# *Gold mineralization associated with alkaline intrusives at the Carache Canyon breccia pipe prospect, Ortiz Mountains, New Mexico*

J. Leroy Schutz

1995, pp. 167-173. https://doi.org/10.56577/FFC-46.167

*in:*

*Geology of the Santa Fe Region*, Bauer, P. W.; Kues, B. S.; Dunbar, N. W.; Karlstrom, K. E.; Harrison, B.; [eds.], New Mexico Geological Society 46 th Annual Fall Field Conference Guidebook, 338 p. https://doi.org/10.56577/FFC-46

*This page is intentionally left blank to maintain order of facing pages.*

# GOLD MINERALIZATION ASSOCIATED WITH ALKALINE INTRUSIVES AT THE CARACHE CANYON BRECCIA PIPE PROSPECT, ORTIZ MOUNTAINS, NEW MEXICO

J. LEROY SCHUTZ
Newmont Exploration Ltd., P.O. Box 669, Carlin, NV 89822

**Abstract**—The Carache Canyon hypabyssal breccia pipe developed along the Tijeras–Cañoncito fault system near the eastern Rio Grande rift margin. Upper Cretaceous clastic strata were intruded by several stacked 34 ± 2.2 Ma calc-alkaline sills and subsequently brecciated during early phases of a 28–30 Ma alkaline intrusive event. Breccia fragments collapsed 400–800 ft into the pipe, retaining a well-defined relict stratigraphy. Coinciding with a late alkaline dike swarm, hydrothermal fluids exploited open-spaced fractures and voids preserved in competent sill and sandstone lithologies outside and inside the southwest pipe margin. Early fluids were hot (275–>400°C), saline (25–46 wt% eNaCl), $CO_2$-rich, and apparently of magmatic origin. The fluids deposited quartz, adularia, calcite, sericite, additional gangue, tungsten minerals and base-metal sulfides. Late stage gold-bearing fluids were cooler (160–250°C), less-saline (10.4–12.1 wt% eNaCl), $CO_2$-rich and of meteoric and/or magmatic origin. Late fluids deposited iron sulfides, iron oxides, coarse native gold and carbonate gangue. The Carache Canyon adularia-sericite epithermal system contains a 1,169,000 troy oz gold resource averaging 0.070 oz/short ton. The coarse native gold occurrence and irregular fracture distribution induced a significant nugget effect, providing uncertainty in the average deposit grade. Consequently, a decline was designed to collect statistically accurate bulk samples and evaluate fracture pattern predictability.

## INTRODUCTION

The Ortiz Mountains are an isolated range located along NM–14, midway between Santa Fe and Albuquerque. Placer gold was discovered in 1828, establishing the Old Placers (Ortiz Mountains) district as the first gold mining district west of the Mississippi River. Lode gold was discovered in 1832 at the original Ortiz mine, the center of a 100 mi$^2$ mine grant given to Lieutenant José Francisco Ortiz by the Mexican government. As Spanish and Mexican land and mine grants were honored by the 1848 Treaty of Guadelupe Hidalgo (Townley, 1971), the Ortiz mine grant was later transferred into private ownership where it remains today. Lac Minerals (USA) Inc. currently leases the 22,000-acre western mine grant mineral rights from Ortiz Mines, Inc., of Joplin, Missouri.

There has been no previous gold production from the Carache Canyon prospect. Small-scale prospecting and exploration efforts between 1934 and 1969 proved unsuccessful at encountering significant gold occurrences (Schutz and Nelsen, 1990). Conoco drilled the first seven holes in Carache Canyon between 1973 and 1975 without intersecting the presently defined resource. Lac Minerals leased the western mine grant in 1983 and, during three years of systematic exploration, discovered significant gold mineralization. Continued exploration and delineation drilling between 1986 and 1989 focused on determining geologic resources at Carache Canyon and Lukas Canyon. Lac Minerals eventually published a 1988 Carache Canyon gold resource of 5 million short tons averaging 0.094 oz/st. Pegasus Gold Corporation entered a 50:50 joint venture agreement in 1989. After two years of development drilling and geologic modelling, Pegasus reported a gold resource inside and outside the pipe of 16.7 million short tons averaging 0.070 oz/st.

This paper summarizes results from nine years of combined geologic mapping, geochemical sampling, airborne and ground geophysics, drilling (230 core and reverse circulation drill holes totaling 215,000 ft), metallurgy, hydrology, geotechnical studies, 3-dimensional modelling, open pit and underground engineering and krige resource estimations. Additionally, research by Coles (1990) provided valuable insight on igneous rock classification, alteration, mineralization and hydrothermal fluid chemistry.

## REGIONAL SETTING

Ortiz Mountains gold occurrences are categorized with North American Cordillera precious metal deposits related to alkaline igneous rocks (Mutschler et al., 1985). The Cripple Creek district in southern Colorado eclipses all others in gold production, having recovered in excess of 23 million troy oz. Three of the top ten New Mexican gold mining districts are alkaline-related and characterized as Great Plains Margin deposits (North and McLemore, 1986). Elizabethtown-Baldy is the largest district with 471,000 troy oz past production. Old Placers (Ortiz Mountains) with 350,000 oz and White Oaks (163,000 oz) are third and eighth largest, respectively. Several structural, textural and mineralogical elements of the Carache Canyon prospect are analogous to gold-producing breccia pipes at the Cunningham Hill mine (Kay, 1986; Coles, 1990; Maynard, this volume), the Golden Sunlight mine in southwestern Montana (Foster, 1991) and the Kidston mine in Queensland, Australia (Mustard, 1986). Readers are referred to Maynard (this volume) for a regional geologic summary.

