SALTON SEA FILTERCAKE

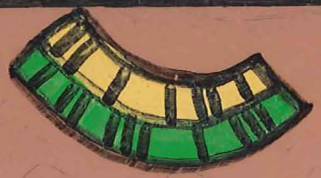

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TABLE 1

LOCATION & SAMPLE	LOELLINGITE	WESTERVELDITE	OMEIYNITE & METAOMEIYNITE	ALLARGENTUM	$Cu_{3-x}Sb$	Cu_3SnS_2	CHALCOPYRITE	Cu / Ag	MAGNETITE	GOETHITE	OPAL A	OPAL CT	CALCITE	BARITE	FLUORITE	HALITE	SMECTITE	QUARTZ	UNIDENTIFIED AMORPHOUS
PHASES PRESENT (RELATIVE ABUNDANCE)																			
REGION 1																			
WHOLE SAMPLES 11/20/00																			
(R1) DRIED & WASHED											MM+					m		<m	
(R2)											MM+					m			
PCU FILTER CAKE											MM+					m			
SCU FILTER CAKE											MM+			<m	<m	m	m	<m	
REGION 1																			
SIEVED: +50 MESH 12/07/01																			
• UNIT / • PARTICLE TYPE																			
(R1) 1b	m?								m					m	m		MM		
(R1) 5			MM																M
(R2) $1a_1$																m	M	<m	M — Ⓐ
(R2) $1a_2$	m					mm			m				m				M		mm — Ⓐ
(R2) 1b									m					M	<m		M		mm — Ⓐ
(R2) 5 (FRAG. 1)		mm	mm						m					M					M
(R2) 5 (FRAG. 2)		mm	mm						<m?									mm	M
(R2) 5		m?	m?						mm					m	m				MM
(R2) 1b (FRAG. 4)														M	<m		M		mm — Ⓐ
(R2) 9 (FRAG. 3)											MM				m	<m			
PCU $1a_1$													m			m	M	<m	MM — Ⓐ
PCU $1a_2$	mm					mm		m	mm										M — Ⓐ
REGION 2																			
SIEVED: +50 MESH 12/6-7/01																			
• UNIT / • PARTICLE TYPE																			
PCU 1a																m	m		MM — Ⓐ
PCU 1b																	MM+		
PCU 4														MM+					
PCU 5			MM					m	m		M				mm				M
PCU 7			m	MM				m							m				
PCU 9b											MM+								
PCU 12											MM			M					
REGION 1																			
+58μ — V5214 SOLIDS COLL 01/03/01																<m	MM	<m — Ⓑ	M
+75μ — V5215 SOLIDS COLL 01/02/01																	M		MM

XRD SUMMARY: SOLIDS & FILTER CAKES FROM REGION 1 & REGION 2 BRINE CRYSTALLIZATION & CLARIFICATION SYSTEM SALTON SEA GEOTHERMAL FIELD

<m = <1% m = 1-5% mm = 5-15% M = 15-50% MM = 50-90% MM+ = >90%

Ⓐ ALMOST CERTAINLY DOMINATED BY HISINGERITE

Ⓑ ALSO OTHER CLASTIC GRAINS

TABLE 2

LOCATION & SAMPLE	PHASES PRESENT (RELATIVE ABUNDANCE)																			
	LOELLINGITE	WESTERVELDITE	POMEYRITE & METAPOMEYRITE	ALLARGENTUM	$Cu_{3+x}Sb$	$CuSiSb_2$	CHALCOPYRITE	Cu / Ag	MAGNETITE	GOETHITE	OPAL A	OPAL CT	CALCITE	BARITE	FLUORITE	HALITE	SMECTITE	SASSOLITE	UNIDENTIFIED AMORPHOUS Ⓐ
REGION 1 BULK ** SCALE SAMPLES																			
No. 14 VS2/2 Discharge		*m?							m		M				m	M	M		
No. 25 (R1) Lime Inlet																			
"DARK MUD"							<m							m		mm			MM
"LARGE PLATES"											MM			m	m	m			
No. 21 (R2) W. Baffle, BACK			*m?		MM			m/m	m					m	m				MM
No. 20 (R2) W. Baffle, FRONT			*m?						m		M			m	M	M			
No. 18 (R2) SW Wall					M			m/m						m	mm	m			
No. 19 (R2) NE Wall 6"			mm											m	m	m			MM

** COLLECTED BY WILL OSBORN 01/20-24/2001:
(R1) = REACTOR 1
(R2) = REACTOR 3

★ DIAGNOSTIC PEAKS OVERLAPPED BY THOSE OF OTHER PHASES

Ⓐ ALMOST CERTAINLY DOMINATED BY HISINGERITE

XRD SUMMARY: SCALE SAMPLES FROM REGION 1 BRINE CLARIFICATION AND CRYSTALLIZATION VESSELS, CONDUITS, & PORTS

SALTON SEA GEOTHERMAL FIELD

< <m = <1% m = 1-5% mm = 5-15% M = 15-50% MM = 50-90% MM+ = >90%

Subject: more XRD
Date: Fri, 16 Feb 2001 11:39:33 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: Will Osborn <will.osborn@calenergy.com>

Will --

Here are XRD results for the other five of your rush samples.

No. 20, Region 1, Reactor 2, west baffle front

$Cu_{3.3}Sb$ -- M
Native Cu -- m
Barite -- m
Fluorite -- m
Magnetite -- m
Amorphous -- MM
Metadomeykinte and domeykite are permissible, but the major peaks of these two phases are overlapped by those of $Cu_{3.3}Sb$

No. 21, Region 1, Reactor 2, west baffle back

Same as #20. Clearly, the results shouldn't be the same, as #21, from bulk XRF, contains much more copper. Suspect splitting and homogenizing a much larger portion of each sample will resolve the discrepancy. In other words, the small chips that were analyzed for each sample are basically identical, but they may not adequately reflect the mineralogic composition of the entire samples from which they were picked.

Region 1, Reactor 2, southwest wall

Same as #21

Region 1, Reactor 2, northeast wall, 6"

Halite -- mm
Fluorite -- m
Barite -- m
Domeykite -- mm
Metadomeykite -- m
Amorphous -- MM (dominated by opal-A)

V5212, discharge

Halite -- M

Saponite -- M
Sylvite -- m
Sassolite (?) (hydrogen borate) -- m
Amorphous -- MM (dominated by opal-A)

I'll be down at the Sample Laboratory this afternoon, but will be back in the office by about 3:45P your time if you'd like to talk about these results. I'll submit new splits of Nos. 20 and 21 right now, so they may be ready when I get back.

Best --

Jeff

Subject: XRD
Date: Wed, 14 Feb 2001 07:02:16 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: will.osborn@calenergy.com

Will --

Three of your rush samples X-rayed and interpreted. The rest to be finished today, reported early tomorrow morning.

Here's a key for the analyses.

MM = >50%
M = >20-50%
mm = >5-20%
m = >1-5%
<m = <1%

Because of the artificial nature of the crystallization process, natural standards may not apply. More precise quantification would require development of site/process-specific standards from pure examples of each phase. Identifications of phases with <1% (<m) concentrations are necessarily tentative. Reported below are the crystalline phases, with speculation about compositions of associated, X-ray amorphous components.

No. 24, Region 2, HP brine leg, 01/29/01, 10:30

Chalcopyrite -- MM
Halite -- m

No. 25, Region 1, Reactor 1, lime inlet, 01/21/01, 10:45 -- dark brown mud

Halite -- mm
Barite -- m
Chalcopyrite -- <m (?)
Amorphous -- MM (probably dominated by amorphous iron oxides)

No. 25, Region 1, Reactor 1, lime inlet, 01/21/01 10:30 -- large, undulose, light-colored plates

Halite -- m
Barite -- m
Fluorite -- m
Chalcopyrite -- <m (?)
Amorphous -- MM (almost certainly dominated by opal-A)

I can't get away next week. Yet another admin. emergency to deal with, and, on the more pleasant side, I've been asked to write an article, for "Living Planet" magazine, about the benefits of volcanoes. I'm going to use the opportunity to trumpet the environmental benefits of geothermal energy. Another possible angle might be how truly beneficial CalEnergy's metal recovery process will be in terms of reducing the need to dig huge holes in the ground for conventional mining operations. What do you think? I believe there have been press releases to this effect already, so we wouldn't be divulging new proprietary information.

Would the second week of March be feasible for rescheduling my visit? By that time, there's a good chance we'll be finished with the samples you've submitted to date, and I could provide a more comprehensive overview.

Subject: XRD results
Date: Sat, 13 Jan 2001 16:08:04 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: will.osborn@calenergy.com

Will --

Two of the samples you shipped to us last week, and for which I sent you descriptions, were suitable for XRD analysis. The third was too small, and too contaminated with small fibers (probably from the filter paper).

Sample #2 (V-5215 solids, >75 mesh, 713 gal., 540 min., 0.423 g) has the following approximate composition: Saponite -- 25%; quartz -- 1%; plagioclase -- 3%; K-feldspar -- 1%; halite -- 1%; amorphous and below detection limit -- 69%. The latter category is probably mostly opal, which is amorphous to X-rays. The quartz and feldspar are likely clastic grains.

Sample #3 (V-5214 solids, >53 mesh, 357 gal., 450 min., 0.1831 g) contains mostly saponite (app. 83%) with the remainder amorphous and below detection limit (app. 17%). Again, the latter category is most likely opal.

Neither of these two samples contained metallic constituents (none visually recognizable with binocular microscope; none detectable by XRD). It should be borne in mind that phases present below 1-2%, depending on composition and crystallinity, are generally not detectable by XRD.

Hope things went well in the tank.

Best wishes --

Jeff Hulen

CalEnergy- M. Wright

Salton Sea - scale samples from geothermal wells

Mineralogy, Approx. Wt.% [x] (or) Relative Abundance [x]

Sample No.	Quartz	Plagioclase	K-feldspar	Calcite	Halite	Loellingite	Magnetite	Chlorite	Illite+/-Mica	Nontronite- 15A	Smectite	*Amorphous Silica	Amorphous/ Below Detection	
Injection wells:														
Sinclair-26	1	tr				tr?	1	tr		7		MM		
Sinclair-26 black	tr			1		tr?	1			2		M	M	tr sphalerite?
Elmore-101	2	2	2		1		tr	2	1		2	MM		
Production wells:														
Sinclair-10										52*			M	
Sinclair-11	1					2				36*			M	
Elmore-12	tr			tr		18				40*			M	

*The presence of amorphous silica is characterized by a broad hump in the diffraction pattern centered at about 3.90 angstroms. Apparently, the amorphous iron silicate (hisingerite?) leaves no signature on the diffractograms.

