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M E M O R A N D U M

TO: J. David Lowell
FROM: John E. Kinnison *John E. Kinnison*
SUBJECT: Old Dominion Mine - Disseminated Block Cave Potential
DATE: June 17, 1977

The Old Dominion Mine was a major underground copper producer in the Miami district, operating for 50 years and producing 850,000,000 pounds of copper. The mine was closed in 1931. The major production came from the upper levels of the vein where replacement had extended into the limestone wallrock and was quite high grade, being enriched by chalcocite. The Total known length of the Old Dominion vein, including probable extensions through the Iron Cap and other mines, is about 3 miles. The vein strikes northeast, and on its southwest end passes beneath a thrust block of unmineralized diorite, and the alluvial-filled valley of Pinto Creek. The vein has been followed a distance of perhaps 2,500 feet beneath cover to the southwest. Brief notes on production and history are appended for reference.

The trace of the vein is shown by Attachment "A", from U.S.G.S. Professional Paper No. 342 by Nels Peterson. Longitudinal sections of the footwall and hanging wall, as plotted by Peterson, are given at a reduced scale by Attachment "B".

DISSEMINATED OREBODY

Minor reference is made by Peterson to disseminated chalcopyrite in diabase, and the longitudinal sections attached show a small area of stopping in both the hanging wall and the footwall of the vein on the 23rd level - the supposed position of this lower grade and non-commercial disseminated chalcopyrite, carried in reserves by Miami Copper at only 2 or 3 million tons of 2.5% Cu.

In 1955 Robert Bryant, whom I had known a couple of years previously as a fellow graduate student, was given an assignment directly from the New York offices of the Tennessee Copper Corporation, who controlled the Miami Copper Company. He was asked to undertake a special search of all pertinent

information, including a study of the surface geology and old mine records, to determine if any residual exploration possibilities remained at the Old Dominion. He was sent from New York and reported to New York; Ben Coil, Manager of the operating Miami Copper Company, and his Chief Geologist, Woody Simmons, had no authority over Mr. Bryant's work, but were merely asked to provide him access to all information. This line of authority was no doubt resented by Mr. Coil, and probably by Woody Simmons also. It is somewhat unusual to send a young man with relatively little experience as a specialist into a district to study and report separately to the home office, with no accounting to the local management. I was living in Globe at the time Bryant did this work, and saw him on occasion.

Later, at an Arizona Geological Society meeting in November, 1957, I had a chance to casually discuss the results of this investigation with Mr. Bryant. He reported that he could find no new exploration possibilities of particular interest, although about five drill holes were finally drilled at wildcat targets - presumably as a last ditch attempt to find something new. Bryant then related, however, that in examining the old level maps and assays he discovered that a block of low grade chalcopyrite in diabase, being carried at 2 or 3 million tons at 2.5% Cu as a reserve within the Old Dominion, could be re-estimated simply by changing the cutoff grade of mining. He recalculated the assays and the outline of ore by dropping the cutoff grade down from 2.0% Cu to either 0.9% Cu or 0.7% Cu (my notes are hazy on this subject)³⁰ that a block of ore 400'-700' in height was estimated to contain 40,000,000 tons grading 1.2% Cu. A few years ago (1972) I asked Bob Bryant about the cutoff grade which he used and even he could not recall the exact figure. He has no copies of his report, and my attempts to get more information at that time were unsuccessful.

I had occasion to ask Nels Peterson about this calculation of Bryant's, of which he was aware, and he indicated that the area was that of the 23rd level shown on the long. sections. Presumably, this is the base of ore and the rise is from the 23rd level up. The 23rd level is roughly 1,800 feet beneath the surface at the ~~sight~~^{site} of these old stopes.

The Old Dominion shaft is timbered to the 1,900 foot level. When Bryant was in Globe in 1957, the water level stood somewhat below the 2,000 foot level, and pumping (Globe city water supply) lowered the level about 3 inches per day.

Pinto Creek flows over the area in question and pumping during operation of the Old Dominion was a problem due to water inflow. The highway which enters Globe from Miami also is roughly in this position, but the town itself has dwindled into a few poor houses scattered on hillsides, and is outside the main area of the town of Globe.

