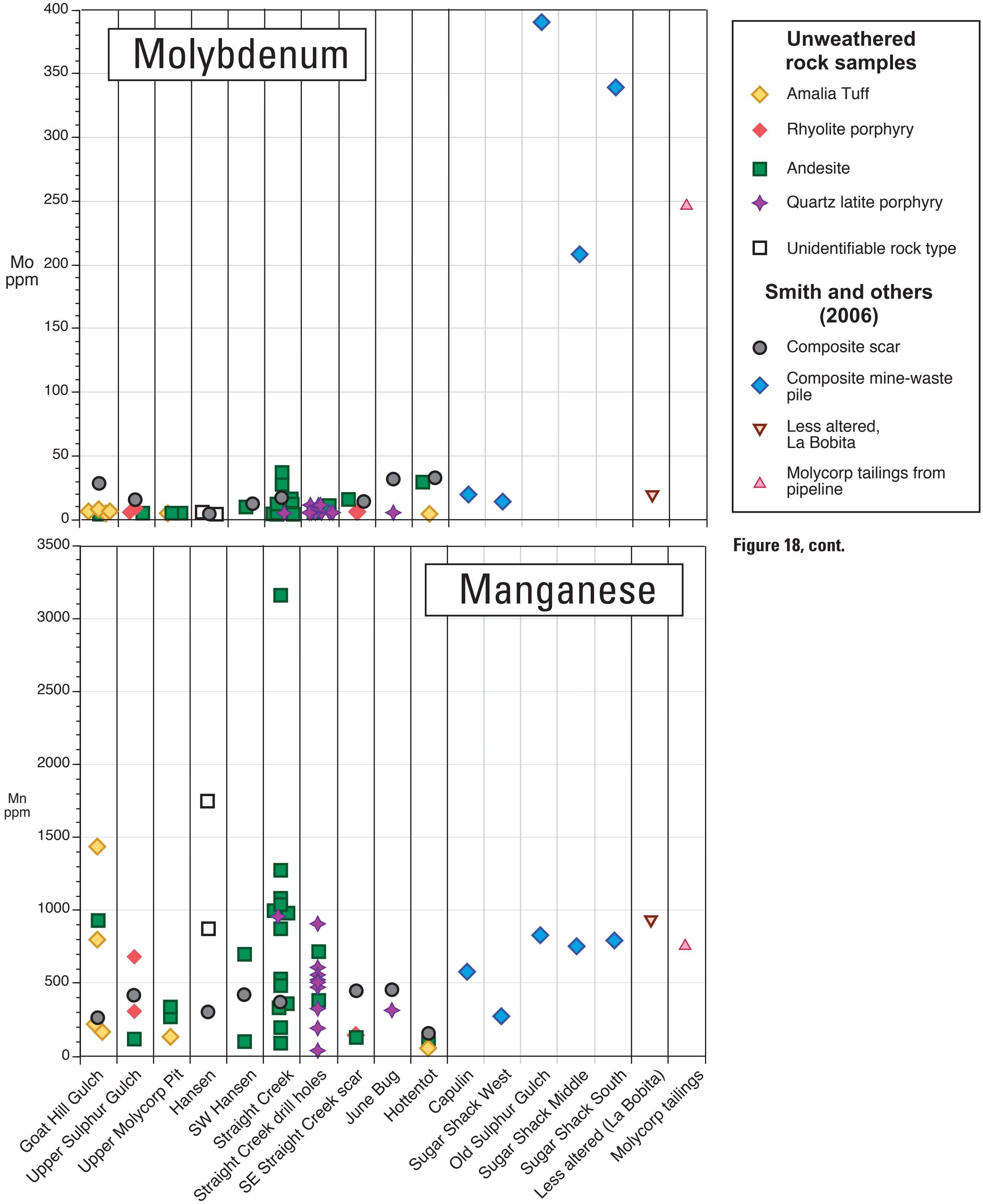

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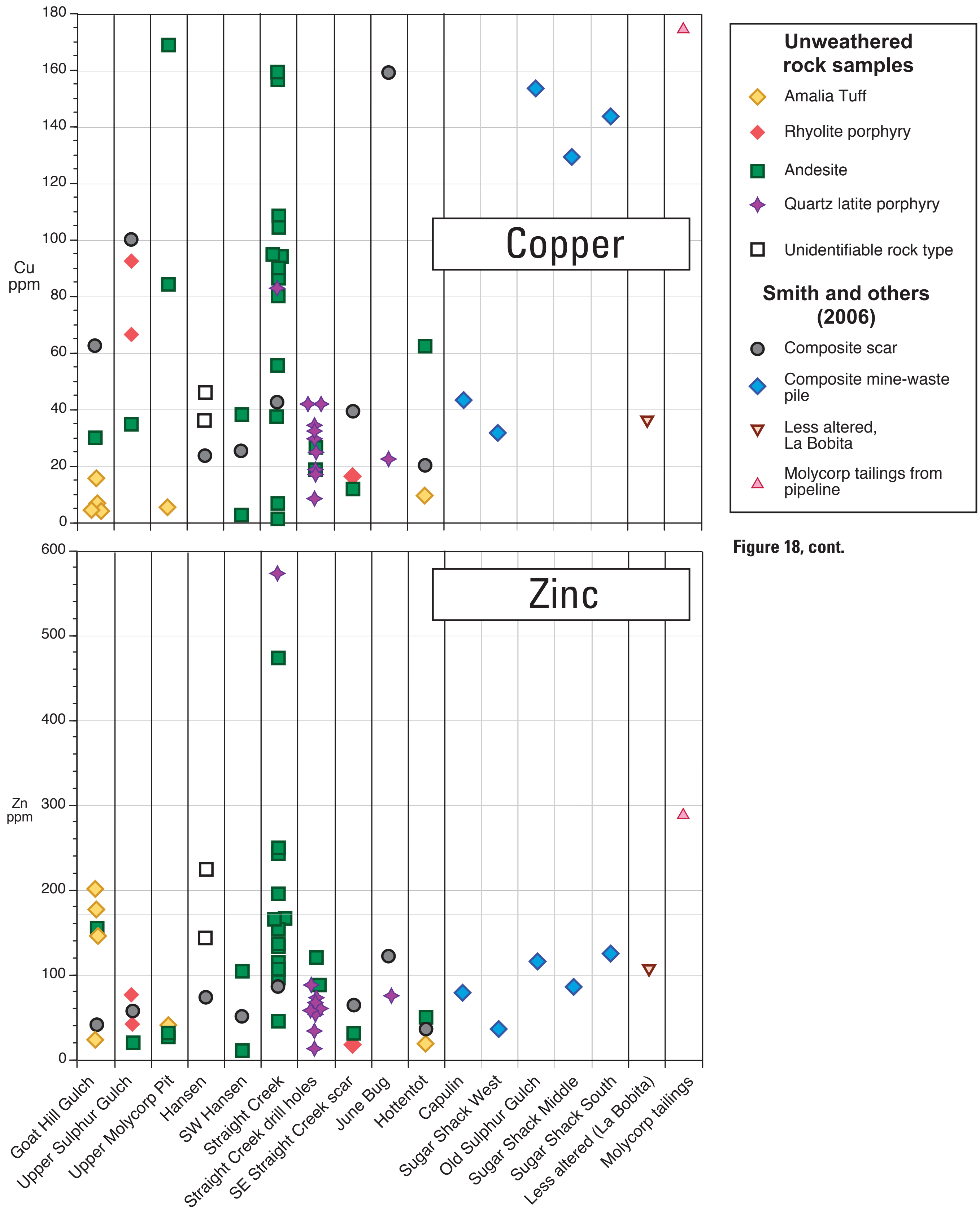

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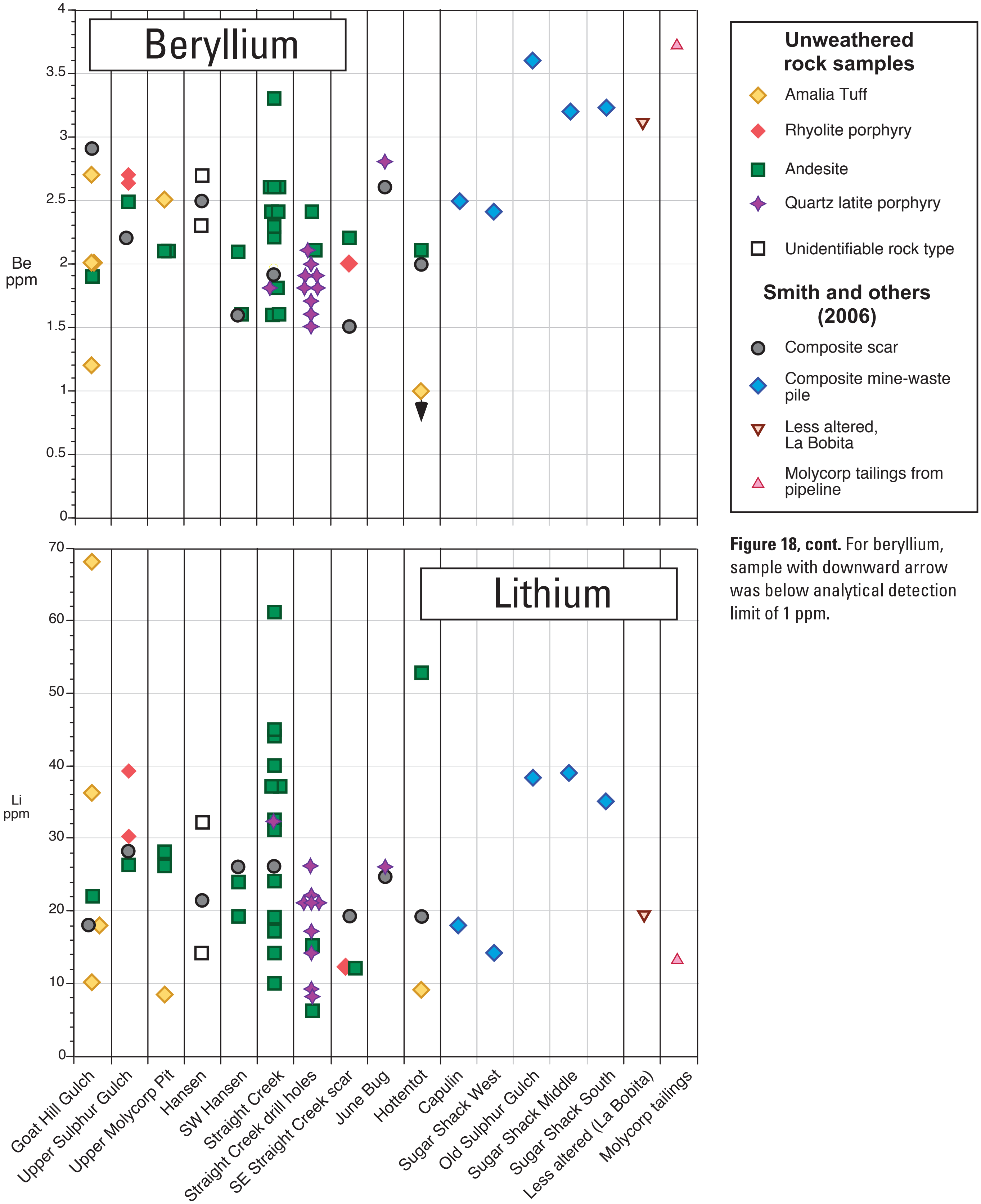

Figure 18, cont. For beryllium, sample with downward arrow was below analytical detection limit of 1 ppm.

Bobita composite sample is comprised primarily of propylitized andesites, with a minor component of weakly altered rhyolite dikes. The tailings sample is a point-in-time indication of the unweathered composition of mineralized rocks from the open-pit main ore zones, less most of the molybdenite and other sulfides removed by flotation.

The analytical results from this study and Smith and others (2006, in press) reveal complex variations in chemical composition of major elements and trace elements. This complexity results from several variably overlapping factors, including: a) original chemical differences between the unaltered rock types, b) chemical differences due to variability in the type(s) and relative intensities of hydrothermal alteration and mineralization that affected each sample, and, c) differences in the extent of chemical weathering that affected each sample.

Bulk chemical variations in unweathered samples

In general, variations in unweathered chemical composition that can be linked systematically to a specific rock type, alteration type, or scar area appear to be limited. The interpretation of the data is unfortunately complicated by the lack of silica analyses provided by the ICP-AES technique; elevated silica content, especially in the more mafic rock types, would likely be a good indicator of more intense alteration and mineralization. More interpretable results would also likely result from the collection of multiple samples of given rock and alteration types from each of the scar areas, and the statistical evaluation of the resulting chemical data. Such a detailed chemical analysis is beyond the funding and temporal scope of the current study. Nonetheless, some useful conclusions can be drawn based on the current data set.

As would be expected, samples of Amalia Tuff generally have higher potassium concentrations than samples of other rock types, due to the K-enriched nature of the unaltered rock. Relatively unaltered Amalia Tuff (as represented by the sample from the Hottentot scar) appears to be low in elements such as iron, magnesium, calcium, strontium, manganese, molybdenum, beryllium, lithium, and zinc. The QSP alteration and mineralization processes appear to have increased concentrations of all of these elements (with the exception of molybdenum) in the Amalia Tuff.

If the La Bobita composite sample can be assumed to be mostly representative of weakly propylitized andesite, then the mineralization and QSP alteration processes appear to have enriched the andesites in elements such as aluminum, magnesium, calcium, molybdenum, copper, zinc, and lithium. The La Bobita composite sample and samples of unaltered andesites from the northern Questa caldera area (S. Ludington, P. Lipman unpub. data) are relatively enriched in manganese compared to other unmineralized rock types in the Red River trend.

As would be expected given that the tailings sample originated from a high-grade molybdenite ore body associated with potassically altered, incompatible element-enriched granite (Ludington and others, 1995), the tailings sample is enriched in potassium, beryllium, molybdenum, copper, and zinc relative to most other samples. The mine waste piles derived from unweathered rocks between the high grade open-pit ore body and QSP-altered rocks in the Goat Hill Gulch and Sulphur Gulch scars are enriched in iron, magnesium, calcium, strontium, molybdenum, beryllium, and copper, indicating that these elements were added to the rocks around but proximal to the main ore bodies by the hydrothermal mineralization and alteration processes,

Anomalous levels of various elements such as calcium, manganese, zinc, copper, lead, and lithium are variably present in some samples compared to the majority of the Questa samples. These levels are likely a nugget effect that resulted from the localized enrichment of hydrothermal minerals such as rhodochrosite (Mn), calcite (Ca and Sr), sphalerite (Zn), chalcopyrite (Cu), and galena (Pb) in the rocks.

Bulk chemical variations caused by weathering

The composite scar samples and the composite Capulin and Sugar Shack West waste pile samples collected and analyzed by Smith and others (2006, in press) are a mix of weathered and unweathered material, and so provide useful insights into the bulk chemical changes that occur in the mineralized rocks as a result of weathering.

For example, aluminum and, to a lesser extent, zinc and manganese concentrations in the scar and scar-dominated waste pile samples are generally lower than their concentrations in most of the unweathered mineralized rock samples (fig. 18). This indicates that the sulfide oxidation and acid weathering process produces a sufficiently acidic pH in the waters percolating through the weathered veneer in the scar areas to prevent substantial precipitation of Al and Mn from solution. Net zinc loss is also not surprising given its aqueous mobility and general lack of sorption onto secondary iron minerals.

In contrast, iron appears to be enriched in the samples with weathered material. This provides an indication that the pH of waters percolating through the weathered veneer of the scar areas is not sufficiently acidic to transport all iron out of the rocks, and is consistent with the formation of abundant jarosite and goethite observed in the weathered scar rocks (Ludington and others, 2004).

Some elements including calcium, magnesium, strontium, lead, and copper seem to show a mixed behavior depending upon the scar, with depletions in some composite scar samples relative to the unweathered rocks and enrichments in other composite scar samples (fig. 18). This is consistent with their leaching from the rocks as a result of the sulfide oxidation, acid generation, and acid weathering processes, coupled with their variable precipitation as secondary minerals (i.e., sulfates, and, in the case of Ca and Mg, possibly clay minerals), or sorption onto secondary iron minerals.

Discussion

Reconnaissance mineralogical characterization and mineral composition studies of mineralized and altered rock samples provide several important findings pertinent to the overall Questa ground-water study goals.

Zonation of minerals and mineral compositions around intrusive centers

Our results provide further details into the potential zoning of hydrothermal minerals and hydrothermal mineral compositions around the source intrusions responsible for mineralization along the Red River trend. For example, compositional data for chlorite indicate that chlorite Fe/Mg ratio may decrease substantially with increasing distance or elevation from the intrusions. This is indicated by the high FeO and low MgO contents of chlorites from the Molycorp open pit and Upper Sulphur Gulch scar (both proximal to the mineralizing intrusions), and the inverse in chlorites from the Straight Creek scar distal from the mineralizing intrusions (fig. 14, table 4). These variations in chlorite composition may reflect the increased incorporation of iron into pyrite rather than chlorite in the QSP-propylitic alteration zones compared to the deeper, hotter ore zones. It is possible that this occurred in response to decreasing temperatures of formation and/or changes in the chemical composition of the hydrothermal fluids away from the intrusions.

The most Mg- and Mn-rich carbonates appear to be most abundant within or in relatively close proximity to the high-grade Mo mineralization and/or source intrusions. There are also indications from the Goat Hill Gulch and Sulphur Gulch scar rocks that QSP alteration closest to the source intrusions and high-grade molybdenite mineralization is marked by the increased occurrence of a number of exotic microscopic phases such as: REE-bearing carbonates, phosphates, and Ti-oxides; native silver in pyrite; and sulfides and alloys of Bi, Te, Cu, and/or Sn. Such minerals are not readily apparent in QSP-propylitically altered Hansen, Hottentot, Straight Creek, and June Bug scar rocks, suggesting that their abundance diminishes away from the source intrusions. However, these minerals are noted in samples from the Straight Creek drill holes and the adjacent SE Straight scar, supporting a hypothesis that source intrusion(s) may be relatively close at depth in these areas. Hence, the choice of the lower Straight Creek area as an analogue site for environmental processes active beneath the Sulphur Gulch and Goat Hill Gulch scars on the Molycorp mine site prior to mining is geologically appropriate from the standpoint of generally similar locations within the hydrothermal alteration and mineralization zoning around source intrusions.

Microscopic chalcopyrite, pyrrhotite, and barite are sufficiently common throughout all of the QSP-propylitically altered rocks studied that their occurrence cannot be considered as diagnostic of a particular location within the QSP alteration halo surrounding the intrusive centers.

Mineralogic sources for water constituents

Our analytical results provide insights into the elemental content of different mineral phases such as the various sulfides (pyrite, pyrrhotite, molybdenite, chalcopyrite, sphalerite, galena), carbonates (calcite, dolomite, REE carbonates), fluorite, sulfates (anhydrite, gypsum, barite), and silicates (illite, chlorite, feldspars, groundmass).

In a previous paper (Ludington and others, 2004), we developed a general and qualitative sequence of reactivity (ie, weathering/dissolution rate) for alteration and rock-forming minerals found in the scar areas and mineral deposits along the lower Red River. This sequence was based in part on observed variations in mineral abundances with increasing elevation in a weathering profile developed on QSP-propylitically altered andesite from the Straight Creek scar. It was also based on information from elsewhere in the literature (i.e., Plumlee, 1999, and references therein) about the weathering rates of minerals not examined in this particular profile. We have since modified the reactivity sequence slightly from that listed in Ludington and others (2004) to incorporate additional data from Questa and information provided by other scientists during peer review of this paper (D. Bove, K. Nordstrom, written comm., 2005). Minerals listed first in the following sequence with the greatest reactivities are therefore likely to weather more rapidly in the near-surface environment than minerals listed later in the sequence:

pyrrhotite, pyrite, Ca-carbonate >
chalcopyrite, fluorite, Mn-carbonate, dolomite >
chlorite, epidote?, calcic plagioclase? >
illite, molybdenite? >
biotite?, alunite, kaolinite >
sodic plagioclase, potassium feldspar >
quartz.

When coupled with information on mineral abundances and weathering rates, the mineral composition data gathered in this study can be used to infer the most likely mineralogical sources for elements of environmental concern found in ground and surface waters in the Red River mineralized areas (fig. 19). For example, calcite is the dominant mineral likely to be contributing calcium, strontium, and yttrium into waters due to its abundance, its elevated content of these elements, and its high reactivity. Calcium-rich plagioclase may also contribute some Ca to the waters due to its abundance and moderate reactivity.

Dolomite may be a locally important source for magnesium in the isolated areas where it occurs in small amounts. Magnesium is present in calcites from most scar areas; however, its content in calcite may be sufficiently low to indicate that other mineral sources are also required for Mg in these waters. For example, chlorite, in spite of its lower reactivity than Mg-carbonates, may be sufficiently abundant and of sufficiently small grain size that weathering of chlorite could contribute substantial Mg to acidic waters percolating through the weathered veneer in the scars.

Rhodochrosite and/or Mn-rich calcite are likely the predominant sources for Mn-enriched waters draining areas within or proximal to the source intrusions (such as on the mine site) due to the greater abundances of these minerals in these areas. In other scar areas, very locally abundant

Element	Least reactive → Most reactive
Ca	Na-feldspar Ca-feldspar Chlorite Dolomite **Calcite** Epidote Rhodochrosite Gypsum, anhydrite* Fluorite Gypsum, anhydrite°
Mg	Chlorite Dolomite Calcite
Na	Na-feldspar Ca-feldspar Illite
K	K-feldspar Illite
Al	K-feldspar **Ca-feldspar** **Chlorite** Na-feldspar Illite Alunite *Smectite* Kaolinite
Fe	Jarosite Chlorite **Pyrite** Fe-Ti oxides Epidote Pyrrhotite Chalcopyrite
S (as sulfate)	**Pyrite** Chalcopyrite Pyrrhotite Galena Sphalerite Gypsum, anhydrite* Gypsum, anhydrite°
Mn	Chlorite Rhodochrosite **Calcite**
Sr	*Ca-feldspar* Chlorite Dolomite **Calcite** Illite Rhodochrosite
F	Biotite Chlorite **Fluorite** REE-F carbonates Illite
Ti	Fe-Ti oxides Biotite Chlorite Illite
P	**Ca, REE phosphates**
Cu	**Chalcopyrite**
Pb	**Galena**
Zn	**Sphalerite**
Cd	**Sphalerite**
Co, Ni	**Pyrite** Pyrrhotite
Cr	*Fe-Ti oxides?* *Chlorite?*
Mo	**Molybdenite** Ferrimolybdite
Be	*K-feldspar?* Illite? Chlorite? *Smectite?* Groundmass?
Li	*K-feldspar?* Illite? Chlorite? *Na-feldspar* *Smectite?* Groundmass?
Light REE	Ca, REE phosphates **Fluorite** **REE-F carbonate**
Y	Fe-Ti oxides Ca, REE phosphates **Fluorite** **REE-F carbonates** **Calcite**
Sn, Bi, Te	Miscellaneous minor alloys, sulfides, tellurides
Ag	Native silver

Figure 18. Mineral phases most likely to be contributing elements to ground and surface waters from mineralized rocks along the Red River, organized according to their inferred relative reactivities under geochemical conditions present in surface or ground waters. Minerals shown in **bold** are the likely predominant mineralogic sources for elements released into ground and surface waters, based on the reactivity of the minerals and the concentration(s) of the elements in the minerals. If no minerals are shown in bold for a given element, then all listed may contribute approximately equally, based on the concentration of the element in the mineral. Minerals shown in *italics* are a presumed mineralogic source for the element, inferred without any supporting compositional data. Minerals followed by "?" are speculative. * – reactivity in sulfate-rich waters; ° – reactivity in sulfate-poor waters.

rhodochrosite (i.e., possibly in the Straight Creek sample with 3,140 ppm manganese, table 6), more widespread Mn-bearing calcite, and possibly Mn-bearing silicates such as chlorite or epidote, are likely sources of Mn in the waters.

Pyrite is the dominant hydrothermal source mineral for iron, sulfate, cobalt, and nickel in the waters. Dissolution of gypsum and anhydrite may provide some sulfate and calcium to low-sulfate waters. Iron-rich chlorite and epidote may also contribute some Fe as well. Sphalerite, chalcopyrite, and galena are likely the dominant sources for Zn and Cd, Cu, and Pb in the waters, respectively.

Fluorite is the dominant source for F due to its widespread occurrence and relatively high reactivity. Biotite, due to its low reactivity, likely only contributes a small proportion of F to waters in the potassically-altered rocks within and proximal to the source intrusions. In QSP-altered rocks, F-bearing chlorites, illites, and phosphates, due to their lower reactivities, likely provide only a small proportion of the total F. Synchisite may contribute some F in areas where it occurs.

Although their reactivities are relatively low compared to the carbonates and sulfides, the most likely sources for Al (based upon their abundance, grain size, and reactivities) are chlorite, Ca-feldspar, and to a lesser extent hydrothermal illites, secondary smectite, and both hydrothermal and secondary kaolinite.

Mineralogic input for mass-balance modeling of water-rock interactions

The compositional data can also be used to refine mineral compositions used as input to mass-balance chemical modeling calculations of the chemical evolution of ground waters and surface waters in response to water-rock interactions. For example, chlorite compositions reflecting the different Mg/Fe ratios of the different scar areas allow for a greater refinement in the mass balance models than are available from the use of idealized chlorite compositions.

Conclusions

Reconnaissance mineralogical characterization and mineral composition studies of hydrothermal alteration and vein minerals from the Red River scar areas, drill holes, and the Molycorp mine site provide useful constraints on potential mineralogic sources for elements found in ground and surface waters from the area that are of potential environmental concern. The predominant mineralogical sources for each element are a function of the concentration of the element in various mineral hosts, coupled with the abundance of the mineral hosts and the mineral hosts' reactivities in the weathering environment. In general, the most dominant sources are those that are most reactive and abundant, such as calcite (the likely dominant source for Ca, Mg, Mn, and Sr), pyrite (the likely dominant source for Fe, sulfate, Co, and Ni), and fluorite (the dominant source for F). However, less reactive but abundant minerals may also contribute significantly to water compositions. For example, chlorite is likely a potentially major source for Al and Si, and may also contribute a small proportion of the Mg, Fe, and Mn. Minerals such as dolomite and rhodochrosite may be locally important sources for Mg and Mn, respectively.