Nontronite-15A has a general formula of: $Na_{0.3}\ Fe_2\ Si_4\ O_{10}\ (OH)_2\ .\ x\ H_2O$, and is characterized by broad peaks at: 14.3 (air-dried) to 16.4 (glycolated), 4.48, 2.61, and 1.53 angstroms.

Loellingite ($Fe\ As_2$) exhibits peaks at 2.61, 2.54, 2.42, 2.34, 2.21, 1.86, 1.69, and 1.64 angstroms.

*Based on laboratory nontronite sample — may not be applicable JH 01/30/00

MM = Predominant M = Major m = Minor Tr = Trace ? = Tentative Identification

EGI

SUMMARY OF X-RAY DIFFRACTION ANALYSIS

Energy & Geoscience Institute at the University of Utah

S. Lutz
2-2000
801 585-9688

① = FeAs
② = Cu_3As

	MINERALS PRESENT (Relative Abundances)																
	① ②																
	WESTERVELDITE	DOMEYKITE &/or METADOMEYKITE	MAGNETITE	HEMATITE	GOETHITE	BARITE	ANHYDRITE	CALCITE	FLUORITE	OPAL	CRISTOBALITE	QUARTZ	PLAGIOCLASE	CHLORITE	SMECTITE	HALITE
REG. 1, RCTR. 2 +50 mesh, 12/7/00*																
Fragment 1	m~M	m~M	m	tr?	m	M			m							
Fragment 2	m~M	m~M	m?			m			m		m?	M			M	m
Fragment 3									m	MM						tr
Fragment 4			m			M	m?		tr~m						M	
Fragment 5								m	m	MM		tr~m	m	m	m	
REGION 1 MISCELL. SMPLS.																
Reactor 2, dried & washed solids										MM						m
Reactor 1, dried & washed solids										MM		tr				m
SCU filter cake +325 mesh						m			m	MM					m	m
SCU filter cake −325 mesh										MM		tr				
PCU filter cake										MM						m
SUC 0106 - PCU, whole sample, No Wash										MM					m	m

whole samples 11/20/00*

date?

* sample collection dates (CEOC)

MM = dominant (>50%)
M = major (15-50%)
m = minor (1-15%)
tr = trace to 1%

FILTER CAKE INVESTIGATION
XRD RESULTS TO DATE

JBH 12/17/00

① = FeAs
② = Cu_3As

MINERALS PRESENT (Relative Abundances) ①, ②

	Westerveldite	Domeykite &/or Metadomeykite	Magnetite	Hematite	Goethite	Barite	Anhydrite	Calcite	Fluorite	Opal	Cristobalite	Quartz	Plagioclase	Chlorite	Smectite	Halite
REG. 1, RCTR. 2 +50 mesh, 12/7/00*																
Fragment 1	m–M	m–M	m	tr?	m	M			m							
Fragment 2	m–M	m–M	m?			m			m		m?	M			M	m
Fragment 3									m	MM						tr
Fragment 4			m			M	m?		tr–m						M	
Fragment 5								m	m	MM		tr–m	m	m	m	
REGION 1 MISCELL. SMPLS.																
Reactor 2, dried & washed solids										MM						m
Reactor 1, dried & washed solids										MM		tr				m
SCU filter cake +325 mesh						m			m	MM					m	m
SCU filter cake −325 mesh										MM		tr				
PCU filter cake										MM						m
SUC 0106 – PCU, whole sample, No Wash										MM					m	m

whole samples 11/20/00*

date?

* Sample collection dates (CECC)

tr = trace to 1% m = minor (1–15%) M = major (15–50%) MM = dominant (> 50%)

FILTER CAKE INVESTIGATION
XRD RESULTS TO DATE

JBH 12/17/00

Region 1, Reactor 2
11/20/00
+50 mesh

Table 1. Summary of SEM Notes - Group 1

Sample No.	Image No.	Notes	EDX
1a	01	Rind of calcite on glass surface; concoidal fracture	Ca, Si, Fe
	02	Si- and Fe-rich rind on concoidal glass	Outer rind: Si, Fe Inner Fibrous: Fe, Si
	03	Low mag, includes previous	
1b	01	Low mag, very siliceous, microxln, porous, w/ cracks	Si, O, Fe (small) SEE FILE
	02	Detail of porous opal in above view; "vesicular" texture	Si, O, (Fe)
	03	More altered piece, fibrous texture, alteration to clay.	Si, O, Fe, Mg, Al SEE FILE
2a	01	Opaline silica, microxln spherules, uniform texture.	Si, O, Fe SEE FILE
2b	01	Very low mag - irregular, hollow piece with smooth outer surface, opaline silica within.	Si, O [no Fe]
	02	Another hollow opal piece, similar to above.	
	03	Detail - center of previous; loosely packed, microxln opal; particles <1 micron.	
2c	01	Opaline "egg".	Si, O, Fe
2d		Tightly xln opal.	
2e	01	Clay flakes and needles, microxln opal.	Si, Mg, Fe
	02	Detail of clay in previous. Chlorite?	
	03	Platy clay, likely chlorite.	Si, O, Mg, Fe, Mn SEE FILE
	04	Low mag of opaline "egg" that includes previous; clay alteration at center.	
4	01	Alteration to clay (nontronite); fibrous texture.	Si, Fe, Mg, (Al)

TerraTek
University Research Park
400 Wakara Way • Salt Lake City, Utah 84108
Telephone (801) 584-2400
FAX (801) 584-2406

Table 1. (cont'd) Summary of SEM Notes - Group 1

Sample No.	Image No.	Notes	EDX
4	02	Detail of smectite-like clay (nontronite).	
	03	Alteration of glass to smectite-type clay.	Spot EDX in webby stuff at center: Si, Fe, O, Mg, Al, Ca, K SEE FILE
5	01	Possible As/Cu bearing minerals in opal.	Si, O, Fe, Cu, As
	02	Close up of grungy texture containing As and Cu.	Fe, Cu, As
	03	Very high mag of As-bearing zone + glassy host.	As, Cu, Fe
	04	As/Cu minerals w/ minor barite.	As, Fe, Cu
	05	Banded zone contains varying proportions of metals.	Cu, Sb, As, Fe
	06	Variable texture in contaminated sample. Similar view to 5-09.	SEE FILES (2)
	07	Close-up of previous; poorly xln As-bearing zone; banded w/ barite and glass.	Spot EDX at center left SEE FILE
	08	Another piece includes barite and As/Cu/Fe minerals.	Spot EDX at chunk to right of euhedral barite. SEE FILE
	09	Banded texture includes a host of minerals and glass: opal, Fe/As, barite, fluorite.	Several EDX spots from upper right to lower left. SEE FILES (5)
6	01	Banded sample; glass/opal w/ varying proportions of Fe and varying crystallinity.	Si, O, Fe SEE FILE
	02	Close-up of variable texture; opal/glass.	SEE FILE
	03	Another fragment; some alteration of glass, fibrous texture.	SEE FILE
7	01	Opal-ct + barite.	Ba, S, Si
	02	High mag of euhedral barite.	Si, Fe (Opal); S, Ba, (V) (crystals)
	03	Barite and opal-ct.	SEE FILE

Table 1. (cont'd) Summary of SEM Notes - Group 1

Sample No.	Image No.	Notes	EDX
8	01	Opaline silica spherules more pure; chunky texture contains Fe.	Si, O, Fe in chunky zone SEE FILE
	02	Low mag includes previous; glassy texture with cracks.	Si, O, (Fe)
9	01	Overview of nearly pure microxln opal. Very porous.	Si, O only. SEE FILE
	02	Detail of above; more tightly xln opal, small pores.	Si, O, (Fe) SEE FILE
	03	Low mag of banded texture.	Spot EDX (2) - smooth and porous glass SEE FILES (2)
10	01	Almost entire fragment composed of fluorite; fibrous, tight.	Ca, F SEE FILE
	02	Another fragment at higher mag; angular glassy material on surface - mixture of glass and fluorite.	EDX - whole view - Si, O, Ca SEE FILE
11	01	Opaline texture at higher mag; microxln, generally tight.	Si, Ca, O, (Mg) SEE FILE
	02	Detail of delicate fibrous clay.	SEE FILE
	03	More porous glass/opal w/ minor clay, possible sulfate, glassy rind.	Spot EDX - sulfates and clay?; Rind: Si, O; SEE FILE
	04	Another fragment; more uniform glass.	Whole view - Si, Fe, O SEE FILE
13	01	Opaline spherules, no clay, comparatively smooth and tight.	Si, Fe, O SEE FILE
	02	General overview of smooth opaline egg w/ cracks.	