In our previous conversation a few weeks ago, I had indicated a 400 foot length of ore, and we speculated on the possibility of calculating a possible width. Both these factors would bear on the possibility of successful block caving. I have found that a precise re-reading of my old notes, however,

give only the height of ore, varying from 400'-700'. Although Nels Peterson refers to disseminated ore on the 23rd level in the footwall of the vein, Bryant was specific that the occurrence was contained in the hanging wall. The dip of the vein is generally south at a high angle and, if this is the case, the hanging wall mineralization should offer no particular technical problem in caving. Cross section "A" on Attachment "C" is a cross section by Peterson which is drawn closest to the orebody being discussed, but still somewhat to the northeast of it. The location of the attached cross sections are shown on Attachment "D", with a skeletonized framework of the veins of the district.

The outcome was somewhat predictable. Mr. Bryant's report was received in New York, whose management immediately dispatched a question to Ben Coil concerning why, for thirty years, had the local management of Miami Copper Company carried a 40,000,000 ton orebody at a reserve of only 2 or 3 million tons. The answer returned was that Bryant's reserve of chalcopyrite in diabase was not susceptible to successful caving, and that the smaller reserve was a carry-over from a potentially successful and commercial method of mining employed toward the end of the life of the mine by employing either top ~~splicing~~ or by a particular method of caving referred to as "timbered slide caving", which had been developed at Morenci. An Arizona Bureau of Mines bulletin published in 1930 entitled, "Second Report on the Mineral Industries of Arizona," briefly describes this method of mining and contains the following comments:

"The method is especially adaptable to the Old Dominion due to the fact that the hanging wall of the vein is mineralized to such an extent that a large overdraw is practicable, thus ensuring almost complete extraction of ore between walls and a large additional tonnage of lean ore which, with more expensive mining methods, could not be taken at a profit."

I suspect that the local management at Miami was incensed over the method of approach to re-examination of the Old Dominion potential and may have overreacted in their contention that the 40,000,000 tons calculated by Bryant was not susceptible to caving.

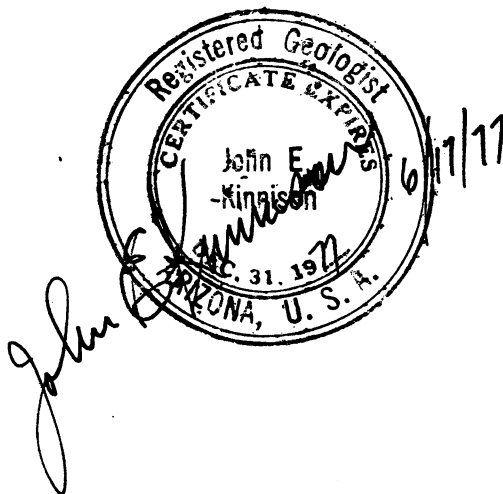
PROPOSAL

I would propose that, since Ben Coil's retirement and Woody Simmons' death, and a large change of personnel who may have been employed by Miami at that time, the block cave potential might now be more rationally assessed. There may, in fact, be technical reasons for disputing the calculated ore reserve, as I have no way of knowing precisely how Bryant handled the assay data, and we are uncertain as to the length and width of the reported ore deposit. However, Cities Service, who now controls the Miami division, might be more susceptible to a reconsideration of this possibility of a block cave mine.

Although it would seem that there is little reason to entice Cities Service into a joint venture on a property they already own, I might point out that they have heavily invested in Pinto Valley, which must be surely in financial difficulty under the current low copper price, and their reserves at the Copper Cities and Diamond H pits are nearing exhaustion. The future of their Miami East underground deposit is highly speculative. An outside company with both capital to invest, and with prior underground mining experience (which no longer exists at the Miami division), might be able to negotiate such a joint operation.

The first step is to try to locate Bryant's report for an independent appraisal of its internal validity. It is my personal feeling that an approach would have to be made initially through an executive level contact between a company interested in pursuing the possibility, and the executive management of Cities Service. If a direct contact is made with local Miami management, it could result in a referral to higher authority coupled with a recommendation for rejection - and this would kill the project at inception. And, of course, you may have in mind other possibilities of an approach to Cities Service.

JEK/jeb
Attachments



NOTES

STATISTICS TO 1901

Ransome 1903 Prof. Paper 12

1882 - 1901 118,000,000 # Cu*
 (59,000 Tons Cu)

 * includes United Globe-extension of O.D. Vein

May 1884 490 Tons Cu Smelted
 (about 16 Tons per day Cu)
 -60 Tons Ore per day
 = (27% Cu Ore)

1888 & 1889 each 10,500,000 # Cu
 (5,250 Tons Cu)

1888 - 1893 Ave. 8,000,000 # Cu/year
 = (4,000 Tons Cu)

 12 levels, 3 comp. shaft 827 feet deep.
 3600 feet lateral development.
 Stopes above 8th level (600' approx. deep)
 6% is low-grade ore.
 To 8th level all oxidized - mainly cuprite
 and "limonite". In 1901 developed 5th level stope
 of "good ore" with cuprite and malachite of
 7 - 13% Cu.
 6% Cu marginal - 20% considered high-grade, most
 is between the two limits. 11th and 12th
 level (800 and 900 feet deep), in diabase,
 "pyrite ore" - the poorest grades 3% Cu, much
 is 5%, some more than this. Cu probably as
 Chalcopyrite.