This study has also identified variations in microscopic mineralogy and mineral composition that apparently occur with increasing distance away from the source intrusions responsible for mineralization. These include increasing Fe/Mg ratio in chlorite, decreasing amounts of Mn-rich carbonates and Mg-carbonates, and the occurrence of exotic metal alloys and sulfides, as well as REE carbonates, phosphates, and Ti-oxides in QSP-altered rocks proximal to the intrusions. Such mineralogical variability can influence the composition of waters draining specific alteration zones in each of the different scar areas. For example, waters with elevated Mn contents would be expected to develop in zones within or close to the intrusions where Mn-rich carbonates occur.

A variety of more detailed studies could be done to elaborate on the results of this reconnaissancelevel characterization study. For example, more detailed petrographic studies of thin sections of unweathered samples from all scars would further elucidate details of mineral zoning relationships, as well as compositional variability away from the source intrusions. More detailed mineralogical studies of core from deep exploration drill holes beneath the Hottentot, Hansen, June Bug, and Straight Creek scars would provide further insights as to whether similar mineral zoning and compositional variations are present in these areas as those that have been identified in the mine site scars, the SE Straight scar, and the drill holes beneath lower Straight Creek.

References

Loucks, T.A., Phillips, J.S., and Newell, R.A., 1977, Exploration potential of the Questa East area, private report for Kennecott Copper Corporation.

Ludington, S., Bookstrom, A.A., Kamilli, R.J., Walker, B.M., and Klein, D. P., 1995, Climax Mo deposits, in du Bray, E.A., ed., Preliminary compilation of descriptive geoenvironmental mineral deposit models. U.S. Geological Survey Open-File Report 95-831, p. 70-74.

Ludington, S., Plumlee, G., Caine, J.S., Bove, D., Holloway, J., and Livo, E., 2004, Questa baseline and pre-mining ground-water quality investigation. 10. Geologic influences on ground and surface waters in the lower Red River watershed, New Mexico: U.S. Geological Survey Scientific Investigations Report 2004-5245, 45 p.

Martineau, M.P., Heinemeyer, G.R., Craig, S.D. and McAndrews, K.P., 1977, Geological report, Questa project, 1975-1977, Questa Molybdenum Company, internal report, 161 p.

Meyer, J.W., and Leonardson, R.W., 1990, Tectonic, hydrothermal and geomorphic controls on alteration scar formation near Questa, New Mexico: in Bauer, P.W., Lucas, S.G., Mawer, C.K., and McIntosh, W.C., eds., Tectonic development of the southern Sangre de Cristo Mountains, New Mexico, New Mexico Geological Society Guidebook, v. 41, p. 417-422.

Molling, P.A., 1989, Applications of the reaction progress variable to the hydrothermal alteration associated with the deposition of the Questa molybdenite deposit, NM: unpublished Ph.D. dissertation, Johns Hopkins University, 229 p.

Nordstrom, D.K., 2006 in press, Questa baseline and pre-mining ground-water quality investigation. 25. Summary of investigations. U.S. Geological Survey Scientific Investigations Report 06-xxxx.

Plumlee, G.S., 1999, The environmental geology of mineral deposits, in Plumlee, G.S., and Logsdon, M.J., eds., *The Environmental Geochemistry of Mineral Deposits, Part A: Processes, Techniques, and Health Issues*, Society of Economic Geologists Reviews in Economic Geology, Vol. 6A, pp. 71-116.

Ross, P., Jébrak, M., and Walker, B.M., 2002, Discharge of hydrothermal fluids from a magma chamber and concomitant formation of a stratified breccia zone at the Questa porphyry molybdenum deposit, New Mexico: Economic Geology, v. 97, p. 1679–1700.

Schilling, J., 1956, Geology of the Questa molybdenum (Moly) mine area, Taos County, New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 51, 87 p.

Smith, K.S., Hageman, P.L., Briggs, P.H., Sutley, S.J., McCleskey, R.B., Livo, K.E., Verplanck, P.L., Adams, M.G., and Gemery-Hill, P.A., 2006 in press, Questa baseline and pre-mining ground-water quality investigation. 19. Leaching characteristics of composited materials from mine waste-rock piles and naturally altered areas near Questa, New Mexico: U.S. Geological Survey Scientific Investigations Report 2006-xxxx.

Taggart, J.E., Jr., ed. (2002) Analytical methods for chemical analysis of geologic and other materials, U.S. Geological Survey: U.S. Geological Survey Open-file Report 02-0223, v. 5.0, URL: http://pubs.usgs.gov/of/2002/0fr-02-0223/

Table 1. Compilation of mineral occurrence data in rock samples from Red River scar areas, the Molycorp open pit, and USGS drill holes in lower Straight Creek. “h” - hand sample; “m” - microscopic; “a” - abundant; “c” - common; “r” - rare; “vr” - very rare; “REE” - rare earth elements. *Dominant elements listed where phase not identifiable based on SEM analysis. ** SC-1B has little of interest other than pyrite. ^Tentative; differentiated from secondary gypsum based on encapsulation in primary minerals, lack of obvious secondary iron oxides.

Table 1

Source location	Hottentot scar	SE Hottentot scar	June Bug scar	SE Straight scar	Straight Cr. drill holes	Straight scar	Hansen scar	S Hansen scar	SW Hansen scar	La Bobita drainage
Samples examined	10-16-02-5	No samples analyzed microscopically	10-15-02-2	10-18-02-04A; 10-18-02-04AB	SC-5B277; SC-3B 195-200' SC-1B 88-95 **	Upper Straight; 10-17-02-3; 10-17-02-1b	No samples analyzed microscopically	No samples analyzed microscopically	UL Hansen 9125	10-18-02-06b
Mineral*										
Pyrite	h a	h a	h a; m a	h a; m a	h a; m a	h a; m a	h a	h a; m a	h a; m a	
Pyrrhotite			m c						m c	
Chalcopyrite	m c		m c	m c	m r	m c			m c	
Galena	h vr; m c		m r	m c	m c	m c				
Sphalerite	h vr; m c			m r	m c	m r				
Molybdenite	m c		m r							
Calcite			m c	h r; m c	m c				m c	
Mn-rich calcite				m r						
Dolomite				m r						
Ca, Fe, Mn, Mg										
Barite			m a	m c	m c	m c			m c	
Anhydrite^				m vr?						
Gypsum			m r	m r	m r	m c			m c	
Pb, Ca, Sr sulfate										
Synchysite/REE				m c	m c					
REE, O					m r					
REE, Y, Ca										
REE Phosphate	m r			m c	m r	m r				
Apatite			m c		m c	m c			m c	m c
Fe phosphate			m vr							
Y, Ti, W, REE					m r					
Y, Ti, O										
Ti oxides			m c	m c	m c	m c			m c	m c
U, Th in TiO2					m r					
Ilmenite										m c
Magnetite										m c
Native silver				m vr	m vr					
Te, Cu, Sulfide				m vr						
Bi, Cu sulfide				m vr						
Alunite	h a									
Cu, Sn sulfide					m vr					
Bi, Pb, Ag, Se, Cu					m vr					
Sphene										
Fluorite						h r				
Illite	m c		m c	m c	m c	m c			m c	m r
Chlorite	m c				m c	m c				h a; m a
Epidote			h c; m c		m c	m r			m c	m a
Phlogopite										
K-feldspar				m c	m c					m c
Zircon										
Pb, Bi										
Bi, Pb, Te										
Sphene										m c
Amphibole/pyroxene										m c

Table 1

Source location	Upper Sulphur scar	Molycorp pit	Goat Hill scar	Goat Hill South scar	Goat Hill West scar	Eagle Rock scar	Ranger Station scar
Samples examined	Q02-10-15-UO; Q02-18;	Q02-19b,c	Q02-21	Q10-17-02-11a, 10b	No samples analyzed microscopically	No samples analyzed microscopically	Q10-18-02-7
Mineral*							
Pyrite	h a; m a	h r; m c	h a; m a	h a; m a	h a	h a	h a; m a
Pyrrhotite	m r		m c				
Chalcopyrite	m r	m r	m c	m c			
Galena	m r	m r	m r	m r			
Sphalerite		m r	m r	m r			
Molybdenite	m r	h c; m c					
Calcite	h c; m c	h c; m c					
Mn-rich calcite		m r	m r				
Dolomite							
Ca, Fe, Mn, Mg			m r				
Barite	m c		m r	m c			m c
Anhydrite^	m vr?			m c			
Gypsum	m c	m r					
Pb, Ca, Sr sulfate		m r					
Synchysite/REE	m c		m c				
REE, O			m c				
REE, Y, Ca			m r				
REE Phosphate	m r	m r	m r	m c			
Apatite	m c						
Fe phosphate							
Y, Ti, W, REE			m c				
Y, Ti, O			m r				
Ti oxides		m c	m c	m c			m c
U, Th in TiO2							
Ilmenite							
Magnetite							
Native silver		m vr	m vr				
Te, Cu, Sulfide							
Bi, Cu sulfide							
Alunite							h c
Cu, Sn sulfide							
Bi, Pb, Ag, Se, Cu							
Sphene		m r					
Fluorite	m r	h c; m c					
Illite	m c	m c	m c	m a			m c
Chlorite	m r	m r	m r	h c; m c			m r
Epidote	m r			m c			
Phlogopite				m r			
K-feldspar							m c
Zircon		m r		m r			
Pb, Bi				m r			
Bi, Pb, Te				m r			
Sphene							
Amphibole/pyroxene							

Table 2. Compilation of electron probe microanalytical data for sulfides from Red River scar areas, the Molycorp open pit, and USGS drill holes from the lower Straight Creek area. Element concentrations are listed first as weight % and then recalculated and listed as the number of atoms, normalized to the standard number of sulfur atoms in the appropriate idealized mineral formula. Element concentrations listed in gray have an error of > 10% 1 sigma based on counting statistics; while it is likely that these elements are present, their concentrations in the material are uncertain.

Table 2.

Sample	Vein /	Mineral	Data Point	Weight % Cu	Fe	As	S	Pb	Zn	Ni	Se	Mo	Ag	Co	Bi
Molycorp open pit, lower Sulphur Gulch															
Q02-19b	Vein	Molybendite	1-A2-1MoS	0.00	0.00	0.00	39.7	0.00	0.12	0.00	0.00	61.6	0.00	0.00	0.00
Q02-19b	Vein	Molybendite	1-A2-2MoS	0.00	0.23	0.00	39.2	0.00	0.17	0.00	0.00	60.3	0.00	0.00	0.00
Q02-19b	Dissem.	Pyrite	1-A2-3PyR	0.00	47.6	0.00	53.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Q02-19b	Dissem.	Pyrite	1-A2-4PyC	0.00	47.9	0.00	52.8	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Q02-19b	Dissem.	Pyrite	1-A2-5PyR	0.00	47.9	0.00	54.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Q02-19b	Dissem.	Pyrite	1-A2-6PyC	0.00	47.6	0.00	53.8	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Q02-19b	Dissem.	Pyrite	1-A2-7PyR	0.00	47.9	0.00	53.3	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Q02-19b	Dissem.	Pyrite	1-A3-1PyR	0.00	47.4	0.00	52.5	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Q02-19b	Dissem.	Pyrite	1-A3-2PyC	0.00	47.7	0.00	53.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Q02-19b	Dissem.	Pyrite	1-A3-3Py	0.00	47.0	0.00	52.9	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Q02-19b	Dissem.	Galena	1-A4-1PbS	0.00	0.00	0.00	13.4	88.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Q02-19b	Dissem.	Sphalerite	1-A6-1ZnS	0.00	0.30	0.00	33.4	0.00	66.0	0.00	0.00	0.00	0.00	0.00	0.00
Q02-19C	Dissem.	Pyrite	4-A4-1	0.00	47.4	0.00	53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Q02-19C	Dissem.	Pyrite	4-A4-2	0.00	47.6	0.00	53.5	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Q02-19C	Dissem.	Sphalerite	4-A4-4	0.00	4.55	0.00	33.0	0.00	63.8	0.00	0.00	0.00	0.00	0.00	0.00
Q02-19C	Dissem.	Sphalerite	4-A4-5	0.00	2.97	0.00	33.3	0.00	64.3	0.00	0.00	0.00	0.00	0.00	0.00
Q02-19C	Dissem.	Pyrite	4-A5-1	0.00	47.9	0.00	53.8	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Q02-19C	Dissem.	Pyrite	4-A5-2	0.00	47.8	0.00	53.3	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Q02-19C	Dissem.	Pyrite	4-A6-1	0.00	47.4	0.00	53.6	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Q02-19C	Dissem.	Pyrite	4-A6-2	0.00	47.4	0.00	53.1	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
Q02-19C	Dissem.	Pyrite	4-A6-3	0.00	47.9	0.00	52.4	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Q02-19C	Dissem.	Pyrite	4-A7-1	0.00	47.7	0.00	53.6	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
Q02-19C	Dissem.	Pyrite	4-A7-3	0.00	47.5	0.00	53.3	0.36	0.00	0.00	0.00	0.00	0.00	0.14	0.00
Q02-19C	Dissem.	Pyrite	4-A7-4	0.00	47.8	0.00	53.3	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Upper Sulphur Gulch															
Q02-18	Dissem.	Pyrite	2-A03-01r	0.00	47.0	0.00	53.6	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
Q02-18	Dissem.	Pyrite	2-A03-02c	0.00	47.1	0.00	53.5	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
Q02-18	Dissem.	Pyrite	2-A04-1r	0.00	47.6	0.00	53.4	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Q02-18	Dissem.	Pyrite	2-A04-2c	0.00	47.5	0.00	52.9	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
Q02-18	Dissem.	Pyrite	2-A08-01r	0.00	47.5	0.00	53.5	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Q02-18	Dissem.	Pyrite	2-A08-02c	0.00	47.2	0.00	53.1	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Q02-18	Dissem.	Pyrite	2-A09-1	0.00	47.6	0.00	53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Q02-18	Vein	Pyrite	2-A10-1	0.00	47.8	0.00	52.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A10-2	0.00	48.0	0.00	53.0	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
Q02-18	Vein	Pyrite	2-A10-3	0.00	47.9	0.00	52.8	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00

Table 2.

Sample	Vein /	Mineral	Data Point	Weight % Cu	Fe	As	S	Pb	Zn	Ni	Se	Mo	Ag	Co	Bi
Q02-18	Vein	Pyrite	2-A10-4	0.00	48.2	0.00	53.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A10-5	0.00	48.1	0.00	53.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A10-6	0.00	47.4	0.00	52.7	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
Q02-18	Vein	Pyrite	2-A10-7	0.00	47.5	0.00	52.2	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Q02-18	Vein	Pyrite	2-A10-8	0.00	47.5	0.00	51.8	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Q02-18	Vein	Pyrite	2-A10-9	0.00	47.1	0.00	51.3	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Q02-18	Vein	Pyrite	2-A10-10	0.00	47.0	0.00	52.0	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
Q02-18	Dissem.	Pyrite	2-A11-1	0.00	47.5	0.00	51.8	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
Q02-18	Dissem.	Pyrite	2-A11-2	0.00	47.9	0.00	52.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A11-3	0.00	47.5	0.00	51.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A11-4	0.00	47.8	0.00	51.7	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Q02-18	Dissem.	Pyrite	2-A11-5	0.00	47.3	0.00	51.1	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
Q02-18	Dissem.	Pyrite	2-A11-6	0.00	47.4	0.00	51.7	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Q02-18	Vein	Pyrite	2-A12-1	0.00	47.7	0.00	52.1	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Q02-18	Vein	Pyrite	2-A12-2	0.00	47.7	0.00	51.7	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
Q02-18	Vein	Pyrite	2-A12-3	0.00	47.6	0.00	52.3	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Q02-18	Vein	Pyrite	2-A12-4	0.00	47.7	0.00	51.9	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
Q02-18	Vein	Pyrite	2-A12-5	0.00	47.8	0.00	52.0	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Q02-18	Vein	Pyrite	2-A5-1	0.00	46.7	0.00	52.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A6-1	0.00	47.0	0.00	51.1	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
Q02-18	Vein	Pyrite	2-A6-2	0.00	47.3	0.00	51.9	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Q02-18	Dissem.	Pyrite	2-A7-1	0.00	47.4	0.00	52.0	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Q02-18	Dissem.	Pyrite	2-A7-3	0.00	48.0	0.00	52.1	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Q02-15-UO	Dissem.	Pyrite	3-A10-1	0.00	47.6	0.00	53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Q02-15-UO	Dissem.	Pyrite	3-A10-2	0.00	47.9	0.00	53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Q02-15-UO	Dissem.	Pyrite	3-A12-1	0.00	47.0	0.00	52.1	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00
Q02-15-UO	Dissem.	Pyrite	3-A12-2	0.00	47.7	0.00	53.1	0.32	0.00	0.00	0.00	0.00	0.00	0.19	0.00
Q02-15-UO	Dissem.	Pyrite	3-A12-3	0.00	47.5	0.00	53.3	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
Q02-15-UO	Dissem.	Pyrite	3-A12-4	0.00	47.5	0.00	52.9	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00
Q02-15-UO	Dissem.	Pyrite	3-A13-1	0.00	47.3	0.00	53.0	0.00	0.00	0.18	0.00	0.00	0.00	0.08	0.00
Q02-15-UO	Dissem.	Pyrite	3-A13-2	0.00	48.0	0.00	53.6	0.00	0.00	0.14	0.00	0.00	0.00	0.20	0.00
Q02-15-UO	Dissem.	Pyrite	3-A13-3	0.00	47.4	0.00	53.3	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Q02-15-UO	Dissem.	Pyrite	3-A13-4	0.00	47.4	0.00	53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
Q02-15-UO	Vein	Pyrite	3-A4-1	0.00	47.7	0.00	52.0	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Q02-15-UO	Vein	Pyrite	3-A4-2	0.00	47.9	0.00	52.5	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Q02-15-UO	Vein	Pyrite	3-A4-3	0.00	47.7	0.00	52.3	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00

Table 2.

Sample	Vein /	Mineral	Data Point	Weight % Cu	Fe	As	S	Pb	Zn	Ni	Se	Mo	Ag	Co	Bi
Q02-15-UO	Vein	Pyrite	3-A5-1	0.00	48.1	0.00	52.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Q02-15-UO	Vein	Pyrite	3-A6-1	0.00	47.9	0.00	53.3	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Q02-15-UO	Vein	Pyrite	3-A8-1	0.00	47.7	0.00	53.1	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00
Q02-15-UO	Vein	Pyrite	3-A8-2	0.00	47.9	0.00	52.7	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Q02-15-UO	Vein	Pyrite	3-A8-3	0.00	48.0	0.00	53.1	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
Q02-15-UO	Vein	Pyrite	3-A8-4	0.00	48.2	0.00	52.7	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00
Q02-15-UO	Vein	Pyrite	3-A8-5	0.00	48.1	0.00	52.6	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Q02-21	Dissem.	Pyrite	5-A2-1	0.00	46.9	0.00	54.4	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Q02-21	Dissem.	Pyrite	5-A5-1	0.00	46.3	0.00	54.5	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Q02-21	Dissem.	Pyrite	5-A5-2	0.00	46.3	0.00	54.5	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Q02-21	Dissem.	Chalcopyrite	5-A5-3	34.8	31.5	0.00	35.4	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Q02-21	Dissem.	Pyrite	5-A8-1	0.00	46.9	0.00	54.3	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Q02-21	Dissem.	Chalcopyrite	5-A8-2	34.4	31.5	0.00	35.0	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Q02-21	Dissem.	Pyrite	5-A9-1	0.00	46.8	0.00	54.4	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Q02-21	Dissem.	Pyrite	5-A9-3	0.00	47.2	0.00	54.2	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
SW Hansen															
ULHANSEN 9125	Dissem.	Pyrite	7-A1-1	0.00	45.6	0.00	52.6	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
ULHANSEN 9125	Dissem.	Pyrite	7-A3-1	0.00	46.2	0.00	53.9	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
ULHANSEN 9125	Dissem.	Pyrhotite	7-A3-2	0.00	59.2	0.00	39.6	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
ULHANSEN 9125	Dissem.	Pyrhotite	7-A3-3	0.00	59.4	0.00	39.1	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
ULHANSEN 9125	Dissem.	Chalcopyrite	7-A3-5	34.2	31.4	0.00	35.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ULHANSEN 9125	Dissem.	Pyrite	7-A3-6	0.00	45.9	0.00	54.3	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
ULHANSEN 9125	Dissem.	Pyrite	7-A4-1	0.00	46.0	0.00	53.8	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
ULHANSEN 9125	Dissem.	Chalcopyrite	7-A4-2	34.5	31.7	0.00	35.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ULHANSEN 9125	Dissem.	Pyrhotite	7-A4-3	0.00	60.1	0.00	39.2	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
ULHANSEN 9125	Dissem.	Pyrite	7-A5-1	0.00	45.5	0.00	53.9	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
ULHANSEN 9125	Dissem.	Pyrite	7-A7-1	0.00	45.5	0.00	54.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ULHANSEN 9125	Dissem.	Pyrite	7-A7-2	0.00	45.5	0.00	54.4	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00
Straight Creek Scar															
Q10-17-02-01B	Dissem.	Pyrite	8-A1-1	0.00	46.2	0.00	54.3	0.00	0.00	0.09	0.00	0.00	0.00	0.09	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A1-2	0.00	46.5	0.00	54.0	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A4-1	0.00	45.8	0.00	54.7	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A5-1	0.00	46.7	0.00	54.1	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00

Table 2.

Sample	Vein /	Mineral	Data Point	Weight % Cu	Fe	As	S	Pb	Zn	Ni	Se	Mo	Ag	Co	Bi
Q10-17-02-01B	Dissem.	Pyrite	8-A5-2	0.00	46.7	0.00	53.7	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A7-1	0.00	46.9	0.00	53.9	0.00	0.00	0.10	0.00	0.00	0.00	0.11	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A7-2	0.00	46.7	0.00	54.0	0.00	0.00	0.12	0.00	0.00	0.00	0.10	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A7-3	0.00	46.9	0.00	53.9	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A7-4	0.00	46.3	0.00	54.2	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
Q10-17-02-01B	Vein	Pyrite	8-A10-1	0.00	46.4	0.00	53.9	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
Q10-17-02-01B	Vein	Pyrite	8-A10-2	0.00	46.6	0.00	53.5	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Q10-17-02-01B	Vein	Pyrite	8-A10-3	0.00	47.3	0.00	53.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Q10-17-02-01B	Vein	Sphalerite	8-A12-1	0.18	0.49	0.00	33.9	0.00	65.6	0.00	0.00	0.00	0.00	0.00	0.00
Q10-17-02-01B	Vein	Sphalerite	8-A12-2	0.00	0.35	0.00	33.8	0.00	66.3	0.00	0.00	0.00	0.00	0.00	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A13-1	0.00	45.8	0.00	53.5	0.00	0.00	0.11	0.00	0.00	0.00	0.15	0.00
Q10-17-02-01B	Dissem.	Galena	8-A13-2	0.00	0.25	0.00	13.2	86.1	0.00	0.00	0.36	0.00	0.00	0.00	0.00
Q10-17-02-01B	Dissem.	Sphalerite	8-A13-3	0.18	0.69	0.00	33.7	0.00	65.5	0.00	0.00	0.00	0.00	0.00	0.00
Q10-17-02-01B	Dissem.	Chalcopyrite	8-A13-4	35.1	30.9	0.00	35.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Straight	Vein	Pyrite	9-A1-1	0.00	47.2	0.00	54.5	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
Upper Straight	Vein	Pyrite	9-A5-1	0.00	47.1	0.00	54.3	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Upper Straight	Vein	Pyrite	9-A5-3	0.00	47.2	0.00	54.7	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Upper Straight	Vein	Pyrite	9-A6-1	0.00	46.7	0.00	54.7	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
Upper Straight	Vein	Chalcopyrite	9-A6-2	34.5	32.7	0.00	35.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Straight	Vein	Pyrite	9-A6-4	0.00	47.9	0.00	54.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Straight	Vein	Pyrite	9-A6-6	0.00	48.0	0.00	54.9	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Upper Straight	Vein	Pyrite	9-A6-7	0.00	46.6	0.00	55.0	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
Upper Straight	Dissem.	Pyrite	9-A7-1	0.00	46.7	0.00	54.9	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Upper Straight	Dissem.	Pyrite	9-A7-2	0.00	47.9	0.00	54.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Straight	Dissem.	Pyrite	9-A7-3	0.00	48.1	0.00	54.5	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
Upper Straight	Dissem.	Pyrite	9-A8-1	0.00	47.0	0.00	54.6	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00

Table 2.