## CARACHE CANYON GEOLOGY

### Sedimentary rocks

Carache Canyon sedimentary rocks consists of Upper Cretaceous clastic units dipping 25°-35°NE (Fig. 1). Resistant sandstone beds form north-

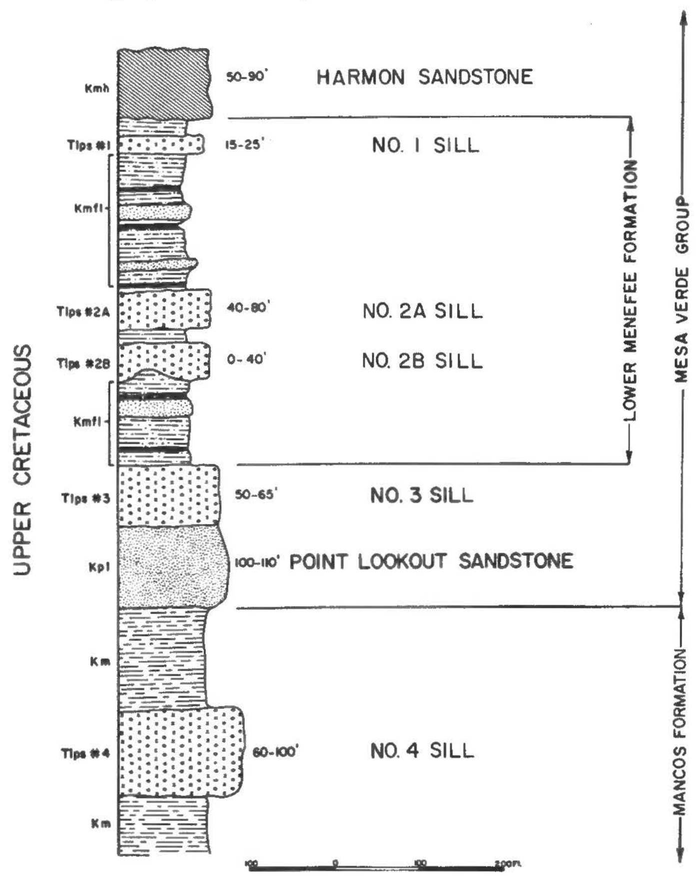



FIGURE 1. Stratigraphic section of the Carache Canyon prospect. Angled hatch and dot patterns represent sandstone; dash-dot pattern represents siltstone; dashes represent shale; thick, dark dashes are coal lenses; x o x pattern represents andesite porphyry sills.

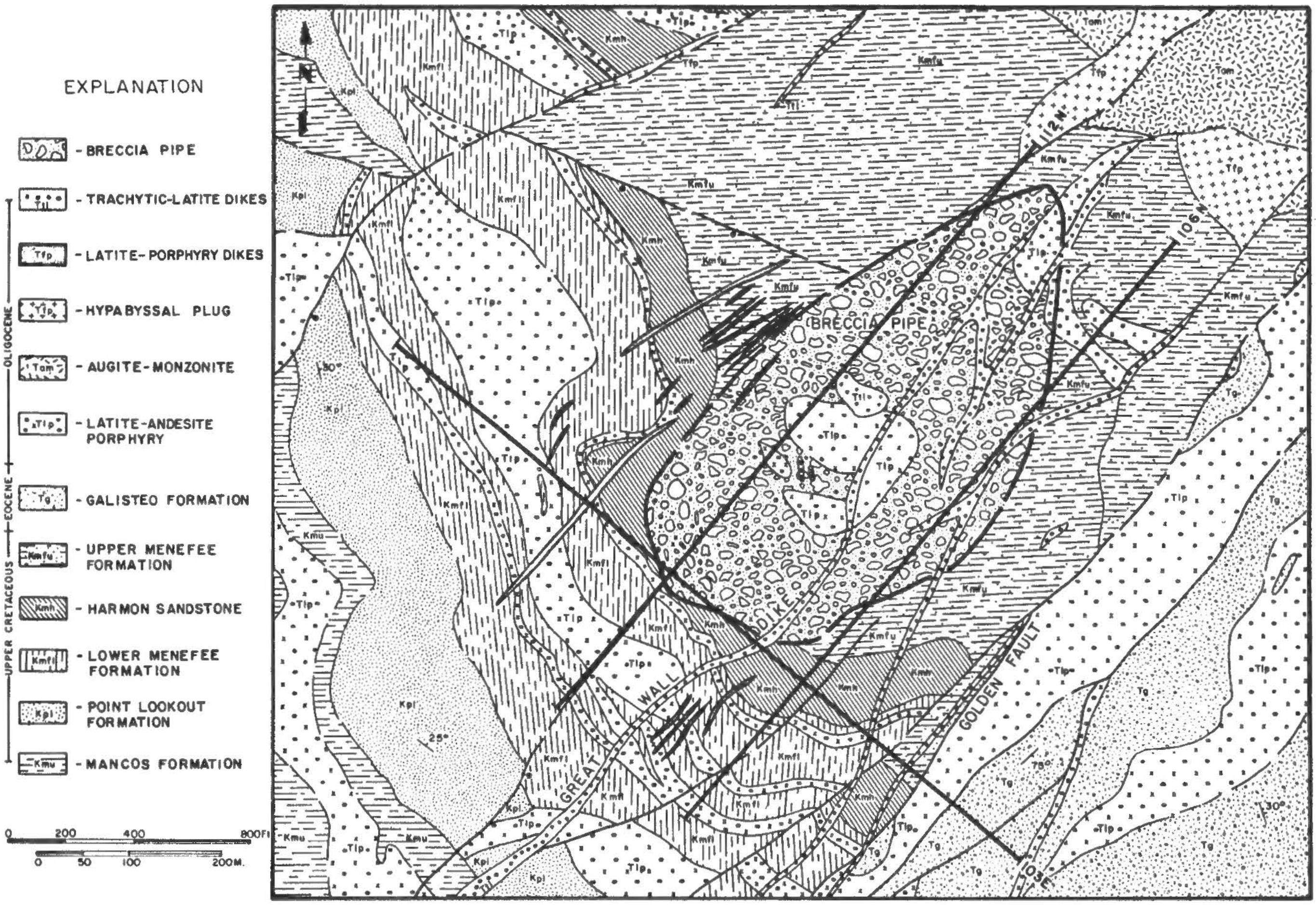



FIGURE 2. Carache Canyon geologic map. Bold solid lines are cross sections illustrated in Figures 3, 5 and 7. The bold dashed line is the breccia pipe contact. Source: Lac Minerals (USA) Inc.

west-trending ridges, whereas shale and siltstone weathered to form topographic depressions. Southeast of the Golden fault, Eocene sandstone was down-dropped against the Cretaceous units, forming resistant northeast-trending hills incised by Carache Canyon. The following rock descriptions are based on more than 150,000 ft of diamond drill core.

### Mancos Formation

The Cretaceous marine upper Mancos Formation consists of a 450-ft-thick, medium- and thinly-bedded, gray to black calcareous shale, siltstone and sandstone sequence. Contact metamorphism, at breccia pipe depths greater than 1000 ft, recrystallized these units to quartz-biotite hornfels and calc-silicate hornfels.