April 23, 1968

Chalcocite first occurrence on 5th level
(350 feet deep)

The surface open cut contained some "good ore" encased in "worthless" masses of limonite and specularitex (this is the outcrop of vein that can be seen today - JEK.)

1930

Mineral Industries, Arizona Bur. Mines Bull. 129

Mining mostly by caving.

Comparison made in 1928.

Square set 4.7 tons/manshift

Top Slice 10.9 " "

Caving 19.8 " "

Mine 758 men employed (1930)

other 189 " "

Total 947 " "

1929 Production: 416,000 Tons

18,940,000 # Cu = (9,470 Tons)

(2.3% Cu) (1,150 tpd ore)

Arizona Commercial, 1929

62,100 Tons ore

3,800,000 # Cu = 1,900 tons

(173 tpd)

1928

MINERAL INDUSTRIES

Arizona Bur. Mines Bull. 125

Soft ore: Rill Stopping & fill

Square set & fill

Top slicing

Deeper Ore in Primary:

Inclined cut & fill

April 23, 1968

Shrinkage stoping

Block Caving (Morencie method, by inclined slides) (ore & waste)

"A" shaft 5 comp. 2 skips 2 cages

Concentrator - 1600 tpd

Mine 625 men

Other 180 men

Total 805 men

Note: Mill also treated Ariz na Commercial and Iron Cap Ores (Petersons); No mention of direct smelting ore tonnage.

1933

Lindgren Volume: (Mine closed 1931)

p. 709 - 50 years active operation (1881-1931) 700,000,000 # Cu (minor gold - silver)

= (350,000 Tons Cu)

4.38% Cu Ave.

8,000,000 Tons Ore

also 1,600,000 Tons Ore

Extension same vein on Arizona Commercial & Iron Cap

150,000,000 # Cu

= (75,000 Tons Cu)

4.7% Cu. Ave.

Developed: length more than 3 miles (including ext. beyond O.D. Copper Co.); 2200 feet deep. Westerly beneath dacite and gravel 4,500 ft.

N.E. strike - fault fissure

Ore occurrence as: 1) in fault as replacement
2) in limestone walls, large replacment bodies
3) diss. in diabase walls

