CONTACT INFORMATION
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Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

December 1st, 1941.

Dr. H.E.McKinstry,
Department of Geology,
University of Wisconsin,
Madison, Wisc.

Dear McKinstry:

Sorry I haven't a chance of being in Boston for the G.S.A.-S.E.G. meeting. I spent the first winters in the East for 20 years, in 1939 and 1940, and the G.S.A. met those years in Minneapolis and Austin respectively. At present the demand keeps right on through the winter out here, and since you have to make hay while the sun shines in the consulting business, it just costs too much in missed fees, beside the actual payed-out expense, to go east for meetings.

Coast range quicksilver deposits are surely sui generis in showing neat and pretty structural control. Most of those I have seen depend for their being on a brittle rock to crack, and a horizontal or vertical compressive stress to crack the brittle rock. Almaden and New Idria exemplify vertical stress, uplift. At Almaden a serpentine boss, stock, or possibly very thick sill was uplifted at a period very close to that of the silica-carbonate-cinnabar mineralization, and of course long after the intrusion of the serpentine and close folding of the Franciscan sediments surrounding it. The serpentine boss is capped by a layer of shale with thin sandstone lentils. The top surface of the serpentine mass has hills and vallies in it (structural, not erosional). Over the hills the cover was stretched; shear, flow, took place in the shale, turning it to gouge (the "alta", sometimes interpreted as a thrust). Where the relief of the serpentine surface was less pronounced, nothing much happened; the "alta" is recognizable shale and sandstone. Ore occurs on top of, and partly down the flanks of, the hills or rather ridges; the vallies and flat places are barren. The ore is found in cinnabar seams always perpendicular to the flattish alta: typical cross joints. Thus where the alta is gouge, there are cross joints and ore; where the alta is undisturbed shale, there are no cross joints, no ore. This fact was known in the 'eighties, and exploration was conducted by driving a drift in the footwall of the alta, in order to cut the seams perp. to the alta, for which seams the drift was a cross cut. I had never seen New Almaden when I gave my talk in N.Y. last Feb., so you can imagine my pleasure on seeing it. The brittle rock at Almaden is the crust of hard silica-carbonate rock that encases the otherwise rather soft serpentine.

That's all very well. But it is an autopsy; to search for more Almadens, we need, among other things, the whole picture of Almaden. For instance, we ought to know the relation between the serpentine boss and the folding in the Franciscan. Was it a hard nubbin that was there when the folding commended, and that resisted folding? Or did it flow in like a salt dome, during or after the folding? The sharp folds of the region, anticlines and synclines, seem to die out at the boss; the rock

the beds
very suddenly, and/surround the boss like an oilfied dome, so that the shale horizon that forms the alta seems to be always the same horizon. I have not yet succeeded in working out how the transition takes place, nor do I know how much the doming is due to Mesozoic deformation, how much to Pleistocene. What are the mechanics, anyway, of intrusion & folding, so often apparently associated in time? Which comes first, or are they simultaneous, and if so, how do they work? What is folding, anyway? I mean sharp anticlines and synclines, often overturned. I don't think it's Willis's Appalachian pushbox. The soft Coast Range sandstones and shales, yea, the late Tertiary unconsolidated but sharply folded gravels and sands, these could not transmit a compressive stress from the east edge of the belt to a buttress on the west (or vice versa) sufficient to buckle themselves as they are today. Whatever folded the beds must have been operative on them within themselves, not merely from outside.

What is the age of the folding here? Only Franciscan rocks are exposed. I have seen the Franciscan grade without notable uncomformity into lower Cretaceous, and Cretaceous into Eocene ditto; in places the whole works are folded. I do not say there was but one, and that a ~~xxxx~~ recent, period of Coast Range folding; of course not. But the various spasms have not been unravelled completely, leaving the man studying a sinle mine holding the bag. In hunting for a second Almaden it will not do to seek an empirical duplicate; obviously the association of quicksilver ore with serpentine is structural, not "genetic", for the ore came along eons after the serpentine. But to evaluate intelligently Coast Range quicksilver prospects, we need to know how these serpentine masses emplaced themselves in the first place; otherwise we cannot guess their shape, strength etc., factors needed in judging their reaction to the recent deformation that accompanied the quicksilver deposition. In other words, the Pleistocene deformation that formed openings for the ore was in effect new forces working on an old structural set-up (asis almost any deformation); to judge the effects of this late defomation we must know the details of the ancient structure that was deformed; and to understand these details, we must decipher the geologic history of their origin. That's the hell of it. But we have to look at everything.

Excuse this further discourse. I am full of this stuff and you are a congenial person to tell it to. It might make a bit clearer some of the points hinted at in the first letter.

Sincerely,

Edward Wisser

H. E. McKINSTRY SCIENCE HALL MADISON, WISCONSIN

Your letter is full of meat; just the sort of stuff I wanted. It will help a lot.
I would like to use quite a bit of it, whether in direct quotes or not (but of course with acknowledgment)
We must get together one of these days and hash some of these things out. Are you going to Boston at Christmas time? If so, what about giving us (S.E.G.) five minutes or ten on ideas on Hg?

MADISON
NOV 25
7 PM
1941
WIS.

BUY
DEFENSE SAV
BONDS AND ST

THIS SIDE OF CARD IS FOR ADDRESS

Mr. Edward Wisser,
533 Call Building,
San Francisco, Cal.

September 3rd, 1941.

New Almaden Corporation,
Almaden, Calif.

<u>To Edward Wisser, Dr.</u>

To professional services, New Almaden Mine, for August, 1941 (August 9th-16th).................................	$100.00
Carfare...	0.10
Lunch...	0.65
Ticket to San Jose......................................	0.95
" , Palo Alto to San Francisco..........................	0.55
	$102.25

Jan. 1st, 1942.

New Almaden Corpration,
Almaden, Calif.

<u>To Edward Wisser, Dr.</u>

To professional services, December, 1941......	$100.00
R.R. Ticket to San Francisco..................	0.95
Taxi...	0.45
Lunch..	0.52
	$101 92

New Almaden Corporation

Almaden, Santa Clara County, California

Date December 22, 1941 Voucher No. Check No. 2094

Edward Wisser [redacted]
74 New Montgomery St.
San Francisco, Calif.

NO RECEIPT NECESSARY

Check herewith in settlement as stated below.			CHARGE TO
INVOICE	PARTICULARS	NET AMOUNT	
12/22/41	Professional services as geologist, & expenses, months of October & November, 1941	$ 204.58	110 Exploration $ 204.58

New Almaden Corporation,
Almaden, Calif.

To Edward Wisser, Dr.

To professional services, November, 1941........$100.00

New Almaden Corporation

Almaden, Santa Clara County, California

Date October 23, 1941 Voucher No. Check No. 1756

Edward Wisser
533 Call Bldg.
San Francisco, Calif.

NO RECEIPT NECESSARY

Check herewith in settlement as stated below.

INVOICE	PARTICULARS	NET AMOUNT	CHARGE TO	
10/6	Professional services at New Almaden Mine - geology September 1941	$ 100.00	110 Exploration	$100.00

New Almaden Corporation,
Almaden, Calif.

To Edward Wisser, Dr.

To professional services, October, 1941.........	$100.00
Folders, paper etc. for report.................	1.58
Microphotographs (receipt attached)...........	3.00
	$104.58

October 6th, 1941.

New Almaden Corporation,
Almaden, Calif.

<u>To Edward Wisser, Dr.</u>

To professional services, New Almaden mine; at property, Sept.*3-7; writing quarterly report, Sept.8-12,1941............................$100.00

New Almaden Corporation

Almaden, Santa Clara County, California

Date September 6, 1941 Voucher No. Check No. 1542

Edward Wisser
533 Call Building
San Francisco, Calif.

NO RECEIPT NECESSARY

Check herewith in settlement as stated below.

INVOICE	PARTICULARS	NET AMOUNT	CHARGE TO	
9/3	Professional Services - August - Geological mapping	$ 100.00		
	Expenses	2.25		
		$ 102.25	110 Exploration	$ 102.25

New Almaden Corporation

Almaden, Santa Clara County, California

Date August 18, 1941 Voucher No. .... Check No. 1466

Mr. Edward Wisser
Call Building
San Francisco, Calif.

NO RECEIPT NECESSARY

Check herewith in settlement as stated below.