### Mesaverde Group

The Cretaceous Point Lookout Sandstone of the Mesaverde Group is a distinct 100-ft-thick resistant marker horizon. The sandstone is a regressive, white to light gray, medium-bedded to massive, fine-grained quartz arenite with minor shale partings. The non-marine Menefee Formation overlies the Point Lookout and is divided into three informal units (Figs. 1, 2). Lower Menefee consists of a 350-ft-thick gray to black, thin-bedded carbonaceous shale, siltstone, sandstone and 2–24-in.-thick coal seams. The Harmon Sandstone Member is a medium-grained channel sandstone ranging from 50–90 ft thick with gradational upper and lower contacts. The upper Menefee consists of thin-bedded gray carbonaceous shale with siltstone and minor sandstone interbeds.

### Galisteo Formation

The Eocene Galisteo Formation includes thinly-bedded to massive, medium- to coarse-grained arkosic sandstone with local pebble conglomerate and black to gray shale interbeds. The Galisteo Formation occurs in the hanging wall of the Golden fault, southeast of the breccia pipe (Fig. 2). Although not an important gold host, the unit provided stable ground conditions in the decline excavation.

## Igneous rocks

Coles (1990) employed petrographic analyses and whole-rock petrochemistry to categorize Carache Canyon igneous rocks as calc-alkaline and mildly alkaline. Calc-alkaline intrusives (K/Ar-dated at $34.0 \pm 2.2$ Ma) are the main gold hosts. Drill core data and cross-cutting relationships suggest alkaline dikes (K/Ar-dated at 28–30 Ma) are spatially and temporally related to gold deposition.

### Calc-alkaline intrusive rocks

Oligocene andesite porphyry sills and dikes intruded the Cretaceous and Tertiary sedimentary rocks without appreciably altering the contacts. Although seven stacked sills have been identified by drilling, only four were extensively evaluated as gold targets. The four main sills range from 10–100 ft thick and are situated between the Harmon Sandstone and upper Mancos Formation (Figs. 1, 2). They are laterally consistent despite local pinchouts, structural dams, bifurcations, and dike-like advances across bedding planes. Lastly, andesite porphyry dikes ranging between 20–450 ft wide intruded the Golden fault and locally host gold mineralization outside the defined gold resource.

### Alkaline intrusive rocks

Alkaline intrusive rocks include a small portion of a nepheline-bearing augite monzonite stock and northeast-trending latite porphyry and trachyte dike swarms (Fig. 2). Contact metamorphosed hornfels extends

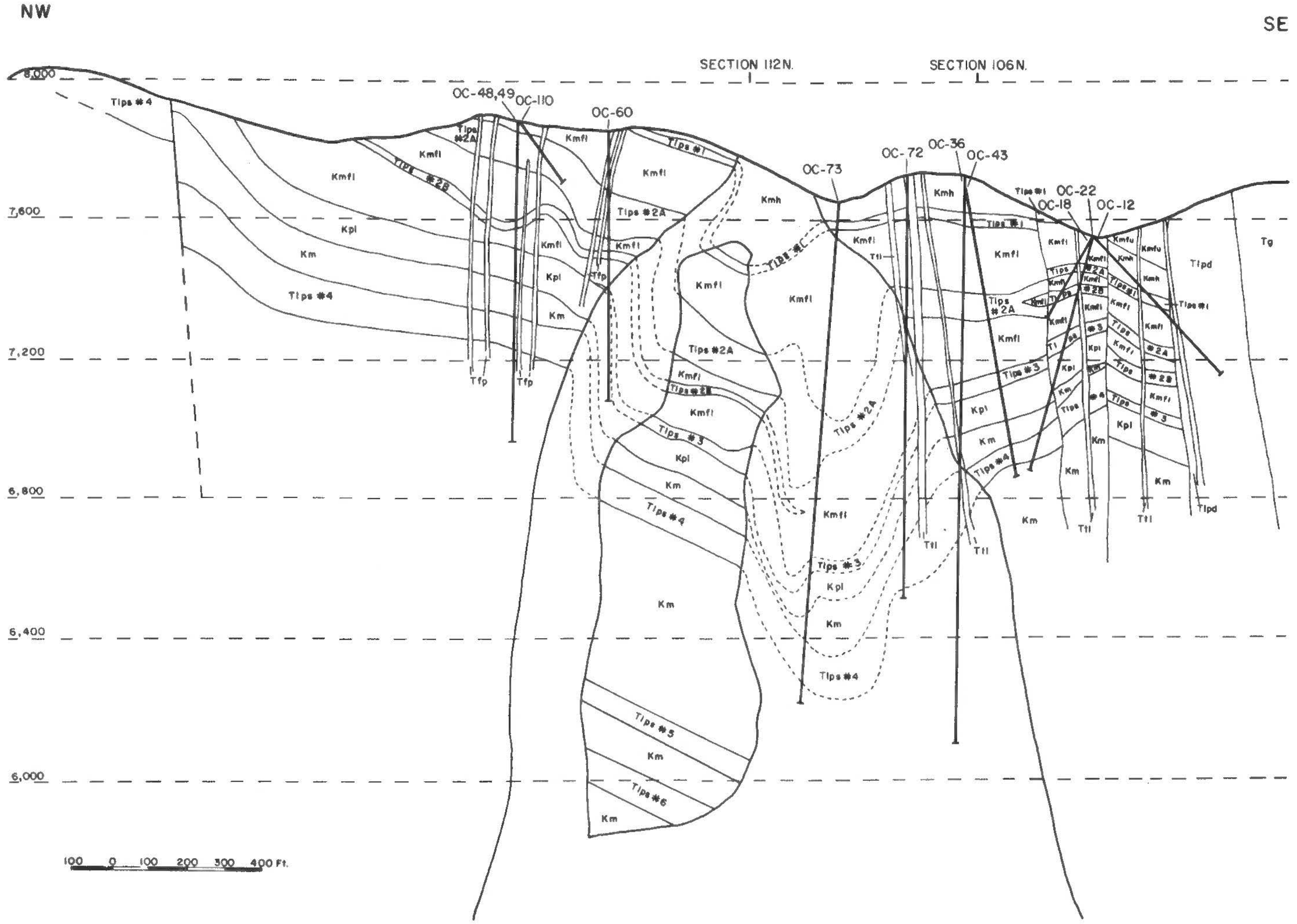



FIGURE 3. Geologic cross section 103E facing northeast. Dashed lines represent brecciated, collapsed relict stratigraphy within the Carache Canyon breccia pipe. Drill holes are labeled with "OC" prefixes at collars.