									Atoms						
Sample	Vein /	Mineral	Data Point	Te	Sb	Cd	Au	Total	Cu	Fe	As	S	Pb	Zn	Ni
Molycorp open pit, lower Sulphur Gulch															
Q02-19b	Vein	Molybendite	1-A2-1MoS	0.00	0.00	0.00	0.00	101.9	0.00	0.00	0.00	1.97	0.00	0.00	0.00
Q02-19b	Vein	Molybendite	1-A2-2MoS	0.00	0.00	0.00	0.00	100.3	0.00	0.01	0.00	1.97	0.00	0.00	0.00
Q02-19b	Dissem.	Pyrite	1-A2-3PyR	0.00	0.00	0.00	0.00	100.9	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-19b	Dissem.	Pyrite	1-A2-4PyC	0.00	0.00	0.00	0.00	100.9	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-19b	Dissem.	Pyrite	1-A2-5PyR	0.00	0.00	0.00	0.00	102.3	0.00	1.01	0.00	1.99	0.00	0.00	0.00
Q02-19b	Dissem.	Pyrite	1-A2-6PyC	0.00	0.00	0.00	0.00	101.5	0.00	1.01	0.00	1.99	0.00	0.00	0.00
Q02-19b	Dissem.	Pyrite	1-A2-7PyR	0.00	0.00	0.00	0.00	101.3	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-19b	Dissem.	Pyrite	1-A3-1PyR	0.00	0.00	0.00	0.00	100.0	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-19b	Dissem.	Pyrite	1-A3-2PyC	0.00	0.00	0.00	0.00	100.8	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-19b	Dissem.	Pyrite	1-A3-3Py	0.00	0.00	0.00	0.00	100.1	0.00	1.01	0.00	1.99	0.00	0.00	0.00
Q02-19b	Dissem.	Galena	1-A4-1PbS	0.00	0.00	0.00	0.00	101.5	0.00	0.00	0.00	0.99	1.01	0.00	0.00
Q02-19b	Dissem.	Sphalerite	1-A6-1ZnS	0.00	0.00	0.00	0.00	99.7	0.00	0.01	0.00	1.01	0.00	0.98	0.00
Q02-19C	Dissem.	Pyrite	4-A4-1	0.00	0.00	0.00	0.00	100.7	0.00	1.01	0.00	1.98	0.00	0.00	0.00
Q02-19C	Dissem.	Pyrite	4-A4-2	0.00	0.00	0.00	0.00	101.2	0.00	1.01	0.00	1.98	0.00	0.00	0.00
Q02-19C	Dissem.	Sphalerite	4-A4-4	0.00	0.00	0.48	0.00	101.9	0.00	0.08	0.00	0.98	0.00	0.93	0.00
Q02-19C	Dissem.	Sphalerite	4-A4-5	0.00	0.00	0.38	0.00	100.9	0.00	0.05	0.00	1.00	0.00	0.95	0.00
Q02-19C	Dissem.	Pyrite	4-A5-1	0.00	0.00	0.00	0.00	101.8	0.00	1.01	0.00	1.98	0.00	0.00	0.00
Q02-19C	Dissem.	Pyrite	4-A5-2	0.00	0.00	0.00	0.00	101.2	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-19C	Dissem.	Pyrite	4-A6-1	0.00	0.00	0.00	0.00	101.1	0.00	1.01	0.00	1.99	0.00	0.00	0.00
Q02-19C	Dissem.	Pyrite	4-A6-2	0.00	0.00	0.00	0.00	100.6	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-19C	Dissem.	Pyrite	4-A6-3	0.00	0.00	0.00	0.00	100.5	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-19C	Dissem.	Pyrite	4-A7-1	0.00	0.00	0.00	0.00	101.4	0.00	1.01	0.00	1.98	0.00	0.00	0.00
Q02-19C	Dissem.	Pyrite	4-A7-3	0.00	0.00	0.00	0.00	101.3	0.00	1.01	0.00	1.98	0.00	0.00	0.00
Q02-19C	Dissem.	Pyrite	4-A7-4	0.00	0.00	0.00	0.00	101.2	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Upper Sulphur Gulch															
Q02-18	Dissem.	Pyrite	2-A03-01r	0.00	0.00	0.00	0.00	100.7	0.00	1.00	0.00	1.99	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A03-02c	0.00	0.00	0.00	0.00	100.7	0.00	1.01	0.00	1.99	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A04-1r	0.00	0.00	0.00	0.00	101.1	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A04-2c	0.00	0.00	0.00	0.00	100.4	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A08-01r	0.00	0.00	0.00	0.00	101.1	0.00	1.01	0.00	1.99	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A08-02c	0.00	0.00	0.00	0.00	100.5	0.00	1.01	0.00	1.98	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A09-1	0.00	0.00	0.00	0.00	100.9	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A10-1	0.00	0.00	0.00	0.00	100.5	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A10-2	0.00	0.00	0.00	0.00	101.1	0.00	1.02	0.00	1.97	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A10-3	0.00	0.00	0.00	0.00	100.8	0.00	1.03	0.00	1.97	0.00	0.00	0.00

Table 2.

Sample	Vein /	Mineral	Data Point	Te	Sb	Cd	Au	Total	Atoms Cu	Fe	As	S	Pb	Zn	Ni
Q02-18	Vein	Pyrite	2-A10-4	0.00	0.00	0.00	0.00	101.7	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A10-5	0.00	0.00	0.00	0.00	101.1	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A10-6	0.00	0.00	0.00	0.00	100.2	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A10-7	0.00	0.00	0.00	0.00	99.9	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A10-8	0.00	0.00	0.00	0.00	99.4	0.00	1.04	0.00	1.96	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A10-9	0.00	0.00	0.00	0.00	98.5	0.00	1.04	0.00	1.96	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A10-10	0.00	0.00	0.00	0.00	99.0	0.00	1.02	0.00	1.97	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A11-1	0.00	0.00	0.00	0.00	99.4	0.00	1.03	0.00	1.96	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A11-2	0.00	0.00	0.00	0.00	100.6	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A11-3	0.00	0.00	0.00	0.00	99.4	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A11-4	0.00	0.00	0.00	0.00	99.5	0.00	1.04	0.00	1.96	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A11-5	0.00	0.00	0.00	0.00	98.5	0.00	1.04	0.00	1.96	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A11-6	0.00	0.00	0.00	0.00	99.2	0.00	1.03	0.00	1.96	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A12-1	0.00	0.00	0.00	0.00	99.9	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A12-2	0.00	0.00	0.00	0.00	99.4	0.00	1.04	0.00	1.96	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A12-3	0.00	0.00	0.00	0.00	100.0	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A12-4	0.00	0.00	0.00	0.00	99.7	0.00	1.04	0.00	1.96	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A12-5	0.00	0.00	0.00	0.00	100.0	0.00	1.04	0.00	1.96	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A5-1	0.00	0.00	0.00	0.00	98.7	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A6-1	0.00	0.00	0.00	0.00	98.2	0.00	1.04	0.00	1.96	0.00	0.00	0.00
Q02-18	Vein	Pyrite	2-A6-2	0.00	0.00	0.00	0.00	99.3	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A7-1	0.00	0.00	0.00	0.00	99.5	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-18	Dissem.	Pyrite	2-A7-3	0.00	0.00	0.00	0.00	100.2	0.00	1.04	0.00	1.96	0.00	0.00	0.00
Q02-15-UO	Dissem.	Pyrite	3-A10-1	0.00	0.00	0.00	0.00	100.9	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-15-UO	Dissem.	Pyrite	3-A10-2	0.00	0.00	0.00	0.00	101.3	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-15-UO	Dissem.	Pyrite	3-A12-1	0.00	0.00	0.00	0.00	99.3	0.00	1.02	0.00	1.97	0.00	0.00	0.00
Q02-15-UO	Dissem.	Pyrite	3-A12-2	0.00	0.00	0.00	0.00	101.3	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-15-UO	Dissem.	Pyrite	3-A12-3	0.00	0.00	0.00	0.00	100.9	0.00	1.01	0.00	1.98	0.00	0.00	0.00
Q02-15-UO	Dissem.	Pyrite	3-A12-4	0.00	0.00	0.00	0.00	101.0	0.00	1.02	0.00	1.97	0.00	0.00	0.00
Q02-15-UO	Dissem.	Pyrite	3-A13-1	0.19	0.00	0.00	0.00	100.7	0.00	1.01	0.00	1.98	0.00	0.00	0.00
Q02-15-UO	Dissem.	Pyrite	3-A13-2	0.00	0.00	0.00	0.00	102.0	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-15-UO	Dissem.	Pyrite	3-A13-3	0.00	0.00	0.00	0.00	100.8	0.00	1.01	0.00	1.98	0.00	0.00	0.00
Q02-15-UO	Dissem.	Pyrite	3-A13-4	0.00	0.00	0.00	0.00	100.7	0.00	1.01	0.00	1.98	0.00	0.00	0.00
Q02-15-UO	Vein	Pyrite	3-A4-1	0.00	0.00	0.00	0.00	99.8	0.00	1.03	0.00	1.96	0.00	0.00	0.00
Q02-15-UO	Vein	Pyrite	3-A4-2	0.00	0.00	0.00	0.00	100.6	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-15-UO	Vein	Pyrite	3-A4-3	0.00	0.00	0.00	0.00	100.2	0.00	1.03	0.00	1.97	0.00	0.00	0.00

Table 2.

Sample	Vein /	Mineral	Data Point	Te	Sb	Cd	Au	Total	Atoms Cu	Fe	As	S	Pb	Zn	Ni
Q02-15-UO	Vein	Pyrite	3-A5-1	0.00	0.00	0.00	0.00	100.8	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-15-UO	Vein	Pyrite	3-A6-1	0.00	0.00	0.00	0.00	101.3	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-15-UO	Vein	Pyrite	3-A8-1	0.00	0.00	0.00	0.00	101.0	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q02-15-UO	Vein	Pyrite	3-A8-2	0.00	0.00	0.00	0.00	100.7	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-15-UO	Vein	Pyrite	3-A8-3	0.00	0.00	0.00	0.00	101.2	0.00	1.02	0.00	1.97	0.00	0.00	0.00
Q02-15-UO	Vein	Pyrite	3-A8-4	0.00	0.00	0.00	0.00	101.0	0.00	1.03	0.00	1.96	0.00	0.00	0.00
Q02-15-UO	Vein	Pyrite	3-A8-5	0.00	0.00	0.00	0.00	100.8	0.00	1.03	0.00	1.97	0.00	0.00	0.00
Q02-21	Dissem.	Pyrite	5-A2-1	0.00	0.00	0.00	0.00	101.4	0.00	0.99	0.00	2.01	0.00	0.00	0.00
Q02-21	Dissem.	Pyrite	5-A5-1	0.00	0.00	0.00	0.00	100.9	0.00	0.98	0.00	2.02	0.00	0.00	0.00
Q02-21	Dissem.	Pyrite	5-A5-2	0.00	0.00	0.00	0.00	101.0	0.00	0.98	0.00	2.01	0.00	0.00	0.00
Q02-21	Dissem.	Chalcopyrite	5-A5-3	0.00	0.00	0.00	0.00	101.8	0.99	1.02	0.00	1.99	0.00	0.00	0.00
Q02-21	Dissem.	Pyrite	5-A8-1	0.00	0.00	0.00	0.00	101.3	0.00	0.99	0.00	2.00	0.00	0.00	0.00
Q02-21	Dissem.	Chalcopyrite	5-A8-2	0.00	0.00	0.00	0.00	101.0	0.99	1.03	0.00	1.99	0.00	0.00	0.00
Q02-21	Dissem.	Pyrite	5-A9-1	0.00	0.00	0.00	0.00	101.4	0.00	0.99	0.00	2.01	0.00	0.00	0.00
Q02-21	Dissem.	Pyrite	5-A9-3	0.00	0.00	0.00	0.00	101.4	0.00	1.00	0.00	2.00	0.00	0.00	0.00
SW Hansen															
ULHANSEN 9125	Dissem.	Pyrite	7-A1-1	0.00	0.00	0.00	0.00	98.3	0.00	1.00	0.00	2.00	0.00	0.00	0.00
ULHANSEN 9125	Dissem.	Pyrite	7-A3-1	0.00	0.00	0.00	0.00	100.2	0.00	0.99	0.00	2.01	0.00	0.00	0.00
ULHANSEN 9125	Dissem.	Pyrhotite	7-A3-2	0.00	0.00	0.00	0.00	98.9	0.00	0.92	0.00	1.07	0.00	0.00	0.00
ULHANSEN 9125	Dissem.	Pyrhotite	7-A3-3	0.00	0.00	0.00	0.00	98.6	0.00	0.93	0.00	1.07	0.00	0.00	0.00
ULHANSEN 9125	Dissem.	Chalcopyrite	7-A3-5	0.00	0.00	0.00	0.00	100.9	0.98	1.02	0.00	2.00	0.00	0.00	0.00
ULHANSEN 9125	Dissem.	Pyrite	7-A3-6	0.00	0.00	0.00	0.00	100.3	0.00	0.98	0.00	2.02	0.00	0.00	0.00
ULHANSEN 9125	Dissem.	Pyrite	7-A4-1	0.00	0.00	0.00	0.00	99.9	0.00	0.99	0.00	2.01	0.00	0.00	0.00
ULHANSEN 9125	Dissem.	Chalcopyrite	7-A4-2	0.00	0.00	0.00	0.00	101.3	0.98	1.03	0.00	1.99	0.00	0.00	0.00
ULHANSEN 9125	Dissem.	Pyrhotite	7-A4-3	0.00	0.00	0.00	0.00	99.4	0.00	0.93	0.00	1.06	0.00	0.00	0.00
ULHANSEN 9125	Dissem.	Pyrite	7-A5-1	0.00	0.00	0.00	0.00	99.5	0.00	0.98	0.00	2.02	0.00	0.00	0.00
ULHANSEN 9125	Dissem.	Pyrite	7-A7-1	0.00	0.00	0.00	0.00	99.8	0.00	0.97	0.00	2.03	0.00	0.00	0.00
ULHANSEN 9125	Dissem.	Pyrite	7-A7-2	0.00	0.00	0.00	0.00	100.0	0.00	0.97	0.00	2.02	0.00	0.00	0.00
Straight Creek Scar															
Q10-17-02-01B	Dissem.	Pyrite	8-A1-1	0.00	0.00	0.00	0.00	100.7	0.00	0.98	0.00	2.01	0.00	0.00	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A1-2	0.00	0.00	0.00	0.00	100.7	0.00	0.99	0.00	2.01	0.00	0.00	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A4-1	0.00	0.00	0.00	0.00	100.6	0.00	0.97	0.00	2.02	0.00	0.00	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A5-1	0.00	0.00	0.00	0.00	100.9	0.00	0.99	0.00	2.00	0.00	0.00	0.00

Table 2.

Sample	Vein /	Mineral	Data Point	Te	Sb	Cd	Au	Total	Atoms Cu	Fe	As	S	Pb	Zn	Ni
Q10-17-02-01B	Dissem.	Pyrite	8-A5-2	0.00	0.00	0.00	0.00	100.6	0.00	1.00	0.00	2.00	0.00	0.00	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A7-1	0.00	0.00	0.00	0.00	101.0	0.00	1.00	0.00	2.00	0.00	0.00	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A7-2	0.00	0.00	0.00	0.00	100.9	0.00	0.99	0.00	2.00	0.00	0.00	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A7-3	0.00	0.00	0.00	0.00	100.9	0.00	1.00	0.00	2.00	0.00	0.00	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A7-4	0.00	0.00	0.00	0.00	100.5	0.00	0.99	0.00	2.01	0.00	0.00	0.00
Q10-17-02-01B	Vein	Pyrite	8-A10-1	0.00	0.00	0.00	0.00	100.5	0.00	0.99	0.00	2.01	0.00	0.00	0.00
Q10-17-02-01B	Vein	Pyrite	8-A10-2	0.00	0.00	0.00	0.00	100.2	0.00	1.00	0.00	2.00	0.00	0.00	0.00
Q10-17-02-01B	Vein	Pyrite	8-A10-3	0.00	0.00	0.00	0.00	100.5	0.00	1.02	0.00	1.98	0.00	0.00	0.00
Q10-17-02-01B	Vein	Sphalerite	8-A12-1	0.00	0.00	1.09	0.00	101.2	0.00	0.01	0.00	1.02	0.00	0.96	0.00
Q10-17-02-01B	Vein	Sphalerite	8-A12-2	0.00	0.00	1.23	0.00	101.7	0.00	0.01	0.00	1.01	0.00	0.97	0.00
Q10-17-02-01B	Dissem.	Pyrite	8-A13-1	0.00	0.00	0.00	0.00	99.5	0.00	0.99	0.00	2.01	0.00	0.00	0.00
Q10-17-02-01B	Dissem.	Galena	8-A13-2	0.00	0.00	0.00	0.00	99.9	0.00	0.01	0.00	0.99	0.99	0.00	0.00
Q10-17-02-01B	Dissem.	Sphalerite	8-A13-3	0.00	0.00	1.05	0.00	101.1	0.00	0.01	0.00	1.01	0.00	0.97	0.00
Q10-17-02-01B	Dissem.	Chalcopyrite	8-A13-4	0.00	0.00	0.00	0.00	101.3	1.00	1.00	0.00	1.99	0.00	0.00	0.00
Upper Straight	Vein	Pyrite	9-A1-1	0.00	0.00	0.00	0.00	101.8	0.00	1.00	0.00	2.00	0.00	0.00	0.00
Upper Straight	Vein	Pyrite	9-A5-1	0.00	0.00	0.00	0.00	101.5	0.00	1.00	0.00	2.00	0.00	0.00	0.00
Upper Straight	Vein	Pyrite	9-A5-3	0.00	0.00	0.00	0.00	102.0	0.00	0.99	0.00	2.01	0.00	0.00	0.00
Upper Straight	Vein	Pyrite	9-A6-1	0.00	0.00	0.00	0.00	101.5	0.00	0.99	0.00	2.01	0.00	0.00	0.00
Upper Straight	Vein	Chalcopyrite	9-A6-2	0.00	0.00	0.00	0.00	102.5	0.97	1.05	0.00	1.98	0.00	0.00	0.00
Upper Straight	Vein	Pyrite	9-A6-4	0.00	0.00	0.00	0.00	102.7	0.00	1.00	0.00	2.00	0.00	0.00	0.00
Upper Straight	Vein	Pyrite	9-A6-6	0.00	0.00	0.00	0.00	102.9	0.00	1.00	0.00	2.00	0.00	0.00	0.00
Upper Straight	Vein	Pyrite	9-A6-7	0.00	0.00	0.00	0.00	101.7	0.00	0.98	0.00	2.02	0.00	0.00	0.00
Upper Straight	Dissem.	Pyrite	9-A7-1	0.00	0.00	0.00	0.00	101.7	0.00	0.98	0.00	2.01	0.00	0.00	0.00
Upper Straight	Dissem.	Pyrite	9-A7-2	0.00	0.00	0.00	0.00	102.6	0.00	1.00	0.00	2.00	0.00	0.00	0.00
Upper Straight	Dissem.	Pyrite	9-A7-3	0.00	0.00	0.00	0.00	102.7	0.00	1.01	0.00	1.99	0.00	0.00	0.00
Upper Straight	Dissem.	Pyrite	9-A8-1	0.00	0.00	0.00	0.00	101.8	0.00	0.99	0.00	2.01	0.00	0.00	0.00

Table 2.

Sample	Vein /	Mineral	Data Point	Se	Mo	Ag	Co	Bi	Te	Sb	Cd	Au	Total
Molycorp open pit, lower Sulphur Gulch													
Q02-19b	Vein	Molybendite	1-A2-1MoS	0.00	1.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19b	Vein	Molybendite	1-A2-2MoS	0.00	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19b	Dissem.	Pyrite	1-A2-3PyR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19b	Dissem.	Pyrite	1-A2-4PyC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19b	Dissem.	Pyrite	1-A2-5PyR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19b	Dissem.	Pyrite	1-A2-6PyC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19b	Dissem.	Pyrite	1-A2-7PyR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19b	Dissem.	Pyrite	1-A3-1PyR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19b	Dissem.	Pyrite	1-A3-2PyC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19b	Dissem.	Pyrite	1-A3-3Py	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19b	Dissem.	Galena	1-A4-1PbS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
Q02-19b	Dissem.	Sphalerite	1-A6-1ZnS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
Q02-19C	Dissem.	Pyrite	4-A4-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19C	Dissem.	Pyrite	4-A4-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19C	Dissem.	Sphalerite	4-A4-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
Q02-19C	Dissem.	Sphalerite	4-A4-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
Q02-19C	Dissem.	Pyrite	4-A5-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19C	Dissem.	Pyrite	4-A5-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19C	Dissem.	Pyrite	4-A6-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19C	Dissem.	Pyrite	4-A6-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19C	Dissem.	Pyrite	4-A6-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19C	Dissem.	Pyrite	4-A7-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19C	Dissem.	Pyrite	4-A7-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-19C	Dissem.	Pyrite	4-A7-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Upper Sulphur Gulch													
Q02-18	Dissem.	Pyrite	2-A03-01r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Dissem.	Pyrite	2-A03-02c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Dissem.	Pyrite	2-A04-1r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Dissem.	Pyrite	2-A04-2c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Dissem.	Pyrite	2-A08-01r	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Dissem.	Pyrite	2-A08-02c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Dissem.	Pyrite	2-A09-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A10-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A10-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A10-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00

Table 2.

Sample	Vein /	Mineral	Data Point	Se	Mo	Ag	Co	Bi	Te	Sb	Cd	Au	Total
Q02-18	Vein	Pyrite	2-A10-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A10-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A10-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A10-7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A10-8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A10-9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A10-10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Dissem.	Pyrite	2-A11-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Dissem.	Pyrite	2-A11-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Dissem.	Pyrite	2-A11-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Dissem.	Pyrite	2-A11-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Dissem.	Pyrite	2-A11-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Dissem.	Pyrite	2-A11-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A12-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A12-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A12-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A12-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A12-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A5-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A6-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Vein	Pyrite	2-A6-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Dissem.	Pyrite	2-A7-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-18	Dissem.	Pyrite	2-A7-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Dissem.	Pyrite	3-A10-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Dissem.	Pyrite	3-A10-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Dissem.	Pyrite	3-A12-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Dissem.	Pyrite	3-A12-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Dissem.	Pyrite	3-A12-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Dissem.	Pyrite	3-A12-4	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Dissem.	Pyrite	3-A13-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Dissem.	Pyrite	3-A13-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Dissem.	Pyrite	3-A13-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Dissem.	Pyrite	3-A13-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Vein	Pyrite	3-A4-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Vein	Pyrite	3-A4-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Vein	Pyrite	3-A4-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00

Table 2.

Sample	Vein /	Mineral	Data Point	Se	Mo	Ag	Co	Bi	Te	Sb	Cd	Au	Total
Q02-15-UO	Vein	Pyrite	3-A5-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Vein	Pyrite	3-A6-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Vein	Pyrite	3-A8-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Vein	Pyrite	3-A8-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Vein	Pyrite	3-A8-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Vein	Pyrite	3-A8-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-15-UO	Vein	Pyrite	3-A8-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-21	Dissem.	Pyrite	5-A2-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-21	Dissem.	Pyrite	5-A5-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-21	Dissem.	Pyrite	5-A5-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-21	Dissem.	Chalcopyrite	5-A5-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
Q02-21	Dissem.	Pyrite	5-A8-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-21	Dissem.	Chalcopyrite	5-A8-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
Q02-21	Dissem.	Pyrite	5-A9-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q02-21	Dissem.	Pyrite	5-A9-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
SW Hansen													
ULHANSEN 9125	Dissem.	Pyrite	7-A1-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
ULHANSEN 9125	Dissem.	Pyrite	7-A3-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
ULHANSEN 9125	Dissem.	Pyrhotite	7-A3-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
ULHANSEN 9125	Dissem.	Pyrhotite	7-A3-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
ULHANSEN 9125	Dissem.	Chalcopyrite	7-A3-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
ULHANSEN 9125	Dissem.	Pyrite	7-A3-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
ULHANSEN 9125	Dissem.	Pyrite	7-A4-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
ULHANSEN 9125	Dissem.	Chalcopyrite	7-A4-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
ULHANSEN 9125	Dissem.	Pyrhotite	7-A4-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
ULHANSEN 9125	Dissem.	Pyrite	7-A5-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
ULHANSEN 9125	Dissem.	Pyrite	7-A7-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
ULHANSEN 9125	Dissem.	Pyrite	7-A7-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Straight Creek Scar													
Q10-17-02-01B	Dissem.	Pyrite	8-A1-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q10-17-02-01B	Dissem.	Pyrite	8-A1-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q10-17-02-01B	Dissem.	Pyrite	8-A4-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q10-17-02-01B	Dissem.	Pyrite	8-A5-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00

Table 2.

Sample	Vein /	Mineral	Data Point	Se	Mo	Ag	Co	Bi	Te	Sb	Cd	Au	Total
Q10-17-02-01B	Dissem.	Pyrite	8-A5-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q10-17-02-01B	Dissem.	Pyrite	8-A7-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q10-17-02-01B	Dissem.	Pyrite	8-A7-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q10-17-02-01B	Dissem.	Pyrite	8-A7-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q10-17-02-01B	Dissem.	Pyrite	8-A7-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q10-17-02-01B	Vein	Pyrite	8-A10-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q10-17-02-01B	Vein	Pyrite	8-A10-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q10-17-02-01B	Vein	Pyrite	8-A10-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q10-17-02-01B	Vein	Sphalerite	8-A12-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	2.00
Q10-17-02-01B	Vein	Sphalerite	8-A12-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	2.00
Q10-17-02-01B	Dissem.	Pyrite	8-A13-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Q10-17-02-01B	Dissem.	Galena	8-A13-2	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
Q10-17-02-01B	Dissem.	Sphalerite	8-A13-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	2.00
Q10-17-02-01B	Dissem.	Chalcopyrite	8-A13-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
Upper Straight	Vein	Pyrite	9-A1-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Upper Straight	Vein	Pyrite	9-A5-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Upper Straight	Vein	Pyrite	9-A5-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Upper Straight	Vein	Pyrite	9-A6-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Upper Straight	Vein	Chalcopyrite	9-A6-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
Upper Straight	Vein	Pyrite	9-A6-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Upper Straight	Vein	Pyrite	9-A6-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Upper Straight	Vein	Pyrite	9-A6-7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Upper Straight	Dissem.	Pyrite	9-A7-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Upper Straight	Dissem.	Pyrite	9-A7-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Upper Straight	Dissem.	Pyrite	9-A7-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Upper Straight	Dissem.	Pyrite	9-A8-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00

Table 2.