INVOICE	PARTICULARS	NET AMOUNT	CHARGE TO	
8/11/41	Professional services - July - geological mapping	$ 100.00		
	Expense	6.09		
		$ 106.09	Exploration 110	$ 106.09

April 20th,1942

New Almaden Corporation,
Almaden, Calif.

To Edward Wisser, Dr.

To professional services at mine, January,1942........$100.00

April 20th, 1942.

New Almaden Corporation,
Almaden, Calif.

<u>To</u> <u>Edward</u> <u>Wisser</u>, <u>Dr</u>.

To professional services at mine, February, 1942.....$100.00

New Almaden Corporation

Almaden, Santa Clara County, California

Date January 26, 1942 Voucher No. Check No. 2243

Edward Wisser
74 New Montgomery St.
San Francisco, Calif.

NO RECEIPT NECESSARY

Check herewith in settlement as stated below.

INVOICE	PARTICULARS	NET AMOUNT	CHARGE TO	
1/1/42	Professional services as geologist, & expenses, month of December, 1941.	$ 101.92	110 Exploration	$ 101.92

August 11th, 1941

New Almaden Corporation,
Almaden, Calif.

To Edward Wisser, Dr.

To professional services, New Almaden mine......	$100.00
5 thin sections for microscopic study @ $0.75..	3.75
Phone to Almaden, July 21st,1941................	0.35
RR ticket to San Jose,July 21st,1941............	0.95
Dinner, San Jose " " ".............	1.04
	$106.09

July 3rd, 1941.

The New Almaden Corporation,
Almaden, Calif.

To Edward Wisser, Dr.

To professional services, June, 1941.........	$100.00
Lunch, June 28th, 1941......................	0.52
	$100.52

New Almaden Corporation

Almaden, Santa Clara County, California

Date June 5, 1941 Voucher No. Check No. 1103

Edward Wisser
533 Call Building
San Francisco, Calif.

NO RECEIPT NECESSARY

Check herewith in settlement as stated below.			CHARGE TO	
INVOICE	PARTICULARS	NET AMOUNT		
6/4/41	Professional services & expenses - Geological mapping	$ 102.65	Exploration 110	$ 102.65

June 4th, 1941.

New Almaden Corporation,
Almaden, Calif.

To Edward Wisser, Dr.,

To professional service New Almaden Mine	$100.00
Phone to Almaden, May 3rd,1941	0.65
Ticket to San Jose " " "	0.95
" from " " May 11th,1941	0.95
Car fare	0.10
	$102.65

May 17th, 1942.

Mr.C.N.Schuette,
General Manager, New Almaden Corporation,
Almaden, Calif.

SUGGESTED SURFACE EXPLORATION, ST.GEORGE-SAN PEDRO-SANTA MARIANA AREA.

This area, on the north slope and summit of Capitancillos Ridge, is marked by one or more learge bodies of serpentine,apparently sill-like. The upper contact of the serpentine has been largely changed to vein-rock. Cinnabar can be seen at a good many places in this vein-rock;showings are ringed in blue on the accompanying surface map, scale 1" = 200'.

In the San Pedro workings, a prominent NW fracture,dipping 50° NE, carried the ore stoped above the main tunnel level. A winze down on the slip from the main tunnel shows ore in the bottom. This fracture is thought to be in the hangingwall of the serpentine sill exposed on the main ridge about 700' west of the Santa Mariana shaft (see map). The sill dips NE,like the San Pedro fracture,where exposed on the surface.

The actual cinnabar seams exposed in the main San Pedro tunnel along the NW fracture, strike NE and dip nearly vertically. Thus the NW fracture in general is a guide to ore, but in prospecting along the fracture attention must be paid NE minor fractures,which may carry cinnabar for varying distances NE of the main fracture.

The San Pedro NW fracture appears to have localized ore exposed on the surface for a considerable distance along its strike: witness the alignment of a zone of cinnabar showings, from a point about 350' south of the Catherine tunnel portal to a point immediately over the main San Pedro tunnel, a strike distance of nearly 1000'. Cinnabar occurs also however, elsewhere than along the San Pedro NW fracture. NW of the St. George Shaft a great serpentine sill dips westward. This may be the same sill as that mentioned above. At any rate, its lower surface is mineralized and carries cinnabar just west of the St. George Shaft. The other,or Santa Mariana sill, dips quite flatly near the Santa Mariana shaft and for at least 1000' NW,to the bulldozer cut recently made. The flat-lying Santa Mariana ore bodies probably lay on top of this sill.

The above summarizes known conditions of ore localization.

AREAS WHERE TRENCHING WITH BULLDOZER AND SHOVEL ARE SUGGESTED.

I. West of Catherine tunnel portal. Old reports speak of traces of cinnabar found continuously in this tunnel, which is apparently long. Cinnabar was found in the float just west of the portal. Trenching with the bulldozer should be done here. The structure is unknown; but assuming this showing to be along the NW extension of the San Pedro ore f acture, a series of NE trenches is suggested.

II. There is an ore showing just east of the mouth of the new cut here. An ore zone, if any, would probably extend SSE parallel to the serpentine contact. It is suggested that the present cut be enlarged on its E side, and if ore be found, that the cut be extended SSE.

III. This area lies along the surface projection of the San Pedro ore-fracture and immediately over the old stopes. It shows more cinnabar than any other nearby area. There is a skin of loose boulders over the slope of the ridge, that seems to carry ore. In addition, cinnabar was seen in a number of places in solid rock, which would have to be blasted to be mined. In order to get a look at this country the skin of loose material should be removed. It is suggested that a systematic series of bulldozer road-cuts be made, beginning at the top, in the triangle between the main ridge road and the road marked "New Road". Some at least of the loose stuff here is ore. It should be tried by a full days run in the furnace. If this operation is successful, the excavation may be continued SE to the cut showing ore, about 200' NE of Traingulation Station III.

While no detailed plans are offered, the general notion in my mind is to take this San Pedro slope and clean it systematically, beginning at the top, just below the main road. If removing surface material exposes massive ore in place, the latter should be blasted and mined. The "stripping" of loose material could keep ahead of this solid mining.

IV. I have placed the surface sinks over the flat Santa Mariana ore bodies on the map. This area is worth trenching; just where I cannot sat, but very likely beginning in the more solid vein rock near the Santa Mariana shaft. The soft material in the cut N of where I have marked "Tank Tunnel" (probably incorrectly) has some cinnabar and deserves a little cat or shover work, at least.

Insert: IA. The cinnabar showing on the main ridge, across the road and some 350' south of the Catherine tunnel portal deserves exploration.

V. The showing west of the St. George shaft, up the hill should be explored, probably by shovel due to the topography. VA. There is considerable good-looking vein-rock here, just west of the landslide. More detailed examination should be given this. possible by manual trenching. If the result is favorable, a cat-road may be made to this showing.

Edward Wisser

PROVIDENCIA-YELLOW KID JR. AREA.

POSSIBILITIES FOR POWER SHOVEL OPERATIONS.

General.- The Providencia-Yellow Kid Jr. area lies on the south slope of Capitancillos Ridge, about 1.6 miles west of Mine Hill. It is reached by driving along the ridge road to the point where the road leaves the ridge to drop down to the R.R.B. shaft; the car is left at this point on the ridge and a trail followed down the slope to the Providencia mine.

The Providencia produced several hundred tons of high grade ore prior to 1864. All work ceased at the Providencia proper in 1872, except for a crosscut tunnel and short drift run in 1909. In 1872 and before that time, only high grade ore was mined; this fact, with the high grade of ore found and the abundant vein rock float combined to make the Providencia worth investigating now. The Yellow Kid Jr., about 600' south of the Providencia (see surface map) produced 170 tons of high grade ore in 1898 from a surface cut; an attempt to get under this ore body by a tunnel was drowned out by water in 1899. The Yellow Kid Jr., too, merited investigation. The writer spent March 20th and 21st, 1942, on these properties, mapping all accessible underground workings, and, less completely, the surface. His findings are set forth below.

Geology.- The salient feature is a mass of serpentine just north of the Providencia workings, and extending some distance up the slope of the ridge north toward the crest. (See surface map). This mass appears elongated roughly east-west, and its south contact strikes E-W in this area. The contact strikes from steeply south to vertical. (Sections A-A', B-B').

Where workings have penetrated even a few feet into this mass (see Composite Plan of Workings) it shows as a dark, massive rock, incompletely serpentinized--more peridotite than serpentine. It is an obvious intrusive, and its coarseness of grain accords with its great size.