2000 ft from the stock and has been observed in deep breccia pipe drill core. Details of the augite monzonite stock are discussed by Maynard (this volume) and Coles (1990).

Latite porphyry dikes with coarse euhedral feldspar phenocrysts are present along the northwest pipe margin. Based on compositional and textural similarities, the dikes apparently emanated from the Cunningham Gulch porphyritic quartz latite plug 2000 ft northeast of the breccia pipe (Maynard, this volume). Latite porphyry dikes cross-cut the breccia pipe and are locally mineralized. Drill core evidence indicates the quartz latite plug is cut by trachyte dikes.

Trachyte dikes intruded fractures parallel to the Golden fault zone and locally cross-cut the breccia pipe margin (Fig. 2). The most prominent of these, informally termed the Great Wall dike, has a mile strike length and ranges between 15 and 40 ft thick. It separates extensive sill-hosted gold mineralization southeast of the dike from limited sill-hosted gold distribution to the northwest. Drill core evidence indicates mineralization was locally truncated by these dikes. However, the presence of mineralized trachyte dike breccias imply Carache Canyon gold deposition closely followed brecciation and is bracketed within the late alkaline igneous episode.

### Structure

The most prominent Carache Canyon structures are the breccia pipe and Golden fault zone strand of the Tijeras–Cañoncito fault system. The Carache Canyon breccia pipe developed within subsidiary faults parallel to the Golden fault (Fig. 2). Stratigraphic separation along the faults ranges between 40 and 100 ft, whereas the Golden fault exhibits about 2000 ft of vertical separation. Rio Grande rift-related tilting resulted in 25°–35° northeasterly dipping beds and steep southwest breccia pipe plunge.

### Hypabyssal breccia pipe

The Carache Canyon breccia pipe possesses textural characteristics similar to hypabyssal breccia pipes defined by Baker et al. (1986). It is tear-drop shaped in plan view, measuring 1900 ft by 1000 ft, with the long dimension parallel to the Golden fault (Fig. 2). The pipe plunges 70°–80°SW, has a distorted cylindrical cross-section shape and is present at drill depths greater than 3255 ft. An exceptionally large breccia megablock measuring 1800 ft vertical by 600 ft horizontal separated from the pipe margin and subsided 400 ft without significantly changing bedding attitude. The megablock proved instrumental in identifying collapsed relict stratigraphy throughout the pipe. Relict stratigraphy forms a "nested" series of attenuated andesite porphyry sill and sedimentary rock breccias that collapsed 400–800 ft (Fig. 3) (Schutz and Nelsen, 1990).

The breccia pipe is typically clast-supported, consisting of angular to subangular fragments with gray to black rock flour matrix derived from comminuted sedimentary rocks. A second clast-supported breccia event resulted in open-space fractures and matrix voids that cross-cut primary black matrix breccia. Average matrix volume is 2–5% with a maximum of 10%. Clast size is poorly to moderately sorted near the pipe and megablock margins, grading to moderately sorted near the pipe center. Breccia clasts near the pipe margin average 0.5–5.0 ft and those near the pipe center average 0.5–2.0 ft in diameter. Large blocks measuring 30–100 ft long were commonly drilled near the pipe and megablock margins. Although mixed lithology breccias are located along relict contacts and near the pipe center (Fig. 4), they are relatively minor and appear dominated by downward transport.