TerraTek
University Research Park
400 Wakara Way • Salt Lake City, Utah 84108
Telephone (801) 584-2400
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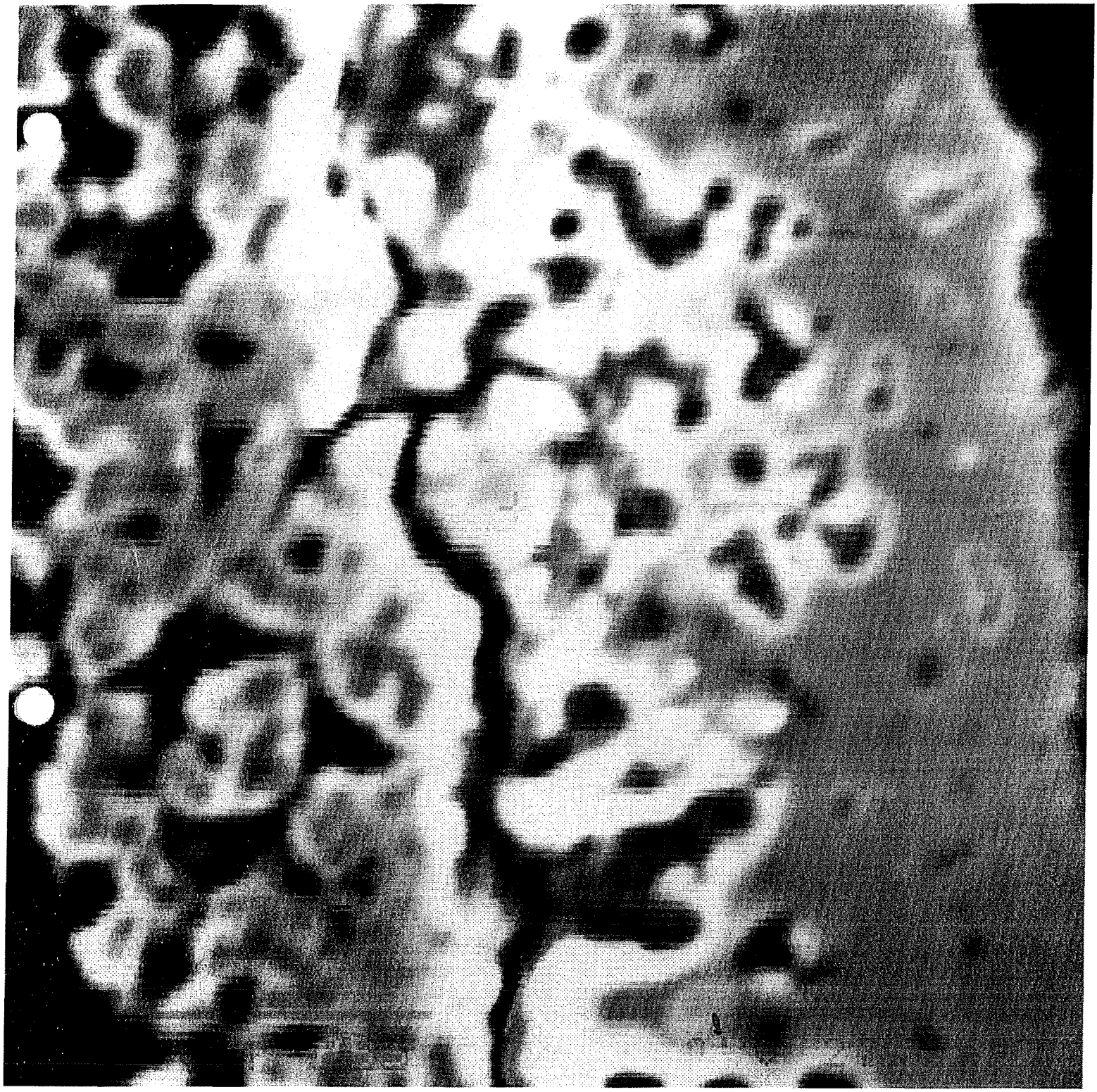
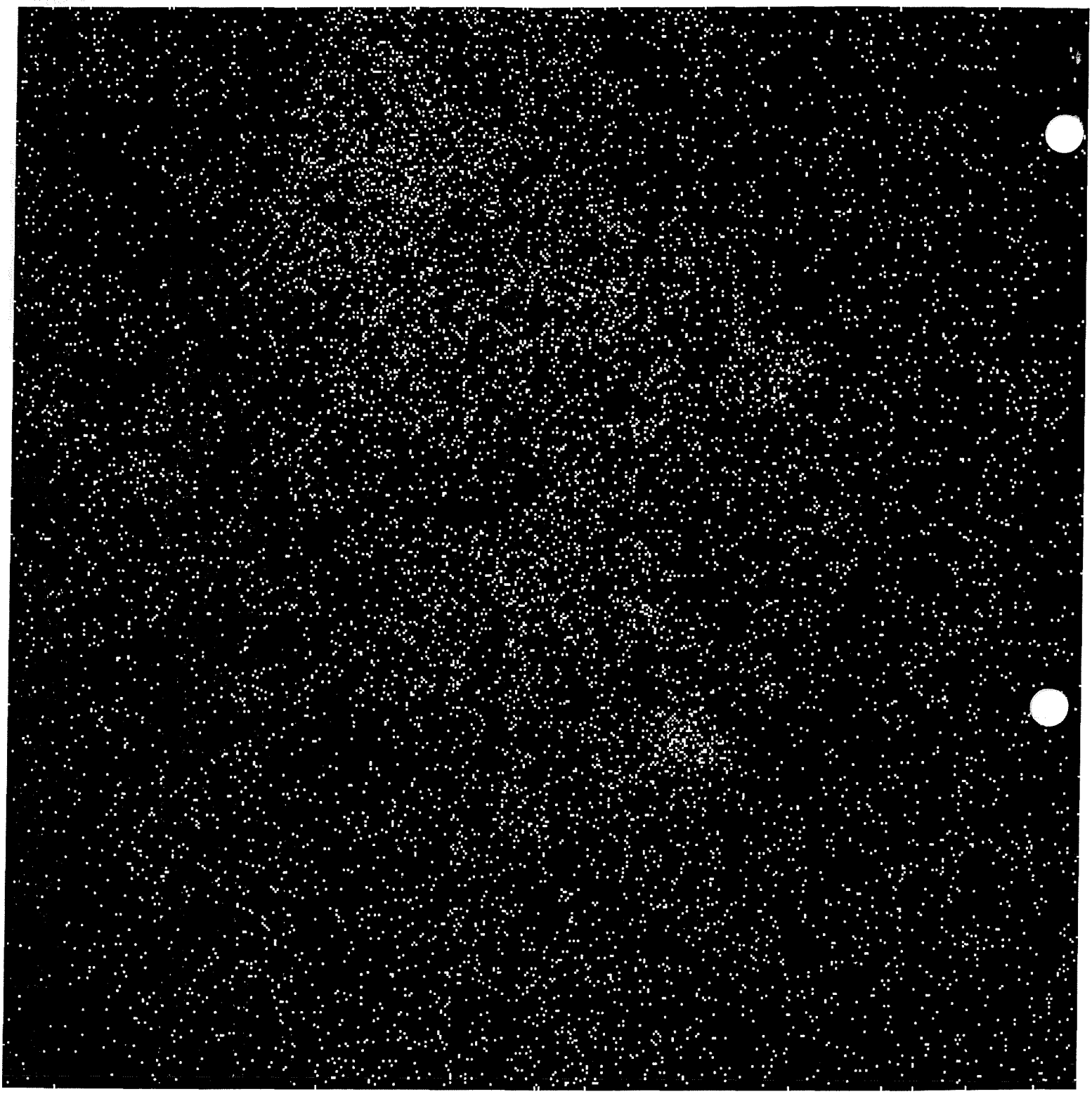