The serpentine mass is fringed on the south by a zone of vein rock, less regular than shown on the surface map, which is generalized because of the scarcity of exposures. Some of this vein rock, the more typical silica-carbonate rock, especially immediately next the steep contact of true serpentine, is altered serpentine. But a great deal of it, farther away from the serpentine mass, is ochreous material traversed by stringers of carbonate, and is altered sandstone, for residual areas of obvious sandstone may be seen in it. Tongues of serpentine that appear to be sills strike parallel with the main serpentine contact and dip into it. (Section B-B' and Composite Plan of Workings). Such tongues are usually mineralized and in places have been changed to true silica-carbonate rock.

South of the vein rock are Franciscan sediments: sandstone and shale. The usual difficulty in deciphering the structure of Franciscan sediments is met at the Providencia. Nevertheless the writer believes the sediments here strike roughly east-west and dip toward the serpentine mass. Eight attitudes are shown on the composite plan; seven of these show dips northerly, toward the serpentine; the eighth shows an eastward dip. The dominant dip of the sediments is shown on the vertical sections. A-A' suggests a steepening of the dip of the beds as they approach the serpentine mass on the north; such a structure might be part of a sharp anticline overturned to the north, with the serpentine a thick sill. This is not thought to be the case. The south contact of the serpentine seems to truncate the beds; it looks discordant; tongue-like offshoots from the main mass, on the other hand, look like sills. (Section B-B'). A discordant relationship of the serpentine to the beds implies that the serpentine mass was shoved into the position it now occupies. The serpentine along its contact and for a short distance inside is notably schistose; the planes of schistosity parallel the contact. Schistosity suggests shearing, movement of ground along the contact, combined probably with an outward shove from the mass into the beds to the south. It suggests also that the igneous mass was shoved into its present position after serpentinization.

The Composite Plan and the sections show a number of faults south of the serpentine, striking parallel to the contact and dipping into it. Important faults dipping southward, away from the serpentine, are found only near the mouth of the Ravine tunnel; most of these seem to belong to the best developed fracture system of the area, the north-south system.

North-south fractures occur mainly however within the vein rock belt along the south contact of the serpentine. These fractures die out toward the massive serpentine on the north, and probably also toward the south, in the less brittle sediments south of the vein rock belt. They strike roughly normal to the serpentine contact, and look like tension fissures. Such fissures are usually aligned parallel to a direction of compressive shove; planes of schistosity are commonly oriented perpendicular to a direction of compression. Both fissures and schistosity would be explained in this case if the supposed uplift of the serpentine mass were accompanied by a shove to the south, as if the mass were making room for itself. The faults parallel to the serpentine contact and dipping steeply toward it probably originated in the upward shove of the mass.

<u>Mineralization. Ore</u>.- The belt of vein rock next the serpentine has been described; it is not certain whether this belt strictly parallel the steep serpentine contact (which may flatten in depth; see Section A-A'), or whether it makes out in favorable beds that dip into the contact. It probably follows mainly the contact, making away from it in certain beds. A second mass of vein rock forms the cliff above the Ravine tunnel portal, and is exposed in the tunnel from the portal to the serpentine 200' in. (Composite Plan; Section A-A'). If this serpentine is continuous with the main mass to the north, then the Ravine tunnel vein rock may connect with the vein rock to the north; but if so the belt plunges beneath the surface between these two areas, for no vein rock connects them on the surface.

The north-south fissures in the main Providencia mine have been mineralized to form carbonate stringers. Very little cinnabar can be seen at Providencia; what little there is seems to occur for the most part as tiny seams in narrow north-south carbonate stringers. The Providencia production came apparently from four stopes; (1) near the incline, NE end of Section A-A'; (2) west sub-drift, Providencia tunnel; (3) above the east drift, Providencia tunnel, probably at about the elevation of the -700 tunnel; (4) Hilo tunnel. All these localities lie within the belt of vein rock adjoining the main serpentine contact, and all but (2) are where concentrated zones of north-south fissures cross that belt. (20 seems to be localized beneath a gougy flat fault or alta (possibly a sheared thin shale bed) and in a bed of brittle sandstone. One north-south fissure crossed this ore body.

The vein rock at Providencia, between these ore loci looks complet ly barren except in the -630 double adit, where a few colors were seen near the portal, along a NW fault and a N-S fissure.

Not much could be made out concerning the Yellow Kid Jr. Cchreous material remaining around the walls of the cut looks promising, and the suggestion is that it is flat-lying. Selected material sacked but never shipped, presumably from the cut, carries cinnabar. It is possible that the Yellow Kid Jr. vein rock is a flattish continuation southward of the Vein rock near the Ravine tunnel portal.

Conclusions.- To make the Providencia-Yellow Kid Jr. area tributary to the furnace, in case ore were found, would require nearly half a mile of rather heavy road construction, from the R.R.B. shaft on the present road east along the south slope of Capitancillos ridge. Trucking distance to the furnace would be about 2.5 miles.

At Providencia, the small though highgrade ore bodies appear to ha been mainly localized along zones of north-south fissures, within the vein rock belt adjoining the serpentine mass on the south. Elsewhere the vein rock is exceedingly "tight" and apparently barren. This area does not seem to me to offer possibilities for power shovel operations of any magnitude. It is true that the old tunnels near and west of Section A-A' may have been started too high on the hill; i.e. there is apparently some unexplored vein rock below (south of) their portals. But this is not the case near the Providencia adit, which is is barren shale and sandstone for 100' north of the portal. While this vein rock belt may possibly be continuous, through flattening, with that near the portal of the Ravine tunnel (Section A-A8), nevertheless if so the belt plunges beneath the surface in the intervening stretch, for hard barren sandstone outcrops there. Prospecting this possible stretch of vein rock by power shovel would be expensive. I do not recommend such work for Providencia. If nevertheless it is decided to try it, then the following scheme suggests itself.

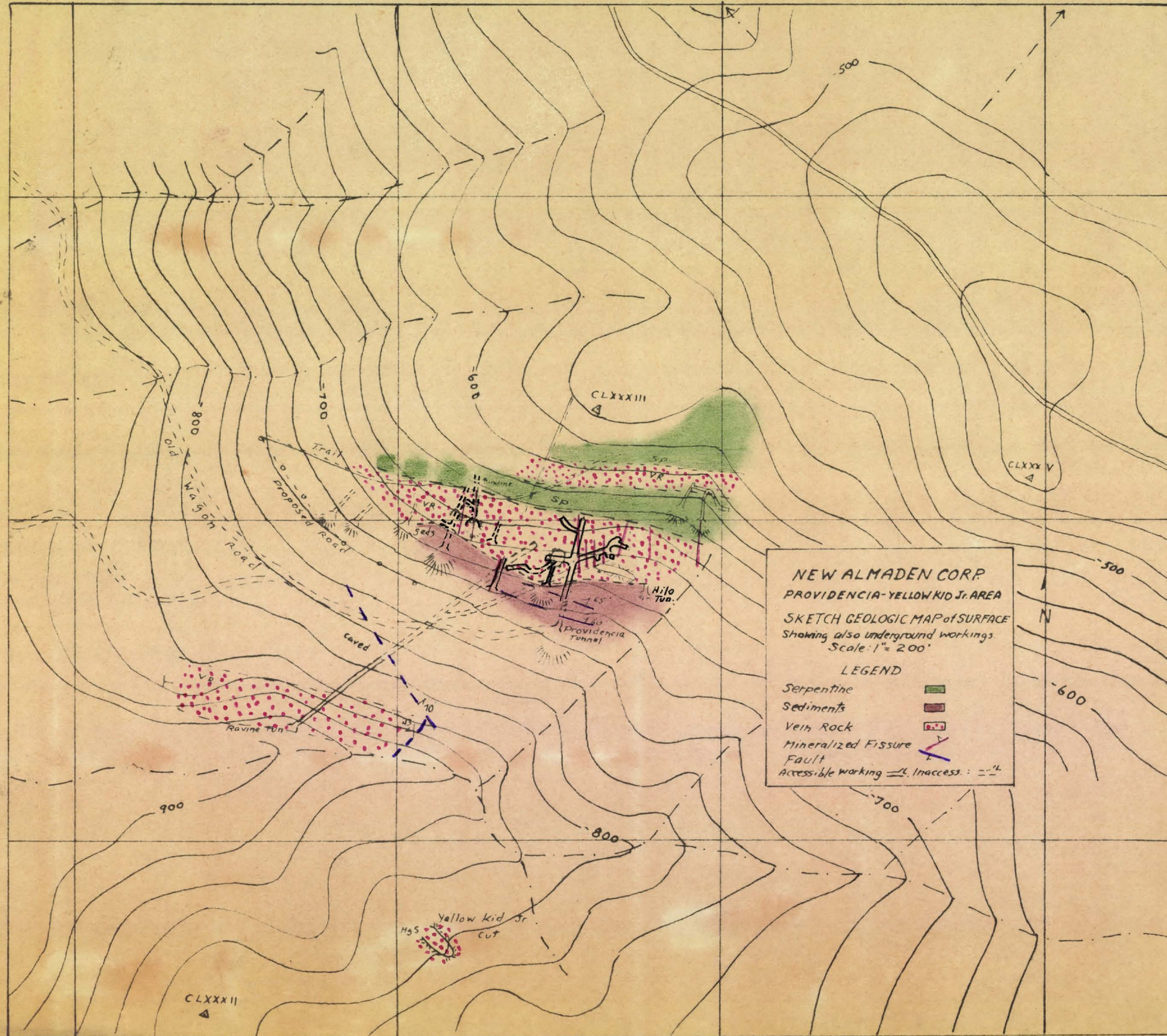
(1) Cut north, straight into the hill, along Section A-A', vicinity of -690 and -660 tunnels. There was a stope here, and the surrounding vein rock looks better than elsewhere. (2) Make a similar cut, vicinity of tunnel -700, near Section B-B8. (3) Possibly a third, similar cut, above the stope in the Hilo tunnel. (4) A longitudinal cut might be tried, along the line of portals of the old caved tunnels west of Section A-A'.