Sample	Vein /	Mineral	Data Point	Description	On Grain
Molycorp open pit, lower Sulphur Gulch					
Q02-19b	Vein	Molybendite	1-A2-1MoS	small vein in quartz on wall of fluorite vein	core
Q02-19b	Vein	Molybendite	1-A2-2MoS	small vein in quartz on wall of fluorite vein	core
Q02-19b	Dissem.	Pyrite	1-A2-3PyR	200 μm euhedral pyrite in quartz on wall of fluorite vein. Molybendite just to the north of this grain	rim
Q02-19b	Dissem.	Pyrite	1-A2-4PyC	core of above	core
Q02-19b	Dissem.	Pyrite	1-A2-5PyR	150 μm euhedral pyrite assoc with quartz and illite in wall of fluorite vein	rim
Q02-19b	Dissem.	Pyrite	1-A2-6PyC	transverse across above	core
Q02-19b	Dissem.	Pyrite	1-A2-7PyR	transverse across above	rim
Q02-19b	Dissem.	Pyrite	1-A3-1PyR	50 μm interstitial filling (somewhat euhedral) in carbonates in center of fluorite vein	rim
Q02-19b	Dissem.	Pyrite	1-A3-2PyC	core of above	core
Q02-19b	Dissem.	Pyrite	1-A3-3Py	thin (10 μm) interstitial filling between carbonate grains found in center of fluorite vein	core
Q02-19b	Dissem.	Galena	1-A4-1PbS	euhedral galena disseminated in carbonate in center of fluorite vein	core
Q02-19b	Dissem.	Sphalerite	1-A6-1ZnS	7 μm subhedral sphalerite disseminated in carbonate near fluorite in vein. Ca, Sr, Pb, S phases in	core
Q02-19C	Dissem.	Pyrite	4-A4-1	disseminated rim of 300 μm euhedral pyrite with sphalerite inclusions	rim
Q02-19C	Dissem.	Pyrite	4-A4-2	core of above	core
Q02-19C	Dissem.	Sphalerite	4-A4-4	sphalerite in above pyrite	core
Q02-19C	Dissem.	Sphalerite	4-A4-5	sphalerite in above pyrite	core
Q02-19C	Dissem.	Pyrite	4-A5-1	Dissemintated 500 μm euhedral pyrite with slightly resorbed looking edges	core
Q02-19C	Dissem.	Pyrite	4-A5-2	core of above next to carbonate plus illite inclusion	core
Q02-19C	Dissem.	Pyrite	4-A6-1	Disseminated 200 μm rounded trigonal pyrite associated with quartz and illite	core
Q02-19C	Dissem.	Pyrite	4-A6-2	Disseminated 200 μm subhedral pyrite associated with quartz and illite	core
Q02-19C	Dissem.	Pyrite	4-A6-3	Disseminated 300 μm euhedral pyrite associated with quartz and illite	core
Q02-19C	Dissem.	Pyrite	4-A7-1	Disseminated 350 μm euhedral pyrite with sphalerite inclusions assoc w/ qtz and ill	rim
Q02-19C	Dissem.	Pyrite	4-A7-3	core of above	core
Q02-19C	Dissem.	Pyrite	4-A7-4	Disseminated 300 μm euhedral pyrite associated with quartz and illite	core
Upper Sulphur Gulch					
Q02-18	Dissem.	Pyrite	2-A03-01r	aggregate of subhedral disseminated pyrite with inclusions of apatite, surrounded by apatite, REE	rim
Q02-18	Dissem.	Pyrite	2-A03-02c	core of above	core
Q02-18	Dissem.	Pyrite	2-A04-1r	300x150 μm anhedral disseminated pyrite with 100 μm gyp inclusion . Pyrite surrounded by ill, kspar,	rim
Q02-18	Dissem.	Pyrite	2-A04-2c	core of above	core
Q02-18	Dissem.	Pyrite	2-A08-01r	~1000 μm anhedral disseminated pyrite with inclusions of apatite and surrounded by apatite and qtz	rim
Q02-18	Dissem.	Pyrite	2-A08-02c	core of above	core
Q02-18	Dissem.	Pyrite	2-A09-1	disseminated pyrite	core
Q02-18	Vein	Pyrite	2-A10-1	vein pyrite: edge near wall rock=qtz, ill, kspar	rim
Q02-18	Vein	Pyrite	2-A10-2	transverse across vein	core
Q02-18	Vein	Pyrite	2-A10-3	transverse across vein	core

Table 2.

Sample	Vein /	Mineral	Data Point	Description	On Grain
Q02-18	Vein	Pyrite	2-A10-4	transverse across vein	core
Q02-18	Vein	Pyrite	2-A10-5	transverse across vein edge near center in contact with carbonate	rim
Q02-18	Vein	Pyrite	2-A10-6	opposite side in contact with carbonate	rim
Q02-18	Vein	Pyrite	2-A10-7	continuing transverse across vein toward wall rock	core
Q02-18	Vein	Pyrite	2-A10-8	continuing transverse across vein toward wall rock	core
Q02-18	Vein	Pyrite	2-A10-9	continuing transverse across vein toward wall rock	core
Q02-18	Vein	Pyrite	2-A10-10	vein edge in contact with wall rock	rim
Q02-18	Dissem.	Pyrite	2-A11-1	disseminated pyrite	core
Q02-18	Dissem.	Pyrite	2-A11-2	disseminated pyrite	core
Q02-18	Dissem.	Pyrite	2-A11-3	disseminated pyrite	core
Q02-18	Dissem.	Pyrite	2-A11-4	disseminated pyrite	core
Q02-18	Dissem.	Pyrite	2-A11-5	disseminated pyrite	core
Q02-18	Dissem.	Pyrite	2-A11-6	disseminated pyrite	core
Q02-18	Vein	Pyrite	2-A12-1	transverse across vein	rim
Q02-18	Vein	Pyrite	2-A12-2	transverse across vein	core
Q02-18	Vein	Pyrite	2-A12-3	transverse across vein	core
Q02-18	Vein	Pyrite	2-A12-4	transverse across vein	core
Q02-18	Vein	Pyrite	2-A12-5	transverse across vein	core
Q02-18	Vein	Pyrite	2-A5-1	transverse across vein	rim
Q02-18	Vein	Pyrite	2-A6-1	Vein pyrite with gypsum and apatite. Molybendite near vein	rim
Q02-18	Vein	Pyrite	2-A6-2	core of above	core
Q02-18	Dissem.	Pyrite	2-A7-1	150 µm euhedral disseminated pyrite associated with molybendite, ill, and qtz	core
Q02-18	Dissem.	Pyrite	2-A7-3	100 µm euhedral disseminated pyrite associated with molybendite, ill, and qtz	core
Q02-15-UO	Dissem.	Pyrite	3-A10-1	100 µm euhedral disseminated pyrite associated with chlorite, barite, and zircon	rim
Q02-15-UO	Dissem.	Pyrite	3-A10-2	core of above	core
Q02-15-UO	Dissem.	Pyrite	3-A12-1	60 µm subhedral disseminated pyrite associated with chlorite and albite	rim
Q02-15-UO	Dissem.	Pyrite	3-A12-2	core of above	core
Q02-15-UO	Dissem.	Pyrite	3-A12-3	60 µm subhedral disseminated pyrite associated with chlorite and albite	rim
Q02-15-UO	Dissem.	Pyrite	3-A12-4	core of above	core
Q02-15-UO	Dissem.	Pyrite	3-A13-1	40 µm subhedral disseminated pyrite associated with chlorite, qtz, apatite, and albite	rim
Q02-15-UO	Dissem.	Pyrite	3-A13-2	core of above	core
Q02-15-UO	Dissem.	Pyrite	3-A13-3	15 µm subhedral disseminated pyrite associated with chlorite, qtz, apatite, and albite	core
Q02-15-UO	Dissem.	Pyrite	3-A13-4	30 µm subhedral disseminated pyrite associated with chlorite, qtz, apatite, and albite	core
Q02-15-UO	Vein	Pyrite	3-A4-1	Vein pyrite with feox, qtz, and apatite.	rim
Q02-15-UO	Vein	Pyrite	3-A4-2	core of above	core
Q02-15-UO	Vein	Pyrite	3-A4-3	opposite rim of above	rim

Table 2.

Sample	Vein /	Mineral	Data Point	Description	On Grain
Q02-15-UO	Vein	Pyrite	3-A5-1	vein pyrite with feox veins and galena	core
Q02-15-UO	Vein	Pyrite	3-A6-1	vein pyrite with feox veins and apatite	core
Q02-15-UO	Vein	Pyrite	3-A8-1	vein pyrite with jarosite vein, quartz, barite, gypsum, and feox	rim
Q02-15-UO	Vein	Pyrite	3-A8-2	core of above next to jarosite vein	core
Q02-15-UO	Vein	Pyrite	3-A8-3	core of above next to nothing	core
Q02-15-UO	Vein	Pyrite	3-A8-4	core of above next to gypsum inclusion	core
Q02-15-UO	Vein	Pyrite	3-A8-5	core of above next to barite inclusion	core
Q02-21	Dissem.	Pyrite	5-A2-1	Disseminated rounded pyrite with REE phosphate and oxide and illite inclusions	core
Q02-21	Dissem.	Pyrite	5-A5-1	Disseminated 20 μm euhedral pyrite in clast that has been replaced by calcite and albite	
Q02-21	Dissem.	Pyrite	5-A5-2	Disseminated 10 μm pyrite surrounded by cpy in clast that has been replaced by calcite and albite	core
Q02-21	Dissem.	Chalcopyrite	5-A5-3	Cpy surrounded pyrite grain of above	core
Q02-21	Dissem.	Pyrite	5-A8-1	Disseminated 50 μm pyrite with galena streaks surrounded by kspar, albite, qtz, and illite	core
Q02-21	Dissem.	Chalcopyrite	5-A8-2	Disseminated 50 μm chalcopyrite with surrounded by kspar, albite, qtz, and illite	
Q02-21	Dissem.	Pyrite	5-A9-1	Disseminated 50 μm pyrite with <5 μm inclusions of CaREE carbonate or oxide and speck of silver	rim
Q02-21	Dissem.	Pyrite	5-A9-3	core of above	core
SW Hansen					
ULHANSEN 9125	Dissem.	Pyrite	7-A1-1	Disseminated 80 μm pyrite with inclusions of illite surrounded by TiO_2, illite, and carbonate	
ULHANSEN 9125	Dissem.	Pyrite	7-A3-1	Disseminated 160 μm pyrite with inclusions of po and cpy	core
ULHANSEN 9125	Dissem.	Pyrhotite	7-A3-2	po in above	core
ULHANSEN 9125	Dissem.	Pyrhotite	7-A3-3	po in above	core
ULHANSEN 9125	Dissem.	Chalcopyrite	7-A3-5	cpy in above	core
ULHANSEN 9125	Dissem.	Pyrite	7-A3-6	same pyrite as above, another analysis	core
ULHANSEN 9125	Dissem.	Pyrite	7-A4-1	Disseminated 250 μm pyrite with inclusion of po and cpy	core
ULHANSEN 9125	Dissem.	Chalcopyrite	7-A4-2	cpy in pyrite also in contact with po	core
ULHANSEN 9125	Dissem.	Pyrhotite	7-A4-3	po in contact with cpy and py	core
ULHANSEN 9125	Dissem.	Pyrite	7-A5-1	Disseminated very euhedral few inclusions	core
ULHANSEN 9125	Dissem.	Pyrite	7-A7-1	Disseminated 25 μm pyrite in contact with barite and sphene associated with epidote. Vein of $FeSO_4$ and gypsum just north of this sample	core
ULHANSEN 9125	Dissem.	Pyrite	7-A7-2	Disseminated 20 μm pyrite in contact with barite and sphene associated with epidote. Vein of $FeSO_4$ and gypsum just north of this sample	core
Straight Creek Scar					
Q10-17-02-01B	Dissem.	Pyrite	8-A1-1	Disseminated 45 μm pyrite with rounded edges and inclusions of galena, albite, and kspar. The grain is surrounded by quartz and illite.	core
Q10-17-02-01B	Dissem.	Pyrite	8-A1-2	core near galena streak	core
Q10-17-02-01B	Dissem.	Pyrite	8-A4-1	Disseminated 35 μm andhedral pyrite associated with TiO_2 and apatite with quartz and illite	core
Q10-17-02-01B	Dissem.	Pyrite	8-A5-1	Disseminated 90 μm anhedral pyrite with inclusion of two copper phases	core

Table 2.

Sample	Vein /	Mineral	Data Point	Description	On Grain
Q10-17-02-01B	Dissem.	Pyrite	8-A5-2	core near copper inclusion	
Q10-17-02-01B	Dissem.	Pyrite	8-A7-1	Disseminated 130 μm subhedral assoc with quartz, apatite, and calcite	core
Q10-17-02-01B	Dissem.	Pyrite	8-A7-2	Disseminated 66 μm subhedral assoc with quartz, apatite, and calcite	core
Q10-17-02-01B	Dissem.	Pyrite	8-A7-3	Disseminated 130 μm subhedral assoc with quartz, apatite, and calcite	core
Q10-17-02-01B	Dissem.	Pyrite	8-A7-4	Disseminated 66 μm subhedral assoc with quartz, apatite, and calcite	core
Q10-17-02-01B	Vein	Pyrite	8-A10-1	Vein pyrite rim	rim
Q10-17-02-01B	Vein	Pyrite	8-A10-2	Vein pyrite core	core
Q10-17-02-01B	Vein	Pyrite	8-A10-3	Vein pyrite rim	rim
Q10-17-02-01B	Vein	Sphalerite	8-A12-1	Sphalerite vein rim	rim
Q10-17-02-01B	Vein	Sphalerite	8-A12-2	Sphalerite vein core	core
Q10-17-02-01B	Dissem.	Pyrite	8-A13-1	Disseminated pyrite 120 μm euhedral with attached galena, chalcopyrite, sphalerite	core
Q10-17-02-01B	Dissem.	Galena	8-A13-2	attached galena to above	core
Q10-17-02-01B	Dissem.	Sphalerite	8-A13-3	attached sph to above	core
Q10-17-02-01B	Dissem.	Chalcopyrite	8-A13-4	attached cpy to above	core
Upper Straight	Vein	Pyrite	9-A1-1	Vein pyrite composed of anhedral aggregates, barite on edge	core
Upper Straight	Vein	Pyrite	9-A5-1	Vein pyrite composed of anhedral aggregates, jarosite veins cutting it, surrounded by illite	rim
Upper Straight	Vein	Pyrite	9-A5-3	Vein pyrite composed of anhedral aggregates, jarosite veins cutting it, surrounded by illite.	core
Upper Straight	Vein	Pyrite	9-A6-1	Vein pyrite composed of anhedral aggregates	core
Upper Straight	Vein	Chalcopyrite	9-A6-2	moving out of center to edge	core
Upper Straight	Vein	Pyrite	9-A6-4	moving out of center to edge	core
Upper Straight	Vein	Pyrite	9-A6-6	moving out of center to edge	core
Upper Straight	Vein	Pyrite	9-A6-7	moving out of center to edge, now at the edge	rim
Upper Straight	Dissem.	Pyrite	9-A7-1	Disseminated pyrite, 50 μm subhedral	core
Upper Straight	Dissem.	Pyrite	9-A7-2	Disseminated pyrite, 50 μm subhedral	core
Upper Straight	Dissem.	Pyrite	9-A7-3	Disseminated pyrite, 100 μm subhedral	core
Upper Straight	Dissem.	Pyrite	9-A8-1	Disseminated pyrite, 80 μm subhedral, surrounded by illite	core

Table 3. Compilation of electron probe microanalytical data for carbonates from Red River scar areas. Element concentrations are listed first as oxide weight % and then recalculated and listed as the number of atoms, normalized to the standard number of oxygen atoms in the appropriate idealized mineral formula.

Table 3.

		Wt%															
	Sample	MnO	La_2O_3	MgO	CaO	SO_3	FeO	Ce_2O_3	SrO	BaO	P_2O_5	ZnO	SiO_2	PbO	Y_2O_3	CO_2	Total
Molycorp Open Pit																	
Q02-19B	01-A01-01	2.27	0.00	0.16	53.4	0.00	1.19	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	43.0	100
Q02-19B	01-A01-02	0.58	0.00	0.09	57.7	0.00	0.23	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	41.4	100
Q02-19B	01-A01-03	1.21	0.00	0.62	53.8	0.00	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.7	100
Q02-19B	01-A01-04	0.59	0.00	0.00	56.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.0	100
Q02-19B	01-A03-01	1.50	0.00	0.00	56.3	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	42.2	100
Q02-19B	01-A03-02	2.93	0.00	0.03	53.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.2	100
Q02-19B	01-A03-03	0.64	0.00	0.15	56.0	0.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.4	100
Q02-19B	01-A03-04	2.80	0.00	0.10	54.0	0.00	0.67	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	42.4	100
Q02-19B	01-A05-02	2.38	0.00	0.00	55.4	0.00	0.61	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	41.6	100
Q02-19B	01-A05-01	2.41	0.00	0.00	55.7	0.00	0.91	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	41.0	100
Q02-19B	01-A05-03	2.34	0.00	0.12	54.8	0.00	1.34	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	41.3	100
Q02-19C	04-A02-01	4.93	0.00	0.00	55.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.2	100
Q02-19C	04-A02-02	5.08	0.00	0.24	54.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.9	100
Q02-19C	04-A02-03	5.56	0.00	0.00	55.6	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.8	100
Q02-18	02-A02-01	1.42	0.00	0.05	56.6	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	41.7	100
Q02-18	02-A02-02	1.10	0.00	0.00	56.9	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	41.8	100
Q02-18	02-A02-03	1.35	0.00	0.12	55.7	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	42.7	100
Q02-18	02-A02-04	1.27	0.00	0.08	55.9	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.01	42.6	100
Q02-18	02-A02-05	1.52	0.00	0.09	55.8	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.03	42.4	100
Q02-18	02-A02-06	1.35	0.00	0.13	56.7	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.01	41.7	100
Q02-18	02-A02-07	2.12	0.00	0.20	56.1	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.01	41.5	100
SW Hansen																	
UL Hansen 9125	07-A01-01	0.00	0.00	0.13	56.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	43.6	100
UL Hansen 9125	07-A01-03	0.59	0.00	0.06	54.6	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	44.7	100
UL Hansen 9125	07-A01-04	0.73	0.00	0.06	56.0	0.00	0.19	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	43.0	100
UL Hansen 9125	07-A08-01	1.10	0.00	0.25	53.6	0.00	0.31	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	44.7	100
UL Hansen 9125	07-A08-02	0.83	0.00	0.12	56.5	0.00	0.22	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	42.3	100
UL Hansen 9125	07-A08-03	0.83	0.00	0.64	53.3	0.00	0.33	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	44.8	100
Straight Creek																	
Q10-17-02-01B	08-A02-01	0.76	0.00	0.00	56.1	0.12	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	42.9	100
Q10-17-02-01B	08-A02-02	0.62	0.00	0.00	52.6	0.12	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	45.7	100
Q10-17-02-01B	08-A02-03	1.35	0.00	0.00	55.2	0.15	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.4	100
Q10-17-02-01B	08-A02-04	1.40	0.00	0.00	54.9	0.00	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.7	100
Q10-17-02-01B	08-A05-01	1.34	0.00	0.28	55.5	0.15	0.54	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	42.2	100
Q10-17-02-01B	08-A05-02	1.63	0.00	0.04	54.6	0.00	2.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	41.5	100
Q10-17-02-01B	08-A05-03	2.25	0.00	0.06	54.8	0.00	1.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.1	100
Q10-17-02-01B	08-A07-01	1.97	0.00	0.38	55.1	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.4	100
Q10-17-02-01B	08-A07-02	1.31	0.00	0.00	55.0	0.16	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.9	100
Q10-17-02-01B	08-A07-03	1.06	0.00	0.04	56.6	0.15	1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.1	100
Q10-17-02-01B	08-A07-04	1.15	0.00	0.00	56.1	0.14	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.8	100
Q10-17-02-01B	08-A07-05	0.87	0.00	0.00	57.1	0.29	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.0	100
Q10-17-02-01B	08-A08-01	1.69	0.00	0.05	48.7	0.00	0.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	48.6	100

Table 3.

		Wt%															
	Sample	MnO	La_2O_3	MgO	CaO	SO_3	FeO	Ce_2O_3	SrO	BaO	P_2O_5	ZnO	SiO_2	PbO	Y_2O_3	CO_2	Total
Q10-17-02-01B	08-A08-02	1.36	0.00	0.10	52.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	46.2	100
Q10-17-02-01B	08-A08-03	1.80	0.00	0.08	52.5	0.00	2.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	43.4	100
Q10-17-02-01B	08-A08-04	2.49	0.00	0.05	53.0	0.00	1.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.6	100
Q10-17-02-01B	08-A08-05	1.18	0.00	0.00	54.9	0.27	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	42.5	100
Q10-17-02-01B	08-A09-01	0.81	0.00	0.11	56.0	0.00	0.49	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.02	42.5	100
Q10-17-02-01B	08-A09-02	1.98	0.00	0.00	54.1	0.00	1.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	42.7	100
Q10-17-02-01B	08-A09-03	1.77	0.00	0.08	54.4	0.00	1.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.3	100
Q10-17-02-01B	08-A09-04	1.26	0.00	0.00	54.8	0.28	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	42.7	100
Q10-17-02-01B	08-A09-05	1.12	0.00	0.05	54.1	0.15	1.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	43.5	100
Q10-17-02-01B	08-A09-06	0.81	0.00	0.00	55.0	0.18	1.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	42.9	100
Q10-17-02-01B	08-A09-07	1.60	0.00	0.00	54.3	0.00	1.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	42.9	100
Q10-17-02-01B	08-A09-08	2.54	0.00	0.07	53.8	0.12	1.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.5	100
Q10-17-02-01B	08-A09-09	1.22	0.00	0.00	55.3	0.26	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.5	100
Q10-17-02-01B	08-A09-10	1.36	0.00	0.00	55.9	0.00	0.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	41.8	100
Q10-17-02-01B	08-A11+13-01	1.30	0.00	0.00	55.8	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	42.0	100
Q10-17-02-01B	08-A11+13-02	1.37	0.00	0.00	55.8	0.24	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.9	100
Q10-17-02-01B	08-A11+13-03	1.65	0.00	0.00	56.1	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.3	100
Q10-17-02-01B	08-A11+13-04	1.15	0.00	0.00	56.0	0.18	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	41.7	100
Q10-17-02-01B	08-A11+13-05	2.06	0.00	0.00	55.1	0.00	1.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.4	100
Q10-17-02-01B	08-A11+13-06	0.81	0.00	0.00	56.0	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	42.8	100
Q10-17-02-01B	08-A11+13-07	0.79	0.00	0.00	54.9	0.24	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.4	100
Q10-17-02-01B	08-A11+13-08	0.92	0.00	0.00	56.2	0.18	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	41.7	100
Q10-17-02-01B	08-A11+13-09	0.46	0.00	0.28	57.3	0.21	1.12	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	40.6	100
Q10-17-02-03	10-A01-01	1.82	0.00	0.16	56.3	0.00	1.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	40.6	100
Q10-17-02-03	10-A01-02	1.67	0.00	0.19	58.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.8	100
Q10-17-02-03	10-A01-03	2.41	0.00	0.10	59.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.5	100
Q10-17-02-03	10-A01-04	1.80	0.00	0.04	58.2	0.00	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.9	100
Q10-17-02-03	10-A01-05	2.03	0.00	0.12	56.7	0.00	1.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.3	100
Q10-17-02-03	10-A01-06	1.70	0.00	0.12	57.2	0.00	1.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	39.1	100
Q10-17-02-03	10-A04-01	1.95	0.00	0.22	57.2	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.02	40.5	100
Q10-17-02-03	10-A04-02	2.81	0.00	0.39	57.0	0.00	1.52	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.05	38.1	100
Q10-17-02-03	10-A06-01	2.46	0.00	0.13	57.1	0.00	1.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.6	100
Q10-17-02-03	10-A06-02	1.89	0.00	0.09	51.3	0.00	1.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.1	100
Q10-17-02-03	10-A06-03	1.91	0.00	0.08	58.3	0.17	1.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	37.7	100
Q10-17-02-03	10-A06-04	1.55	0.00	0.05	58.4	0.00	1.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.7	100

Table 3.

	Sample	Wt% MnO	La_2O_3	MgO	CaO	SO_3	FeO	Ce_2O_3	SrO	BaO	P_2O_5	ZnO	SiO_2	PbO	Y_2O_3	CO_2	Total
Straight Creek drill holes																	
SC1B 88-95 WASH	20-A01-01	1.82	0.00	0.00	55.2	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	42.9	100
SC1B 88-95 WASH	20-A01-02	1.89	0.00	0.00	50.9	0.00	0.00	0.00	0.09	0.15	0.00	0.00	0.00	0.00	0.00	47.0	100
SC1B 88-95 WASH	20-A01-03	1.63	0.00	0.00	54.9	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	43.4	100
SC1B 88-95 WASH	20-A01-04	2.51	0.00	0.00	53.2	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	44.2	100
SC1B 88-95 WASH	20-A02-01	2.86	0.00	0.06	53.8	0.00	0.28	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	42.9	100
SC1B 88-95 WASH	20-A02-02	0.81	0.00	0.00	56.0	0.00	0.29	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	42.8	100
SC1B 88-95 WASH	20-A02-03	0.53	0.00	0.07	55.3	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.9	100
SC3B 195-200	19-A08-01	2.08	0.00	0.00	55.5	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.3	100
SC3B 195-200	19-A08-02	1.62	0.00	0.00	53.0	0.00	0.16	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	45.2	100
SC3B 195-200	19-A08-03	1.70	0.00	0.00	53.6	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	44.7	100
SC3B 195-200	19-A08-04	2.05	0.00	0.00	53.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.2	100
SC3B 195-200	19-A08-05	2.07	0.00	0.00	55.4	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.4	100
SC5B 277 Wash	11-A03-01	1.05	0.00	0.00	56.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	42.2	100
SC5B 277 Wash	11-A03-02	1.11	0.00	0.00	53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.7	100
SC5B 277 Wash	11-A03-03	1.19	0.00	0.00	54.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	44.0	100
SC5B 277 Wash	11-A03-04	0.71	0.00	0.00	58.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.2	100
SC5B 277 Wash	11-A03-05	0.94	0.00	0.00	53.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	45.8	100
SC5B 277 Wash	11-A03-06	1.23	0.00	0.00	58.4	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	40.2	100
SC5B 277 Wash	11-A04-01	0.46	0.00	0.05	56.9	0.00	0.65	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.00	41.5	100
SC5B 277 Wash	11-A08-01	2.09	0.00	0.16	57.6	0.00	0.97	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.06	38.9	100
SC5B 277 Wash	11-A08-02	2.15	0.00	0.15	56.5	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.07	40.9	100
SC5B 277 Wash	11-A08-03	0.86	0.00	0.06	53.0	0.00	0.80	0.00	0.62	0.00	0.00	0.00	0.00	0.00	0.00	44.6	100
SC5B 277 Wash	11-A08-04	1.16	0.00	0.13	59.1	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.13	39.2	100
SC5B 277 Wash	11-A10-01	1.62	0.00	0.13	57.2	0.00	0.72	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	40.3	100
SC5B 277 Wash	11-A10-02	0.81	0.00	0.00	52.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.0	100
SC5B 277 Wash	11-A10-03	1.85	0.00	0.08	59.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	39.1	100
SC5B 277 Wash	11-A10-04	0.71	0.00	0.00	57.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	42.3	100
SC5B 277 Wash	11-A10-05	0.95	0.00	0.00	57.7	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	41.1	100
SC5B 277 Wash	11-A11-01	0.34	0.00	0.04	56.3	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.00	42.8	100
SC5B 277 Wash	11-A11-02	0.53	0.00	0.00	58.7	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.03	40.6	100
SC5B 277 Wash	11-A11-03	0.56	0.00	0.00	59.6	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	39.8	100
SE Straight																	
Q10-18-02-4A	12-A02-01	0.73	0.00	21.5	31.0	0.00	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.7	100
Q10-18-02-4A	12-A02-02	3.09	0.00	0.22	56.7	0.00	2.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	37.5	100
Q10-18-02-4A	12-A02-03	2.38	0.00	0.12	57.4	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.3	100
Q10-18-02-4A	12-A02-04	0.46	0.00	21.5	31.1	0.00	0.61	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.01	46.2	100
Q10-18-02-4A	12-A02-05	2.10	0.00	0.17	57.2	0.00	1.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	38.8	100
Q10-18-02-4A	12-A04-01b	0.85	0.00	0.12	54.5	0.13	1.76	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	42.5	100

Table 3.