REGION 1 PCU

PCU
RECOVERY PLANT SCALE

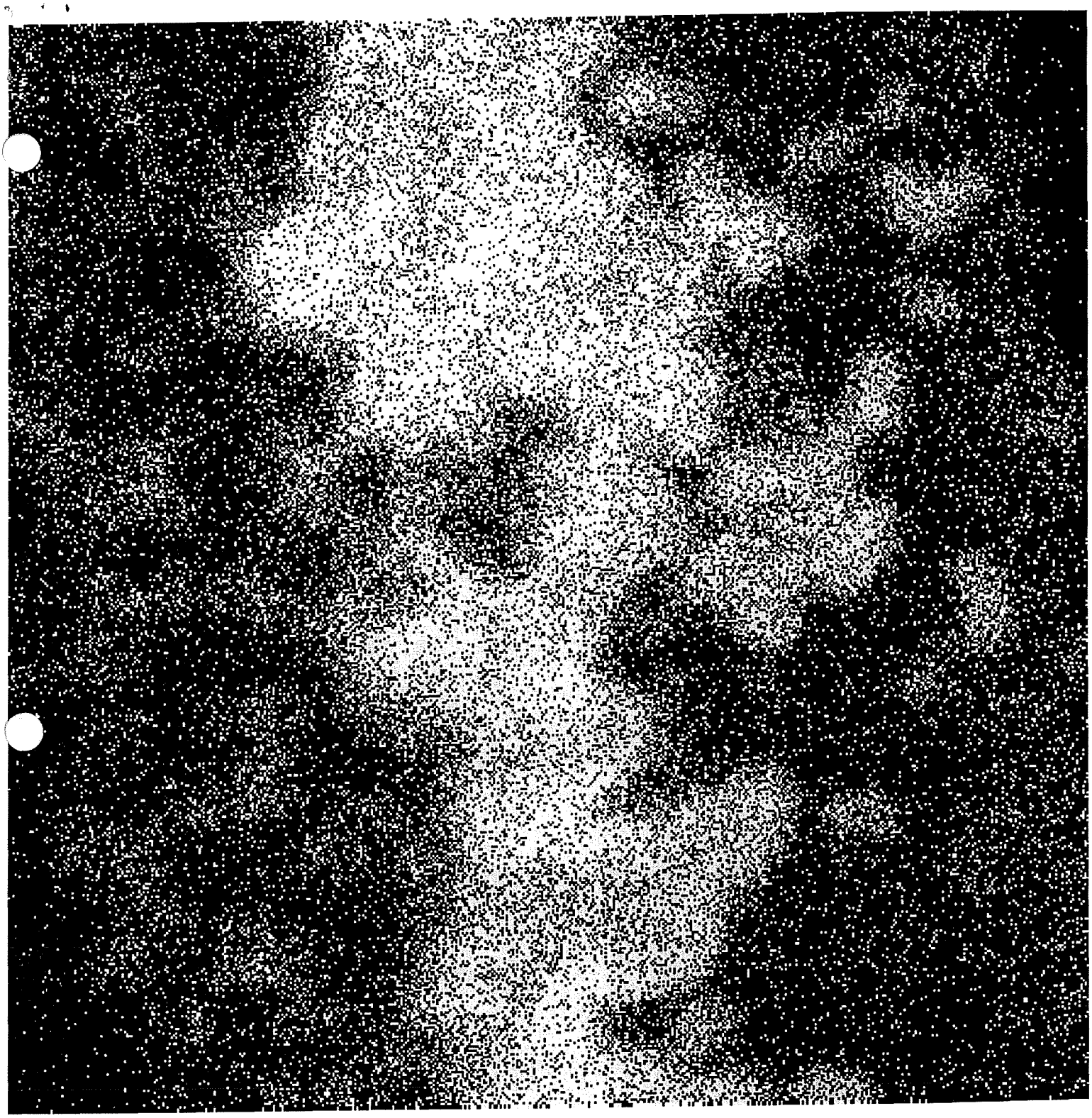
EC1_1S1ASFEABSTIFF

ECCY



As

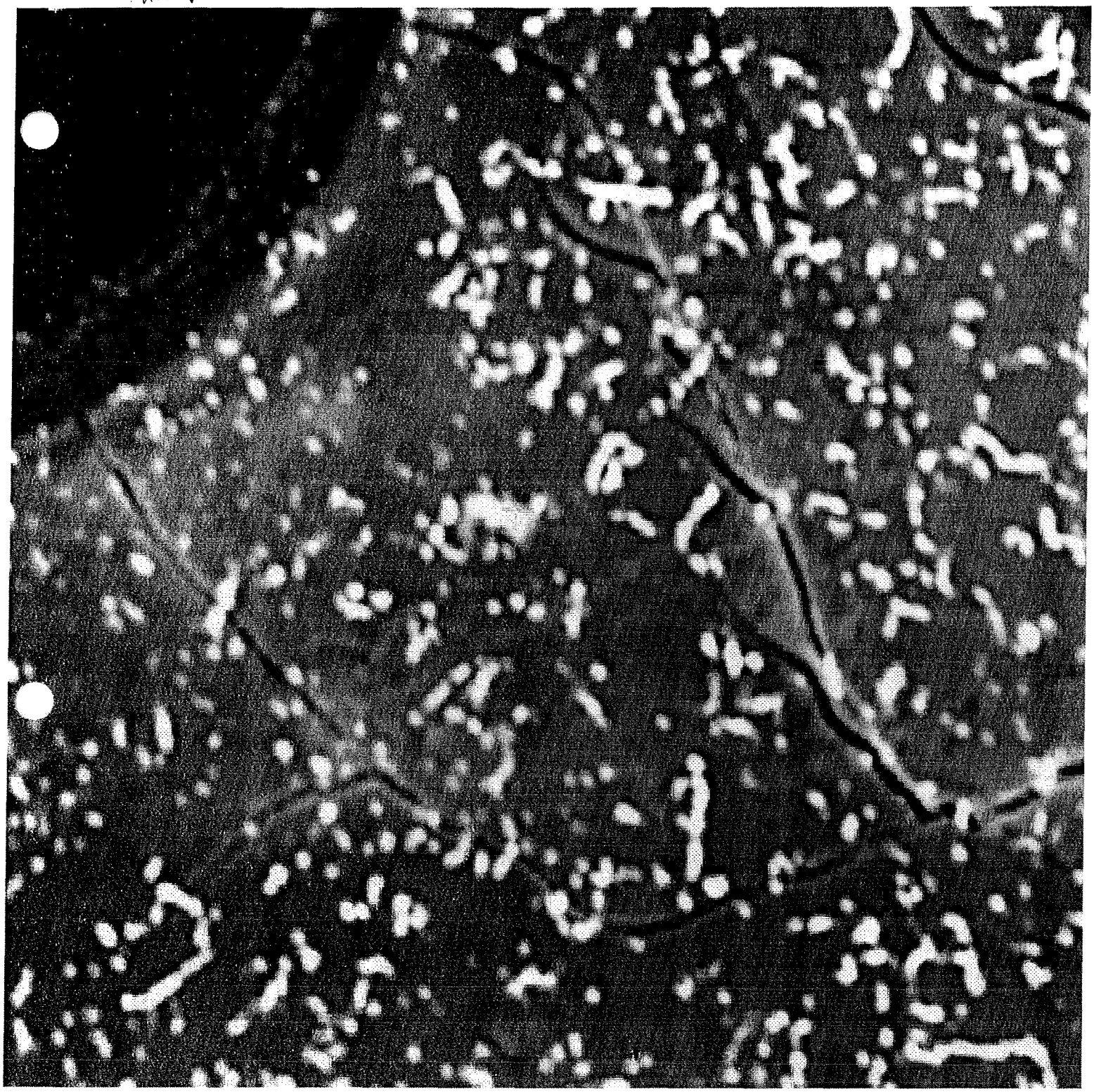
EG1_1S1AsFE(P5).TIFF

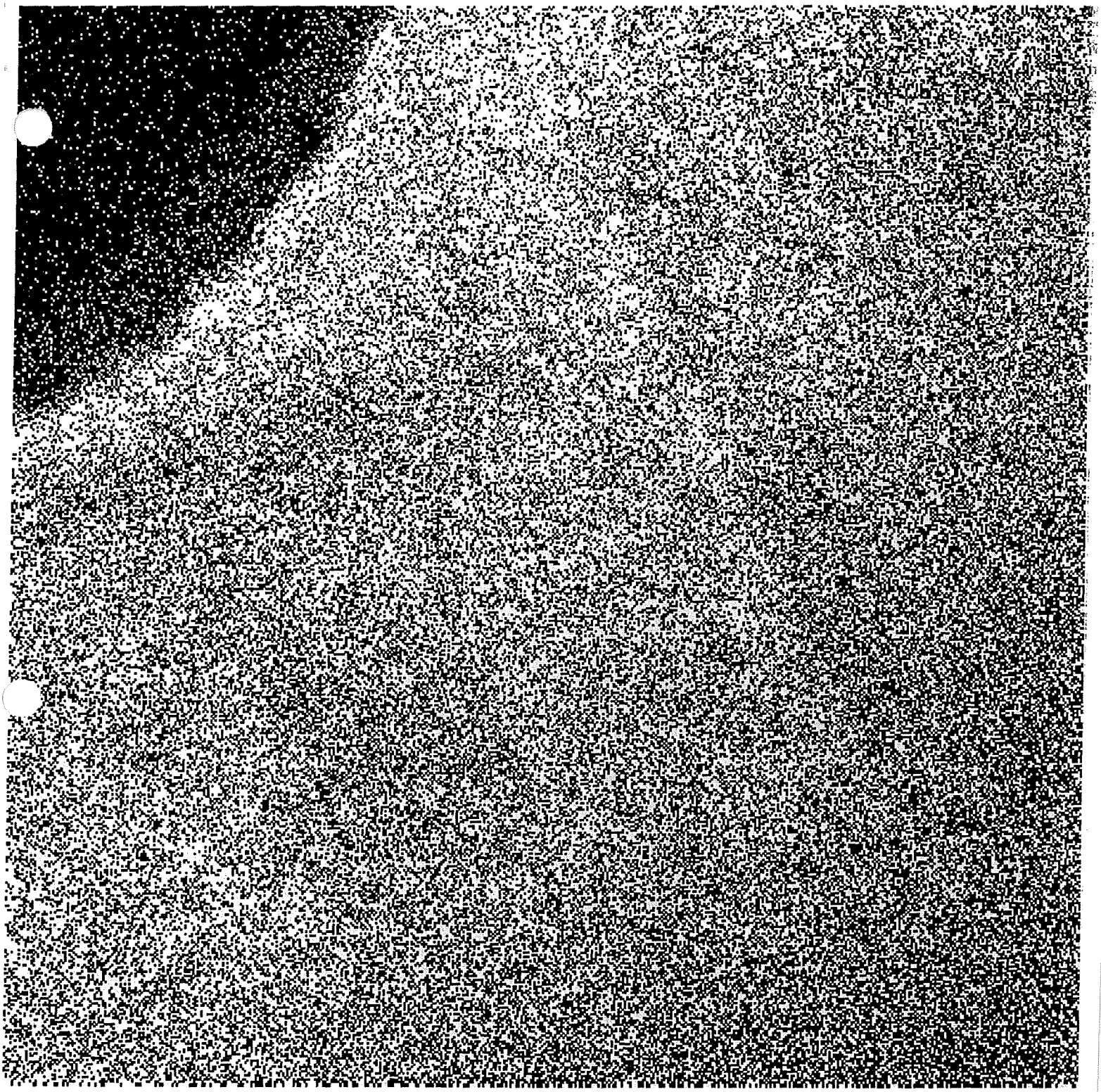


FE

EG1-1 SIASFE CH4. TIFF

hole ↓





AL

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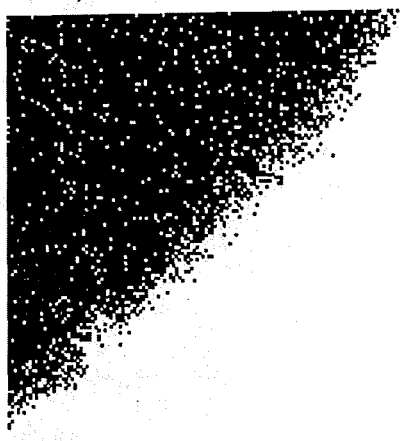