The Yellow Kid Jr. could be prospected with the bulldozer alone, since it seems to lie flat in flat country, while the above work would need a shovel (also a poetable compressor) and the extension of the road, The bulldozer could be brought in down the slope without a road.

I recommend that the bulldozer, when it can be spared, be brought down to the Yellow Kid Jr. and that an attempt be made to find lateral extensions of the apparently flat-lying vein rock now exposed in the Yellow Kid Jr. cut. At the same time, the longitudinal cut suggested in Item 4, Providencia, could be tried with the bulldozer. If this work should open up sufficient ore to make this area a real prospect, then the proposed extension of the road from the R.R.B. shaft can be constructed and a shovel brought in to continue the work started by the bulldozer.

New Almaden Mine,
Santa Clara Co., Calif.
March 22nd, 1942.

Edward Wisser



NEW ALMADEN CORP.
PROVIDENCIA-YELLOW KID Jr. AREA
SKETCH GEOLOGIC MAP of SURFACE
Showing also underground workings
Scale: 1" = 200'
LEGEND
Serpentine
Sediments
Vein Rock
Mineralized Fissure
Fault
Accessible working Inaccess.
N
500
600
700
800
900
CLXXXIII
CLXXXV
CLXXXII
Old Wagon Road
Proposed Road
Trail
Caved
Ravine Tun.
Hilo Tun.
Providencia Tunnel
Yellow Kid Jr. Cut
HgS
SP
VR
Seds

DOMES: New Almaden Hg, Calif.

Serpentine, probably as thick sill, in Franciscan ss., sh. etc. Original fold trends NW; supeimposed on this is a most irregular dome, suggestion that serpentine squeezed in and up while ~~still plastic~~ plastic. Dome has a ser es of noses on its surface, plunge down flabks. Outer shell of serp, mass altered, to varying extentmto silica-carbonage rock, intimate, fg. mixture of chalcedony and dolomite. FwW or lower surface of shell gradational, but upper surface sharpy, defined, marked by layer of gougy dark squeezed stuff--alta: squeezed shale with ss attrition boulders. Shell intensely cracked below this alta, most cracks perp. to alta surface. More squeezed the alta, greater the number and strength of cracks. Brittle block subjected to compression, tends to crack, cracks contain direction of compression. With brittle block between two soft layers, tendency to crack greatly increased, for segments of block between incipient cracks glide away from each other thru lubricating action of soft layers. Cover thereby stretches.

These cross cracks commonly filled with dolomite, but s.t. with HgS. Enough with HgS, OB.

If the whole serp. mass had been vertically uplifted, maximum stretching would be across crest-lines of anticlines or noses. Silica-carbonate shell acts like a bed, flexed, because it has soft alta above it, soft sepp. below. (Not too soft however to transmit stress). Ore prefers noses, shuns valleys, where blocks are slipping together, no cracking. Crests also probably acted as traps for ascending gaseous HG solutions, as crests of anticlines and domes trapped petroleum.

Concentric and radial fissures also localized ore (S.F. mine).

EDWARD WISSER
MINING GEOLOGIST
533 CALL BUILDING
SAN FRANCISCO
TELEPHONE GArfield 4676

September 10th, 1941.

Mr. C.N.Schuette,
General Manager,
New Almaden Corporation,
Almaden, Calif.

Dear Sir:

Herewith is submitted the initial progress report on the geologic work at New Almaden. The report covers a four-month period. Growing aquaintance with a mining district leads to the accumulation of field data and ideas on ore control at a progressively increasing rate. From now on it is hoped to report progress at quarterly instead of four-month intervals.

Yours truly,
Edward Wisser
Edward Wisser

PROGRESS REPORT, GEOLOGIC WORK AT NEW ALMADEN MINE.

INTRODUCTION.

The following report sums up results of work at the property of the New Almaden Corporation during May, June, July and August, 1941. An average of one week per month was put in, with a total of 29 days spent on the property.

Field Work.- The geology of a surface area 2000' x 2000', in the general vicinity of Mine Hill has been mapped. Underground, approximately 9200 linear feet of workings have been mapped in detail, covering practically the entire Harry and Cora Blanca mines.

Office Work.- The following maps are in the stages of completion indicated:

Map	Scale	% Completion
Surface map to cover area of main mine, from Buena Vista shaft south.....	1" = 200'	20%
Composite mine map, same area......	1" = 200'	35
Composite mine map, Cora Blanca...	1" = 40'	80
Mine Hill opencut, surface map.....	1" = 40'	Up to date.
Composite mine map, workings below opencut..............................	1" = 40'	50
Three vertical sections thru Mine Hill.............................	1" = 100'	100

The geology of about 10,000 linear feet of inaccessible workings has been plotted on the 1"=200' composite mine map from old records. The process is somewhat laborious, but it serves to fill out the general picture by adding areas not likely to be opened up for personal observation in the immediate future.

A number of thin sections have been made of rock specimens. Study of these under the microscope has aided the recognition of the various rock types, such as greenstone, arkosic sandstone etc.

Object of this Work.-The field work consists of mapping, on a topographic surface map, or an underground level map, the various significant rock formations, such as sedimentary beds, serpentine contacts, mineralization, quicksilver ore, etc. The office work consists in the preparation of convenient maps from the individual field sheets, in order to portray at a glance the features studied in the field.

There is but one objective in all this work: to find ore. The method pursued in the search for ore, although complicated in practice is simple in principle--to determine by the study outlined under what conditions known ore bodies were localized, and then to search for new areas offering suggestions of similar conditions. The present study is still in the first stage, that of the assemblage of facts bearing on the localization of known ore bodies; but already certain areas suggest themselves as offering promising chances for ore.

The following report starts with a description of the structural setting of the former ore bodies, attempts to formulate some guides for exploration based on this study, and uses these guides in pointing out several areas that seem to show promise. These are as yet merely tentative notions, and doubtless will be somewhat modified as new facts are accumulated.

GEOLOGIC ENVIRONMENT OF THE NEW ALMADEN ORE BODIES.

Area Discussed.- The area discussed is that of the accompanying composite mine map.

General Geology; Structure.- Ore bodies never simply happen; there is always a reason for their occurring where they do. Solutions, usually rising from considerable depth, drop their load of ore and gangue minerals where conditions for deposition are right. The right condition may be primarily chemical, e.g. an easily replaced rock such as limestone in the path of the solutions; or primarily physical, e.g. an easily fissured rock into which the solutions penetrate and drop their load. At New Almaden there is little or no replacement, and it is plain that the factors localizing the ore bodies were in the main structural or physical rather than chemical. It is necessary therefore to review the geologic structure at New Almaden and see how certain favorable structures effected the localization of the ore bodies.