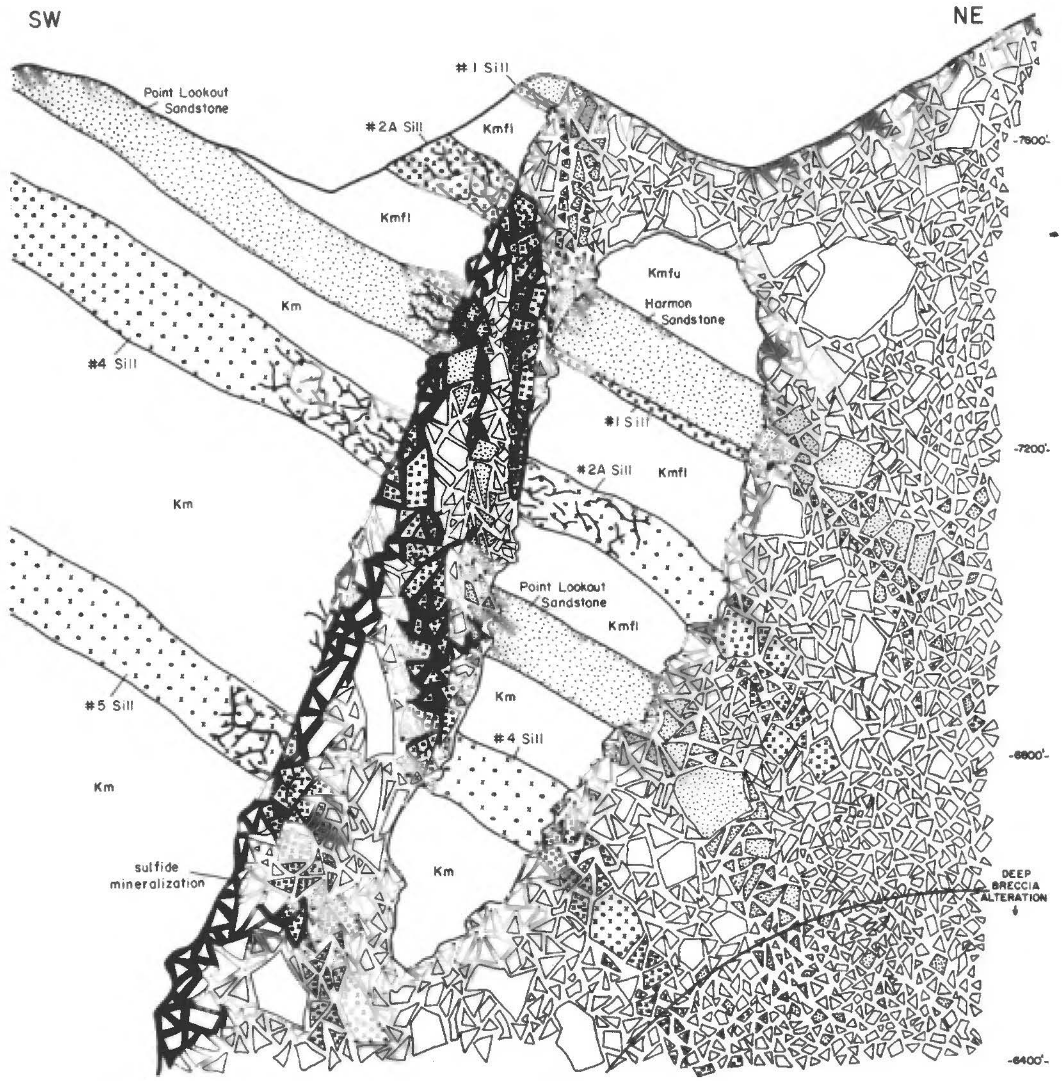



FIGURE 4. Diagrammatic sketch of the Carache Canyon breccia pipe facing northwest. Darkened breccia matrix and fractures in sills and sandstone depict gold and sulfide distribution. Note collapsed relict stratigraphy, size sorting, scale of large breccia blocks and deep breccia alteration boundary.

### Hydrothermal alteration

Wallrock alteration is distributed in a broad zonal pattern relative to depth and open-space fracture and void frequency. Deep breccia (+1000 ft depth) igneous rock clasts were silicified, sericitized and locally potassic-altered. Sedimentary rock clasts were decarbonized and intensely silicified to pale brown and green hornfels. Deep breccia also contains a considerable amount of matrix-infill calcite, siderite, mariposite, pyrrhotite and chalcopyrite, compared to shallow breccia. Deep level alteration probably reflects contact metamorphism near the augite monzonite stock, superimposed by hydrothermal alteration related to mineralization.

Shallow breccia alteration primarily developed in andesite porphyry and trachyte dike clasts as intense sericitic replacement of plagioclase phenocrysts and groundmass. Sedimentary rock fragments were not appreciably altered. Similar alteration occurred in sills outside the pipe, where sericitic alteration intensity is directly correlated with fracture frequency. As fracture frequency decreases outward from the pipe margin, alteration intensity in andesite porphyry sills decreases from strong sericitic alteration to pervasive propylitic and local biotitic alteration (Coles, 1990). Cross-cutting relationships imply several sericitic alteration events occurred.

Coles (1990) concluded that pervasive propylitic and biotitic alteration was the first alteration event, occurring within calc-alkaline sills and alkaline dikes. Intense pervasive sericitic alteration closely linked to breccia pipe formation followed as the main alteration event. Lastly, minor silicic, sericitic, K-feldspar, clays and carbonate alteration developed during gold mineralization.

## GOLD DISTRIBUTION

Sulfide, gold and gangue mineralization selectively occurred around and within the southwest breccia pipe margin where fracture cavities and breccia matrix voids were preferentially developed. Due to relative competency differences, open-spaced textures were well preserved in andesite porphyry sills and Point Lookout Sandstone, and poorly preserved in less competent Menefee and Mancos shales. This theme is consistent outside and inside the breccia pipe, resulting in two geometrically different gold distributions. In the first setting, gold occurred outside the pipe in gently dipping, tabular, fractured, permeable sills and sandstone separated above and below by impermeable barren Menefee Formation and Mancos Formation shales (Fig. 5; Schutz and Nelsen, 1990). Gold-bearing fractures outside the pipe are generally referred to as crackle breccia due to apparently random orientation. However, angle drill core intercepts also suggest the presence of a superimposed fracture pattern oriented N35°-45°E in the extensively mineralized region southeast of the Great Wall dike (Fig. 6). Fractures concentric around the southwest pipe margin are also postulated to be important gold distribution controls.

The second setting is shallow breccia mineralization distributed in collapsed, near-vertical, sill and sandstone relict stratigraphy breccias