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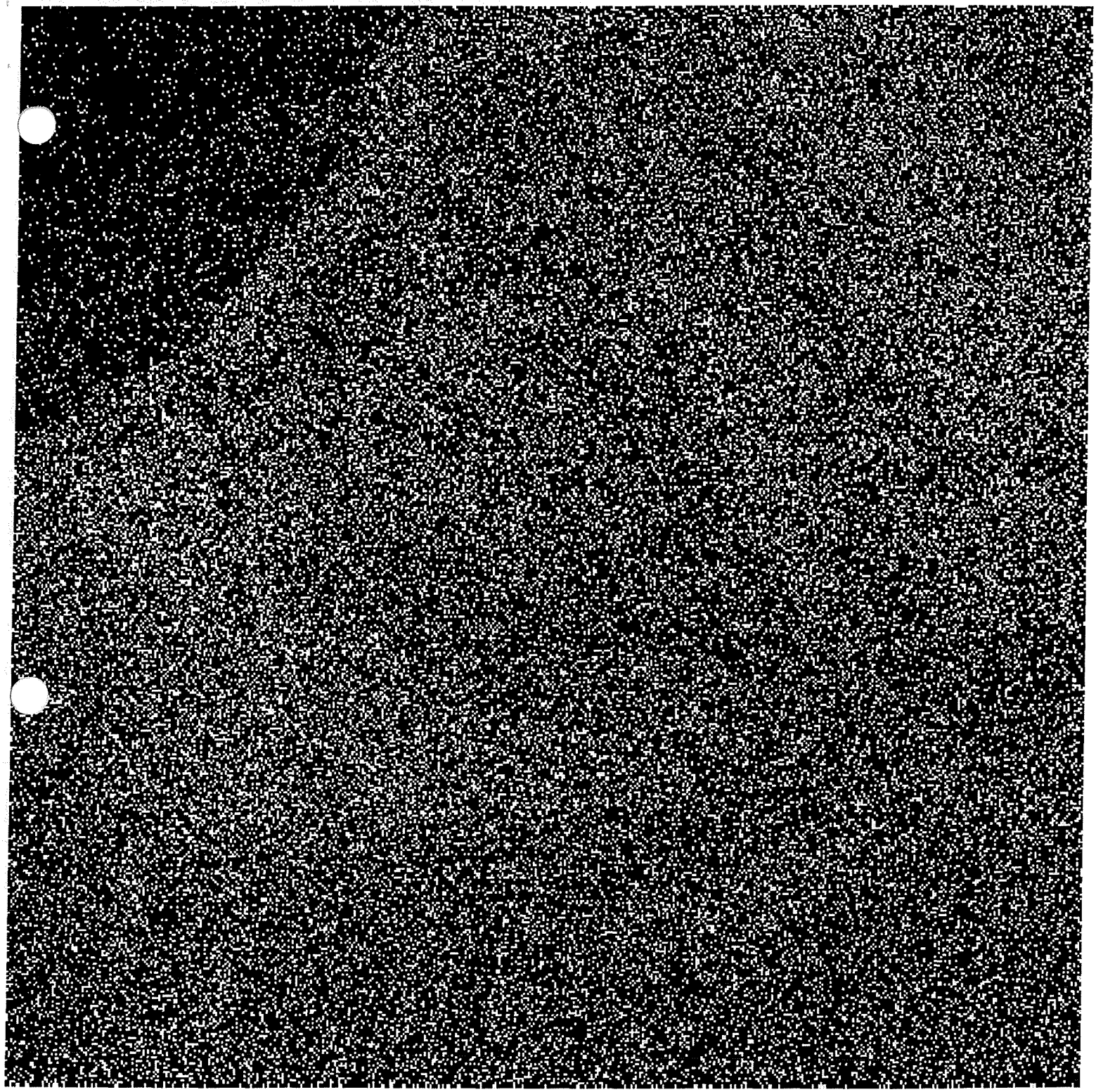
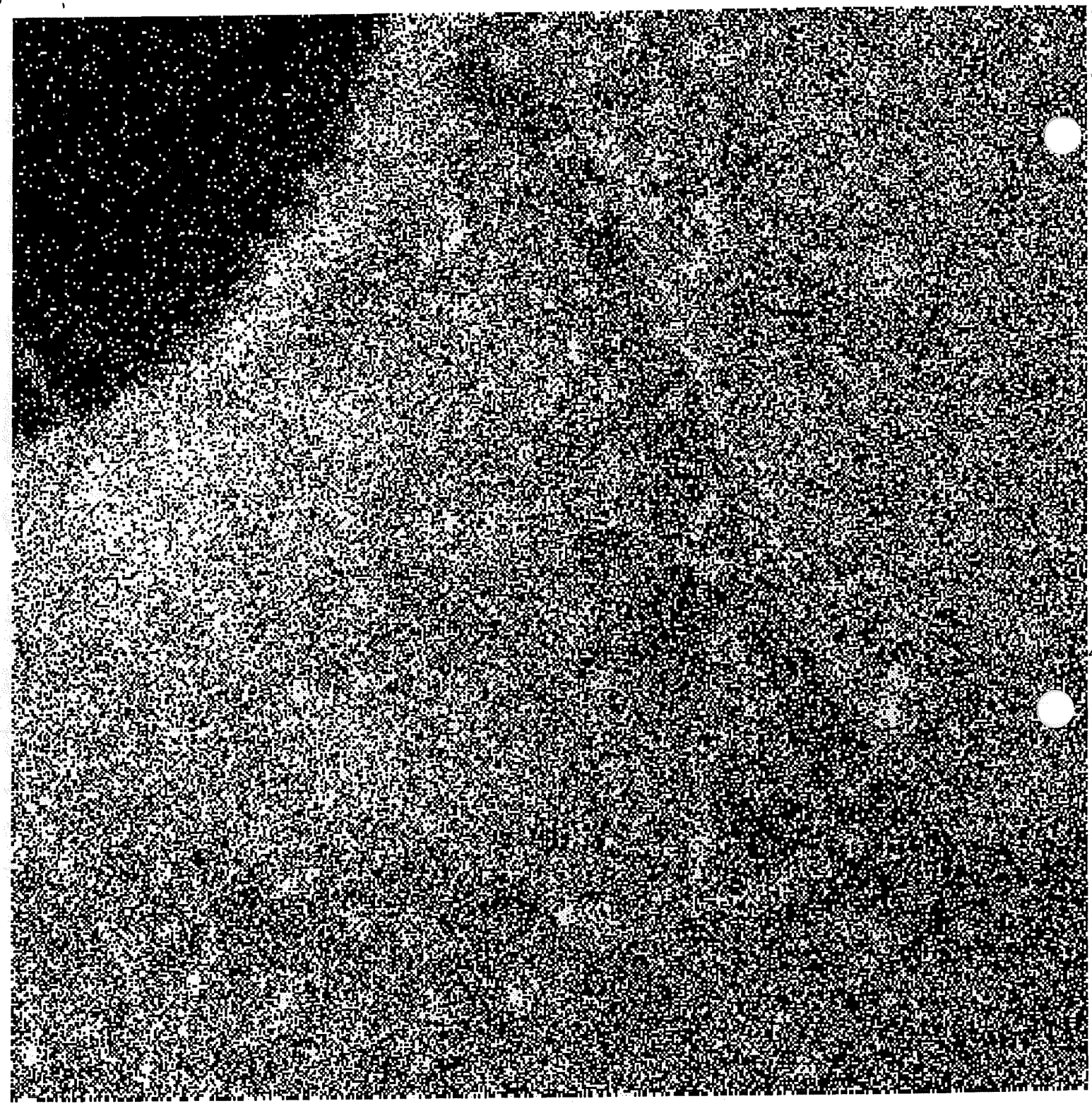


CL

EC1_4_ACSCCLSP3.TIFF



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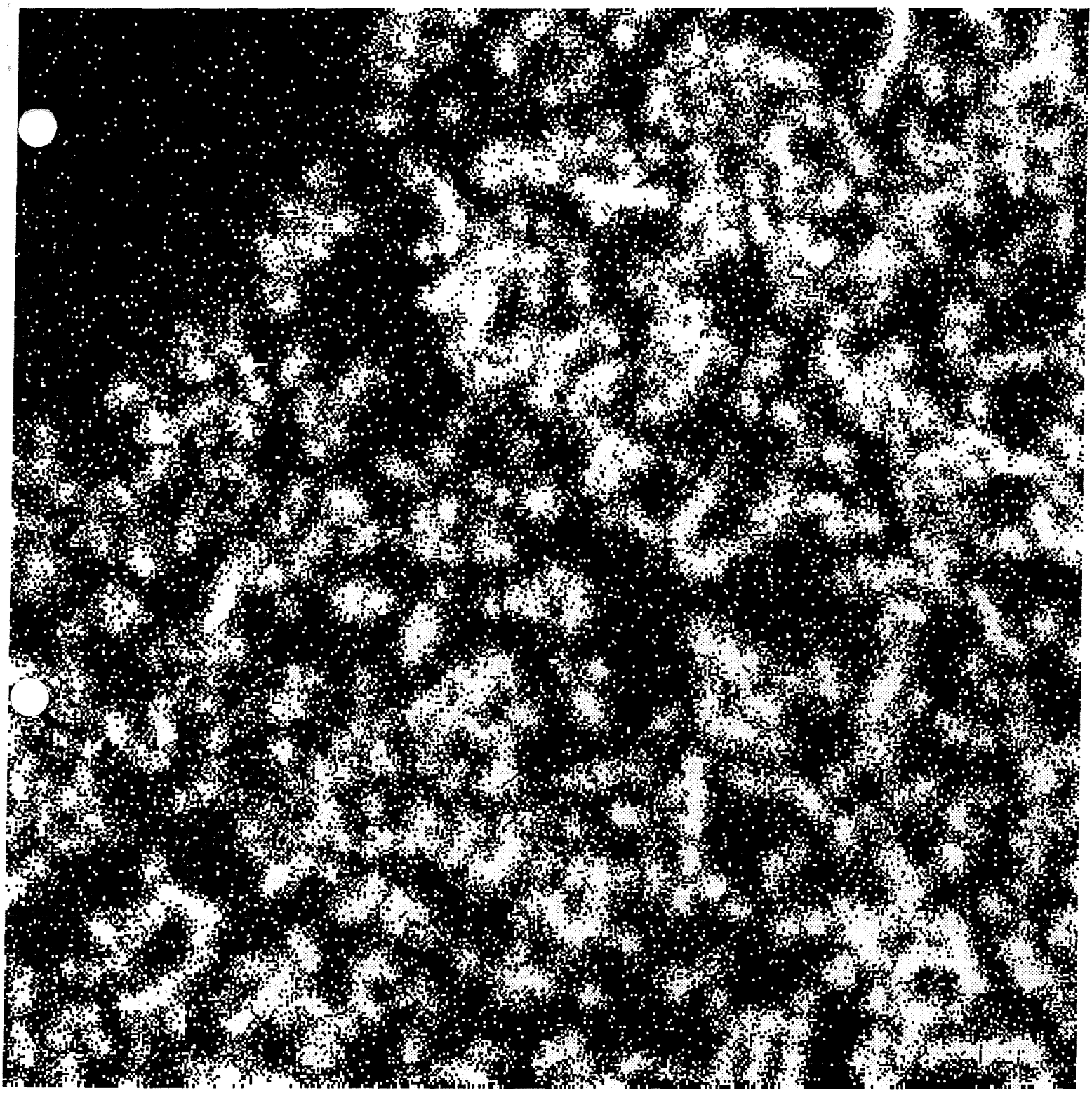
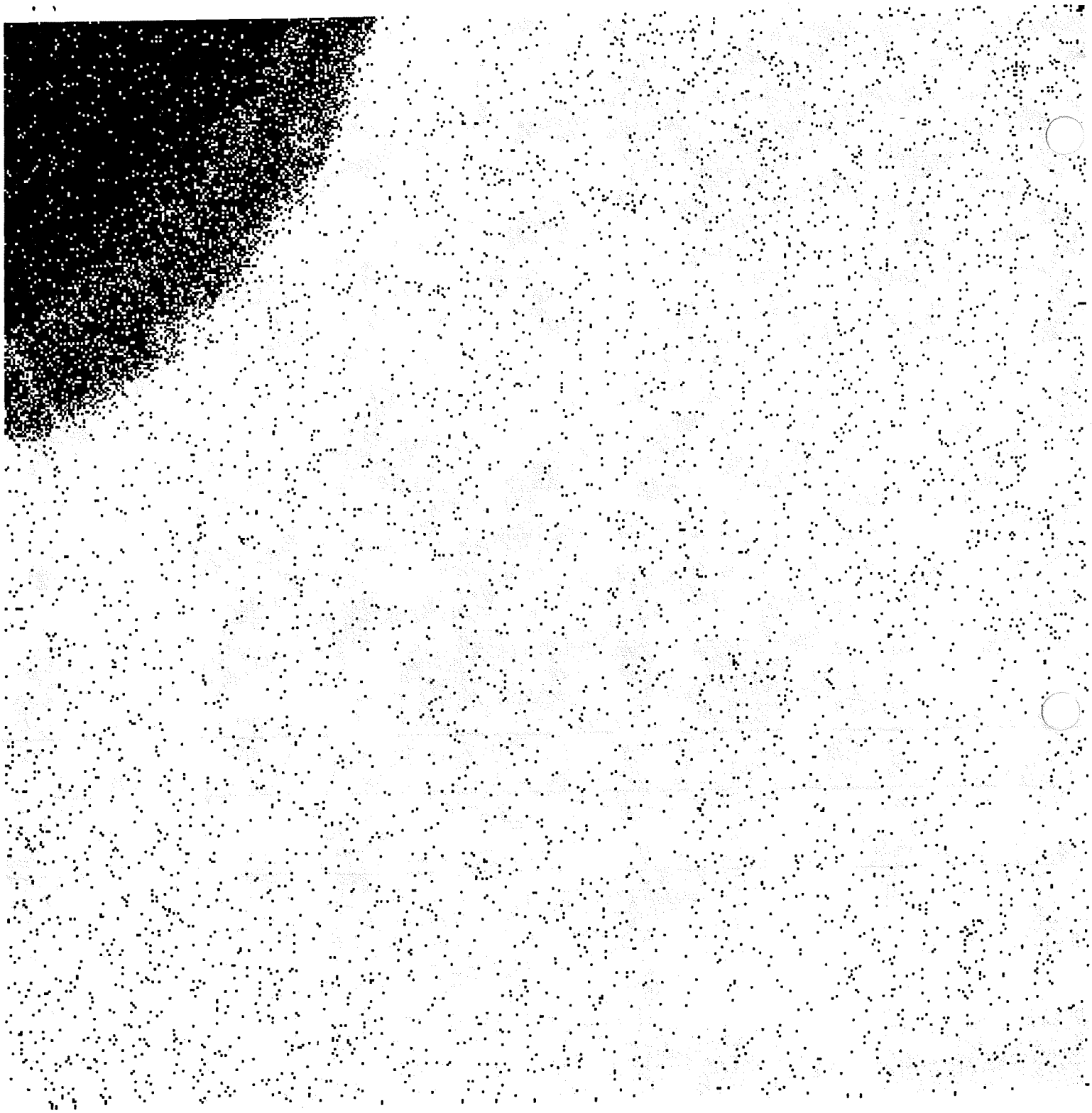