The New Almaden mine lies within the Coast Range province of California, where the main structural trends, i.e. those of the major faults, folds and intrusive masses is northwest. Mine Ridge, at the south end of which the main New Almaden mine lies, seems to be no exception. The dominant rocks are sediments, of Franciscan (upper Jurassic) age, comprising arkosic sandstone, shale, chert and beds of conglomerate. Intercalated in this series are sheets of greenstone, (highly altered lava), also of Franciscan age. Intrusive into this series are masses of serpentine.

The sediments appear to be rather sharply folded into a series of anticlines and synclines trending northwest. In the northeastern part of the area discussed this regional structure prevails. But over the rest of the area within which lies the main New Almaden mine, the regional structure is disturbed. The disturbance is connected with a great mass of serpentine, forming the core of Mine Hill. The mass is like an underground mountain, cropping out at the surface in a limited area, and widening with depth. Around this mass lie the Franciscan sediments, and they strike in this border zone, not necessarily northwest, but conformably to the flanks of the serpentine mass.

The nature of this serpentine mass is not understood, other than the fact that it is intrusive into the Franciscan sediments. It may be a stock, extending to unknown depths; or it may be a thick sill, partaking to some extent in the folding of the sediments, but resisting to some extent also. The writer suspects that the mass is both stock-like and sill-like: a central core which is essentially a stock, with sill-like offshoots into the surrounding sediments. In the present discussion, the top surface of the stock or sill will be described. This surface nearly everywhere forms the footwall of the ore bodies.

The shape of this surface is only partly known. The serpentine mass outcrops near the summit of Mine Hill, the outcrop extending to near the portal of the Main Tunnel. The mass increases in area with increasing depth, and the shape in horizontal section appears to be that of an ellipse, with the major axis trending northwest. The southeast "prow" of the ellipse is fairly well indicated by mine workings (Cora Blanca); but the northwest "prow" is not exposed.

In a very general way, then, the serpentine "mountain" has the shape of a hogback, sloping outward on the northeast, southeast, south and southwest sides. On the accompanying map, the winding workings are drifts that follow for the most part the upper surface of the serpentine mass; the drifts may be considered as contours of the "mountain". Not all the drifts have been placed on the map, so that the "contour map" is as yet quite incomplete. However, they are complete enough to show a number of irregularities in the serpentine surface. These have an important bearing on ore, and will be briefly described.

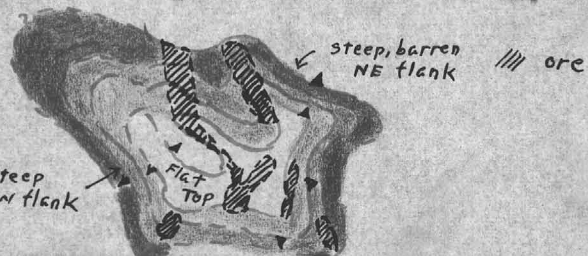
The top of the "mountain" is flattish, a sort of sloping plateau, part of which outcrops on the southwest side of Mine Hill. Passing underground, the plateau slopes gently down to the north; the Great Santa Rita ore body lay within this nearly flat surface. North of the Giant Powder ore shoot this north slope of the "mountain" steepens rapidly, so that in the lower levels of the mine it is in places vertical or even overturned. Two "spurs" or "noses" mark the northern slope. The most pronounced nose lies just east of the Randol shaft; here each drift makes a sharp bend convex to the north. The other nose lies west of the Randol shaft, and is very broad and gentle. Between the two noses is a "canyon" or valley, very pronounced between the 1200 and 800 levels.

The northeast side of the "mountain" is marked by a steep wall, trending northwest and dipping steeply northeast. This is exposed in the Day tunnel. This slope flatten above the Day tunnel (800) level, and dips about 40° in the Great Eastern Tunnel. There must be a very pronounced nose pointing east south of the Great Eastern Tunnel, as suggested on the map. From the vicinity of the Santa Maria shaft to the Cora Blanca mine, the serpentine contact is very irregular in detail, with a number of minor noses and valleys, but in general slopes gently down to the east. At the south end of the Cora Blanca mine it swings decidedly to the west; this is the southeast "prow" of the ellipse. Nothing is known of the contact between here and the San Francisco mine.

In the San Francisco mine, the contact probably trends northwest and dips southwest about 40°. Ore formed along this gentle slope (New World ore body) and along a steep northwest fissure passing through the San Francisco shaft. To the northwest, in the workings from the Almaden shaft, the contact strikes west of north and dips steeply west. No ore was found in this stretch.

The north slope of the serpentine mass was followed west from the south crosscut, 1400' level, from the Santa Isabel shaft, for about 500' (Report of S.B.Christy, 1889). It strikes about west in this segment. Prolonging this strike west, and that from the Almaden shaft 500' level northwest, as shown on the map, is as close as we can come at present to outlining the northwest periphery of the serpentine oval.

In summary, the general structural picture is that of a serpentine whaleback trending northwest. The whaleback is flattish on top; its northeast and southwest flanks are straight, steep, and in the main barren of ore. The north side of the whaleback is marked by a pair of noses looking north; The west side of the eastern nose, and the very apex of the flatter nose, carry almost continuous stopes to the 1800' level.



The eastern slope, toward the southeast "prow", forms a gently sloping curved surface, a true whaleback; the Harry and Cora Blanca stopes lie on this surface. The New World stope lies on the corresponding gently curving surface on the western side of the whaleback. A local nose has helped localize the Cora Blanca ore bodies, and a similar one may have localized the New World system of ore shoots.

Note that the general trend of the New Almaden ore bodies, except the New World system, is a little west of north, or transverse to the major axis of the serpentine oval. This is probably due to a north-south arch superimposed on the northwest-trending oval, which is itself probably an arch plunging down at both ends. An ore control already suggested, then, is furnished by the tops and sides of arches or "anticlines".

<u>Localization of Ore Shoots.</u>- The subject of ore occurrence has been introduced into that of the general structure, in order to show the close connection. Structural factors localizing ore shoots are now described in more detail.

Ore at New Almaden occurs in a chararacteristic manner. The outer shell of the serpentine mass is changed to "vein rock", i.e. altered serpentine now an extremely fine-grained and intimate mixture of chalcedony and dolomite, with irregular stringers of these minerals and considerable iron oxide.

This intense alteration preceded the introduction of cinnabar. The thickness of the altered shell varies greatly, and the footwall or inner boundary of the shell is gradational toward straight serpentine.
The outer edge of the shell, on the contrary, is usually very sharply defined, and marked by a layer of gougy, dark squeezed material locally called the "alta". Careful examination, including microscopic study, has demonstrated the fact that this alta is squeezed shale, often with sandstone lenses that have been broken and rounded by attrition. Through the Harry and Cora Blanca mines, at least, this shale is always the same formation, a unit in the stratigraphic series of the Franciscan sediments. This means that here the upper surface of the serpentine is strictly sill-like, i.e. the intrusion has not cut across the sediments at all.

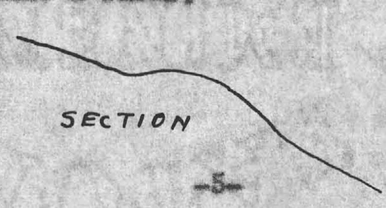
The shell of vein rock beneath this alta has been intensely cracked in places, and most of the cracks are oriented perpendicular to the plane of the alta. This was pointed out as early as 1889 by S.B. Christy.

The writer has noticed in many places that the more squeezed the alta, that is, the more movement along it, the greater the number and strength of the cracks perpendicular to the alta. This suggests the action of a cracking force acting perpendicular to the plane of the alta; in general, it suggests uplift. The writer has seen precisely the same thing at San Dimas, Durango, Mexico, and at the Abbott quicksilver mine in Lake County. The principle is simple. Where a brittle block is subjected to compressive force it tends to crack, and the cracks are parallel to the direction of compression. Where the brittle block lies between two soft layers, the tendency for it to crack is greatly increased, for the segments of the block between incipient cracks can glide away from one another through the lubricating action of the soft layers. (See sketch above).