April 23, 1968

-

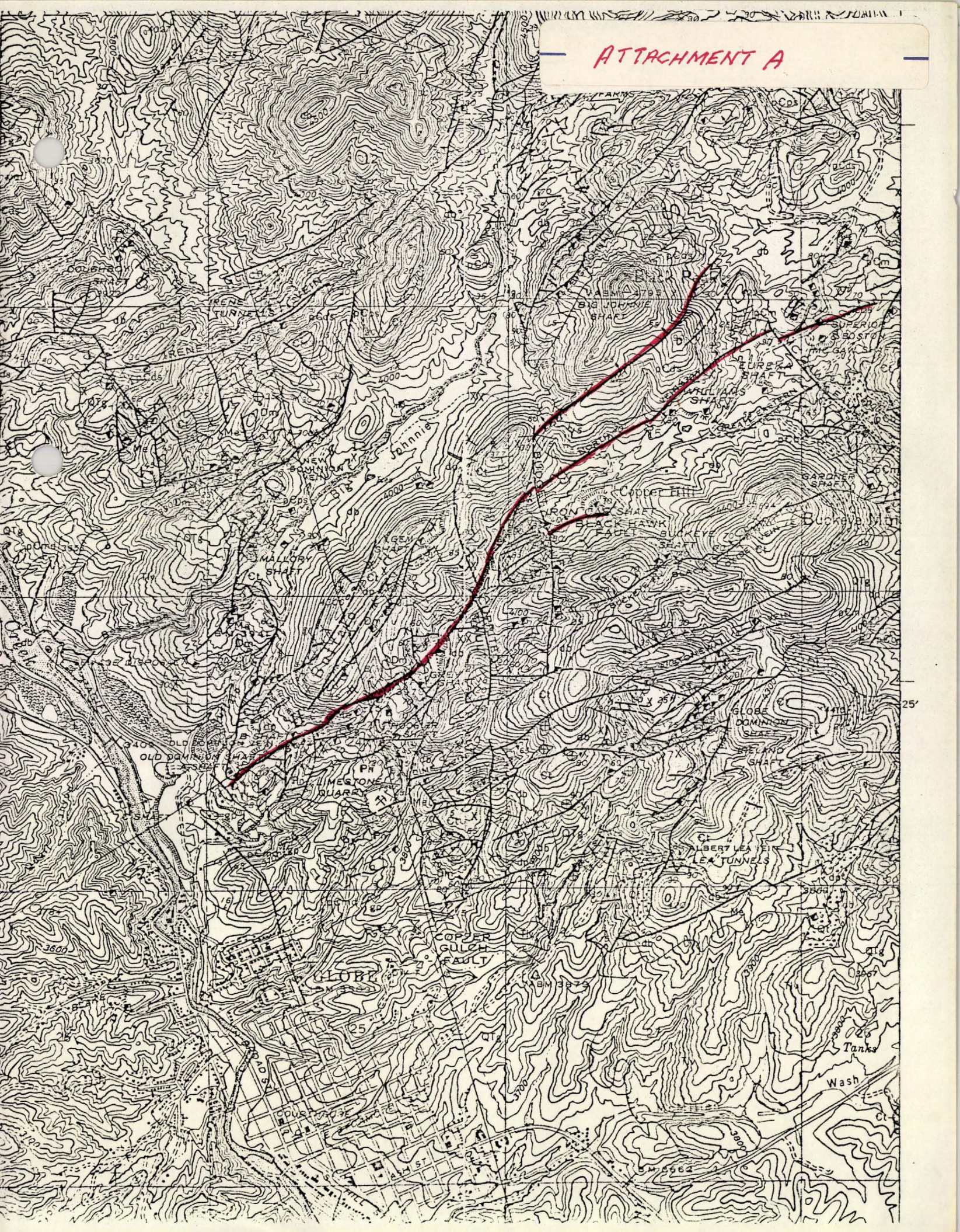
Top slicing and caving methods. Mentioned
pillars at 4% Cu.

By calculation from above figures:

458 Tons / day as ave. assuming 8 mill.

Tons for 50 years, and 360 days per year.