	Sample	Wt% MnO	La_2O_3	MgO	CaO	SO_3	FeO	Ce_2O_3	SrO	BaO	P_2O_5	ZnO	SiO_2	PbO	Y_2O_3	CO_2	Total
Q10-18-02-4A	12-A04-02b	2.08	0.00	0.04	54.7	0.28	0.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.0	100
Q10-18-02-4A	12-A04-03b	3.03	0.00	0.32	54.0	0.00	1.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.2	100
Q10-18-02-4A	12-A04-04	2.82	0.00	0.04	56.5	0.36	1.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.6	100
Q10-18-02-4A	12-A04-05	0.71	0.00	0.00	60.0	0.16	1.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.1	100
Q10-18-02-4A	12-A04-06	2.54	0.00	0.04	57.5	0.31	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	38.6	100
Q10-18-02-4A	12-A04-07	1.00	0.00	0.21	55.5	0.00	1.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.3	100
Q10-18-02-4A	12-A04-08	2.70	0.00	0.55	55.5	0.00	1.71	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.05	39.4	100
Q10-18-02-4A	12-A04-09	2.43	0.00	0.14	55.6	0.00	1.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.8	100

Table 3.

	Sample	Atoms Mn	La	Mg	Ca	S	Fe	Ce	Sr	Ba	P	Zn	Si	Pb	Y	C
Molycorp Open Pit																
Q02-19B	01-A01-01	0.065	0.000	0.008	1.930	0.000	0.033	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.981
Q02-19B	01-A01-02	0.017	0.000	0.004	2.109	0.000	0.006	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.931
Q02-19B	01-A01-03	0.034	0.000	0.031	1.927	0.000	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.995
Q02-19B	01-A01-04	0.017	0.000	0.000	2.033	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.975
Q02-19B	01-A03-01	0.043	0.000	0.000	2.046	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	1.954
Q02-19B	01-A03-02	0.084	0.000	0.002	1.944	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.985
Q02-19B	01-A03-03	0.018	0.000	0.008	2.029	0.000	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.961
Q02-19B	01-A03-04	0.081	0.000	0.005	1.964	0.000	0.019	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	1.965
Q02-19B	01-A05-02	0.069	0.000	0.000	2.028	0.000	0.017	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.942
Q02-19B	01-A05-01	0.070	0.000	0.000	2.052	0.000	0.026	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.925
Q02-19B	01-A05-03	0.068	0.000	0.006	2.015	0.000	0.038	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	1.935
Q02-19C	04-A02-01	0.146	0.000	0.000	2.099	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.877
Q02-19C	04-A02-02	0.150	0.000	0.012	2.044	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.897
Q02-19C	04-A02-03	0.166	0.000	0.000	2.096	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.864
Q02-18	02-A02-01	0.041	0.000	0.002	2.068	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	1.943
Q02-18	02-A02-02	0.032	0.000	0.000	2.076	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	1.944
Q02-18	02-A02-03	0.039	0.000	0.006	2.015	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	1.969
Q02-18	02-A02-04	0.036	0.000	0.004	2.025	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	1.966
Q02-18	02-A02-05	0.044	0.000	0.005	2.024	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	1.962
Q02-18	02-A02-06	0.039	0.000	0.007	2.070	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	1.941
Q02-18	02-A02-07	0.061	0.000	0.010	2.055	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	1.936
SW Hansen																
UL Hansen 9125	07-A01-01	0.000	0.000	0.006	2.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.991
UL Hansen 9125	07-A01-03	0.016	0.000	0.003	1.939	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	2.020
UL Hansen 9125	07-A01-04	0.021	0.000	0.003	2.017	0.000	0.005	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.976
UL Hansen 9125	07-A08-01	0.031	0.000	0.013	1.900	0.000	0.009	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	2.023
UL Hansen 9125	07-A08-02	0.024	0.000	0.006	2.048	0.000	0.006	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.957
UL Hansen 9125	07-A08-03	0.023	0.000	0.031	1.889	0.000	0.009	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	2.023
Straight Creek																
Q10-17-02-01B	08-A02-01	0.022	0.000	0.000	2.022	0.003	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.973
Q10-17-02-01B	08-A02-02	0.017	0.000	0.000	1.850	0.003	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	2.049
Q10-17-02-01B	08-A02-03	0.039	0.000	0.000	2.003	0.004	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.962
Q10-17-02-01B	08-A02-04	0.040	0.000	0.000	1.989	0.000	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.971
Q10-17-02-01B	08-A05-01	0.038	0.000	0.014	2.014	0.004	0.015	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.953
Q10-17-02-01B	08-A05-02	0.047	0.000	0.002	2.004	0.000	0.061	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.943
Q10-17-02-01B	08-A05-03	0.065	0.000	0.003	2.018	0.000	0.054	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.930
Q10-17-02-01B	08-A07-01	0.057	0.000	0.019	2.001	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.960
Q10-17-02-01B	08-A07-02	0.037	0.000	0.000	1.986	0.004	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.973
Q10-17-02-01B	08-A07-03	0.031	0.000	0.002	2.079	0.004	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.923
Q10-17-02-01B	08-A07-04	0.033	0.000	0.000	2.046	0.004	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.943
Q10-17-02-01B	08-A07-05	0.025	0.000	0.000	2.095	0.007	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.918
Q10-17-02-01B	08-A08-01	0.046	0.000	0.002	1.673	0.000	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	2.127

Table 3.

		Atoms														
	Sample	Mn	La	Mg	Ca	S	Fe	Ce	Sr	Ba	P	Zn	Si	Pb	Y	C
Q10-17-02-01B	08-A08-02	0.038	0.000	0.005	1.830	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.064
Q10-17-02-01B	08-A08-03	0.051	0.000	0.004	1.895	0.000	0.061	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.994
Q10-17-02-01B	08-A08-04	0.071	0.000	0.003	1.928	0.000	0.053	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.973
Q10-17-02-01B	08-A08-05	0.034	0.000	0.000	1.990	0.007	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.962
Q10-17-02-01B	08-A09-01	0.023	0.000	0.006	2.029	0.000	0.014	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	1.963
Q10-17-02-01B	08-A09-02	0.057	0.000	0.000	1.963	0.000	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	1.973
Q10-17-02-01B	08-A09-03	0.051	0.000	0.004	1.980	0.000	0.039	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.963
Q10-17-02-01B	08-A09-04	0.036	0.000	0.000	1.980	0.007	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.968
Q10-17-02-01B	08-A09-05	0.032	0.000	0.002	1.941	0.004	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	1.992
Q10-17-02-01B	08-A09-06	0.023	0.000	0.000	1.983	0.004	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	1.974
Q10-17-02-01B	08-A09-07	0.046	0.000	0.000	1.963	0.000	0.034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	1.979
Q10-17-02-01B	08-A09-08	0.073	0.000	0.003	1.952	0.003	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.967
Q10-17-02-01B	08-A09-09	0.035	0.000	0.000	2.002	0.007	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.961
Q10-17-02-01B	08-A09-10	0.039	0.000	0.000	2.042	0.000	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.947
Q10-17-02-01B	08-A11+13-01	0.037	0.000	0.000	2.033	0.000	0.027	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.951
Q10-17-02-01B	08-A11+13-02	0.039	0.000	0.000	2.030	0.006	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.946
Q10-17-02-01B	08-A11+13-03	0.048	0.000	0.000	2.058	0.000	0.027	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.934
Q10-17-02-01B	08-A11+13-04	0.033	0.000	0.000	2.045	0.005	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.941
Q10-17-02-01B	08-A11+13-05	0.060	0.000	0.000	2.024	0.000	0.040	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.938
Q10-17-02-01B	08-A11+13-06	0.023	0.000	0.000	2.017	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	1.968
Q10-17-02-01B	08-A11+13-07	0.023	0.000	0.000	1.971	0.006	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.986
Q10-17-02-01B	08-A11+13-08	0.027	0.000	0.000	2.051	0.004	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.940
Q10-17-02-01B	08-A11+13-09	0.013	0.000	0.014	2.109	0.005	0.032	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	1.905
Q10-17-02-03	10-A01-01	0.053	0.000	0.008	2.082	0.000	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.912
Q10-17-02-03	10-A01-02	0.049	0.000	0.010	2.169	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.886
Q10-17-02-03	10-A01-03	0.072	0.000	0.005	2.221	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.851
Q10-17-02-03	10-A01-04	0.054	0.000	0.002	2.187	0.000	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.864
Q10-17-02-03	10-A01-05	0.060	0.000	0.006	2.124	0.000	0.056	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.877
Q10-17-02-03	10-A01-06	0.050	0.000	0.006	2.146	0.000	0.055	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.871
Q10-17-02-03	10-A04-01	0.057	0.000	0.011	2.113	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	1.906
Q10-17-02-03	10-A04-02	0.084	0.000	0.020	2.159	0.000	0.045	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.001	1.839
Q10-17-02-03	10-A06-01	0.073	0.000	0.007	2.157	0.000	0.050	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.856
Q10-17-02-03	10-A06-02	0.053	0.000	0.004	1.820	0.000	0.044	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.039
Q10-17-02-03	10-A06-03	0.057	0.000	0.004	2.216	0.005	0.055	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.827
Q10-17-02-03	10-A06-04	0.046	0.000	0.002	2.200	0.000	0.038	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.857

Table 3.

	Sample	Atoms Mn	La	Mg	Ca	S	Fe	Ce	Sr	Ba	P	Zn	Si	Pb	Y	C
Straight Creek drill holes																
SC1B 88-95 WASH	20-A01-01	0.052	0.000	0.000	1.993	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	1.976
SC1B 88-95 WASH	20-A01-02	0.052	0.000	0.000	1.771	0.000	0.000	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	2.087
SC1B 88-95 WASH	20-A01-03	0.046	0.000	0.000	1.972	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.990
SC1B 88-95 WASH	20-A01-04	0.071	0.000	0.000	1.903	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	2.012
SC1B 88-95 WASH	20-A02-01	0.082	0.000	0.003	1.945	0.000	0.008	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.980
SC1B 88-95 WASH	20-A02-02	0.023	0.000	0.000	2.023	0.000	0.008	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.972
SC1B 88-95 WASH	20-A02-03	0.015	0.000	0.004	1.975	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.000
SC3B 195-200	19-A08-01	0.060	0.000	0.000	2.018	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.959
SC3B 195-200	19-A08-02	0.045	0.000	0.000	1.873	0.000	0.004	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	2.038
SC3B 195-200	19-A08-03	0.048	0.000	0.000	1.903	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	2.024
SC3B 195-200	19-A08-04	0.058	0.000	0.000	1.919	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.012
SC3B 195-200	19-A08-05	0.060	0.000	0.000	2.011	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.962
SC5B 277 Wash	11-A03-01	0.030	0.000	0.000	2.059	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.955
SC5B 277 Wash	11-A03-02	0.031	0.000	0.000	1.869	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.050
SC5B 277 Wash	11-A03-03	0.034	0.000	0.000	1.957	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.004
SC5B 277 Wash	11-A03-04	0.021	0.000	0.000	2.130	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.924
SC5B 277 Wash	11-A03-05	0.026	0.000	0.000	1.870	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.052
SC5B 277 Wash	11-A03-06	0.036	0.000	0.000	2.162	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.896
SC5B 277 Wash	11-A04-01	0.013	0.000	0.003	2.082	0.000	0.019	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	1.938
SC5B 277 Wash	11-A08-01	0.062	0.000	0.008	2.168	0.000	0.029	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.001	1.864
SC5B 277 Wash	11-A08-02	0.063	0.000	0.008	2.082	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.001	1.920
SC5B 277 Wash	11-A08-03	0.024	0.000	0.003	1.887	0.000	0.022	0.000	0.012	0.000	0.000	0.000	0.000	0.000	0.000	2.026
SC5B 277 Wash	11-A08-04	0.034	0.000	0.007	2.211	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.002	1.871
SC5B 277 Wash	11-A10-01	0.047	0.000	0.007	2.119	0.000	0.021	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	1.902
SC5B 277 Wash	11-A10-02	0.022	0.000	0.000	1.816	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.081
SC5B 277 Wash	11-A10-03	0.055	0.000	0.004	2.209	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.866
SC5B 277 Wash	11-A10-04	0.020	0.000	0.000	2.069	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	1.955
SC5B 277 Wash	11-A10-05	0.028	0.000	0.000	2.111	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.921
SC5B 277 Wash	11-A11-01	0.010	0.000	0.002	2.034	0.000	0.000	0.000	0.009	0.000	0.000	0.000	0.000	0.000	0.000	1.973
SC5B 277 Wash	11-A11-02	0.015	0.000	0.000	2.166	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	1.908
SC5B 277 Wash	11-A11-03	0.016	0.000	0.000	2.214	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	1.884
SE Straight																
Q10-18-02-4A	12-A02-01	0.019	0.000	1.002	1.039	0.000	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.955
Q10-18-02-4A	12-A02-02	0.093	0.000	0.012	2.166	0.000	0.074	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.827
Q10-18-02-4A	12-A02-03	0.071	0.000	0.006	2.149	0.000	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.875
Q10-18-02-4A	12-A02-04	0.012	0.000	0.997	1.040	0.000	0.016	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	1.966
Q10-18-02-4A	12-A02-05	0.063	0.000	0.009	2.153	0.000	0.050	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.863
Q10-18-02-4A	12-A04-01b	0.024	0.000	0.006	1.976	0.003	0.050	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	1.964

Table 3.

	Sample	Atoms Mn	La	Mg	Ca	S	Fe	Ce	Sr	Ba	P	Zn	Si	Pb	Y	C
Q10-18-02-4A	12-A04-02b	0.060	0.000	0.002	1.993	0.007	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.950
Q10-18-02-4A	12-A04-03b	0.088	0.000	0.016	1.988	0.000	0.039	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.934
Q10-18-02-4A	12-A04-04	0.084	0.000	0.002	2.128	0.009	0.049	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.854
Q10-18-02-4A	12-A04-05	0.021	0.000	0.000	2.268	0.004	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.834
Q10-18-02-4A	12-A04-06	0.076	0.000	0.002	2.163	0.008	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	1.852
Q10-18-02-4A	12-A04-07	0.029	0.000	0.011	2.036	0.000	0.056	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.934
Q10-18-02-4A	12-A04-08	0.080	0.000	0.028	2.080	0.000	0.050	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	1.880
Q10-18-02-4A	12-A04-09	0.071	0.000	0.007	2.052	0.000	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.919

Table 3.

	Sample	Description	Location on grain
Molycorp Open Pit			
Q02-19B	01-A01-01	Carbonate in center of fluorite vein with quartz walls.	Mottled rim
Q02-19B	01-A01-02	Carbonate in center of fluorite vein with quartz walls.	Clean core of above
Q02-19B	01-A01-03	Carbonate in center of fluorite vein with quartz walls.	Mottled rim
Q02-19B	01-A01-04	Carbonate in center of fluorite vein with quartz walls. Pyrite nearby	Clean core of above
Q02-19B	01-A03-01	Carbonate in center of fluorite vein with quartz walls. Pyrite nearby	Rim
Q02-19B	01-A03-02	Carbonate with interstitial pyrite in center of fluorite vein with quartz walls.	Slightly brighter core of above
Q02-19B	01-A03-03	Carbonate with interstitial pyrite in center of fluorite vein with quartz walls.	Mottled rim next to pyrite
Q02-19B	01-A03-04	Carbonate with interstitial pyrite in center of fluorite vein with quartz walls.	Mottle core of above
Q02-19B	01-A05-02	Carbonate with interstitial chlorite (replacing carbonate?) in center of fluorite vein with quartz walls.	Slighty mottled core
Q02-19B	01-A05-01	Carbonate with interstitial chlorite (replacing carbonate?) in center of fluorite vein with quartz walls.	Core
Q02-19B	01-A05-03	Carbonate with interstitial chlorite (replacing carbonate?) in center of fluorite vein with quartz walls.	Rim of above next to chlorite
Q02-19C	04-A02-01	Carbonate patch surrounded by quartz. Gypsum on edges	Rim
Q02-19C	04-A02-02	Carbonate patch surrounded by quartz. Gypsum on edges	Core
Q02-19C	04-A02-03	Carbonate patch surrounded by quartz. Gypsum on edges	Rim
Q02-18	02-A02-01	Carbonate in center of vein with pyrite walls	Core of lamellae
Q02-18	02-A02-02	Carbonate in center of vein with pyrite walls	Core of lamellae
Q02-18	02-A02-03	Carbonate in center of vein with pyrite walls	Core of lamellae
Q02-18	02-A02-04	Carbonate in center of vein with pyrite walls	Core of lamellae
Q02-18	02-A02-05	Carbonate in center of vein with pyrite walls	Core of lamellae
Q02-18	02-A02-06	Carbonate in center of vein with pyrite walls	Core of lamellae
Q02-18	02-A02-07	Carbonate in center of vein with pyrite walls	Core of lamellae
SW Hansen			
UL Hansen 9125	07-A01-01	Carbonate with pyrite, TiO2, albite, and K-Al-Si phase	
UL Hansen 9125	07-A01-03	Carbonate with pyrite, TiO2, albite, and K-Al-Si phase	
UL Hansen 9125	07-A01-04	Carbonate with pyrite, TiO2, albite, and K-Al-Si phase	
UL Hansen 9125	07-A08-01	Carbonate and k-spar surrounding pyrite. Apatite, albite, and TiO2 also present	Core
UL Hansen 9125	07-A08-02	Carbonate and k-spar surrounding pyrite. Apatite, albite, and TiO2 also present	Core
UL Hansen 9125	07-A08-03	Patchy carbonate in albite of above	
Straight Creek			
Q10-17-02-01B	08-A02-01	Calcite, quartz, gypsum, and apatite cluster surrounded by illite	Rim
Q10-17-02-01B	08-A02-02	Calcite, quartz, gypsum, and apatite cluster surrounded by illite	Core of above
Q10-17-02-01B	08-A02-03	Calcite, quartz, gypsum, and apatite cluster surrounded by illite	Core
Q10-17-02-01B	08-A02-04	Calcite, quartz, gypsum, and apatite cluster surrounded by illite	Rim of above
Q10-17-02-01B	08-A05-01	Calcite next to pyrite with TiO2 and illite	Rim next to pyrite
Q10-17-02-01B	08-A05-02	Calcite next to pyrite with TiO2 and illite	Core
Q10-17-02-01B	08-A05-03	Calcite next to pyrite with TiO2 and illite	Rim next to illite
Q10-17-02-01B	08-A07-01	Interstitial calcite between euhedral quartz, apatite, and pyrite. Cluster surrounded by illite and quartz	Core
Q10-17-02-01B	08-A07-02	Interstitial calcite between euhedral quartz, apatite, and pyrite. Cluster surrounded by illite and quartz	Core
Q10-17-02-01B	08-A07-03	Interstitial calcite between euhedral quartz, apatite, and pyrite. Cluster surrounded by illite and quartz	Rim
Q10-17-02-01B	08-A07-04	Interstitial calcite between euhedral quartz, apatite, and pyrite. Cluster surrounded by illite and quartz	Core of above
Q10-17-02-01B	08-A07-05	Interstitial calcite between euhedral quartz, apatite, and pyrite. Cluster surrounded by illite and quartz	Core
Q10-17-02-01B	08-A08-01	Calcite on edge of pyrite vein	Rim

Table 3.

	Sample	Description	Location on grain
Q10-17-02-01B	08-A08-02	Calcite on edge of pyrite vein	Core
Q10-17-02-01B	08-A08-03	Calcite on edge of pyrite vein	Rim next to pyrite
Q10-17-02-01B	08-A08-04	Calcite on edge of pyrite vein	Rim next to pyrite
Q10-17-02-01B	08-A08-05	Calcite on edge of pyrite vein	Core
Q10-17-02-01B	08-A09-01	Interstitial calcite between euhedral quartz and apatite grains in vein	Rim
Q10-17-02-01B	08-A09-02	Interstitial calcite between euhedral quartz and apatite grains in vein	Core
Q10-17-02-01B	08-A09-03	Interstitial calcite between euhedral quartz and apatite grains in vein	Core
Q10-17-02-01B	08-A09-04	Interstitial calcite between euhedral quartz and apatite grains in vein	Core
Q10-17-02-01B	08-A09-05	Interstitial calcite between euhedral quartz and apatite grains in vein	Core
Q10-17-02-01B	08-A09-06	Interstitial calcite between euhedral quartz and apatite grains in vein	Rim
Q10-17-02-01B	08-A09-07	Interstitial calcite between euhedral quartz and apatite grains in vein	Rim
Q10-17-02-01B	08-A09-08	Interstitial calcite between euhedral quartz and apatite grains in vein	Core
Q10-17-02-01B	08-A09-09	Interstitial calcite between euhedral quartz and apatite grains in vein	Core
Q10-17-02-01B	08-A09-10	Interstitial calcite between euhedral quartz and apatite grains in vein	Rim
Q10-17-02-01B	08-A11+13-01	Calcite near pyrite, cpy, and galena south of pyrite vein	Core
Q10-17-02-01B	08-A11+13-02	Calcite near pyrite, cpy, and galena south of pyrite vein	Core
Q10-17-02-01B	08-A11+13-03	Calcite near pyrite, cpy, and galena south of pyrite vein	Core
Q10-17-02-01B	08-A11+13-04	Calcite near pyrite, cpy, and galena south of pyrite vein	Core
Q10-17-02-01B	08-A11+13-05	Calcite near pyrite, cpy, and galena south of pyrite vein	Core
Q10-17-02-01B	08-A11+13-06	Calcite near pyrite, cpy, and galena south of pyrite vein	Core
Q10-17-02-01B	08-A11+13-07	Calcite near pyrite, cpy, and galena south of pyrite vein	Core
Q10-17-02-01B	08-A11+13-08	Calcite near pyrite, cpy, and galena south of pyrite vein	Core
Q10-17-02-01B	08-A11+13-09	Calcite near pyrite, cpy, and galena south of pyrite vein	Core
Q10-17-02-03	10-A01-01	Calcite between quartz and pyrite in vein. Galena also present	Core
Q10-17-02-03	10-A01-02	Calcite between quartz and pyrite in vein. Galena also present	Core
Q10-17-02-03	10-A01-03	Calcite between quartz and pyrite in vein. Galena also present	Rim
Q10-17-02-03	10-A01-04	Calcite between quartz and pyrite in vein. Galena also present	Core of above
Q10-17-02-03	10-A01-05	Calcite between quartz and pyrite in vein. Galena also present	Rim near quartz
Q10-17-02-03	10-A01-06	Calcite between quartz and pyrite in vein. Galena also present	Rim near pyrite
Q10-17-02-03	10-A04-01	Calcite in small vein with pyrite, quartz, and apatite	Core
Q10-17-02-03	10-A04-02	Calcite in small vein with pyrite, quartz, and apatite	Rim
Q10-17-02-03	10-A06-01	Calcite on edge of vein. Pyrite and quartz present	Core
Q10-17-02-03	10-A06-02	Calcite on edge of vein. Pyrite and quartz present	Core
Q10-17-02-03	10-A06-03	Calcite on edge of vein. Pyrite and quartz present	Core
Q10-17-02-03	10-A06-04	Calcite on edge of vein. Pyrite and quartz present	Core

Table 3.

	Sample	Description	Location on grain
Straight Creek drill holes			
SC1B 88-95 WASH	20-A01-01	Patch of carbonate + k-spar in albite and illite matrix	
SC1B 88-95 WASH	20-A01-02	Patch of carbonate + k-spar in albite and illite matrix	
SC1B 88-95 WASH	20-A01-03	Patch of carbonate + k-spar in albite and illite matrix	
SC1B 88-95 WASH	20-A01-04	Patch of carbonate + k-spar in albite and illite matrix	
SC1B 88-95 WASH	20-A02-01	Calcite rim on epidote	
SC1B 88-95 WASH	20-A02-02	Calcite rim on epidote	
SC1B 88-95 WASH	20-A02-03	Calcite rim on epidote	
SC3B 195-200	19-A08-01	Patch of carbonate + k-spar in qtz and illite grain	
SC3B 195-200	19-A08-02	Patch of carbonate + k-spar in qtz and illite grain	
SC3B 195-200	19-A08-03	Patch of carbonate + k-spar in qtz and illite grain	
SC3B 195-200	19-A08-04	Patch of carbonate + k-spar in qtz and illite grain	
SC3B 195-200	19-A08-05	Patch of carbonate + k-spar in qtz and illite grain	
SC5B 277 Wash	11-A03-01	Calcite with barite, kspar, and albite	core
SC5B 277 Wash	11-A03-02	Calcite with barite, kspar, and albite	core
SC5B 277 Wash	11-A03-03	Calcite with barite, kspar, and albite	core
SC5B 277 Wash	11-A03-04	Calcite with barite, kspar, and albite	rim
SC5B 277 Wash	11-A03-05	Calcite with barite, kspar, and albite	brighter core of above
SC5B 277 Wash	11-A03-06	Calcite with barite, kspar, and albite	core of above
SC5B 277 Wash	11-A04-01	Calcite with illite, kspar, chlorite, and feathery FeOx	core
SC5B 277 Wash	11-A08-01	Calcite with illite, TiO_2, and synchisite	core
SC5B 277 Wash	11-A08-02	Calcite with illite, TiO_2, and synchisite	core
SC5B 277 Wash	11-A08-03	Calcite with illite, TiO_2, and synchisite	bright core of adjacent calcite
SC5B 277 Wash	11-A08-04	Calcite with illite, TiO_2, and synchisite	core
SC5B 277 Wash	11-A10-01	Calcite vein in grain. Calcite has bright specks	rim
SC5B 277 Wash	11-A10-02	Calcite vein in grain. Calcite has bright specks	core
SC5B 277 Wash	11-A10-03	Calcite vein in grain. Calcite has bright specks	rim
SC5B 277 Wash	11-A10-04	Calcite vein in grain. Calcite has bright specks	rim
SC5B 277 Wash	11-A10-05	Calcite vein in grain. Calcite has bright specks	rim
SC5B 277 Wash	11-A11-01	Calcite with epidote, illite, feox, and albite	core
SC5B 277 Wash	11-A11-02	Calcite with epidote, illite, feox, and albite	core
SC5B 277 Wash	11-A11-03	Calcite with epidote, illite, feox, and albite	core
SE Straight			
Q10-18-02-4A	12-A02-01	Calcite vug surrounded by dolomite	dolomite rim
Q10-18-02-4A	12-A02-02	Calcite vug surrounded by dolomite	calcite rim
Q10-18-02-4A	12-A02-03	Calcite vug surrounded by dolomite	core of calcite
Q10-18-02-4A	12-A02-04	Calcite vug surrounded by dolomite	dolomite rim
Q10-18-02-4A	12-A02-05	Calcite vug surrounded by dolomite	calcite rim
Q10-18-02-4A	12-A04-01b	Darker core of carbonate near quartz grain	

Table 3.