These cross cracks are commonly filled with dolomite, but in some places, with cinnabar. Where enough are filled with cinnabar, an ore body results; the suggestion is strong that the cracking in such cases took place just as the cinnabar was being introduced, that in places where dolomite fills the cracks, at a period too early for the cinnabar.

The sketch above shows that with uplift, the maximum stretching of the vein rock shell takes place at anticlines or arches or domes. The material in stretching tends to move laterally down the flanks of the arch toward the adjoining synclines or troughs, so that tension prevails on the arch crests, compression in the intervening troughs. This accounts, in part, for the preference of ore bodies for the crests, and their avoidance of the troughs. The crests, also, probably acted as traps for ascending cinnabar solutions, just as the crests of anticlines and domes trapped petroleum.

The arches or "anticlines" thought to have localized ore shoots at New Almaden were not necessarily on the very top of the serpentine oval. I have shown that on the north slope two noses occur; these are simply anticlines pitching down the north slope of the mass; here they look like noses. An anticline part way down a slope and trending with a contour of the slope would look on the structural map like a shelf:



With these points in mind, the main ore occurrences will be briefly reviewed.

The Cora Blanca ore bodies were localized along a decided nose pointing southeast. This gives them a rake transverse to the dip of the serpentine contact here, which is due east. This south-eastern projection of the line of rake has never been explored below the 700' level.

The Harry ore bodies were localized along a shelf in the eastward-dipping flank of the serpentine mass, north of Cora Blanca. East of these stopes the flank slopes moderately east; but west of them, the surface of the serpentine is nearly flat. Compare section, bottom of page 5.

For the Ardilla, Dios te Guie etc. group of ore bodies under Mine Hill, the map (data incomplete) suggests localization along a local ridge in the generally flattish upper surface of the serpentine mass. According to the Christy report of 1889, the Great Santa Rita, the northern continuation of the ore bodies mentioned, was along a narrow, long arch or ridge, the overlying alta dipping east and west from the central axis of the ore body, as indicated on the map.

The Great Santa Rita ore shoot split toward the north, one fork being the Santa Rita East, the other the Santa Rita West. The Santa Rita East continued north down the north slope of the serpentine mass, so long as one or more noses persisted in that direction. But this ore shoot stopped at the brink of the large "canyon" already described, lying southeast of the Randol shaft, and marked "valley" on the map. This valley is notably barren of ore. No arching, no ore.

The Santa Rita West branch ran along the southwest edge of a well-defined nose or ridge pointing northwest. The Don Federico group of ore bodies appears to have lain along a gentler downward continuation of the same nose, which here swerves to the north.

Note on the map that on the 2100' level both the nose east of the Randol shaft, and that west of it, gives out with depth, so that the 2100' level exhibits no convexities toward the north (noses seen in plan). All ore quit above this level.

CHANGES FOR FURTHER ORE.

While not every ridge or nose on the upper surface of the serpentine mass can be assumed to be ore-bearing, all such structures as yet incompletely unexplored warrant exploration. Unexplored areas close to known ore also warrant exploration, even where nothing is known of the structure.

<u>South Flank of the Serpentine Mass.</u>-A glance at the map shows the marked north-south trend of the ore shoots, corresponding to the trend of the arch superimposed on the northwest-trending whaleback. It is hard to fathom why the south flank of this plunging arch was never explored, between the Cora Blanca and San Francisco mines. Many New Almaden ore shoots ended going upward far below the present surface, so that lack of ore outcrops is no argument against possible ore on this south flank of the serpentine mass.

A definite exploration objective leads into this area. That is the unexplored south or southeastward extension of the pitch of the Cora Blanca ore shoots. From a geologic (not necessarily a mining) viewpoint, the way to explore this is by continuing the 800 Cora Blanca to the south. This general objective was stressed by Schmette in his report of 1935. The present writer believes that this project in particular and the exploration of the south flank in general, offers the best chances for large new ore bodies in the area discussed. Detailed plans for exploration must be left for a later date. In practice, the exploration level will probably lie above the 800 Cora Blanca, for the latter presents operating difficulties.

East Flank of the Serpentine Mass.- The straight, steep northeast flank of the mass, exposed in the 1100 East and in the Day and Great Eastern Tunnels, is unfavorable. But a nose pointing east must exist to the south, as described above. This nose is worth exploring. It might be explored by driving east along the contact from the Day Tunnel; by similar driving from the Great Eastern Tunnel, after reopening that tunnel; possibly by a west crosscut from the Neff Tunnal, which having been driven in hard rock, is probably caved only near the portal. Again, detailed plans for exploration must await the collection of more data.

Top of the Mass.- Exploration on the plateau-like top of the serpentine mass has been very limited. This area contained the Great Santa Rita ore body. Other, similar ridges, like the one that localised the Great Santa Rita, may exist here. The logical way to explore this area is from the Santa Rita shaft. The serpentine contact should be explored both east and west of the Great Santa Rita ore body.

The above three are the exploration projects most obvious at present. A few more doubtful ones, or less convenient to tackle, will next be mentioned.

Northeast Flank above Day Tunnel.- While the northeast contact is straight, steep and unfavorable from the 800 (Day Tunnel) to the 1100 levels, the map suggests a nose above that tunnel. It is true that the Great Eastern tunnel explored part of this nose without result; but there is room for a fair sized ore shoot still, for all drifts along the contact above the 1000' level stopped well west of the nose. This area might be explored by raising from the Day Tunnel. This nose seems to be the northeast continuation of the Harry "shelf"; the Harry stopes trend toward it, giving an additional reason for its exploration.

North Flank, South of Santa Isabel Shaft.- All west drifts along the contact, from the 900 level down, seem to have stopped just short of a nose pointing north. The two ore bodies stoped above and below the 1500 seem to be on this nose, where it is flattening with depth. Certainly the ground above these ore bodies has not been sufficiently explored. Leasers working from the Victoria shaft report that the 1100 in this area is at present dry, and that considerable ore was left there. The 800 level makes the turn to the south round the sharp nose described (below the Ossuna stope). If we open the mine on the 800 level in this area, I suggest continuation of the 1000' level west drift to the west. Toward the south, and from the 900 level up, this area is probably unfavorable, for a deep valley trends from here southeast toward the Junction shaft.

Northwest "Prow" of the Serpentine Oval.- With its position and shape unknown, this portion of the oval cannot be evaluated at present from the viewpoint of possible ore. As a start toward such evaluation, it is planned to map the serpentine contact on the surface above this area in detail.

GENERAL.

The present initial report attempts to lay the groundwork for guides to new ore at New Almaden. Work so far has suggested (in line with notions advanced by Schuette in 1935 but developed independently by the present writer) the localization of ore along ridges, domes, noses etc. superimposed on the top surface of the great mass of serpentine that makes up the core of Mine Hill. Such favorable structures form however, but one of two factors in the localization of ore bodies; they form a receptacle for ore. The other factor is the presence of quicksilver-bearing solutions in the vicinity of such favorable structures. Much of the "vein rock" at New Almaden is quite barren of ore, although all ore is contained in the shell of vein rock. The altering solutions that formed this shell entered the area at a time distinctly earlier than the time of cinnabar deposition, although within the same general epoch. Only in favorable localities did cinnabar deposit in the vein rock shell. Most of the favorable structures can probably be found by ordinary field mapping; these should be explored within the vein rock shell, i.e. along the upper surface of the serpentine. But it would be extremely desirable if we could go a step farther, and be able to decide which among these favorable structures offer signs that cinnabar solutions were actually operative in their areas.

Just as the solutions entering this region before cinnabar deposition altered extensively the top surface of the serpentine mass, so it may be possible that the cinnabar solutions effected alteration of the wall rocks immediately surrounding the ore bodies that these solutions built up. In this case, a "halo" or "envelope" of altered rock would surround the ore bodies, and since the halo would be considerably larger than the ore body contained within it, the halo should be easier to find, and hence would form a guide to ore. If now this possible "ore type" of alteration may be distinguished from the earlier, wide-spread type, then a practical guide to ore may be formulated, that of characteristic wall rock alteration indicating a near-by ore body. It is planned to make thin sections of the wall rock adjoining a number of the old stopes, to see whether a diagnostic type of wall rock alteration does accompany the deposition of ore at New Almaden. If we can add this microscopic ore guide to the structural guide we already have, the precision of our exploration for new ore should be materially increased.