ATTACHMENT A



GEOLOGY AND ORE DEPOSITS, GLOBE-MIAMI DISTRICT, ARIZONA

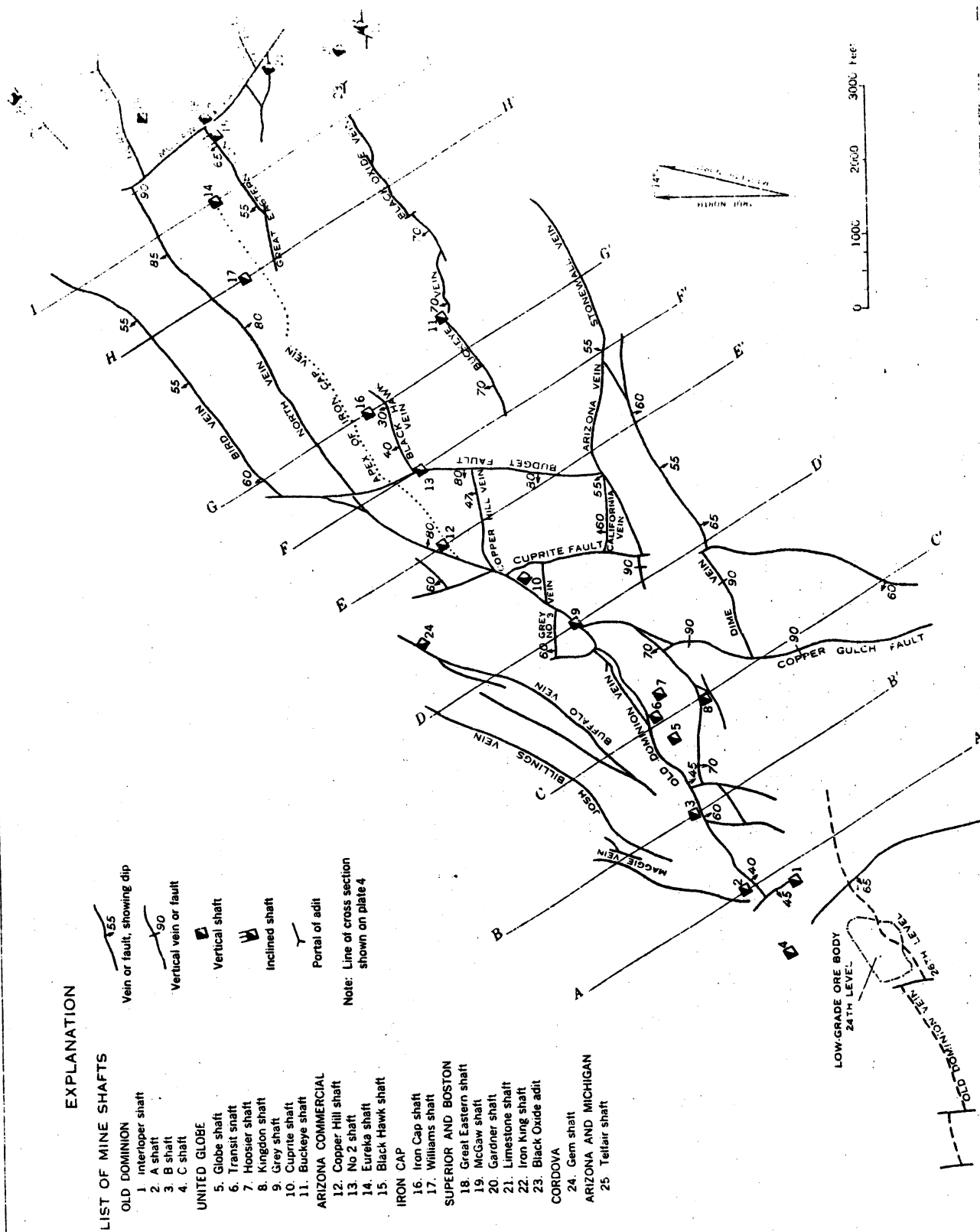