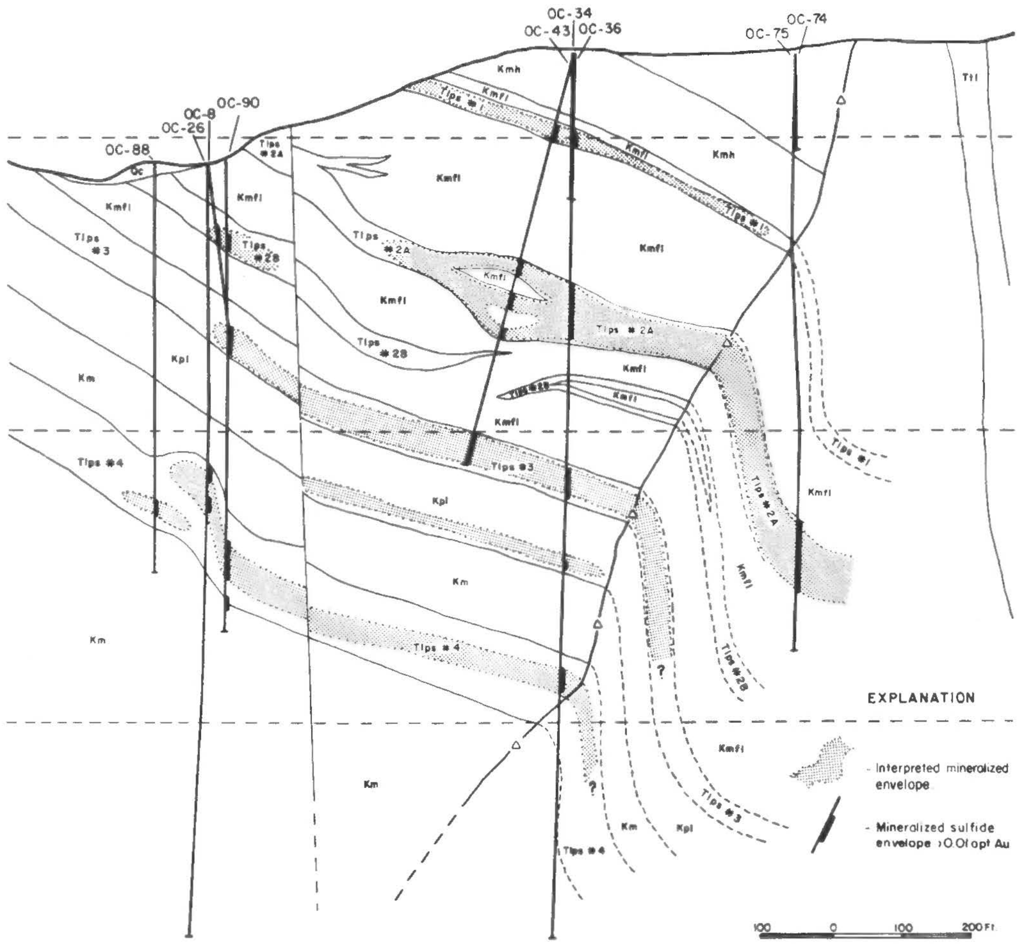



FIGURE 5. Geologic cross section 106N illustrating gold and sulfide distribution predominantly outside the breccia pipe, southeast of the Great Wall dike. View direction is northwest. Breccia pipe contact is shown with solid line and triangles. Relict stratigraphy is shown as dashed lines. Drill holes are labeled with "OC" prefixes at collars.

separated by weakly mineralized or barren Menefee and Mancos shale breccia (Figs. 4, 7). Gold and sulfides were distributed between the megablock and pipe margin and locally within megablock sills.

A third style is deep breccia gold mineralization in andesite porphyry and hornfels breccia below the #4 sill breccia (Fig. 4). Details of deep breccia gold distribution are poorly understood due to limited drill data. At increasing drill depths below 1000 ft, Mancos shale and siltstone were progressively thermally metamorphosed to brittle hornfels. Competent hornfels induced breccia matrix permeability. Therefore, gold was distributed among igneous- and sedimentary-fragment breccia matrix voids divergent from the relict stratigraphy control seen in shallow breccia.

## Mineralization characteristics

### Preliminary paragenesis

Gold frequency distribution and mineral composition are nearly identical inside and outside the breccia pipe. Petrographic studies of Carache Canyon breccia and sill mineralization support a preliminary hypogene paragenetic interpretation, including an early gangue event (stage I) followed by tungsten minerals (stage II), base metal sulfides (stage III), and native gold-carbonate gangue-sulfide-iron oxides (stage IV) (Fig. 8; Coles, 1990). Stage I gangue minerals coated open-spaced fractures and voids with a thin veneer of quartz, adularia, tourmaline, and minor barite, chlorite, sericite and cassiterite. Deep breccia also contains abundant Stage I calcite and mariposite. Stage II scheelite and wolframite veins are rare. Their paragenetic position is based on limited cross-cutting mineral boundary relationships. Stage III minerals form the majority of open-space fillings and consist largely of pyrrhotite with minor chalcopyrite, sphalerite and galena. Stage IV minerals consist of marcasite, pyrite, magnetite, arsenopyrite, hematite, gold and gangue siderite, ankerite, dolomite and calcite (Fig. 8). Mineralized fractures outside the pipe are typified by distinctly zoned orange and green iron oxide selvages extending outward as much as three times the fracture vein width. Colorful oxide selvages are uncommon in the breccia pipe. Stage V supergene minerals include hematite, goethite, digenite, covellite, malachite and jarosite (Coles, 1990).

### Fluid inclusions

Coles (1990) examined fluid inclusions from hypogene mineral stages I, II and IV to derive preliminary conclusions linking fluid chemistry with alteration and mineral paragenesis. Homogenization temperatures, trapping pressures, trapping temperatures and salinity data suggest early gangue mineral fluids were relatively hot (275–>400°C), saline (25–46 wt% eNaCl), $CO_2$-rich and show evidence of boiling with variable fluid inclusion liquid:vapor ratios. Stage I and II fluids were interpreted as magmatic, occurring after breccia pipe formation and after intense sericitic alteration.

The gold-bearing stage IV fluids were considerably cooler (160–250°C), less saline (10.4–12.1 wt% eNaCl), $CO_2$-rich and also may have

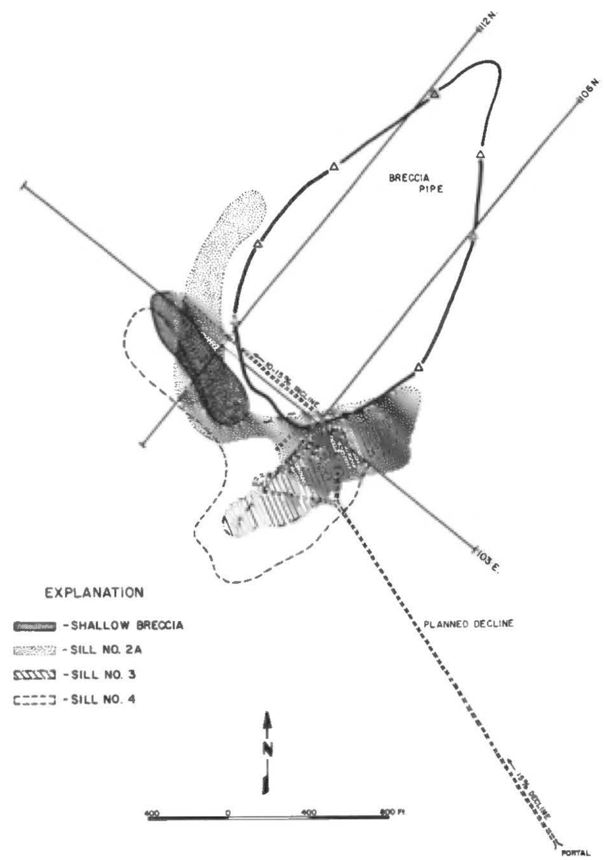



FIGURE 6. Plan projection of mineralized Carache Canyon sills and breccia. Northeast elongation of sill mineralization near section 106N illustrates potentially favorable fracture orientation suggested by drill core data. Also, curved distribution around the pipe margin illustrates potential concentric fracture control suggested by drill core data. Dashed parallel lines represent the bulk sample decline design.

boiled. Stage IV fluids were of meteoric and/or magmatic origin and evolved to lower pH and higher oxygen activity coincident with gold deposition. These data imply that overall fluid conditions ranged between slightly acidic and slightly basic. Based on the above relationships, Coles (1990) determined Carache Canyon could be classified as an adularia-sericite epithermal gold deposit. Coles also compared Carache Canyon and Cunningham Hill data (Kay, 1986), and concluded that fluids depositing gold at both collapse breccia pipe locations were chemically similar.