Edward Wisser

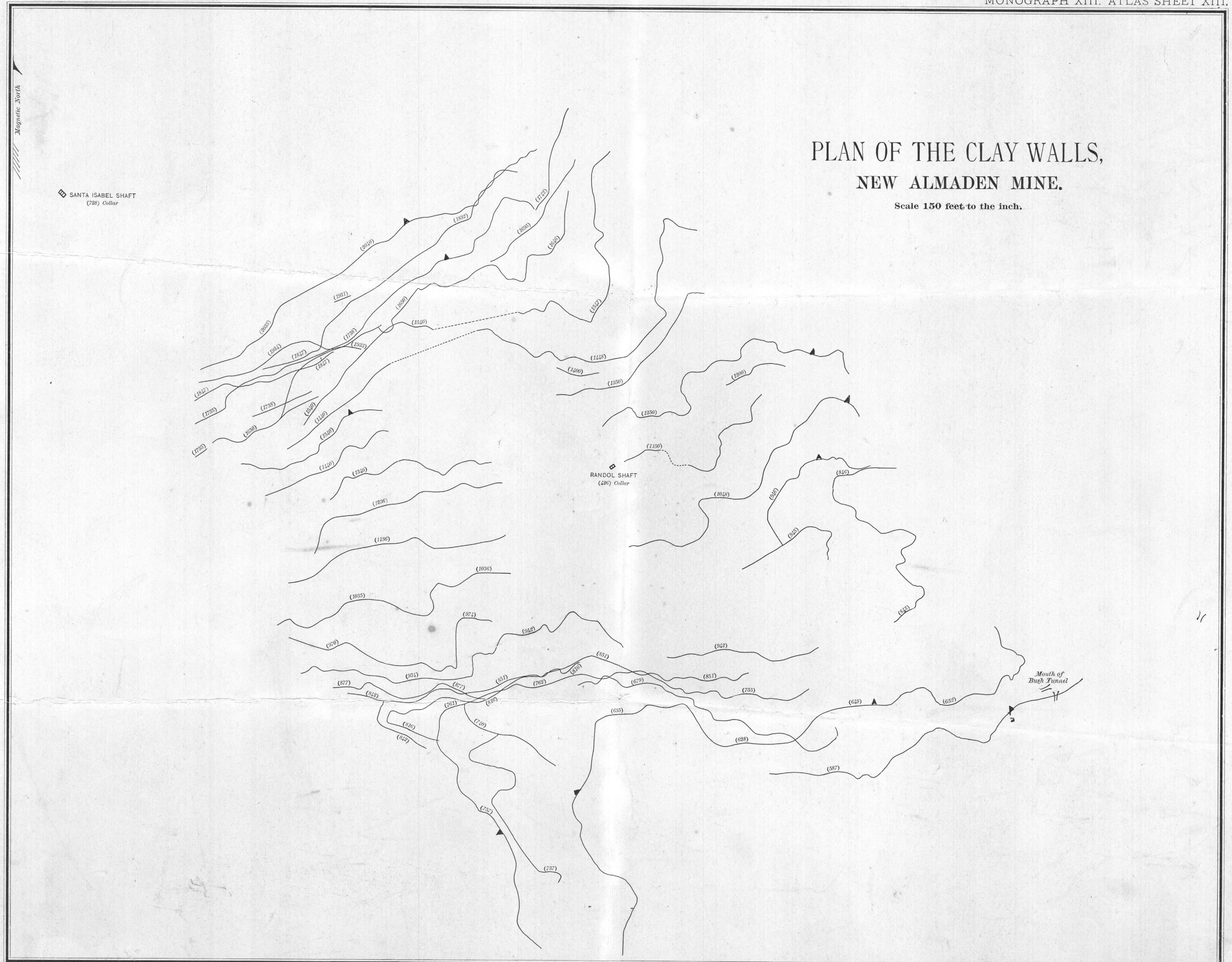
New Almaden, Calif. Edward Wisser
Sept. 5th, 1941.

Wisser

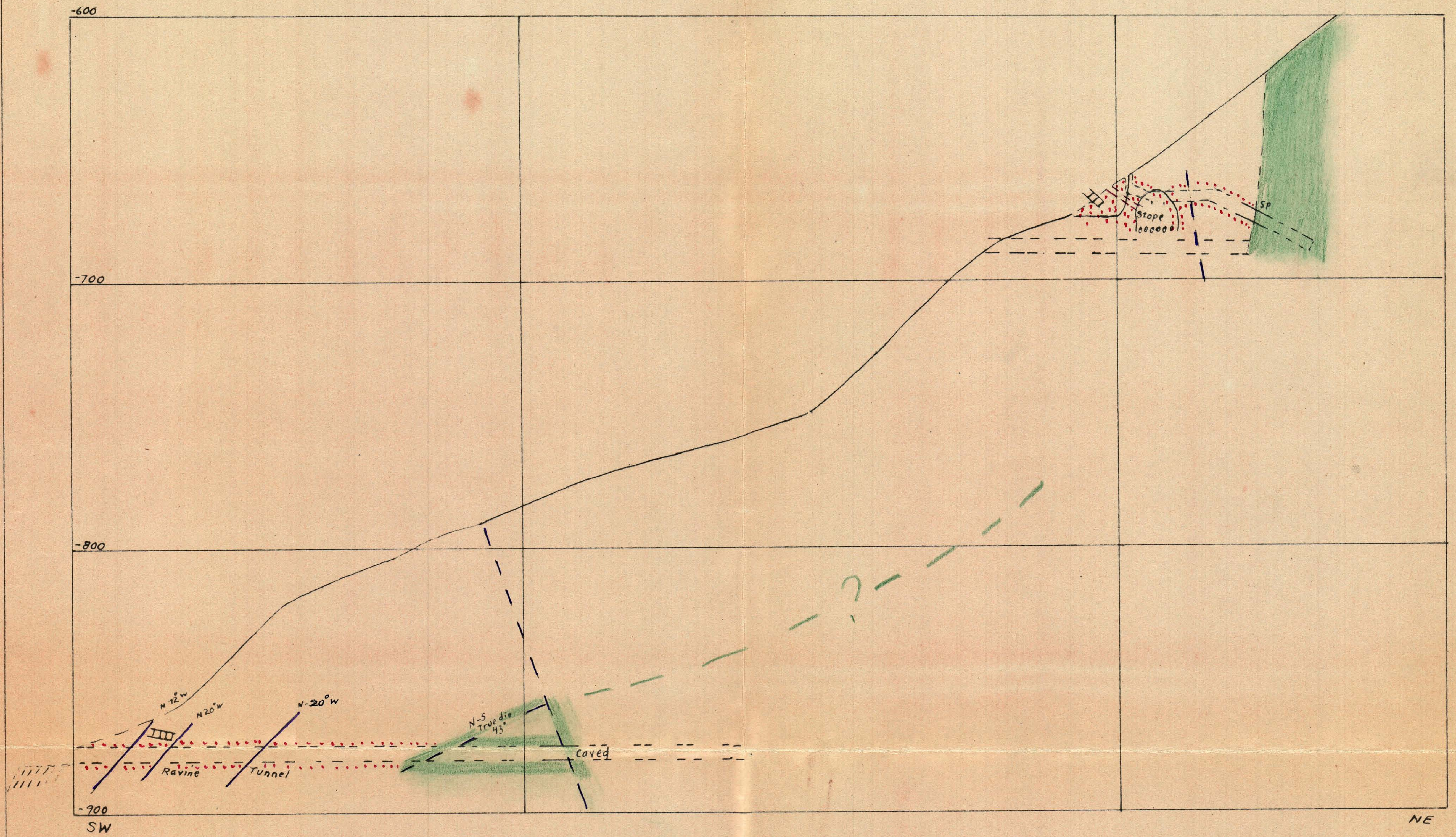
PLAN OF THE CLAY WALLS,

NEW ALMADEN MINE.

Scale 150 feet to the inch.



Compiled by F. READE, 1885.
Giles Lith. & Liberty Ptng. Co. N.Y.
G. F. BECKER, Geologist-in-charge.