A6

E61_4_A5A6FE593.TIFF



FE

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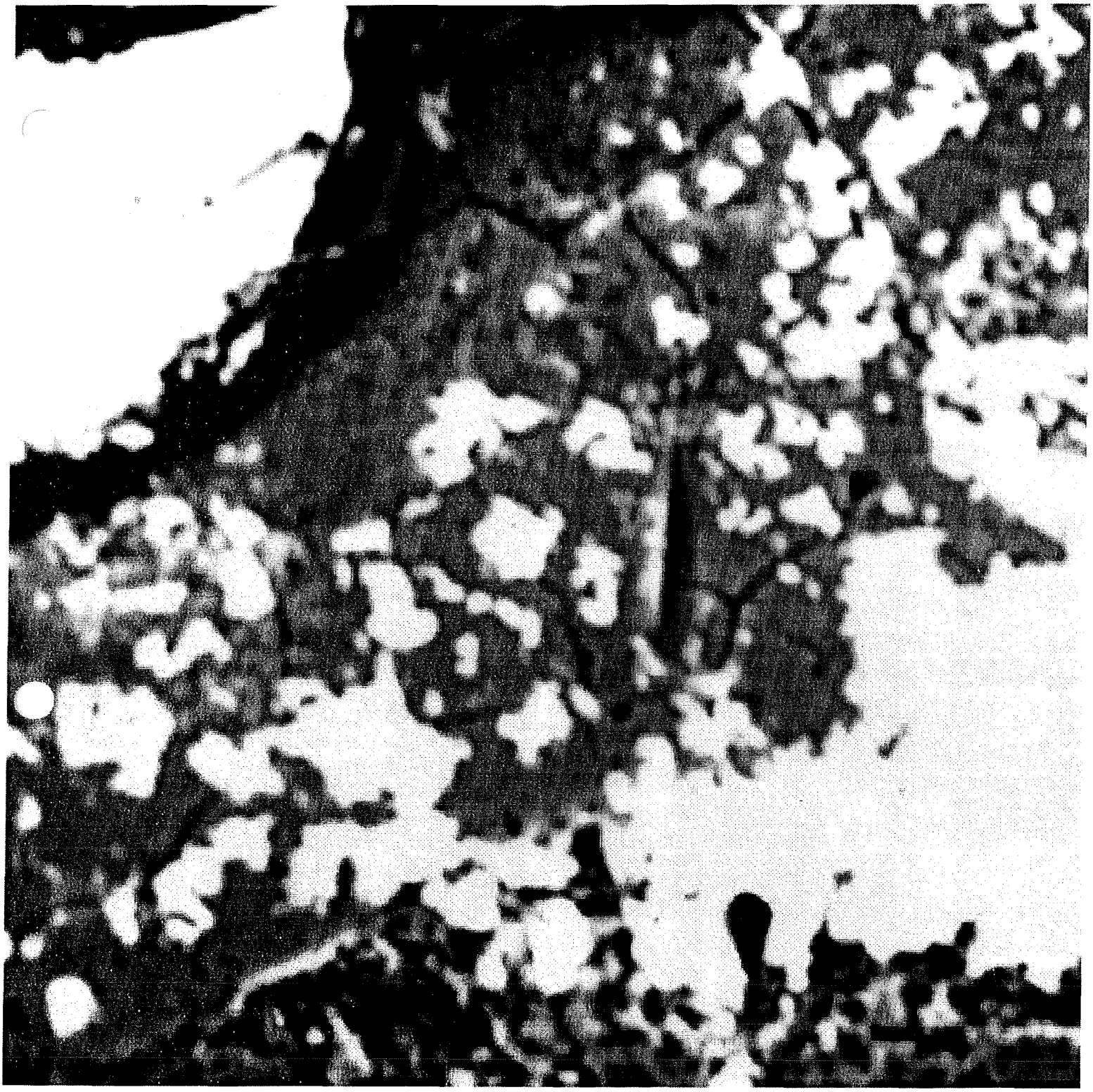
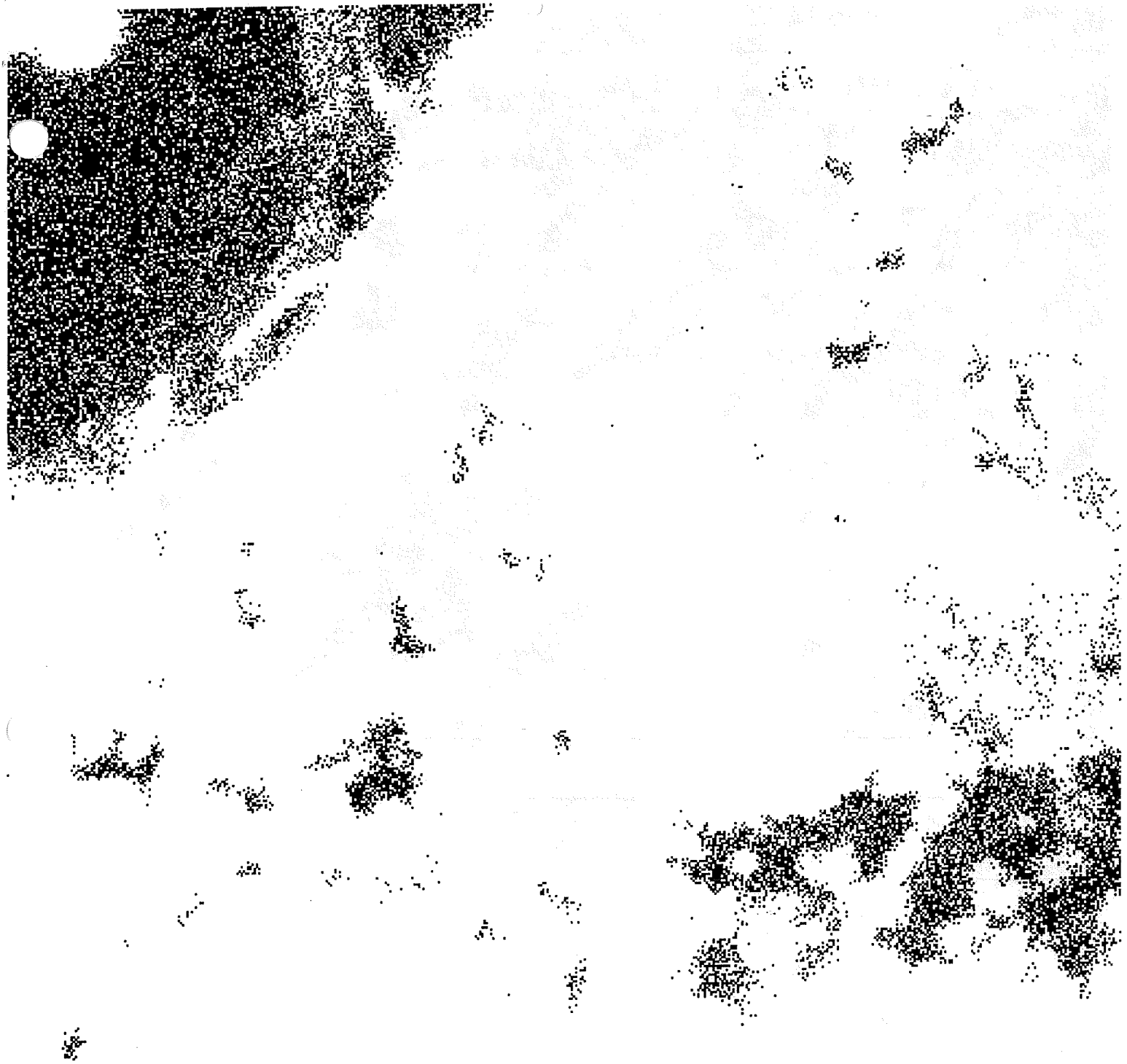
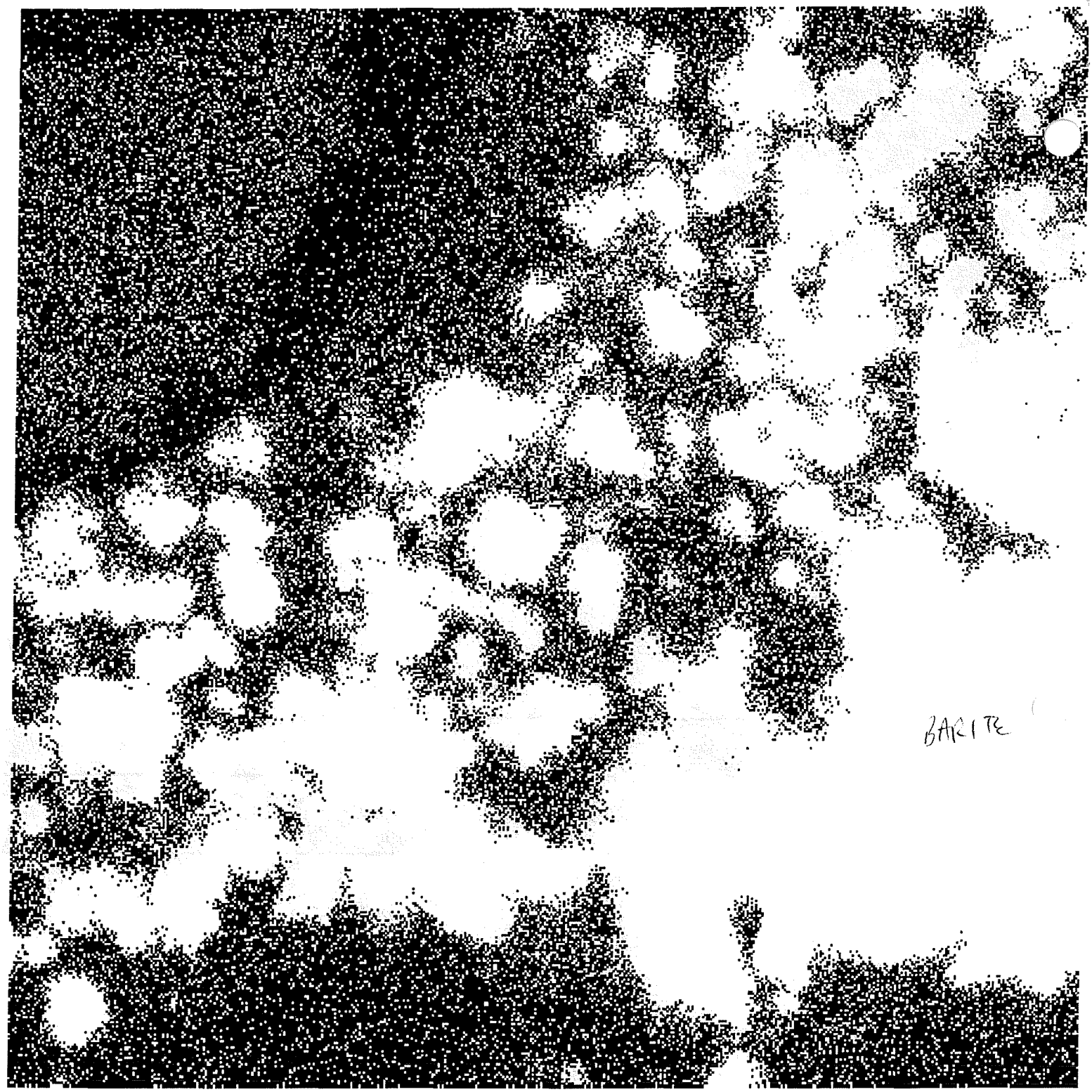