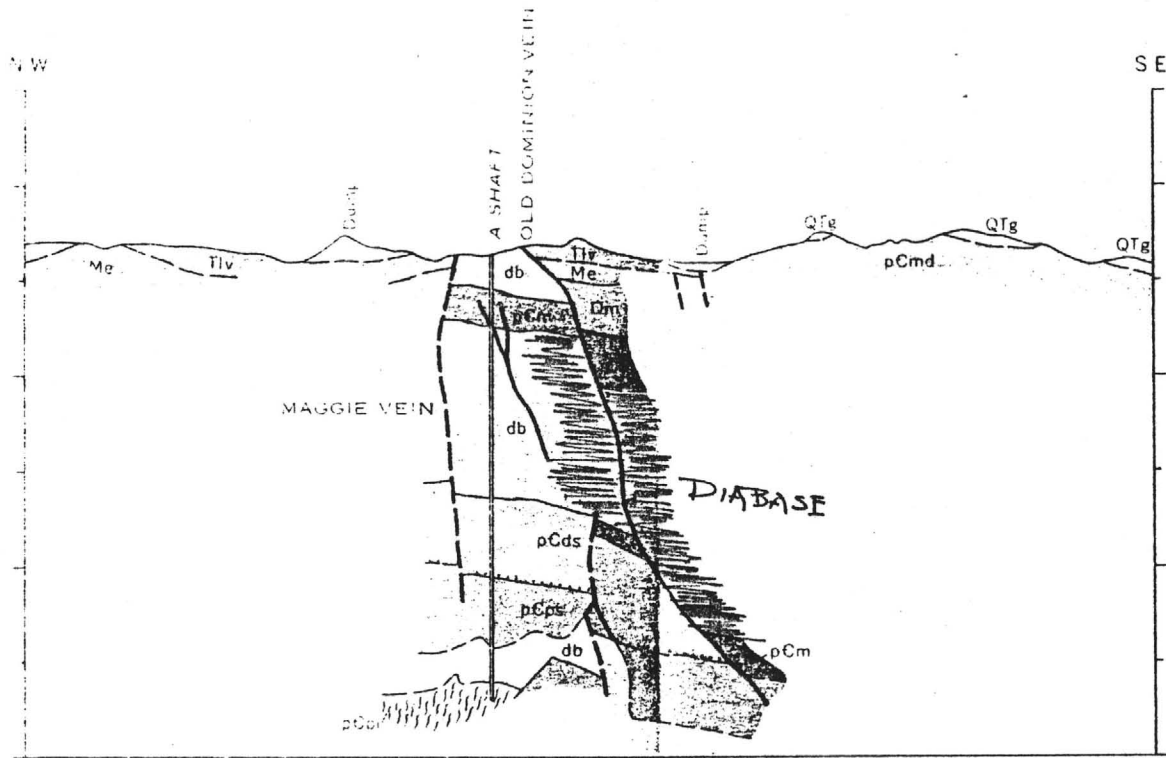
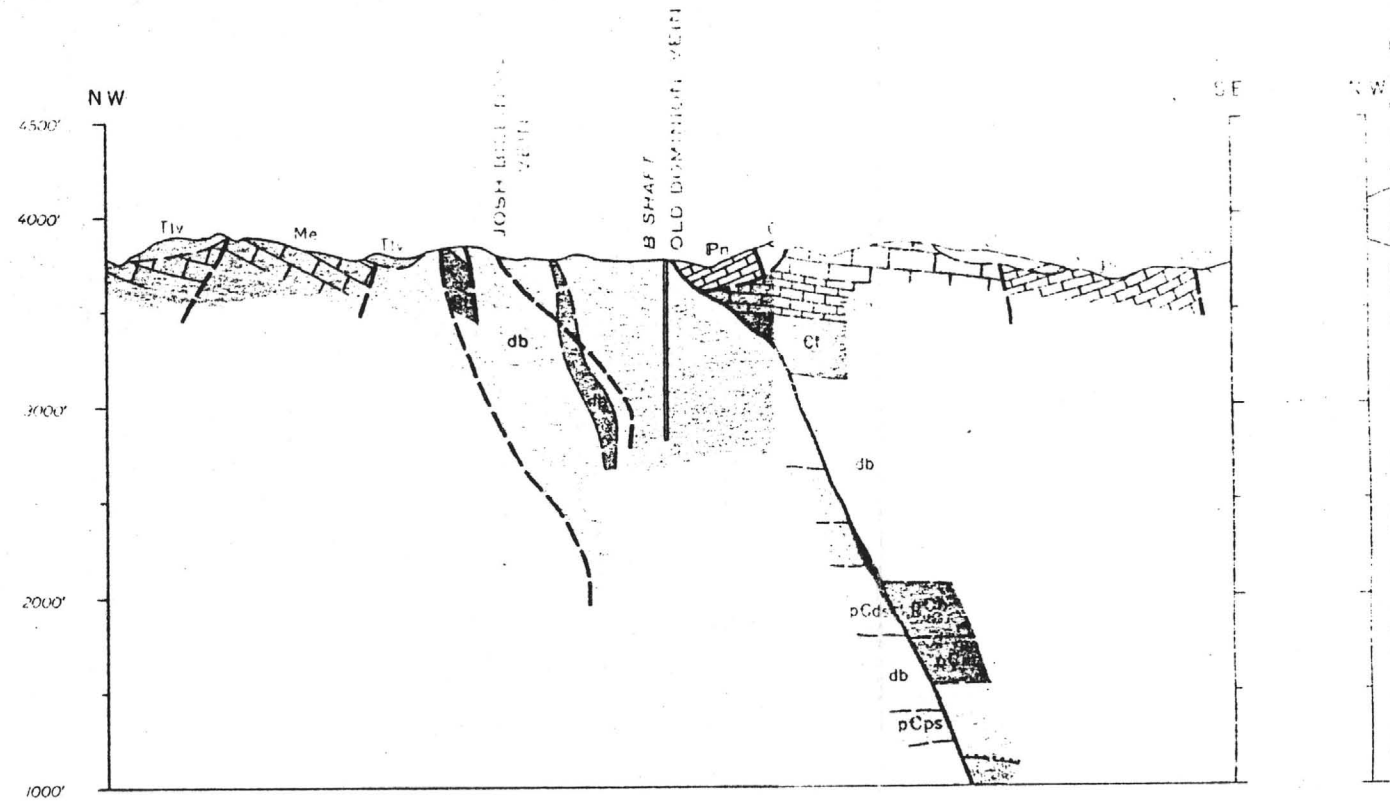