A - A'

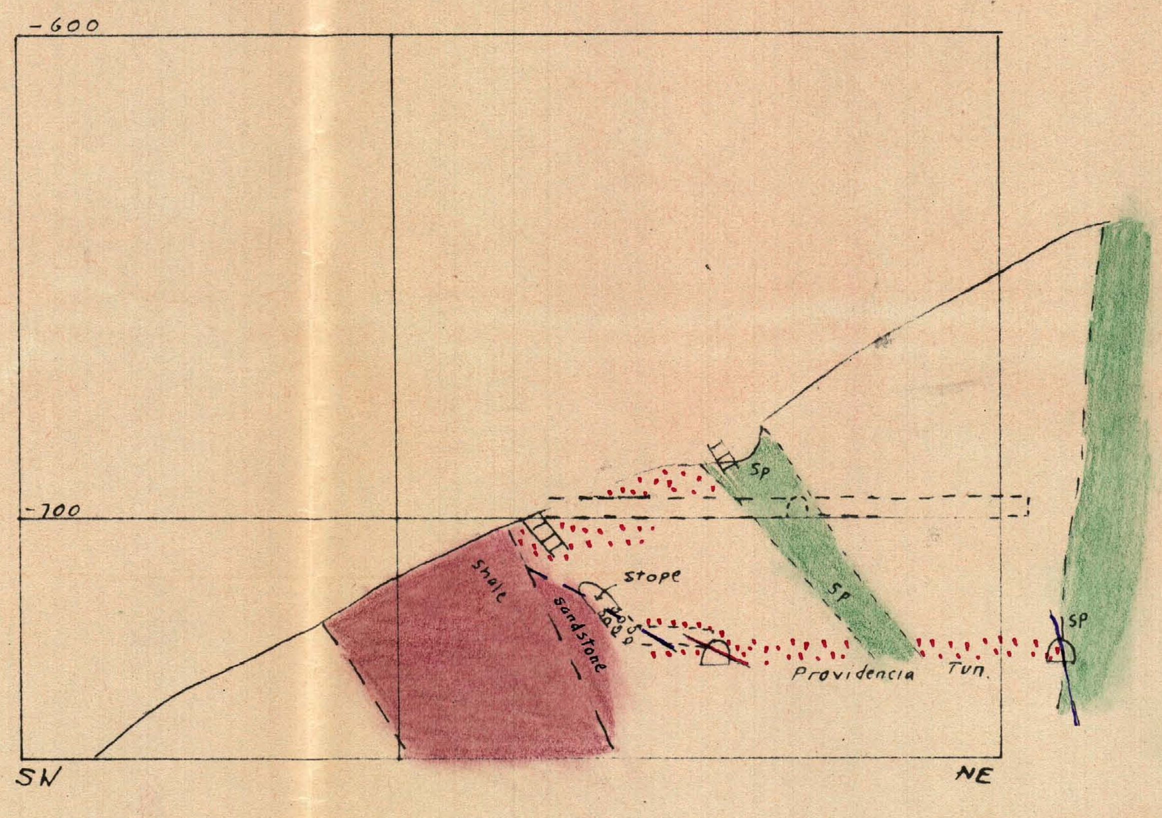
NEW ALMADEN CORP.

PROVIDENCIA MINE

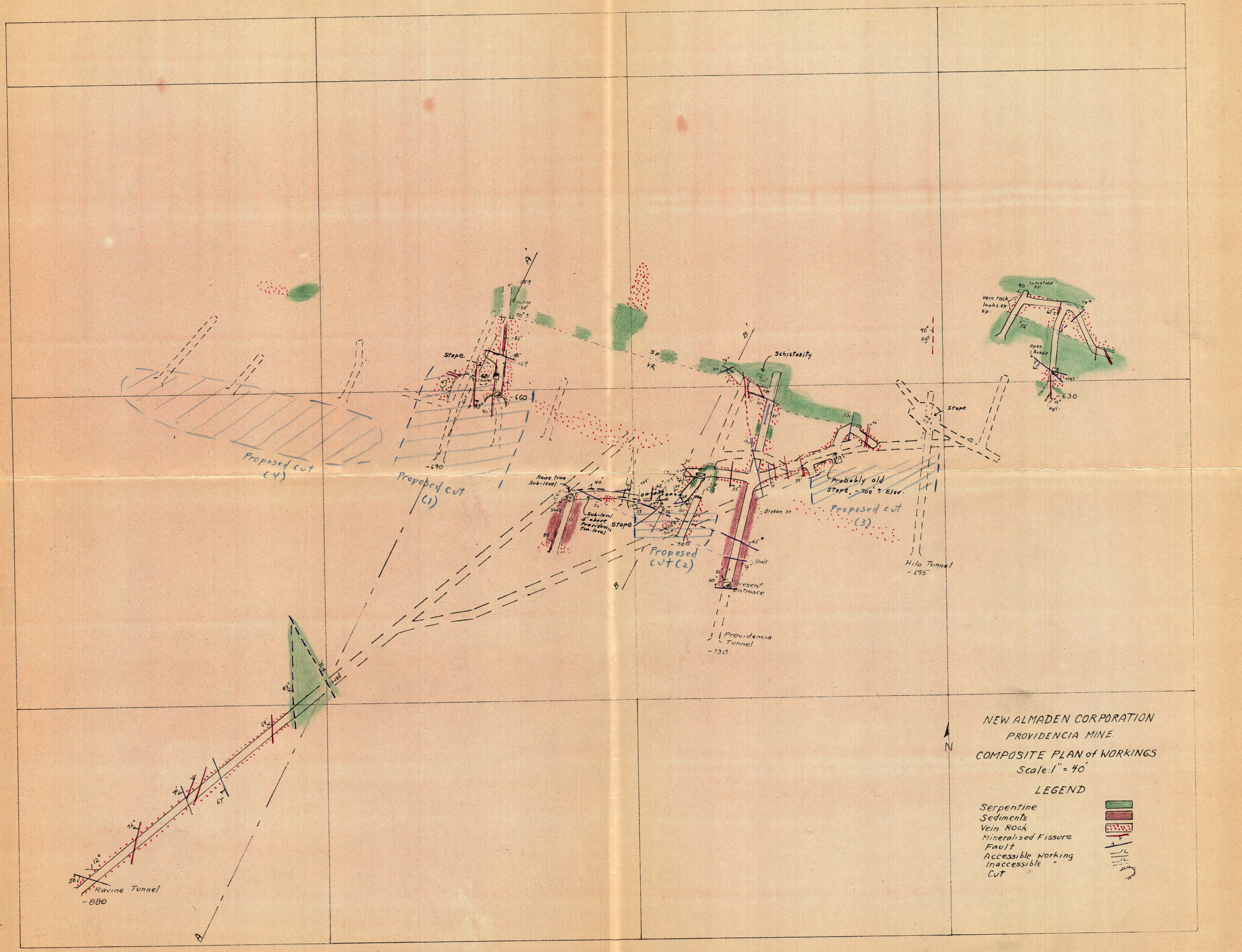
VERTICAL SECTIONS

Scale: 1" = 40'

Dip of formation as seen in section :



B - B'


NEW ALMADEN CORPORATION
PROVIDENCIA MINE
COMPOSITE PLAN of WORKINGS
Scale: 1" = 40'
LEGEND
Serpentine
Sediments
Vein Rock
Mineralized Fissure
Fault
Accessible working
Inaccessible "
Cut
N
Proposed cut (4)
Proposed cut (1)
Proposed cut (2)
Proposed cut (3)
-690
-700
-660
-669
Stope
Schistosity
Probably old stope, -700' ± Elev.
Raise from Sub-level
Sub-level 5' above Providencia Tun. level
Broken ss
Shale
Present Entrance
Providencia Tunnel
-730
Hilo Tunnel
-695
Vein rock looks ex sp.
Ravine Tunnel
-880
SP
VR
A
A'
B
B'


NEW ALMADEN CORPORATION
Almaden, Calif.
COMPOSITE MINEMAP
Showing drifts on "alta", important crosscuts, and stopes.
Scale: 1" = 200'
LEGEND
Alta:
Serpentine Footwall:
Stope:
True N
3300 W Magnetic N of old maps.
00 N
Edward Wisser
Sept., 1941.
Unexplored NW "prow"
500
1400
1500
2000
Probable nose
Extend 1000 level. Page 7
VALLEY
Day Tunnel
Nose. Promising area above Day Tunnel. Page 7
900
800
700
650
Probable "nose" Promising area Page 7
Narrow "ridge"
Alta Shaft
Steep fissure
UNEXPLORED SOUTH FLANK
Indicated Rake of Cora Blanca Ore bodies Page 7
Deep Gulch Tunnel
4000 N
2000 N