### Nugget effect

Coarse native gold was observed in several drill hole cores as equant grains up to 0.2 inches in diameter. The occurrence is uncommon in the Ortiz Mountains and induced a significant nugget effect implied by erratic metallic screen fire assay checks (Table 1). Statistical analyses of ore heterogeneity indicate micro-fracture distribution and relatively large gold grains produce the majority of assay variability, considering such small (drill hole) sample sizes (F. F. Pitard, unpubl report for Lac Minerals, USA, 1988). In an effort to mitigate the nugget effect, a decline was designed to collect statistically accurate bulk samples and evaluate fracture pattern predictability (Fig. 6). The partially constructed decline was idled in 1991 prior to intersecting the gold-bearing targets.

## CONCLUSIONS

The deep-seated Tijeras-Cañoncito fault system provided structural preparation for Oligocene Carache Canyon breccia pipe evolution, alkaline igneous intrusions and gold mineralization. The pipe developed along this structurally weak zone during explosive release of volatile gas above a crystallizing magma. Magmatic withdrawal through the Ortiz diatreme, 3 mi northeast, or intrusion of the nearby augite monzonite stock provided sufficient volume displacement to account for the subsequent Carache Canyon collapse brecciation. Fractured Cretaceous sedimentary rock fragments and Oligocene calc-alkaline quartz andesite porphyry sill clasts collapsed, retaining their original stratigraphic position and preserving permeable voids and fractures in relatively competent rocks. During breccia pipe development, early propylitic and biotitic alteration was followed by an intense sericitic alteration event. Coeval with alkaline igneous activity hydrothermal fluids were dispersed into fractured and brecciated sills and sandstone, but not into adjacent impermeable shale and siltstone. Early fluids were hot (275–>400°C), saline (25–46 wt% eNaCl), $CO_2$-rich, boiling and apparently of magmatic origin. They deposited quartz, adularia, tourmaline, calcite, barite, chlorite, mariposite, sericite and cassiterite as thin veneers in voids. Scheelite, wolframite, pyrrhotite, chalcopyrite, sphalerite and galena filled most of the remaining void space. Late-stage gold-bearing fluids were cooler (160–250°C), less saline (10.4–12.1 wt% eNaCl), $CO_2$-rich and of meteoric and/or magmatic origin. Marcasite, pyrite and magnetite replaced pyrrhotite and base-metal sulfides to a lesser extent. Then, siderite, arsenopyrite, ankerite, dolomite, calcite and coarse native gold were deposited on the edges of sulfide infill. Base-metal sulfides, gold and gangue minerals were preferentially distributed in and around the southwest portion of the breccia pipe. Finally, the coarse native gold occurrence and fracture distribution induced a significant nugget effect, providing uncertainty to the average grade of the deposit. Determining whether the statistically accurate bulk sample average grade is higher or lower than the current resource grade estimation could potentially impact the resource size and mining style.

## ACKNOWLEDGMENTS

The author wishes to thank management at Lac Minerals (USA) Inc. for permission to present this information. Acknowledgments recognizing significant geologic contributions are extended to the late Dennis Sheehan and to Gil Griswold, Craig Nelsen, Steve Maynard, Kalvin Martin, Jon Carlson, Jeff Walterscheid, Mike Hultgren, Graham Kelsey, Mike Kisucky, Rick Lawrence, Dave Coles and Kristen Kenner. Alice Mueller drafted the figures. Thanks to Steve Maynard, Cindy Williams and Dale Finn for useful reviews.

## REFERENCES

Baker, E.M., Kirwin, D.J. and Taylor, R.G., 1986, Hydrothermal breccia pipes: Contributions of the Economic Geology Research Unit, James Cook University of North Queensland, v. 12, 44 p.

Coles, D.W., 1990, Alteration and mineralization of the Carache Canyon gold prospect, Santa Fe County, New Mexico [M.S. thesis]: Ft. Collins, Colorado State University, 183 p.

Foster, F., 1991, Geology and general overview of the Golden Sunlight mine, Jefferson County, Montana; *in* Association of Exploration Geochemists, 15th

TABLE 1. Carache Canyon gold assay variability exhibited in metallic screen fire assay checks (Met) of drill hole OC-11 (#4 sill). Five separate homogeneous splits of each sample interval were analyzed. Results imply a nugget effect indicated by erratic check assay values. All values are oz per short ton.

| Sample Interval (ft) | Met1 | Met2 | Met3 | Met4 | Met5 | Wt Avg |
|---|---|---|---|---|---|---|
| 745-750 | 0.037 | 0.007 | 0.031 | 0.424 | 0.051 | 0.143 |
| 750-755 | 0.671 | 0.741 | 0.158 | 0.066 | 0.364 | 0.322 |
| 755-760 | 0.135 | 0.042 | 0.188 | 0.106 | 0.640 | 0.191 |
| 760-765 | 0.035 | 0.021 | 0.030 | 0.034 | 0.035 | 0.031 |
| 765-770 | 0.013 | 0.031 | 0.283 | 0.008 | 0.135 | 0.101 |
| 770-775 | 0.071 | 0.145 | 1.052 | 0.021 | 0.137 | 0.332 |
| 775-780 | 2.473 | 0.071 | 1.169 | 0.457 | 0.168 | 0.844 |
| 780-785 | 0.151 | 1.236 | 0.364 | 0.202 | 0.189 | 0.377 |
| 785-790 | 0.127 | 0.096 | 0.073 | 0.195 | 0.074 | 0.120 |
| 790-795 | 0.031 | 0.004 | 0.004 | 0.058 | 0.006 | 0.024 |
| 795-800 | 0.008 | 0.004 | 0.005 | 0.030 | 0.333 | 0.057 |
| 800-805 | 0.063 | 0.003 | 0.007 | 0.032 | 0.009 | 0.023 |
| 805-809 | 0.004 | 0.183 | 0.002 | 0.004 | 0.007 | 0.043 |
| **average** | **0.294** | **0.199** | **0.259** | **0.126** | **0.165** | **0.204** |