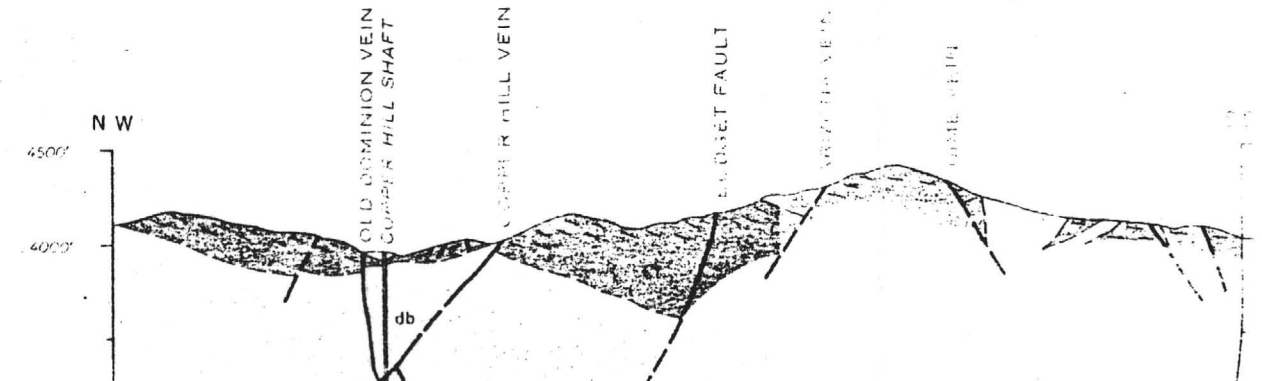
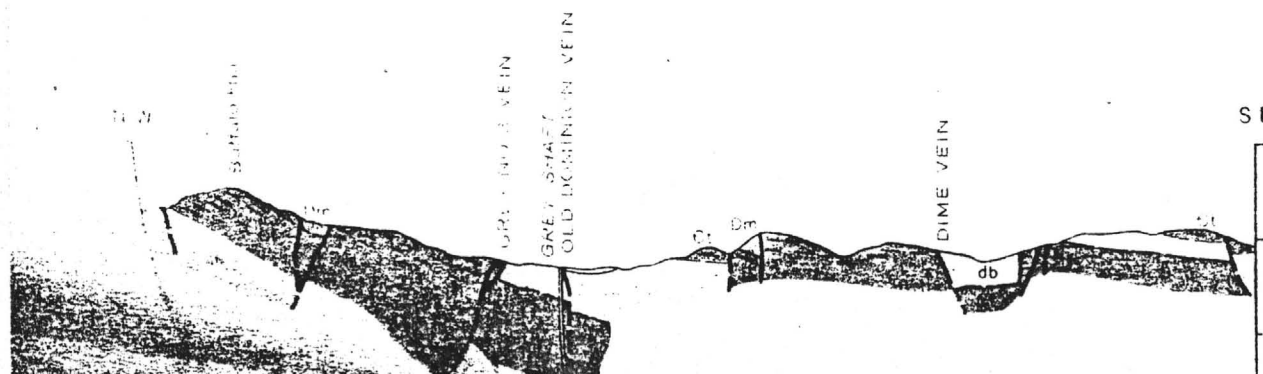
FIGURE 5.—Skeletal plan of the main veins and faults of the Old Dominion system.