	Sample	Description	Location on grain
Q10-18-02-4A	12-A04-02b	Bright rim of above	
Q10-18-02-4A	12-A04-03b	Mottled carbonate adjacent to bright rim of above	
Q10-18-02-4A	12-A04-04	Massive calcite surrounding euhedral quartz	core
Q10-18-02-4A	12-A04-05	Massive calcite surrounding euhedral quartz	core
Q10-18-02-4A	12-A04-06	Massive calcite surrounding euhedral quartz	core
Q10-18-02-4A	12-A04-07	Massive calcite surrounding euhedral quartz	core
Q10-18-02-4A	12-A04-08	Massive calcite surrounding euhedral quartz	core
Q10-18-02-4A	12-A04-09	Massive calcite surrounding euhedral quartz	core

Table 4. Compilation of electron probe microanalytical data, listed as weight % oxide, for rare earth element carbonates from the Red River mineralized rocks. "bdl" – below detection limit. *Not checked against secondary standard because standard unavailable. **Determined by difference assuming 100% total.

Table 4.

Sample	Analysis	Weight% F	Al_2O_3	SiO_2	CaO	MnO	FeO	Y_2O_3	La_2O_3	Ce_2O_3	Pr_2O_3*	Nd_2O_3	Sm_2O_3	Gd_2O_3	ThO_2	UO_2	F=O	Total 1	Total 2	CO_2**
Upper Sulphur Gulch																				
Q02-15-UO	03-A03-01	3.64	17.9	33.2	4.98	bdl	2.14	0.62	4.85	11.2	1.24	4.60	0.71	0.47	bdl	bdl	1.53	84.0	100	16.0
Q02-15-UO	03-A03-02	7.28	2.31	5.25	8.26	bdl	0.54	1.58	8.97	21.7	2.12	9.15	1.23	0.78	bdl	bdl	3.07	66.1	100	33.9
Goat Hill Gulch																				
Q02-21	05-A05-01	2.64	10.2	18.9	20.9	1.67	4.19	0.40	1.70	2.70	0.18	1.17	bdl	bdl	bdl	0.50	1.11	64.0	100	36.0
Straight Creek drill holes																				
SC5B 277 Wash	11-A01-01	5.43	0.39	bdl	19.4	bdl	0.26	1.10	13.2	24.2	2.26	9.41	1.18	0.72	bdl	0.45	2.29	75.7	100	24.3
SC5B 277 Wash	11-A02-01	4.01	0.87	0.62	20.2	bdl	0.23	1.63	12.6	24.5	2.38	10.4	1.46	1.07	bdl	0.52	1.69	78.8	100	21.2
SC5B 277 Wash	11-A06-01	5.02	2.81	7.27	18.4	bdl	0.13	2.69	10.5	21.2	2.17	8.79	1.15	1.10	bdl	1.25	2.12	80.4	100	19.6
SC5B 277 Wash	11-A08-01	6.02	0.44	0.32	19.3	bdl	0.49	2.30	13.2	22.0	2.09	9.37	1.48	1.23	bdl	bdl	2.54	75.7	100	24.3
SC5B 277 Wash	11-A08-02	6.07	bdl	bdl	19.1	bdl	0.11	4.76	12.9	18.8	1.85	9.57	1.61	2.70	bdl	bdl	2.56	74.9	100	25.1
Q10-18-02-4A	12-A03-01	7.67	0.10	bdl	10.7	bdl	0.07	1.04	18.5	30.9	2.60	8.94	1.06	0.69	bdl	bdl	3.23	79.1	100	20.9
Q10-18-02-4A	12-A03-02	9.00	0.24	bdl	4.01	bdl	0.41	0.83	21.5	34.3	2.70	9.44	1.03	0.62	bdl	bdl	3.79	80.2	100	19.8
SC3B 195-200	19-A01-01	5.39	0.13	bdl	17.2	bdl	0.10	1.23	11.3	26.1	2.56	9.77	1.53	0.83	1.70	bdl	2.27	75.5	100	24.5

Table 4.

Sample	Analysis	Weight% F	Al_2O_3	SiO_2	CaO	MnO	FeO	Y_2O_3	La_2O_3	Ce_2O_3	Pr_2O_3*	Nd_2O_3	Sm_2O_3	Gd_2O_3	ThO_2	UO_2	F=O	Total 1	Total 2	CO_2**
SC3B 195-200	19-A01-02	5.39	bdl	bdl	18.4	bdl	0.08	1.36	12.1	27.2	2.65	10.3	1.45	0.79	0.64	bdl	2.27	78.1	100	21.9
SC3B 195-200	19-A01-03	5.62	bdl	0.26	16.3	bdl	bdl	1.34	12.3	29.0	2.79	10.7	1.64	1.01	bdl	bdl	2.37	78.7	100	21.3
SC3B 195-200	19-A01-04	5.65	bdl	bdl	18.3	bdl	0.19	1.93	11.5	26.7	2.55	9.99	1.50	0.82	bdl	bdl	2.38	76.8	100	23.2
SC3B 195-200	19-A01-05	4.77	0.36	0.12	18.2	bdl	0.12	1.62	12.1	28.1	2.87	10.7	1.59	0.89	bdl	bdl	2.01	79.4	100	20.6
SC3B 195-200	19-A01-06	6.07	1.86	2.59	17.2	0.41	0.62	1.54	11.2	25.6	2.51	9.97	1.56	0.90	bdl	bdl	2.56	79.4	100	20.6
SC3B 195-200	19-A01-07	6.64	bdl	bdl	16.0	bdl	bdl	1.37	11.2	28.3	2.82	10.4	1.60	0.94	bdl	bdl	2.80	76.5	100	23.5
SC3B 195-200	19-A03-01	3.91	8.51	24.1	15.1	bdl	0.14	6.52	6.06	14.9	1.78	7.21	1.39	1.55	bdl	0.59	1.65	90.7	100	9.3

*Not checked against secondary standard because standard unavailable

**Determined by difference assuming 100% total

Table 4.

Sample	Analysis	Description
Upper Sulphur Gulch		
Q02-15-UO	03-A03-01	5 μm width intergrown with chlorite, TiO2, and epidote replacement of preexisting mineral.
Q02-15-UO	03-A03-02	3 μm width intergrown with chlorite, TiO2, and epidote replacement of preexisting mineral.
Goat Hill Gulch		
Q02-21	05-A05-01	3 μm square grain surrounded by a REE oxide on three sides. The grain occurs in a matrix of albite, calcite, Mg-Mn-Fe-calcite, pyrite, and chalcopyrite that has replaced a preexisting mineral.
Straight Creek drill holes		
SC5B 277 Wash	11-A01-01	22 μm width interstitial to matrix material. Feathers(?) of TiO2 nearby. This is a grain mount sample
SC5B 277 Wash	11-A02-01	17 μm width interstitial to matrix material. Feathers of TiO2 and Fe,AlO nearby. This is a grain mount sample
SC5B 277 Wash	11-A06-01	5 μm width. Occurs with TiO2, apatite, and FeOx feathers? This is a grain mount sample
SC5B 277 Wash	11-A08-01	20 μm width occurs with calcite, TiO2, and illite/muscovite. This is a grain mount sample
SC5B 277 Wash	11-A08-02	18 μm width occurs with calcite, TiO2, and illite/muscovite. This is a grain mount sample
Q10-18-02-4A	12-A03-01	13 μm width displays some possible zoning (see analysis 12-A03-02 for brighter area of this grain). Occurs with quartz, pyrite, barite, in a kspar-ish region.
Q10-18-02-4A	12-A03-02	Brighter area of 12-A03-02
SC3B 195-200	19-A01-01	60 μm grain with very thin, <1 μm, lamellae (see analysis 19-A01-02 and 19-A01-03). This grain is intergrown with quartz. Pyrite and illite are on one side of this grain

Table 4.

Sample	Analysis	Description
SC3B 195-200	19-A01-02	Lamellae of grain analyzed in 19-A01-01
SC3B 195-200	19-A01-03	Lamellae of grain analyzed in 19-A01-01
SC3B 195-200	19-A01-04	Non-lamellae area of grain analyzed in 19-A01-01
SC3B 195-200	19-A01-05	40 μm grain next to TiO_2. Two analysis taken on this grain (19-A01-05 and 19-A01-06).
SC3B 195-200	19-A01-06	40 μm grain next to TiO_2. Two analysis taken on this grain (19-A01-05 and 19-A01-06).
SC3B 195-200	19-A01-07	25 μm grain with large lamellae, 2 μm, of REE oxide. Did analysis of non-lamellae region only.
SC3B 195-200	19-A03-01	5 μm rim on TiO_2. The TiO_2 is intergrown with chlorite. This is a grain mount.

Table 4.

Sample	Analysis	Note
Upper Sulphur Gulch		
Q02-15-UO	03-A03-01	Most likely contains some portion of surrounding mineral based on levels of Si and/or Al
Q02-15-UO	03-A03-02	Most likely contains some portion of surrounding mineral based on levels of Si and/or Al
Goat Hill Gulch		
Q02-21	05-A05-01	Most likely contains some portion of surrounding mineral based on levels of Si and/or Al
Straight Creek drill holes		
SC5B 277 Wash	11-A01-01	
SC5B 277 Wash	11-A02-01	
SC5B 277 Wash	11-A06-01	Most likely contains some portion of surrounding mineral based on levels of Si and/or Al
SC5B 277 Wash	11-A08-01	
SC5B 277 Wash	11-A08-02	
Q10-18-02-4A	12-A03-01	
Q10-18-02-4A	12-A03-02	
SC3B 195-200	19-A01-01	

Table 4.

Sample	Analysis	Note
SC3B 195-200	19-A01-02	
SC3B 195-200	19-A01-03	
SC3B 195-200	19-A01-04	
SC3B 195-200	19-A01-05	
SC3B 195-200	19-A01-06	
SC3B 195-200	19-A01-07	
SC3B 195-200	19-A03-01	Most likely contains some portion of surrounding mineral based on levels of Si and/or Al

Table 5. Compilation of electron probe microanalytical data for chlorite, illite, and biotite from Red River mineralized rocks, listed as weight %. “bdl” – below detection limit; “ill” – illite; “musc” – muscovite; “verm” – vermiculite.

Table 5.

Sample	Point #	Weight % F	FeO	Na_2O	K_2O	SiO_2	MnO	MgO	Cl	Al_2O_3	TiO_2	CaO	Total
Molycorp Open Pit													
Q02-19B	01-A02-01	bdl	25.3	bdl	bdl	27.2	3.37	13.8	bdl	18.4	bdl	bdl	88.1
Q02-19B	01-A02-02	0.81	0.92	0.14	9.86	51.9	0.09	2.80	bdl	29.4	0.24	0.05	96.2
Q02-19B	01-A02-03	bdl	25.9	bdl	bdl	27.2	3.18	13.3	bdl	19.1	bdl	0.03	88.7
Q02-19B	01-A02-04	0.75	0.52	0.17	9.94	49.8	bdl	2.03	bdl	31.8	0.14	bdl	95.2
Q02-19B	01-A02-05	0.60	1.23	0.19	10.5	47.2	0.05	1.35	bdl	33.1	0.11	0.04	94.3
Q02-19B	01-A05-01	1.22	32.5	0.07	bdl	30.2	0.64	6.97	bdl	10.8	bdl	2.10	84.5
Q02-19B	01-A05-02	0.61	34.1	0.07	0.03	30.2	0.69	6.36	bdl	10.9	bdl	1.95	84.9
Q02-19B	01-A05-3	1.20	30.7	0.06	0.04	27.0	0.69	5.00	bdl	9.89	bdl	4.33	78.9
Q02-19B	01-A05-4	0.72	32.4	0.05	0.04	29.8	0.67	6.84	bdl	10.6	bdl	2.57	83.6
Q02-19C	04-A01-02	2.33	0.60	0.25	10.3	45.6	0.11	1.46	bdl	33.0	0.45	0.03	94.2
Q02-19C	04-A01-03	1.39	0.82	0.19	9.79	48.5	0.13	1.43	bdl	32.5	0.25	0.04	95.0
Q02-19C	04-A06-01	1.94	1.13	0.31	10.4	47.9	0.19	1.38	bdl	33.1	0.23	bdl	96.6
Q02-19C	04-A06-02	1.58	1.69	0.30	10.3	48.2	0.11	1.15	bdl	32.4	0.19	bdl	95.9
Q02-19C	04-A06-03	1.33	0.88	0.44	10.3	46.7	bdl	0.40	bdl	35.3	0.05	bdl	95.4
Q02-19C	04-A06-04	1.44	0.84	0.44	10.5	46.4	bdl	0.27	bdl	36.1	0.25	bdl	96.2
Q02-19C	04-A07-01	1.94	2.25	0.22	10.3	47.2	0.08	2.16	bdl	30.1	0.28	bdl	94.6
Q02-19C	04-A07-02	1.76	1.07	0.29	10.0	48.4	0.18	1.36	bdl	32.6	0.11	bdl	95.8
Upper Sulphur Gulch scar													
Q02-18	02-A04-01	0.54	1.16	0.35	10.1	45.3	bdl	1.27	bdl	34.3	0.45	0.05	93.5
Q02-18	02-A04-02	bdl	1.09	0.48	10.4	44.6	bdl	1.12	bdl	34.7	0.62	bdl	93.1
Q02-18	02-A07-01	0.42	0.79	0.44	10.3	45.6	bdl	0.62	bdl	35.3	0.42	bdl	93.9
Q02-18	02-A07-02	0.52	0.65	0.47	10.1	45.4	bdl	0.57	bdl	36.1	0.35	bdl	94.1
Q02-18	02-A07-03	bdl	1.70	0.35	10.3	47.0	bdl	1.75	bdl	32.5	0.34	bdl	94.0
Q02-18	02-A07-04	bdl	1.33	0.35	10.3	46.6	bdl	1.83	bdl	32.4	0.33	bdl	93.2
Q02-18	02-A08-01	bdl	0.97	0.27	10.2	46.5	bdl	1.20	bdl	34.2	0.42	bdl	93.8
Q02-18	02-A08-02	0.37	1.20	0.33	10.1	46.2	bdl	1.49	bdl	33.7	0.41	bdl	93.8
Q02-15-UO	03-A02-01	bdl	17.6	bdl	bdl	28.7	0.29	21.4	bdl	19.0	bdl	0.05	87.0
Q02-15-UO	03-A02-02	bdl	23.7	bdl	bdl	27.6	0.29	18.4	bdl	18.4	bdl	0.07	88.5
Q02-15-UO	03-A03-01	bdl	18.5	bdl	0.12	28.7	0.32	20.6	bdl	19.3	bdl	bdl	87.5
Q02-15-UO	03-A03-02	0.55	17.9	bdl	0.03	27.9	0.33	20.5	bdl	19.2	0.67	0.05	87.1
Q02-15-UO	03-A10-01	0.38	16.6	bdl	0.32	28.9	0.23	21.7	bdl	19.3	0.18	bdl	87.6
Q02-15-UO	03-A10-02	0.40	17.4	bdl	0.11	28.9	0.31	21.3	bdl	19.1	0.13	bdl	87.7
Q02-15-UO	03-A10-03	0.43	17.9	bdl	bdl	28.3	0.28	21.4	bdl	19.5	0.05	bdl	87.9
Q02-19C	04-A01-01	2.14	0.70	0.26	10.1	47.1	0.16	1.79	bdl	31.8	0.25	bdl	94.3
Q02-21	05-A10-01	0.67	1.58	0.20	10.1	47.5	0.06	2.34	bdl	30.5	0.21	bdl	93.3
Q02-21	05-A10-02	0.68	1.72	0.21	10.1	48.2	0.05	2.27	bdl	30.4	0.19	bdl	93.7

Table 5.		Weight %											
Sample	**Point #**	**F**	**FeO**	**Na_2O**	**K_2O**	**SiO_2**	**MnO**	**MgO**	**Cl**	**Al_2O_3**	**TiO_2**	**CaO**	**Total**
S Goat Hill scar, Molycorp mine entrance													
Q10-17-02-11a	17-A01-01	bdl	2.73	0.30	9.95	46.3	bdl	2.63	0.01	30.5	0.44	bdl	92.8
Q10-17-02-11a	17-A01-02	bdl	2.58	0.26	9.94	47.0	bdl	2.56	bdl	30.7	0.43	bdl	93.5
Q10-17-02-11a	17-A03-01	2.53	8.46	0.14	8.22	39.5	0.05	17.3	0.16	16.6	1.35	0.05	94.3
Q10-17-02-11a	17-A04-01	0.62	3.73	0.54	9.86	43.6	bdl	3.85	0.16	31.0	0.31	bdl	93.7
Q10-17-02-11a	17-A04-02	2.25	6.57	0.09	8.70	41.5	0.14	15.3	0.15	19.2	1.20	bdl	95.2
Q10-17-02-11a	17-A08-01	0.54	2.83	0.18	10.0	48.7	bdl	3.41	bdl	29.5	0.38	bdl	95.6
Q10-17-02-11a	17-A08-02	bdl	2.64	0.26	10.0	46.8	bdl	2.49	bdl	30.2	0.52	bdl	92.9
Q10-17-02-11a	17-A08-03	2.09	7.46	0.13	9.47	40.7	0.10	18.4	0.13	17.1	1.26	bdl	96.8
Q10-17-02-11a	17-A08-04	2.54	7.56	0.10	8.78	39.5	0.07	16.3	0.15	18.5	1.20	bdl	94.6
Q10-17-02-11a	17-A09-01	2.12	8.25	0.08	8.65	40.1	0.11	16.5	0.13	18.4	1.13	0.03	95.5
Q10-17-02-11a	17-A09-02	2.32	8.39	0.10	9.67	39.3	0.07	17.6	0.16	17.5	1.12	bdl	96.2
Q10-17-02-10b	18-A05-01	bdl	1.54	0.10	9.70	49.8	bdl	2.21	bdl	30.4	0.15	bdl	93.9
Q10-17-02-10b	18-A05-02	0.59	0.80	0.11	9.79	50.9	bdl	2.48	bdl	30.7	0.24	bdl	95.5
Q10-17-02-10b	18-A05-03	bdl	0.95	0.10	9.85	50.5	0.07	2.47	bdl	29.8	0.20	bdl	94.0
Q10-17-02-10b	18-A05-04	bdl	1.88	0.13	9.94	50.3	bdl	2.48	bdl	29.5	0.18	bdl	94.3
Q10-17-02-10b	18-A06-01	0.51	1.76	0.12	9.22	50.9	bdl	2.04	bdl	30.0	0.09	bdl	94.7
Q10-17-02-10b	18-A07-01	0.70	1.52	0.13	9.67	49.2	bdl	2.53	bdl	30.1	0.17	bdl	94.0
Q10-17-02-10b	18-A07-02	bdl	0.97	0.09	9.95	49.9	0.12	2.43	bdl	30.1	0.19	bdl	93.8
Q10-17-02-10b	18-A07-03	0.67	0.99	0.10	9.49	49.0	0.12	2.45	bdl	30.2	0.18	0.04	93.2
La Bobita													
Q10-18-02-06b	06-A04-01	bdl	11.6	0.34	0.05	20.1	0.25	18.1	bdl	13.6	0.29	0.35	64.6
Q10-18-02-06b	06-A05-01	0.25	12.5	bdl	bdl	22.8	0.30	18.3	bdl	13.5	0.06	0.05	67.8
Q10-18-02-06b	06-A05-02	bdl	11.5	0.09	0.19	22.9	0.26	18.8	0.01	12.8	0.07	0.10	66.7
Q10-18-02-06b	06-A05-03	bdl	12.3	bdl	0.31	22.1	0.32	17.1	bdl	13.1	0.11	0.10	65.5
Q10-18-02-06b	06-A06-01	0.44	11.8	0.05	7.53	36.0	0.17	13.9	0.20	12.4	1.02	1.12	84.5
Q10-18-02-06b	06-A06-02	0.43	11.5	0.04	7.48	34.2	0.16	13.6	0.20	13.2	1.15	0.11	82.1
SW Hansen scar													
UL Hansen 9125	07-A01-01	bdl	0.75	0.79	9.43	51.3	0.05	2.40	bdl	29.9	0.06	0.11	94.8
UL Hansen 9125	07-A01-02	0.65	0.42	bdl	bdl	30.6	0.63	31.6	bdl	20.6	bdl	0.05	84.7
UL Hansen 9125	07-A02-01	bdl	0.82	0.12	9.37	51.2	bdl	2.08	bdl	30.7	0.15	0.04	94.5
UL Hansen 9125	07-A02-02	bdl	1.04	0.11	9.81	50.0	bdl	2.31	bdl	30.5	0.09	0.09	93.9
UL Hansen 9125	07-A09-01	0.61	2.55	0.11	8.52	47.2	0.17	5.18	bdl	29.8	0.06	0.10	94.3
UL Hansen 9125	07-A09-02	bdl	0.69	0.05	10.2	49.7	0.06	2.28	bdl	30.6	0.11	0.28	93.9
Straight Creek scar													
Q10-17-02-01B	08-A02-01	bdl	0.58	0.27	9.89	45.9	bdl	1.09	bdl	34.8	0.16	bdl	92.7
Q10-17-02-01B	08-A02-02	bdl	0.52	0.32	9.87	46.5	bdl	0.88	bdl	35.1	0.20	bdl	93.3

Table 5.		Weight %											
Sample	**Point #**	**F**	**FeO**	**Na_2O**	**K_2O**	**SiO_2**	**MnO**	**MgO**	**Cl**	**Al_2O_3**	**TiO_2**	**CaO**	**Total**
Q10-17-02-01B	08-A04-01	bdl	0.52	0.25	9.92	48.4	bdl	1.55	bdl	32.2	1.21	bdl	94.1
Q10-17-02-01B	08-A04-02	bdl	0.42	0.32	10.2	47.1	bdl	1.30	0.02	33.8	1.48	bdl	94.7
Q10-17-02-01B	08-A05-01	bdl	0.52	0.34	10.4	46.8	bdl	0.96	bdl	35.1	0.39	bdl	94.5
Q10-17-02-01B	08-A05-02	bdl	0.32	0.36	9.70	46.3	bdl	0.66	bdl	36.1	0.13	bdl	93.6
Q10-17-02-01B	08-A14-01	bdl	1.36	0.25	9.99	47.9	bdl	1.67	bdl	33.7	0.23	bdl	95.1
Q10-17-02-01B	08-A14-02	0.54	7.86	bdl	bdl	29.8	0.54	28.5	bdl	18.6	bdl	bdl	85.9
Q10-17-02-01B	08-A14-03	bdl	1.47	0.25	9.92	45.6	bdl	2.70	bdl	33.4	0.10	bdl	93.5
Q10-17-02-01B	08-A14-04	bdl	0.71	0.29	9.91	46.5	bdl	1.48	bdl	33.7	0.29	0.03	92.9
Upper Straight	09-A05-01	bdl	1.15	0.19	9.66	48.6	bdl	2.22	bdl	31.0	0.14	bdl	92.9
Upper Straight	09-A05-02	bdl	2.97	0.29	9.67	46.1	bdl	2.87	0.03	30.6	0.27	bdl	92.8
Upper Straight	09-A08-01	0.67	1.54	0.27	10.2	45.6	bdl	2.91	0.01	31.7	0.19	bdl	93.0
Upper Straight	09-A08-02	bdl	0.97	0.28	9.68	46.5	bdl	1.96	bdl	32.5	0.22	bdl	92.1
Upper Straight	09-A09-01	bdl	1.92	0.24	10.2	46.5	bdl	2.43	bdl	30.7	0.13	bdl	92.1
Upper Straight	09-A09-02	bdl	1.74	0.27	10.2	48.5	bdl	2.16	bdl	31.3	0.26	bdl	94.5
Upper Straight	09-A09-03	bdl	1.71	0.32	10.3	46.1	bdl	1.40	bdl	33.8	0.31	bdl	93.9
Upper Straight	09-A10-01	bdl	1.28	0.18	10.1	47.4	bdl	2.29	bdl	32.0	0.26	0.03	93.6
Upper Straight	09-A10-02	bdl	1.23	0.18	10.1	45.3	bdl	2.47	bdl	32.0	0.19	bdl	91.5
Q10-17-02-03	10-A02-01	0.36	1.12	bdl	bdl	32.5	0.40	29.1	bdl	21.9	bdl	0.20	85.7
Q10-17-02-03	10-A02-02	0.75	0.90	bdl	0.77	30.5	0.32	30.2	0.01	22.3	bdl	0.11	86.0
Q10-17-02-03	10-A02-03	0.82	0.82	0.03	1.08	31.7	0.30	27.2	0.01	21.9	bdl	0.42	84.2
Q10-17-02-03	10-A02-04	bdl	0.16	0.45	9.34	45.2	bdl	0.14	bdl	36.9	0.09	0.44	92.6
Q10-17-02-03	10-A02-05	bdl	0.87	0.29	9.96	46.4	bdl	1.69	bdl	33.4	0.41	bdl	93.1
Q10-17-02-03	10-A07-01	bdl	0.60	0.46	10.0	44.9	bdl	0.82	bdl	35.5	0.47	bdl	92.7
Q10-17-02-03	10-A07-02	bdl	0.62	0.39	10.2	45.0	bdl	0.88	bdl	35.7	0.44	bdl	93.3
Q10-17-02-03	10-A07-03	bdl	0.22	0.35	9.75	47.4	bdl	0.64	bdl	36.0	0.12	bdl	94.5
Q10-17-02-03	10-A08-01	0.85	0.83	bdl	bdl	29.9	0.36	32.7	bdl	21.2	bdl	bdl	85.8
Q10-17-02-03	10-A08-02	0.60	0.72	bdl	bdl	30.8	0.30	30.8	0.02	20.8	bdl	bdl	84.0
Q10-17-02-03	10-A08-03	0.92	0.86	bdl	bdl	29.6	0.36	31.3	0.01	20.4	bdl	bdl	83.4
Q10-17-02-03	10-A08-04	0.95	1.01	bdl	bdl	30.2	0.43	31.7	0.02	20.4	bdl	bdl	84.7
Q10-17-02-03	10-A08-05	bdl	0.53	0.42	10.3	44.9	bdl	0.93	bdl	35.2	0.33	bdl	92.6
Q10-17-02-03	10-A08-06	bdl	1.07	0.34	10.1	45.2	bdl	1.01	0.01	33.9	0.50	bdl	92.1
Q10-17-02-03	10-A09-01	bdl	0.62	0.37	10.3	44.7	bdl	1.37	bdl	34.4	0.54	bdl	92.3
Q10-17-02-03	10-A09-02	bdl	0.61	0.34	9.98	46.1	bdl	1.45	0.01	33.7	0.42	bdl	92.6
Q10-17-02-03	10-A09-03	bdl	0.74	0.36	10.1	46.6	bdl	1.38	0.01	33.4	0.54	bdl	93.3
Q10-17-02-03	10-A09-04	bdl	0.63	0.36	10.4	45.4	bdl	0.90	0.01	34.8	0.44	bdl	92.9
Straight Creek drill holes													
SC5B 277 Wash	11-A04-01	bdl	5.21	0.05	10.0	49.3	bdl	2.08	bdl	26.8	bdl	0.13	93.6