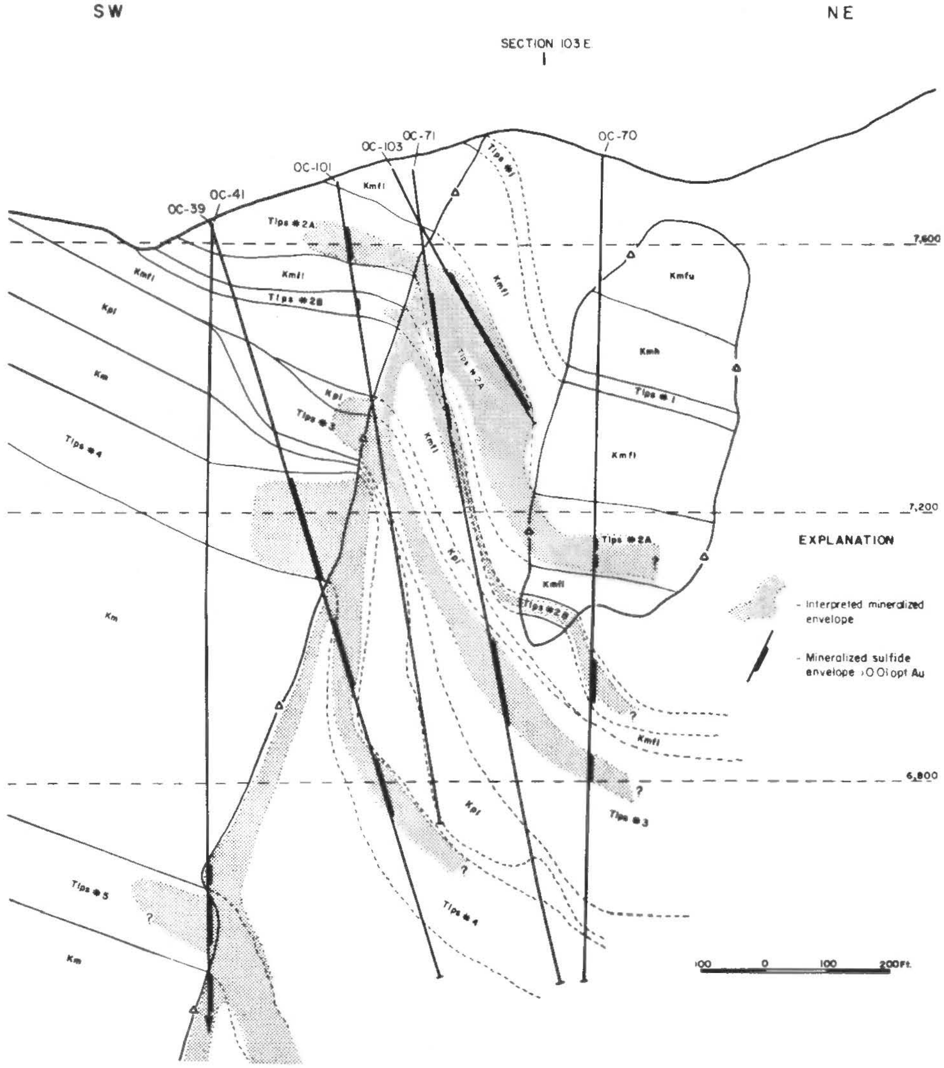
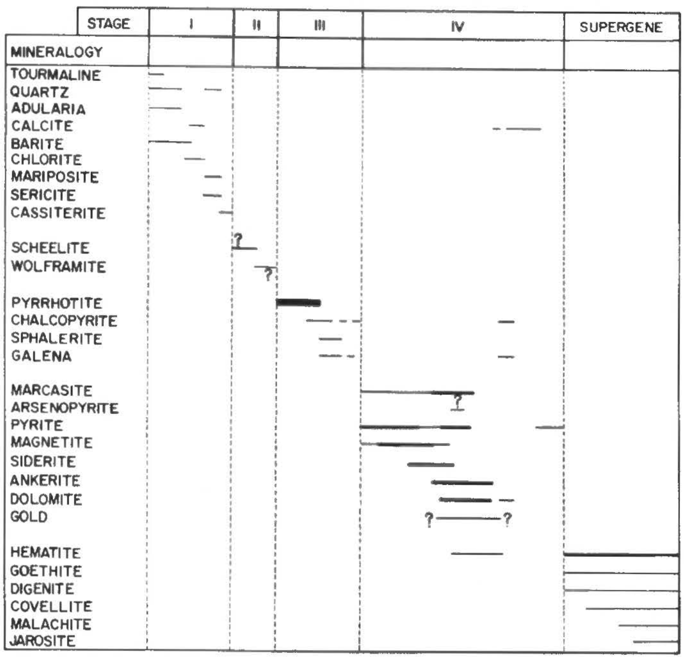



FIGURE 7. Geologic cross section 112N illustrating gold and sulfide distribution predominantly inside the pipe, northwest of the Great Wall dike. View direction is northwest. Breccia pipe contact is shown with solid line and triangles. Relict stratigraphy is shown as dashed lines. Drill holes are labeled with "OC" prefixes at collars.




International Geochemical Exploration Symposium, Field Trip Guidebook to Mineral Deposits of Montana, p. 26–36.

Kay, B.D., 1986, Vein and breccia gold mineralization and associated igneous rocks at the Ortiz mine, New Mexico, U.S.A. [M.S. thesis]: Colorado Springs, Colorado School of Mines, 179 p.

Mustard, H., 1986, Geology and genesis of the Kidston gold deposit, Australia: Proceedings of Gold '86 Symposium, Toronto, Ontario, Canada, p. 404–415.

Mutschler, F.E., Griffin, M.E., Stevens, D.S. and Shannon, S.S. Jr., 1985, Precious metal deposits related to alkaline rocks in the North American Cordillera—an interpretive review: Transactions of the Geological Society of South Africa, v. 88, p. 355–377.

North, R.M. and McLemore, V.T., 1986, Silver and gold occurrences in New Mexico: New Mexico Bureau of Mines and Mineral Resources, Resource, map 15, 32 p.

Schutz, J.L. and Nelsen, C.J., 1990, Geology and gold mineralization of the Carache Canyon breccia pipe, Ortiz Mountains, New Mexico; *in* Gold '90, Proceedings of the Gold '90 symposium, Salt Lake City, Utah, D. M. Hausen editor, p. 65–81.

Townley, J.M., 1971, El Placer: a New Mexico mining boom before 1846: Journal of the West, v. 10, p. 102–115.

FIGURE 8. Carache Canyon preliminary paragenetic diagram. Stages are not drawn to scale and line thickness represents relative mineral abundance (modified from Coles, 1990).