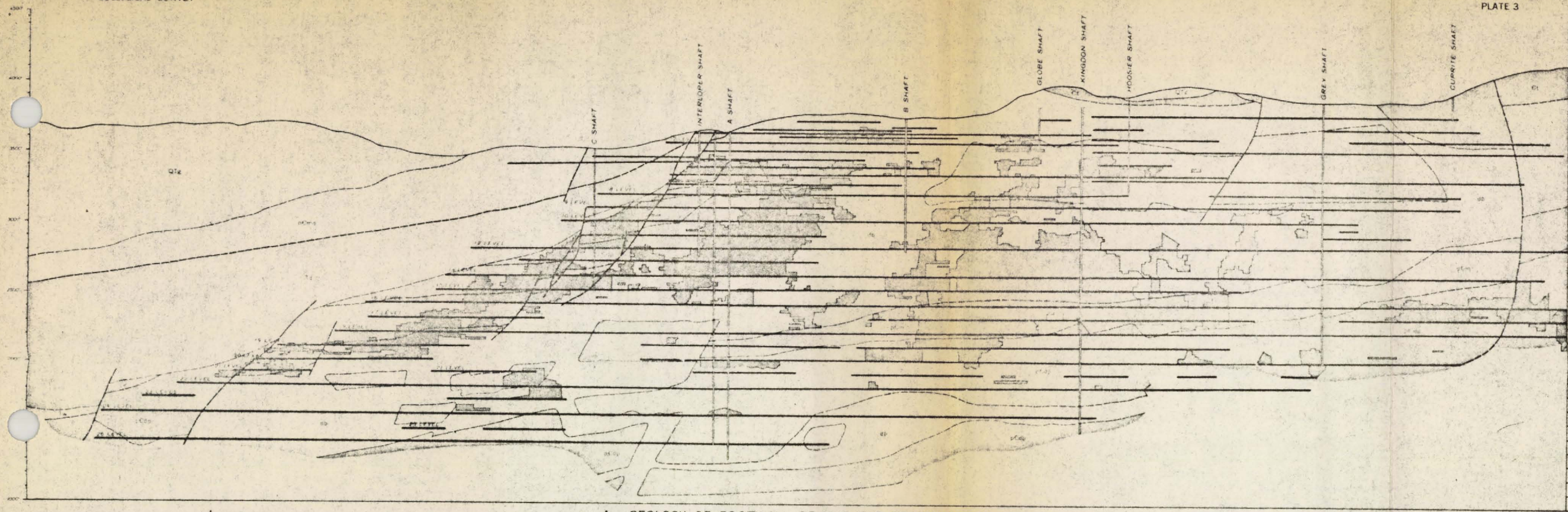


A.—OLD DOMINION A SHAFT

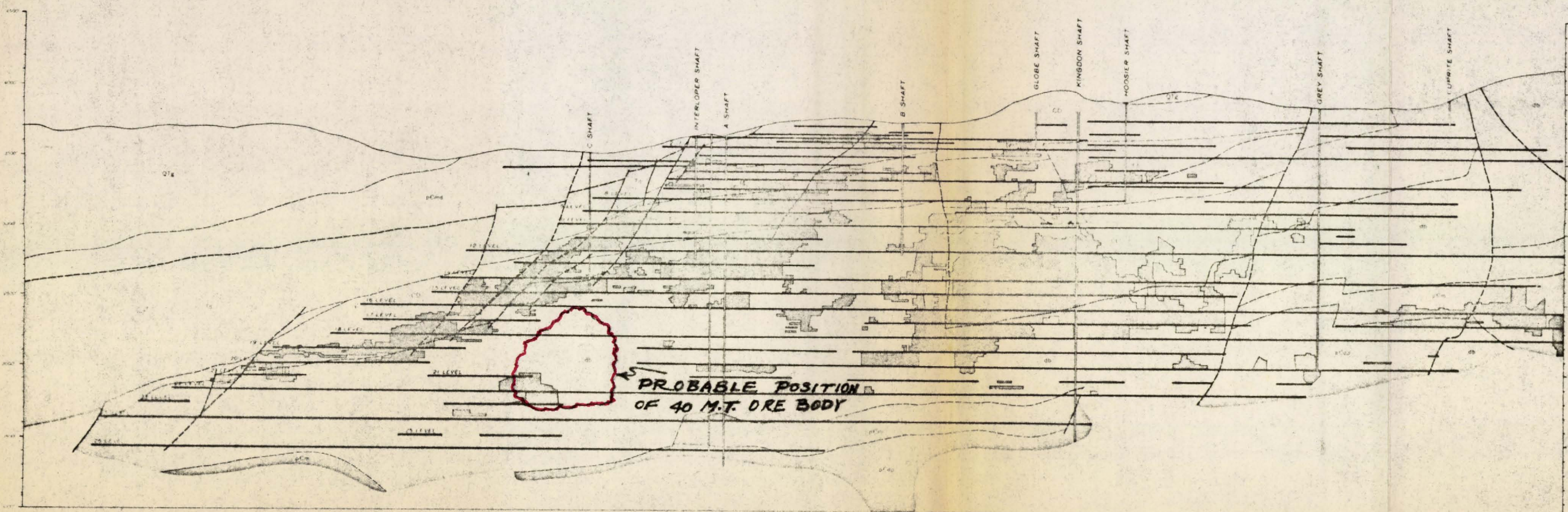


B.—OLD DOMINION B SHAFT





A.—GEOLOGY OF FOOTWALL OF THE OLD DOMINION VEIN



B.—GEOLOGY OF HANGING WALL OF THE OLD DOMINION VEIN

MINE WORKINGS OF THE OLD DOMINION AND UNITED GLOBE PROJECTED ON A VERTICAL PLANE N. 58° E., GLOBE-MIAMI DISTRICT, ARIZONA

500 0 500 1000 Feet

EXPLANATION

- Qtg Gila conglomerate
- Td Dacite
- Tw Whitetail conglomerate
- Db Diabase
Includes basal of Apache group locally
- Ls Limestone
- Iq Iron quartzite
- Ml Mesal limestone
- pCdq Dripping Spring quartzite and Pioneer formation
- pCnd Matara diorite
- Contact and minor faults
Dashed where approximately located
- Major fault
Dashed where approximately located
- Slope

PRECAMBRIAN CAMBRIAN DEVONIAN CRETACEOUS TERTIARY AND QUATERNARY

Geology compiled from company mine maps.
Many slopes above the 6 level are omitted for lack of data.