Table 5.		Weight %											
Sample	Point #	F	FeO	Na_2O	K_2O	SiO_2	MnO	MgO	Cl	Al_2O_3	TiO_2	CaO	Total
SC5B 277 Wash	11-A04-02	bdl	4.31	0.08	10.2	49.4	bdl	1.96	bdl	26.7	0.06	0.10	92.8
SC5B 277 Wash	11-A04-03	0.29	22.3	bdl	0.03	28.0	0.44	17.0	bdl	19.1	bdl	0.05	87.2
SC5B 277 Wash	11-A04b-01	0.43	3.96	0.03	9.81	49.2	0.07	2.03	bdl	27.3	0.16	0.07	93.1
SC5B 277 Wash	11-A04b-02	bdl	13.0	bdl	0.05	29.2	0.57	23.0	bdl	19.0	bdl	bdl	84.9
SC5B 277 Wash	11-A04b-03	0.37	12.6	bdl	bdl	28.6	0.54	23.1	bdl	19.0	0.07	bdl	84.3
SC5B 277 Wash	11-A04b-04	0.30	13.9	bdl	bdl	29.0	0.52	22.4	bdl	19.0	bdl	0.03	85.2
SC5B 277 Wash	11-A04b-05	bdl	15.4	bdl	bdl	28.2	0.46	21.4	bdl	18.9	0.05	bdl	84.4
SC5B 277 Wash	11-A04b-06	bdl	17.5	bdl	bdl	28.6	0.43	21.2	bdl	19.2	bdl	bdl	87.0
SC5B 277 Wash	11-A12-01	0.26	13.5	bdl	bdl	28.7	0.62	23.2	bdl	19.3	bdl	bdl	85.6
SC5B 277 Wash	11-A12-02	bdl	15.0	bdl	0.02	29.1	0.45	21.7	bdl	19.3	bdl	bdl	85.6
SC5B 277 Wash	11-A13-01	0.29	14.4	bdl	bdl	29.1	0.54	22.8	bdl	19.4	bdl	0.03	86.6
SC5B 277 Wash	11-A13-02	0.33	13.3	bdl	bdl	28.8	0.58	23.3	bdl	19.6	bdl	bdl	85.9
SC5B 277 Wash	11-A13-03	bdl	14.7	bdl	0.04	28.9	0.54	21.6	bdl	19.4	bdl	0.05	85.2
SC3B 195-200	19-A03-01	bdl	8.29	bdl	bdl	29.3	1.45	26.1	bdl	20.2	0.10	0.13	85.7
SC3B 195-200	19-A03-02	0.43	8.37	bdl	bdl	29.8	1.47	26.0	0.01	20.1	0.18	0.10	86.3
SC3B 195-200	19-A03-03	0.46	8.14	bdl	bdl	29.3	1.46	26.3	bdl	20.1	0.08	0.07	86.0
SC3B 195-200	19-A09-01	bdl	0.12	0.22	10.1	46.6	bdl	0.13	bdl	36.9	0.09	bdl	94.2
SC3B 195-200	19-A09-02	bdl	0.09	0.26	9.88	46.5	bdl	0.19	bdl	36.6	0.06	bdl	93.6
SC3B 195-200	19-A09-03	bdl	0.07	0.24	9.88	46.2	bdl	0.17	bdl	36.6	0.08	bdl	93.3
SC3B 195-200	19-A10-01	bdl	0.24	0.15	9.57	49.8	bdl	0.82	bdl	34.3	0.07	0.04	95.0
SC3B 195-200	19-A10-02	bdl	0.10	0.18	9.71	47.8	bdl	0.69	bdl	34.6	0.10	bdl	93.2
SC3B 195-200	19-A10-03	bdl	0.30	0.15	9.56	49.2	bdl	0.79	bdl	33.9	0.10	bdl	94.0
SC3B 195-200	19-A10-04	bdl	0.10	0.18	9.70	47.8	0.04	0.48	bdl	34.8	0.06	0.04	93.2
SC1B 88-95 Wash	20-A03-01	bdl	8.76	bdl	0.15	30.1	1.80	25.5	bdl	20.5	0.05	0.05	87.0
SC1B 88-95 Wash	20-A03-02	0.85	7.38	bdl	0.43	30.7	1.84	25.3	bdl	20.4	0.07	0.06	87.1
SC1B 88-95 Wash	20-A03-03	0.51	1.05	0.12	10.1	49.7	0.04	2.54	bdl	30.1	0.08	0.04	94.2
SC1B 88-95 Wash	20-A04-01	bdl	2.75	0.04	10.1	49.2	0.06	1.70	bdl	29.9	0.08	0.10	94.0
SC1B 88-95 Wash	20-A04-02	0.64	14.9	bdl	bdl	28.8	1.56	21.9	bdl	19.5	bdl	0.05	87.3
SC1B 88-95 Wash	20-A04-03	0.55	14.8	bdl	bdl	28.7	1.52	21.5	bdl	19.7	bdl	0.09	86.8
SE Straight scar													
Q10-18-02-04b	15-A04-01	bdl	1.21	0.10	10.4	46.7	bdl	2.44	0.01	31.5	0.24	bdl	92.6
Q10-18-02-04b	15-A04-02	bdl	1.07	0.12	10.1	47.3	bdl	2.42	0.01	31.3	0.26	bdl	92.5
Q10-18-02-04b	15-A05-01	0.58	0.26	bdl	0.08	31.2	0.81	32.3	bdl	20.8	bdl	bdl	86.1
Q10-18-02-04b	15-A05-02	0.49	0.62	bdl	bdl	31.3	0.82	31.9	bdl	20.9	bdl	0.03	86.0
Q10-18-02-04b	15-A05-03	0.52	0.24	bdl	0.09	30.4	0.68	32.2	bdl	20.8	bdl	bdl	84.9
Q10-18-02-04b	15-A06-01	bdl	0.15	0.22	10.7	47.1	bdl	1.20	bdl	35.2	bdl	bdl	94.5
Q10-18-02-04b	15-A06-02	bdl	0.11	0.24	10.4	47.7	bdl	1.84	0.02	34.3	bdl	bdl	94.6

Table 5.		Weight %											
Sample	Point #	F	FeO	Na_2O	K_2O	SiO_2	MnO	MgO	Cl	Al_2O_3	TiO_2	CaO	Total
June Bug scar													
Q10-15-02-2	13-A04-01	0.32	1.94	0.07	7.06	57.4	bdl	1.53	bdl	23.2	0.10	0.07	91.7
Q10-15-02-2	13-A04-02	0.41	0.93	0.81	7.28	49.0	bdl	1.02	bdl	30.6	0.08	0.03	90.2
Q10-15-02-2	13-A04-03	bdl	1.36	0.58	9.79	44.8	bdl	0.42	bdl	35.3	0.44	bdl	92.7
Q10-15-02-2	13-A06-01	bdl	0.13	1.46	7.28	45.7	bdl	0.22	bdl	36.2	0.06	bdl	91.1
Q10-15-02-2	13-A06-02	bdl	0.11	1.27	7.60	46.8	bdl	0.24	bdl	35.7	0.17	bdl	91.9
Q10-15-02-2	13-A07-01	0.37	0.71	0.15	7.91	51.1	bdl	1.66	bdl	30.7	0.07	0.09	92.8
Q10-15-02-2	13-A07-02	bdl	2.64	0.13	7.19	54.9	bdl	1.43	bdl	24.5	0.08	0.06	91.0
Hottentot scar													
Q10-16-02-5	14-A02-01	bdl	0.38	bdl	0.33	45.8	bdl	0.18	0.01	37.3	bdl	0.05	84.1
Q10-16-02-5	14-A02-02	0.32	0.40	bdl	0.76	45.1	bdl	0.37	0.02	36.2	bdl	0.15	83.3
Q10-16-02-5	14-A02-03	bdl	0.77	0.03	3.74	46.2	bdl	0.93	0.03	33.5	bdl	0.10	85.3
Q10-16-02-5	14-A03-01	0.37	0.45	0.03	1.36	48.4	bdl	0.47	bdl	36.8	bdl	0.08	87.9
Q10-16-02-5	14-A04-01	bdl	1.63	0.29	10.4	45.2	bdl	1.07	bdl	34.2	0.60	bdl	93.3
Q10-16-02-5	14-A04-02	bdl	1.28	0.15	9.42	48.6	0.06	2.07	bdl	31.8	0.15	0.05	93.5
Q10-16-02-5	14-A04-03	bdl	1.94	0.10	9.58	48.1	0.07	2.84	0.01	30.1	0.17	bdl	93.0
Ranger Station scar													
Q10-18-02-07	16-A04-01	0.69	0.82	0.59	8.64	47.9	bdl	0.30	bdl	35.2	bdl	bdl	94.2
Q10-18-02-07	16-A04-02	0.54	0.78	0.58	8.86	48.8	bdl	0.21	bdl	36.1	bdl	bdl	95.8
Q10-18-02-07	16-A04-03	bdl	0.76	0.58	8.45	48.4	bdl	0.19	bdl	35.5	0.05	bdl	93.9
Q10-18-02-07	16-A05-01	bdl	1.05	0.69	8.63	47.2	bdl	0.23	bdl	35.9	bdl	0.04	93.8
Q10-18-02-07	16-A05-02	bdl	0.78	0.64	8.66	46.7	bdl	0.22	bdl	35.6	bdl	0.03	92.6

Table 5.

Sample	Point #	Mineral	Description
Molycorp Open Pit			
Q02-19B	01-A02-01	chlorite	Mn-rich chlorite and illite on edge of vein with quartz, illite, pyrite
Q02-19B	01-A02-02	ill/musc	Mn-rich chlorite and illite on edge of vein with quartz, illite, pyrite
Q02-19B	01-A02-03	chlorite	Mn-rich chlorite and illite on edge of vein with quartz, illite, pyrite
Q02-19B	01-A02-04	ill/musc	Mn-rich chlorite and illite on edge of vein with quartz, illite, pyrite
Q02-19B	01-A02-05	ill/musc	Mn-rich chlorite and illite on edge of vein with quartz, illite, pyrite
Q02-19B	01-A05-01	chlorite	"feathers" interstitial to carbonate
Q02-19B	01-A05-02	chlorite	"feathers" interstitial to carbonate
Q02-19B	01-A05-3	chlorite	"feathers" interstitial to carbonate
Q02-19B	01-A05-4	chlorite	"feathers" interstitial to carbonate
Q02-19C	04-A01-02	ill/musc	illite on edge of fluorite
Q02-19C	04-A01-03	ill/musc	illite on edge of fluorite
Q02-19C	04-A06-01	ill/musc	large patch of illite in groundmass
Q02-19C	04-A06-02	ill/musc	large patch of illite in groundmass
Q02-19C	04-A06-03	ill/musc	large patch of illite in groundmass
Q02-19C	04-A06-04	ill/musc	large patch of illite in groundmass
Q02-19C	04-A07-01	ill/musc	large patch of illite in groundmass
Q02-19C	04-A07-02	ill/musc	large patch of illite in groundmass
Upper Sulphur Gulch scar			
Q02-18	02-A04-01	ill/musc	illite interstitial to pyrite
Q02-18	02-A04-02	ill/musc	illite interstitial to pyrite
Q02-18	02-A07-01	ill/musc	illite vein with pyrite and moly
Q02-18	02-A07-02	ill/musc	illite vein with pyrite and moly
Q02-18	02-A07-03	ill/musc	illite in groundmass next to vein of above
Q02-18	02-A07-04	ill/musc	illite in groundmass next to vein of above
Q02-18	02-A08-01	ill/musc	?
Q02-18	02-A08-02	ill/musc	?
Q02-15-UO	03-A02-01	chlorite	chlorite on edge of pyrite vein
Q02-15-UO	03-A02-02	chlorite	chlorite on edge of pyrite vein
Q02-15-UO	03-A03-01	chlorite	chlorite replacing mineral in groundmass
Q02-15-UO	03-A03-02	chlorite	chlorite, TiO2, epidote, replacing mineral in groundmass
Q02-15-UO	03-A10-01	chlorite	chlorite, barite, pyrite replacing mineral in groundmass
Q02-15-UO	03-A10-02	chlorite	chlorite, barite, pyrite replacing mineral in groundmass
Q02-15-UO	03-A10-03	chlorite	chl,orite, barite, pyrite replacing mineral in groundmass
Q02-19C	04-A01-01	ill/musc	illite on edge of fluorite
Q02-21	05-A10-01	ill/musc	albite, pyrite, illite patch in groundmass
Q02-21	05-A10-02	ill/musc	albite, pyrite, illite patch in groundmass

Table 5.

Sample	Point #	Mineral	Description
S Goat Hill scar, Molycorp mine entrance			
Q10-17-02-11a	17-A01-01	ill/musc	illite surrounding pyrite
Q10-17-02-11a	17-A01-02	ill/musc	illite surrounding pyrite
Q10-17-02-11a	17-A03-01	biotite	biotite on edge of pyrite
Q10-17-02-11a	17-A04-01	ill/musc	illite in pyrite
Q10-17-02-11a	17-A04-02	biotite	biotite lath in groundmass
Q10-17-02-11a	17-A08-01	ill/musc	illite fine-grained groundmass
Q10-17-02-11a	17-A08-02	ill/musc	illite fine-grained groundmass
Q10-17-02-11a	17-A08-03	biotite	biotite laths adjaceng to above
Q10-17-02-11a	17-A08-04	biotite	biotite laths adjaceng to above
Q10-17-02-11a	17-A09-01	biotite	biotite grain
Q10-17-02-11a	17-A09-02	biotite	biotite grain
Q10-17-02-10b	18-A05-01	ill/musc	illite groundmass near pyrite
Q10-17-02-10b	18-A05-02	ill/musc	illite groundmass near pyrite
Q10-17-02-10b	18-A05-03	ill/musc	illite groundmass near pyrite
Q10-17-02-10b	18-A05-04	ill/musc	illite groundmass near pyrite
Q10-17-02-10b	18-A06-01	ill/musc	illite in quartz
Q10-17-02-10b	18-A07-01	ill/musc	illite groundmass near pyrite
Q10-17-02-10b	18-A07-02	ill/musc	illite groundmass near pyrite
Q10-17-02-10b	18-A07-03	ill/musc	illite groundmass near pyrite
La Bobita			
Q10-18-02-06b	06-A04-01	chlorite/verm?	chlorite with pyroxene?, albite, epidote, and ilmenite
Q10-18-02-06b	06-A05-01	chlorite/verm?	vermiculite? With albite, iron oxide, and apatite
Q10-18-02-06b	06-A05-02	chlorite/verm?	vermiculite? With albite, iron oxide and apatite
Q10-18-02-06b	06-A05-03	chlorite/verm?	vermiculite? With albite, iron oxide and apatite
Q10-18-02-06b	06-A06-01	ill/musc	illite interstitial to albite, sphene and iron oxide
Q10-18-02-06b	06-A06-02	ill/musc	illite interstitial to albite, sphene and iron oxide
SW Hansen scar			
UL Hansen 9125	07-A01-01	ill/musc	chlorite and illite with albite, TiO2, calcite and epidote
UL Hansen 9125	07-A01-02	chlorite	chlorite and illite with albite, TiO2, calcite and epidote
UL Hansen 9125	07-A02-01	ill/musc	illite surrounding pyrite with apatite
UL Hansen 9125	07-A02-02	ill/musc	illite surrounding pyrite with apatite
UL Hansen 9125	07-A09-01	ill/musc	illite, calcite, TiO2, iron oxide replacing mineral in groundmass
UL Hansen 9125	07-A09-02	ill/musc	illite, calcite, TiO2, iron oxide replacing mineral in groundmass
Straight Creek scar			
Q10-17-02-01B	08-A02-01	ill/musc	?
Q10-17-02-01B	08-A02-02	ill/musc	?

Table 5.

Sample	Point #	Mineral	Description
Q10-17-02-01B	08-A04-01	ill/musc	illite, apatite, and TiO2 replacing mineral. Qtz and pyrite present as well
Q10-17-02-01B	08-A04-02	ill/musc	illite, apatite, and TiO2 replacing mineral. Qtz and pyrite present as well
Q10-17-02-01B	08-A05-01	ill/musc	illite surrounding pyrite
Q10-17-02-01B	08-A05-02	ill/musc	illite surrounding pyrite
Q10-17-02-01B	08-A14-01	ill/musc	illite near edge of rock with gypsum
Q10-17-02-01B	08-A14-02	chlorite	illite near edge of rock with gypsum
Q10-17-02-01B	08-A14-03	ill/musc	illite near edge of rock with gypsum
Q10-17-02-01B	08-A14-04	ill/musc	illite near edge of rock with gypsum
Upper Straight	09-A05-01	ill/musc	illite on edge of pyrite vein
Upper Straight	09-A05-02	ill/musc	illite on edge of pyrite vein
Upper Straight	09-A08-01	ill/musc	illite surrounding pyrite with albite and quartz
Upper Straight	09-A08-02	ill/musc	illite surrounding pyrite with albite and quartz
Upper Straight	09-A09-01	ill/musc	illite replacing mineral
Upper Straight	09-A09-02	ill/musc	illite replacing mineral
Upper Straight	09-A09-03	ill/musc	illite replacing mineral
Upper Straight	09-A10-01	ill/musc	brown illite patch with quartz and pyrite in groundmass
Upper Straight	09-A10-02	ill/musc	brown illite patch with quartz and pyrite in groundmass
Q10-17-02-03	10-A02-01	chlorite	chlorite vein
Q10-17-02-03	10-A02-02	chlorite	chlorite vein
Q10-17-02-03	10-A02-03	chlorite	chlorite vein
Q10-17-02-03	10-A02-04	ill/musc	illite in groundmass next to vein of above
Q10-17-02-03	10-A02-05	ill/musc	illite in groundmass next to vein of above
Q10-17-02-03	10-A07-01	ill/musc	illite replacing mineral
Q10-17-02-03	10-A07-02	ill/musc	illite replacing mineral
Q10-17-02-03	10-A07-03	ill/musc	illite replacing mineral
Q10-17-02-03	10-A08-01	chlorite	chlorite in fracture near pyrite vein
Q10-17-02-03	10-A08-02	chlorite	chlorite in fracture near pyrite vein
Q10-17-02-03	10-A08-03	chlorite	chlorite in fracture near pyrite vein
Q10-17-02-03	10-A08-04	chlorite	chlorite in fracture near pyrite vein
Q10-17-02-03	10-A08-05	ill/musc	illite in groundmass next to vein of above
Q10-17-02-03	10-A08-06	ill/musc	illite in groundmass next to vein of above
Q10-17-02-03	10-A09-01	ill/musc	illite replacing mineral
Q10-17-02-03	10-A09-02	ill/musc	illite replacing mineral
Q10-17-02-03	10-A09-03	ill/musc	illite replacing mineral
Q10-17-02-03	10-A09-04	ill/musc	illite replacing mineral
Straight Creek drill holes			
SC5B 277 Wash	11-A04-01	ill/musc	illite fan intergrown with iron oxide

Table 5.

Sample	Point #	Mineral	Description
SC5B 277 Wash	11-A04-02	ill/musc	illite fan intergrown with iron oxide
SC5B 277 Wash	11-A04-03	chlorite	chlorite near above
SC5B 277 Wash	11-A04b-01	ill/musc	chlorite, illite, iron oxide replacing mineral
SC5B 277 Wash	11-A04b-02	chlorite	chlorite, illite, iron oxide replacing mineral
SC5B 277 Wash	11-A04b-03	chlorite	chlorite, illite, iron oxide replacing mineral
SC5B 277 Wash	11-A04b-04	chlorite	chlorite, illite, iron oxide replacing mineral
SC5B 277 Wash	11-A04b-05	chlorite	chlorite, illite, iron oxide replacing mineral
SC5B 277 Wash	11-A04b-06	chlorite	chlorite, illite, iron oxide replacing mineral
SC5B 277 Wash	11-A12-01	chlorite	chlorite, apatite, TiO2 patch
SC5B 277 Wash	11-A12-02	chlorite	chlorite, apatite, TiO2 patch
SC5B 277 Wash	11-A13-01	chlorite	chlorite, apatite, TiO2 patch replacing mineral
SC5B 277 Wash	11-A13-02	chlorite	chlorite, apatite, TiO2 patch replacing mineral
SC5B 277 Wash	11-A13-03	chlorite	chlorite, apatite, TiO2 patch replacing mineral
SC3B 195-200	19-A03-01	chlorite	chlorite surrounding TiO2 and synchysite
SC3B 195-200	19-A03-02	chlorite	chlorite surrounding TiO2 and synchysite
SC3B 195-200	19-A03-03	chlorite	chlorite surrounding TiO2 and synchysite
SC3B 195-200	19-A09-01	ill/musc	illite patches in quartz
SC3B 195-200	19-A09-02	ill/musc	illite patches in quartz
SC3B 195-200	19-A09-03	ill/musc	illite patches in quartz
SC3B 195-200	19-A10-01	ill/musc	illite patches in quartz
SC3B 195-200	19-A10-02	ill/musc	illite patches in quartz
SC3B 195-200	19-A10-03	ill/musc	illite patches in quartz
SC3B 195-200	19-A10-04	ill/musc	illite patches in quartz
SC1B 88-95 Wash	20-A03-01	chlorite	chlorite near pyrite
SC1B 88-95 Wash	20-A03-02	chlorite	chlorite near pyrite
SC1B 88-95 Wash	20-A03-03	ill/musc	illite in groundmass near chlorite of above
SC1B 88-95 Wash	20-A04-01	ill/musc	interstitial illite to epidote
SC1B 88-95 Wash	20-A04-02	chlorite	chlorite zone between epidote and albite
SC1B 88-95 Wash	20-A04-03	chlorite	chlorite zone between epidote and albite
SE Straight scar			
Q10-18-02-04b	15-A04-01	ill/musc	brown illite patch
Q10-18-02-04b	15-A04-02	ill/musc	interstitial illite in groundmass next to patch
Q10-18-02-04b	15-A05-01	chlorite	chlorite replacing mineral in groundmass
Q10-18-02-04b	15-A05-02	chlorite	chlorite replacing mineral in groundmass
Q10-18-02-04b	15-A05-03	chlorite	chlorite replacing mineral in groundmass
Q10-18-02-04b	15-A06-01	ill/musc	illite patch with gypsum vein present
Q10-18-02-04b	15-A06-02	ill/musc	illite patch with gypsum vein present

Table 5.

Sample	Point #	Mineral	Description
June Bug scar			
Q10-15-02-2	13-A04-01	chlorite	chlorite adjacent to pyrite
Q10-15-02-2	13-A04-02	ill/musc	illite surrounding pyrite
Q10-15-02-2	13-A04-03	ill/musc	illite surrounding pyrite
Q10-15-02-2	13-A06-01	ill/musc	illite patch in quartz rich area
Q10-15-02-2	13-A06-02	ill/musc	illite patch in quartz rich area
Q10-15-02-2	13-A07-01	ill/musc	brown patch surrounding pyrite and barite
Q10-15-02-2	13-A07-02	ill/musc	brown patch surrounding pyrite and barite
Hottentot scar			
Q10-16-02-5	14-A02-01	kaolinite ?	intergrown with chlorite and pyrite
Q10-16-02-5	14-A02-02	kaolinite ?	intergrown with chlorite and pyrite
Q10-16-02-5	14-A02-03	smectite?	intergrown with chlorite and pyrite
Q10-16-02-5	14-A03-01	kaolinite ?	intergrown with chlorite and pyrite
Q10-16-02-5	14-A04-01	ill/musc	illite interstitial to vein pyrite
Q10-16-02-5	14-A04-02	ill/musc	illite interstitial to vein pyrite
Q10-16-02-5	14-A04-03	ill/musc	illite interstitial to vein pyrite
Ranger Station scar			
Q10-18-02-07	16-A04-01	ill/musc	illite and pyrite
Q10-18-02-07	16-A04-02	ill/musc	illite and pyrite
Q10-18-02-07	16-A04-03	ill/musc	illite and pyrite
Q10-18-02-07	16-A05-01	ill/musc	illite and kspar with pyrite
Q10-18-02-07	16-A05-02	ill/musc	illite and kspar with pyrite

Table 6. ICP-AES analytical results for ground unweathered rock samples collected during this study from the various scars, the Molycorp mine site, and USGS drill holes. Also shown in faded gray for comparison are analytical results for samples collected by Smith and others (2006, in press). Results from Smith and others include analyses of composites of samples collected in traverses along: 1) the bases of the different scars, 2) the bases and intermediate levels of major Molycorp mine waste piles, and 3) the base of the hillside near La Bobita picnic ground underlain by weakly propylitized andesites and lesser amounts of weakly altered rhyolite dikes. In addition, the data from Smith and others includes an analysis of a sample of tailings collected from a pipe removed from the Molycorp tailings pipeline. Alteration types are listed in decreasing order of abundance for a given sample. "Qtz" – Quartz; "porph" - porphyry

Table 6.

Sample	Rock type	Alteration type	Al %	Ca %	Fe %	K %	Mg %	Na %	P %
Goat Hill Gulch scar									
Q02-20	Amalia Tuff	QSP	6	0.027	1.9	4.1	0.21	1.1	0.0082
Q02-21	Amalia Tuff	QSP	5.8	0.0098	0.29	4.4	0.22	0.083	<0.005
Q02-5 blk	Amalia Tuff	QSP - QS	8.4	2.7	4.4	3.3	2.8	2	0.19
Q02-5 blch	Amalia Tuff	QSP - QS	8	0.41	3.6	4	1.4	2.8	0.16
Q02-1	Andesite	Prop - QSP	7.7	1.5	3.1	3	1.7	2.7	0.16
Scar composite			5.7	0.14	4.7	3.6	0.38	0.38	0.099
Upper Sulphur Gulch scar									
Q02-15-UO	Rhyolite	Prop - QSP	8.1	0.92	3.8	2.8	1.3	2.3	0.16
Q02-15-O	Rhyolite	Prop - QSP	8	0.73	4.2	2.8	1.8	1.7	0.16
Q02-14	Andesite	QSP- Prop	8.2	0.92	3	1.9	1.3	3.8	0.11
Scar composite			6.7	0.82	5.6	2.9	1.0	0.84	0.16
Upper Molycorp Open Pit									
Q02-10 Amalia	Amalia	QSP	6.3	0.089	1.4	4.7	0.12	1.6	0.009
Q02-8	Andesite	QSP - Prop	8.2	1.4	2.7	3.6	0.9	3.1	0.1
Q02-7	Andesite	QSP - Prop	8.1	1.2	2.7	3.6	0.99	2.9	0.11
Hansen									
Q10-01-3-2	Unknown	QSP-Argillic?	8.4	0.46	3.3	3.2	1.9	0.097	0.13
Q10-01-3-1	Unknown	QSP-Argillic?	8.7	0.44	3.1	2.5	1.5	1.6	0.13
Acar composite			6.3	0.62	3.4	3	0.58	0.41	0.11
SW Hansen									
Q10-01-2 A buff	Andesite?	QSP-Prop	7.9	0.063	0.32	2.1	0.96	1.5	0.037
Q10-01-2 B grey	Andesite?	QSP-Prop	8.3	2.3	3.1	3.2	1.2	2.9	0.12
Scar composite			6.4	0.93	5.1	2.7	1.3	0.88	0.19
Straight Creek									
Q10-01-TOPSTRT	Andesite	QSP - Prop	6.1	0.0076	0.3	2.4	0.1	0.019	<0.005
Q10-01-1 Upper Straight	Andesite	QSP - Prop	7.1	0.53	4.2	2.6	0.77	1.2	0.098
Q10-17-02-1-A	Andesite	QSP - Prop	8.8	0.61	4.4	2.3	3	1.2	0.16
Q10-17-02-1-B	Andesite	QSP - Prop	7.9	2.6	4.2	2.9	1.6	0.61	0.19
Q10-17-02-1-C	Andesite	QSP - Prop	8.1	1	4.2	2	2.2	1.3	0.16
Q10-17-02-1-D	Andesite	QSP - Prop	7.8	1.7	3.2	2.2	2.2	1.1	0.16
Q10-17-02-1-E	Andesite	QSP - Prop	7.7	1.4	4.1	2.4	1.8	1	0.13
Q10-17-02-2 Straight	Andesite	QSP - Prop	6.7	0.035	0.49	3.2	0.42	0.036	0.0081
Q10-17-02-7 Straight	Andesite	QSP - Prop	8.2	0.36	2.9	3.8	0.94	2.7	0.11
Q10-17-02-3 Straight	Andesite	QSP - Prop	7	0.68	2.2	3.3	0.62	0.092	0.075
Q10-17-02-4 Straight porph	Qtz latite porph?	QSP - Prop	8.5	2.5	3.3	3.6	1.5	2.1	0.13
Q10-17-02-5	Andesite	QSP - Prop	8.4	0.23	2.8	3.6	2.2	0.074	0.11

Table 6.

Sample	Rock type	Alteration type	Al %	Ca %	Fe %	K %	Mg %	Na %	P %
Q10-17-02-6 Straight	Andesite	QSP - Prop	8.6	0.31	3.2	3	3.1	0.66	0.13
Q10-18-02-5	Andesite	QSP - Prop	8.4	0.7	3.7	2	2.4	2.8	0.18
Scar composite			6.1	0.57	3.6	2.8	0.96	0.49	0.12
Straight Creek drill holes									
SC5B 170-175	Qtz latite porph	Prop - QSP	7.1	0.17	2.9	3.2	0.4	0.087	0.052
SC5B 255-260	Qtz latite porph	Prop - QSP	6.6	0.22	2.1	3	0.48	0.98	0.051
SC5B 275	Qtz latite porph	Prop - QSP	7	0.022	1.2	3.4	0.33	0.088	0.015
SC5B 277	Qtz latite porph	Prop - QSP	7.4	1.5	2.2	3.8	1.2	1.5	0.11
SC5B 280 odex	Qtz latite porph	Prop - QSP	8.1	1.5	2.6	3.9	1.3	2.8	0.13
SC5B 293	Qtz latite porph	Prop - QSP	7.9	1.7	2.7	3.6	1.2	2.1	0.13
SC5B 320	Qtz latite porph	QSP -Prop	7.9	2.2	2.7	3.1	1.2	2.4	0.12
SC5B 350-355	Qtz latite porph	QSP -Prop	8	1.9	2.7	2.9	1.4	2.6	0.13
SC5B 390	Qtz latite porph	QSP > Prop	7.6	0.5	2	1.9	1.4	2.6	0.083
SC3B 180-185	Andesite	QSP > Prop	7	0.22	1.3	3	0.37	0.22	0.026
SC3B 195-200	Andesite	QSP > Prop	6.5	0.4	1.6	3.1	0.6	0.18	0.052
SE Straight									
Q10-18-02-3	Andesite ?	QSP - Prop	6.2	0.048	1.6	3.3	0.54	0.1	0.039
Q10-18-02-4 B	Rhyolite porph	QSP > Prop	6	0.11	1.3	3.5	0.62	0.056	0.026
Scar composite			6.4	0.53	4.4	2.9	1	0.79	0.17
June Bug									
Q10-15-02-1 A3	Qtz latite porph	QSP- Prop	7.6	0.78	2.7	3	1.4	0.23	0.24
Scar composite			6.9	0.56	5	3.3	1.1	0.52	0.19
Hottentot									
Q10-16-02-5	Andesite ?	QSP > Prop	7.4	0.028	2.3	2.7	0.6	0.056	0.098
Q10-16-02-4 QSP Amalia	Amalia Tuff	QSP	6.6	0.0092	0.61	3	0.071	0.12	0.013
Scar composite			6.5	0.05	3.3	3.3	0.58	0.19	0.16
Mine Waste-Rock Pile Composites									
Capulin			6.8	0.41	2.9	3.2	0.51	0.92	0.055
Sugar Shack West			6.9	0.39	2.3	3.4	0.42	0.73	0.046
Old Sulphur Gulch			7.1	2.1	3.6	3.3	1.3	1.3	0.15
Sugar Shack Middle			6.9	1.9	4.3	2.8	1.5	1.4	0.16
Sugar Shack South			7.4	2.3	4.2	3.2	1.3	1.4	0.16
Other composites									
La Bobita composite			6.4	0.69	3.5	3.2	0.91	0.81	0.12
Molycorp Tailings			5.0	0.90	3.9	4.0	0.38	1.7	0.049

Table 6.

Sample	Ti %	Ag ppm	As ppm	Au ppm	Ba ppm	Be ppm	Bi ppm	Cd ppm	Ce ppm	Co ppm	Cr ppm
Goat Hill Gulch scar											
Q02-20	0.079	<2	<10	<8	135	2	<10	<2	94	3.7	1
Q02-21	0.097	<2	<10	<8	194	2	<10	<2	42	<1	1.3
Q02-5 blk	0.61	<2	<10	<8	1170	2.7	<10	<2	79	22	146
Q02-5 blch	0.3	<2	13	<8	2380	1.2	<10	<2	46	20	141
Q02-1	0.29	<2	<10	<8	1200	1.9	<10	<2	76	17	89
Scar composite	0.12	2.0	14	< 8	435	2.9	< 10	< 2	89	6.7	23
Upper Sulphur Gulch scar											
Q02-15-UO	0.24	<2	<10	<8	1250	2.6	<10	<2	51	18	66
Q02-15-O	0.41	<2	<10	<8	1120	2.7	<10	<2	54	17	115
Q02-14	0.21	<2	<10	<8	879	2.5	<10	<2	35	8.6	74
Scar composite	0.19	< 2	< 10	< 8	258	2.2	< 10	< 2	79	12	83
Upper Molycorp Open Pit											
Q02-10 Amalia	0.064	<2	<10	<8	151	2.5	<10	<2	97	2.8	3
Q02-8	0.24	<2	<10	<8	1410	2.1	<10	<2	63	8.1	41
Q02-7	0.24	<2	10	<8	1450	2.1	<10	<2	64	11	38
Hansen											
Q10-01-3-2	0.3	<2	<10	<8	836	2.7	<10	<2	67	15	42
Q10-01-3-1	0.24	<2	<10	<8	574	2.3	<10	<2	66	16	40
Acar composite	0.23	< 2	< 10	< 8	396	2.5	< 10	< 2	82	10	50
SW Hansen											
Q10-01-2 A buff	0.12	<2	<10	<8	769	2.1	<10	<2	67	1.5	19
Q10-01-2 B grey	0.29	<2	<10	<8	1350	1.6	<10	<2	62	12	44
Scar composite	0.15	< 2	15	< 8	226	1.6	< 10	< 2	62	9	74
Straight Creek											
Q10-01-TOPSTRT	0.078	<2	<10	<8	16	2.6	<10	<2	35	<1	1.9
Q10-01-1 Upper Straight	0.082	<2	<10	<8	794	1.6	<10	<2	32	22	22
Q10-17-02-1-A	0.3	<2	<10	<8	1030	2.3	<10	<2	55	19	151
Q10-17-02-1-B	0.18	<2	<10	<8	901	2.2	<10	<2	52	15	109
Q10-17-02-1-C	0.24	<2	<10	<8	1300	1.9	<10	<2	34	17	94
Q10-17-02-1-D	0.15	<2	<10	<8	860	1.9	<10	<2	58	8.7	110
Q10-17-02-1-E	0.19	<2	<10	<8	1230	1.6	<10	<2	63	7.4	116
Q10-17-02-2 Straight	0.04	<2	<10	<8	211	3.3	<10	<2	36	1.8	<1
Q10-17-02-7 Straight	0.16	<2	<10	<8	891	1.8	<10	<2	23	15	34
Q10-17-02-3 Straight	0.12	<2	<10	<8	619	2.4	<10	<2	47	10	28
Q10-17-02-4 Straight porph	0.3	<2	13	<8	1350	1.8	<10	3.5	74	16	37
Q10-17-02-5	0.12	<2	12	<8	907	2.6	<10	<2	77	16	57

Table 6.

Sample	Ti %	Ag ppm	As ppm	Au ppm	Ba ppm	Be ppm	Bi ppm	Cd ppm	Ce ppm	Co ppm	Cr ppm
Q10-17-02-6 Straight	0.23	<2	<10	<8	1490	2.6	<10	<2	48	14	51
Q10-18-02-5	0.4	<2	<10	<8	616	2.4	<10	<2	52	14	91
Scar composite	0.12	< 2	< 10	< 8	336	1.9	< 10	< 2	56	7	58
Straight Creek drill holes											
SC5B 170-175	0.2	<2	<10	<8	378	2	<10	<2	57	15	42
SC5B 255-260	0.15	<2	<10	<8	892	1.8	<10	<2	38	3.5	39
SC5B 275	0.084	<2	<10	<8	654	1.9	<10	<2	31	3.8	5.1
SC5B 277	0.14	<2	<10	<8	1340	1.9	<10	<2	59	11	31
SC5B 280 odex	0.29	<2	<10	<8	1450	1.6	<10	<2	64	14	35
SC5B 293	0.26	<2	12	<8	1850	1.8	<10	<2	60	13	37
SC5B 320	0.18	<2	13	<8	1460	1.5	<10	<2	66	15	30
SC5B 350-355	0.21	<2	<10	<8	1290	2.1	<10	<2	66	13	38
SC5B 390	0.15	<2	<10	<8	533	1.7	<10	<2	39	7.4	36
SC3B 180-185	0.053	<2	<10	<8	722	2.1	<10	<2	56	4.8	7.8
SC3B 195-200	0.11	<2	<10	<8	727	2.4	<10	<2	55	6.5	15
SE Straight											
Q10-18-02-3	0.1	<2	<10	<8	708	2.2	<10	<2	15	2.7	262
Q10-18-02-4 B	0.067	<2	<10	<8	555	2	<10	<2	12	4.2	7
Scar composite	0.15	< 2	< 10	< 8	419	1.5	< 10	< 2	63	7.1	54
June Bug											
Q10-15-02-1 A3	0.16	<2	<10	<8	2740	2.8	<10	<2	32	8.6	67
Scar composite	0.13	< 2	< 10	< 8	585	2.6	< 10	< 2	48	15	61
Hottentot											
Q10-16-02-5	0.042	2.3	<10	<8	768	2.1	<10	<2	62	9	8.3
Q10-16-02-4 QSP Amalia	0.07	<2	<10	<8	65	<1	<10	<2	7.2	2.3	<1
Scar composite	0.11	< 2	12	< 8	699	2.0	< 10	< 2	63	5	38
Mine Waste-Rock Pile Composites											
Capulin	0.16	< 2	< 10	< 8	447	2.5	< 10	< 2	98	6.4	29
Sugar Shack West	0.12	< 2	< 10	< 8	397	2.4	< 10	< 2	52	4.2	32
Old Sulphur Gulch	0.25	< 2	< 10	< 8	680	3.6	< 10	< 2	85	14	87
Sugar Shack Middle	0.23	< 2	< 10	< 8	684	3.2	< 10	< 2	87	17	100
Sugar Shack South	0.22	< 2	< 10	< 8	704	3.2	< 10	< 2	67	15	92
Other composites											
La Bobita composite	0.31	< 2	< 10	< 8	1050	3.1	< 10	< 2	88	18	72
Molycorp Tailings	0.096	3.3	< 10	< 8	381	3.7	< 10	< 2	68	20	38

Table 6.

Sample	Cu ppm	Eu ppm	Ga ppm	Ho ppm	La ppm	Li ppm	Mn ppm	Mo ppm	Nb ppm	Nd ppm	Ni ppm
Goat Hill Gulch scar											
Q02-20	15	<2	34	<4	45	18	160	5.3	44	46	4.5
Q02-21	3.6	<2	30	<4	21	10	219	3.5	51	18	<2
Q02-5 blk	6.5	<2	14	<4	41	68	1430	2.8	21	37	72
Q02-5 blch	2	<2	9.6	<4	24	36	804	7.8	20	24	67
Q02-1	30	<2	12	<4	42	22	927	2.1	19	36	48
Scar composite	62	< 2	22	< 4	50	18	261	27	15	33	8
Upper Sulphur Gulch scar											
Q02-15-UO	66	<2	14	<4	29	30	290	4	20	24	41
Q02-15-O	92	<2	18	<4	28	39	664	10	22	26	58
Q02-14	34	<2	15	<4	20	26	104	2.9	21	17	26
Scar composite	100	< 2	21	< 4	42	28	408	12	11	36	29
Upper Molycorp Open Pit											
Q02-10 Amalia	5	<2	32	<4	47	8.2	124	3.6	40	46	4.2
Q02-8	169	<2	17	<4	36	26	270	2.2	24	28	26
Q02-7	84	<2	14	<4	37	28	332	3.3	21	28	26
Hansen											
Q10-01-3-2	46	<2	12	<4	36	30	1750	6	18	30	26
Q10-01-3-1	36	<2	12	<4	35	19	864	2.8	17	32	29
Acar composite	22	< 2	23	< 4	39	21	299	4.8	19	36	22
SW Hansen											
Q10-01-2 A buff	2.5	<2	19	<4	36	32	94	6.3	21	28	2.9
Q10-01-2 B grey	38	<2	15	<4	35	14	689	<2	22	29	24
Scar composite	25	< 2	18	< 4	34	21	417	9.7	11	28	18
Straight Creek											
Q10-01-TOPSTRT	1.1	<2	34	<4	21	10	83	5.1	53	9.8	<2
Q10-01-1 Upper Straight	55	<2	14	<4	18	19	332	35	15	17	32
Q10-17-02-1-A	157	<2	8.4	<4	28	61	1270	11	16	28	70
Q10-17-02-1-B	94	<2	14	<4	28	29	977	14	12	30	46
Q10-17-02-1-C	104	<2	12	<4	19	44	1080	7.4	14	18	54
Q10-17-02-1-D	86	<2	9	<4	32	40	866	7.6	14	29	36
Q10-17-02-1-E	94	<2	10	<4	37	37	478	11	14	28	34
Q10-17-02-2 Straight	6.4	<2	26	<4	19	14	196	11	28	13	<2
Q10-17-02-7 Straight	108	<2	16	<4	13	17	995	4.2	18	11	23
Q10-17-02-3 Straight	80	<2	18	<4	26	24	353	30	17	20	19
Q10-17-02-4 Straight porph	83	<2	15	<4	40	32	949	4.6	22	35	33
Q10-17-02-5	37	<2	13	<4	43	37	524	5.6	19	34	38

Table 6.

Sample	Cu ppm	Eu ppm	Ga ppm	Ho ppm	La ppm	Li ppm	Mn ppm	Mo ppm	Nb ppm	Nd ppm	Ni ppm
Q10-17-02-6 Straight	90	<2	14	<4	26	45	3140	4.8	7.1	21	27
Q10-18-02-5	159	<2	15	<4	28	31	1030	2.4	24	23	73
Scar composite	42	< 2	18	< 4	32	26	373	16	12	22	15
Straight Creek drill holes											
SC5B 170-175	29	<2	21	<4	31	8	316	9	21	25	35
SC5B 255-260	34	<2	18	<4	22	14	171	5	22	16	7
SC5B 275	8	<2	20	<4	17	9.2	34	3.6	25	10	7.6
SC5B 277	41	<2	12	<4	33	26	548	5.3	20	27	26
SC5B 280 odex	41	<2	13	<4	36	21	899	5.9	22	27	30
SC5B 293	18	<2	14	<4	34	21	460	4.8	21	26	28
SC5B 320	17	<2	14	<4	37	21	513	2	21	31	28
SC5B 350-355	32	<2	14	<4	37	22	604	2.8	22	30	26
SC5B 390	24	<2	12	<4	22	17	501	5.8	22	17	15
SC3B 180-185	26	<2	17	<4	32	6.2	378	5	18	20	8
SC3B 195-200	18	<2	19	<4	31	15	702	10	19	21	13
SE Straight											
Q10-18-02-3	11	<2	20	<4	9.2	12	126	14	22	5.1	3.9
Q10-18-02-4 B	16	<2	17	<4	7.1	12	130	4.8	21	5.4	5.4
Scar composite	39	< 2	20	< 4	36	19	441	13	12	26	12
June Bug											
Q10-15-02-1 A3	22	<2	16	<4	17	26	302	4.1	20	16	22
Scar composite	159	< 2	19	< 4	23	24	455	31	12	20	22
Hottentot											
Q10-16-02-5	62	<2	14	<4	33	53	70	28	18	30	10
Q10-16-02-4 QSP Amalia	8.5	<2	27	<4	3.1	8.8	37	2.1	32	<4	2.9
Scar composite	20	< 2	22	< 4	32	19	152	32	15	30	7.4
Mine Waste-Rock Pile Composites											
Capulin	43	< 2	26	< 4	53	18	561	18	40	38	12
Sugar Shack West	31	< 2	23	< 4	30	14	261	12	27	22	8.3
Old Sulphur Gulch	153	< 2	14	< 4	48	38	816	389	10	34	39
Sugar Shack Middle	129	< 2	12	< 4	47	39	751	207	9.9	38	45
Sugar Shack South	143	< 2	13	< 4	37	35	781	338	11	28	41
Other composites											
La Bobita composite	36	< 2	20	< 4	44	19	925	18	16	37	39
Molycorp Tailings	174	< 2	14	< 4	42	13	758	244	11	22	30

Table 6.

Sample	Pb ppm	Sc ppm	Sn ppm	Sr ppm	Ta ppm	Th ppm	U ppm	V ppm	Y ppm	Yb ppm	Zn ppm
Goat Hill Gulch scar											
Q02-20	16	<2	<5	35	<40	7.6	<100	4.7	20	2.5	174
Q02-21	114	<2	5	24	<40	4	<100	4.6	11	1.7	22
Q02-5 blk	12	16	<5	489	<40	5.9	<100	146	20	1.8	203
Q02-5 blch	139	8.1	<5	433	<40	<4	<100	68	11	<1	145
Q02-1	33	8.8	<5	646	<40	6.2	<100	72	16	1.2	153
Scar composite	265	5.5	14	101	< 40	12	< 100	50	5.2	< 1	40
Upper Sulphur Gulch scar											
Q02-15-UO	14	9.3	<5	518	<40	9.6	<100	83	11	1	42
Q02-15-O	29	11	6	376	<40	7.6	<100	99	10	1	74
Q02-14	6.4	11	7.3	464	<40	6.1	<100	85	6.8	<1	18
Scar composite	58	9.7	5.2	311	< 40	6.2	< 100	95	8.2	< 1	55
Upper Molycorp Open Pit											
Q02-10 Amalia	24	<2	<5	66	<40	9.2	<100	6.9	34	4	40
Q02-8	17	8.5	<5	553	<40	13	<100	69	14	1.4	30
Q02-7	14	7.7	5.6	505	<40	16	<100	64	14	1.3	25
Hansen											
Q10-01-3-2	85	9.7	7.5	78	<40	7.9	<100	81	7.7	<1	142
Q10-01-3-1	125	9.8	6.6	202	<40	7	<100	78	7.9	<1	224
Acar composite	44	6.4	< 5	199	< 40	5.8	< 100	65	10	< 1	72
SW Hansen											
Q10-01-2 A buff	47	8.3	<5	327	<40	8	<100	63	5.4	<1	10
Q10-01-2 B grey	25	9.6	<5	749	<40	8.7	<100	77	14	1.4	103
Scar composite	72	8.6	8.1	626	< 40	5.4	< 100	91	6.3	< 1	50
Straight Creek											
Q10-01-TOPSTRT	23	<2	5	5.2	<40	13	<100	3.1	48	5.8	45
Q10-01-1 Upper Straight	110	5.3	<5	83	<40	5.7	<100	51	6	<1	164
Q10-17-02-1-A	36	16	8.2	98	<40	10	<100	125	14	1.5	249
Q10-17-02-1-B	37	12	<5	88	<40	8.6	<100	96	15	1.4	131
Q10-17-02-1-C	54	12	6.1	147	<40	8.7	<100	92	10	1.2	195
Q10-17-02-1-D	136	12	<5	165	<40	8	<100	90	12	1.3	153
Q10-17-02-1-E	64	12	5.6	109	<40	9.4	<100	93	7.3	1	106
Q10-17-02-2 Straight	77	<2	<5	13	<40	11	<100	12	5.5	<1	134
Q10-17-02-7 Straight	117	8.4	<5	435	<40	8.7	<100	58	4.8	<1	163
Q10-17-02-3 Straight	53	6.3	<5	38	<40	11	<100	66	7.9	<1	113
Q10-17-02-4 Straight porph	578	9.2	<5	579	<40	8.4	<100	80	15	1.2	572
Q10-17-02-5	26	8.2	6.3	53	<40	9	<100	76	11	1	95

Table 6.

Sample	Pb ppm	Sc ppm	Sn ppm	Sr ppm	Ta ppm	Th ppm	U ppm	V ppm	Y ppm	Yb ppm	Zn ppm
Q10-17-02-6 Straight	88	11	<5	111	<40	8	<100	86	9.2	1	474
Q10-18-02-5	82	12	7.5	567	<40	9.4	<100	183	9.9	1.3	241
Scar composite	173	6.4	6.9	121	< 40	7.2	< 100	66	7	< 1	84
Straight Creek drill holes											
SC5B 170-175	57	7.2	<5	59	<40	5.3	<100	71	7.4	<1	52
SC5B 255-260	56	6.2	<5	223	<40	8.9	<100	54	7.7	1	33
SC5B 275	11	2.9	<5	43	<40	11	<100	24	3.3	<1	12
SC5B 277	12	6.3	<5	323	<40	10	<100	59	11	1	58
SC5B 280 odex	39	7.3	5	580	<40	8.6	<100	68	11	1	88
SC5B 293	42	7.1	<5	788	<40	8.2	<100	65	10	<1	61
SC5B 320	17	7.6	5.1	670	<40	10	<100	67	11	1.1	57
SC5B 350-355	12	7.5	5.7	625	<40	9.4	<100	72	11	1	68
SC5B 390	34	7.3	5.5	284	<40	7.6	<100	62	8.6	1	72
SC3B 180-185	116	2.8	<5	88	<40	10	<100	22	7.7	1	120
SC3B 195-200	95	4.5	<5	78	<40	9.5	<100	41	8.8	1	87
SE Straight											
Q10-18-02-3	89	15	<5	39	<40	9	<100	79	3.7	<1	31
Q10-18-02-4 B	16	3.5	<5	86	<40	10	<100	26	3.5	<1	11
Scar composite	213	7.4	< 5	228	< 40	7.7	< 100	80	4.9	< 1	65
June Bug											
Q10-15-02-1 A3	51	9.2	<5	184	<40	12	<100	80	5.2	<1	73
Scar composite	190	8.4	< 5	304	< 40	7.4	< 100	85	4.9	< 1	117
Hottentot											
Q10-16-02-5	61	6.7	<5	16	<40	7.2	<100	33	8.4	<1	49
Q10-16-02-4 QSP Amalia	21	<2	13	5.9	<40	<4	<100	4.2	<2	<1	18
Scar composite	141	6.6	< 5	99	< 40	7.4	< 100	71	5.4	< 1	35
Mine Waste-Rock Pile Composites											
Capulin	135	4.9	< 5	142	< 40	13	< 100	44	31	3.7	78
Sugar Shack West	71	5.4	< 5	142	< 40	8.4	< 100	52	17	2.3	35
Old Sulphur Gulch	89	10	5.9	505	< 40	10	< 100	92	16	1.4	114
Sugar Shack Middle	67	12	5	477	< 40	8.5	< 100	103	16	1.3	83
Sugar Shack South	118	10	5	560	< 40	11	< 100	95	14	1.3	124
Other composites											
La Bobita composite	41	8.1	< 5	213	< 40	5.4	< 100	85	12	< 1	104
Molycorp Tailings	539	3.6	< 5	172	< 40	18	< 100	29	11	1.0	286