absorbed

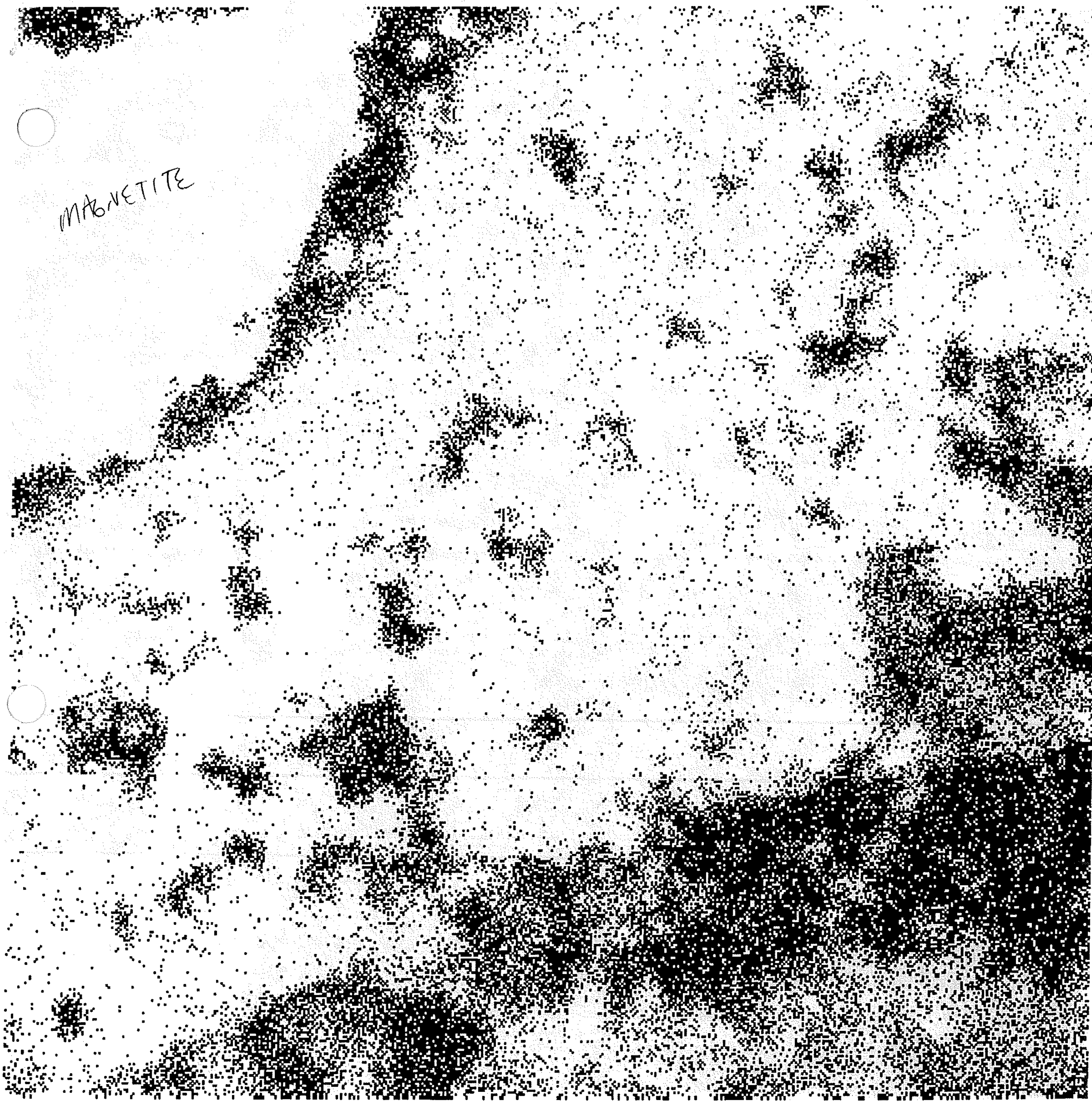
PCU





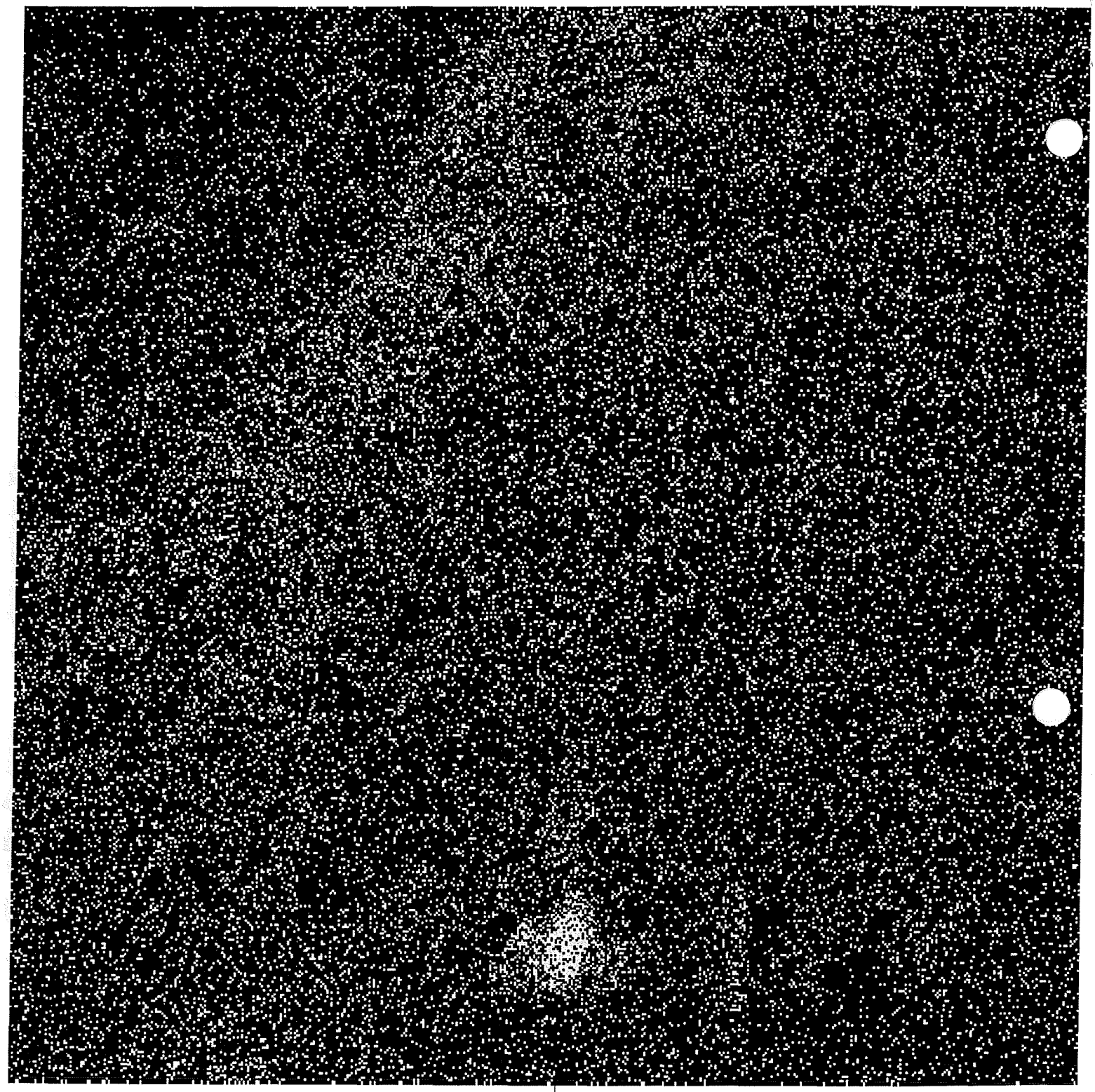
BA

E61_2SIBAFE*13.TIF



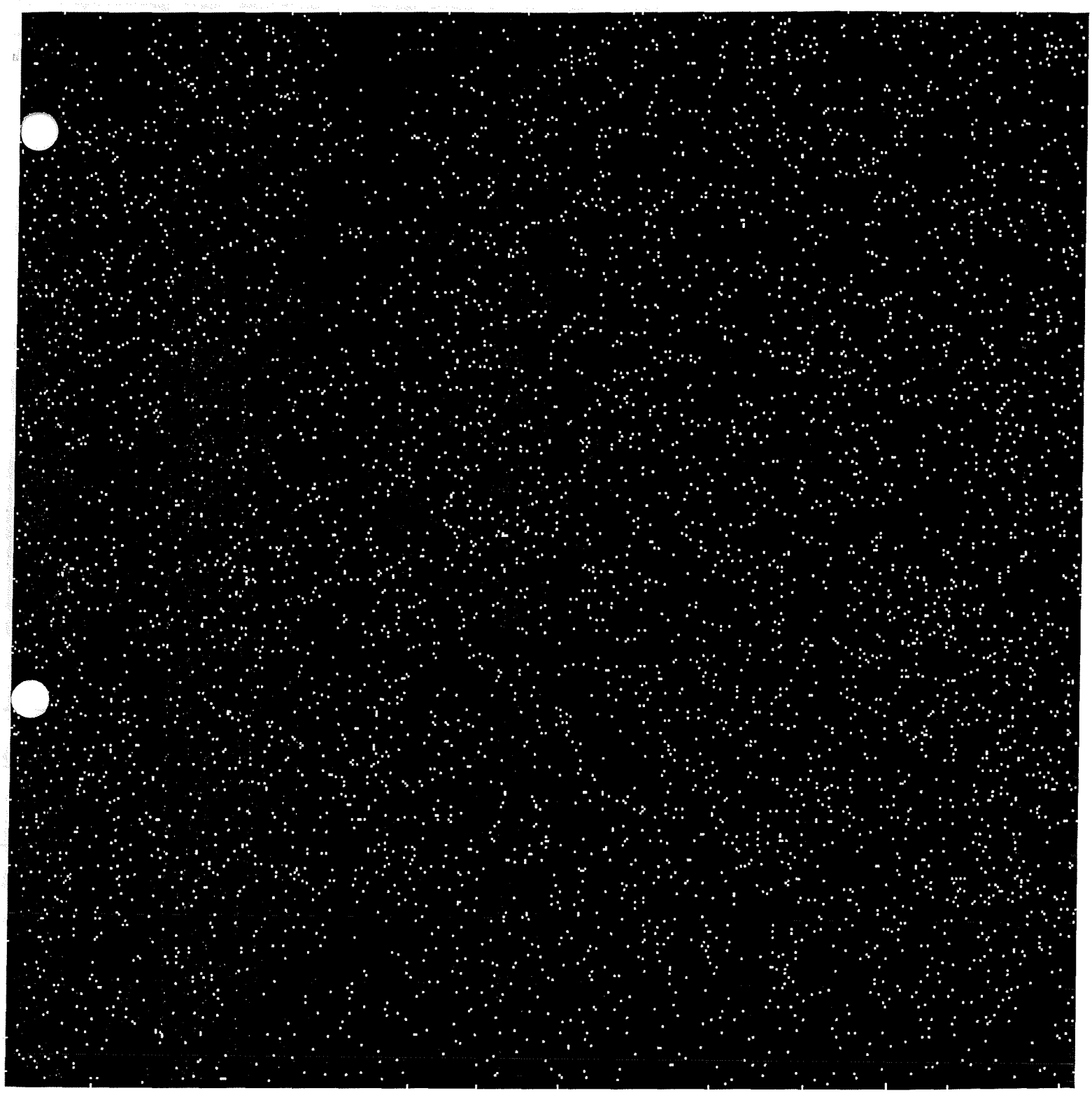
FE

EGL 2 SIKPFE 514.TIF



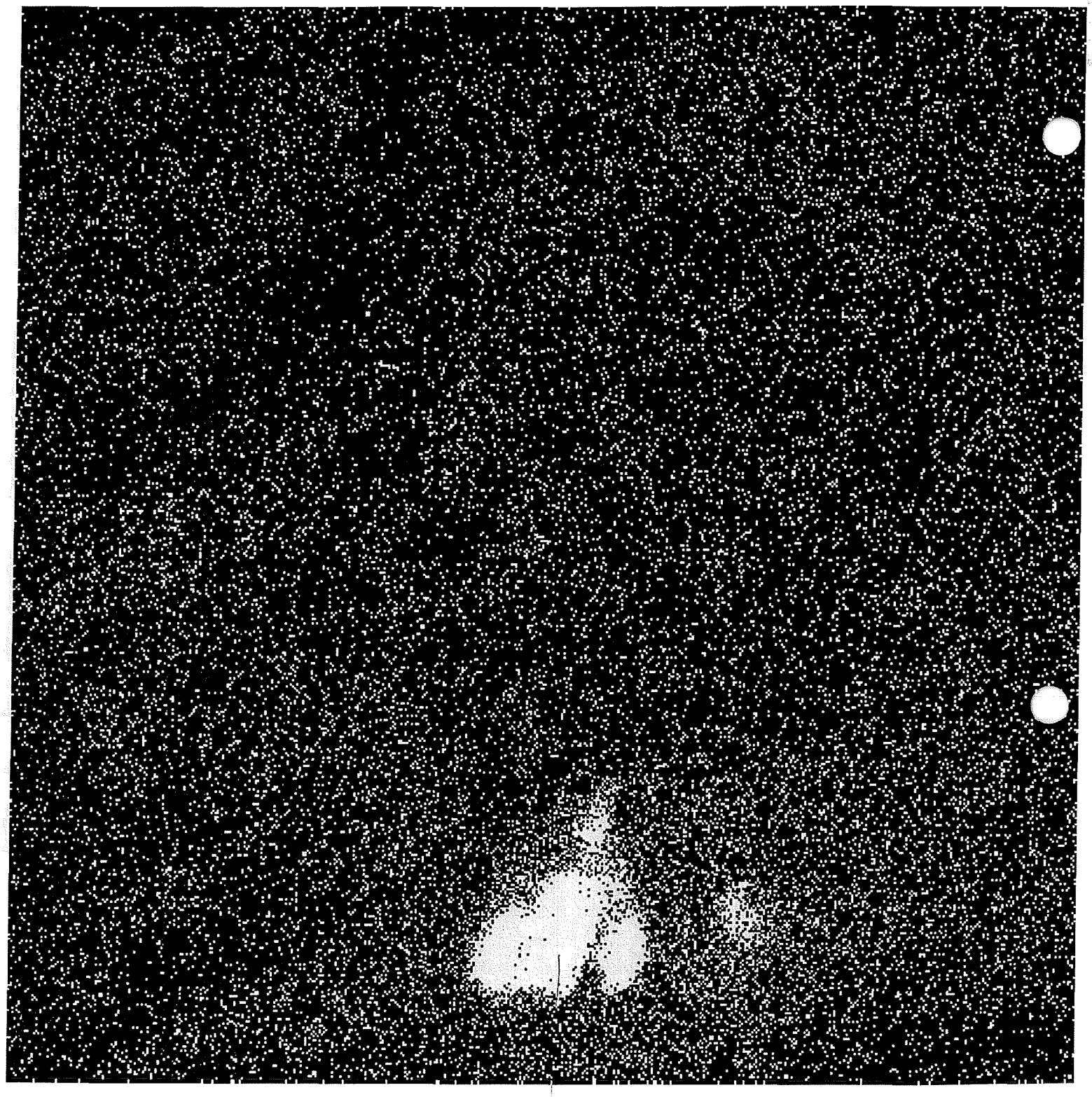
As

CuAs



PB

E61-3-A5[illegible]



CU

CuAs

EKT_3_AS(CU,SI).TIFF

EGI 1. - clarifier scale = PCU

transmitted light - bright

white area
- Cu
- S
- Fe
- Si

Cl } pure Si

one is tan area has Ca

gray area
- Fe
- Si

grungy area = plastic

black
- arsenic
- chlorine
- a little Na
- Mn
- Cu

iron silica

not Fe-Silicate
Fe ≠ Si areas

setting up routine

bright white area with dehydration cracks
- some Ag, some As
- + Ca

Black area along edge - banded — some As, some Ca

magnetite

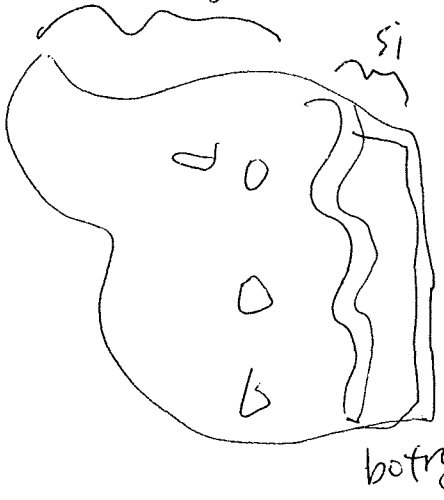
Image maps of:

stored
- Si - Ba - Fe egi 2
- Si - As - Fe egi 1
- As - Pb - Cu egi 3
- (none)

Ag + Cl same place!

egi - elemental analysis

CaSO4 = anhydrite

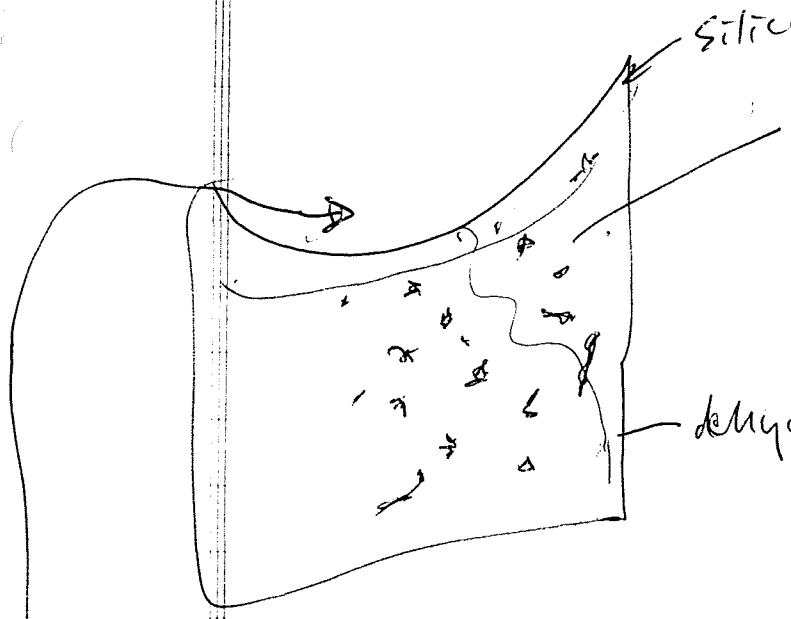


BSE

bright white in black
- magnetite
- all Fe

Shape

~~EG Microprobe lab~~
with Ray Lambert
Oct 27 00



Si, Fe, As, Ag, Cl.

Ag in little worms. black blebs

Ag ● As Ag >> As

is some Al - and Cl - Al in glass

EGIY - Image map As Ag Fe

[elementar analysis not working - Ray will have to work on it.]

EGI5 - Al - Si - Cl } all diffuse - in glass.

slight increase in band at edge + along cracks

Chlorine in plastic - no

try same elem. analysis again:
Mg Al Si S V U Fe Ba As
add Mn + Ag later

Quick look at RR-18

Bi - orangish areas in FeAs - towards interior of scale

Ag - separate black areas in scale

Ca - calcite infilling cavities - gray grungy

Zn - in separate black areas

Salton Sea Power Plants, Regions 1 and 2, Brine Crystallization and Clarification Units

Abbreviated Descriptions of Particle Types in >60-Mesh Fractions of Filter Cakes and Allied Solids

Jeffrey B. Hulen, EGI

February 7, 2001

Type 1a – Glassy to resinous, translucent to opaque, medium to dark gray to greenish-gray, commonly iridescent, conchoidally fractured. Some particles transparent olive- to bottle green in Region 2 samples. Some particles from both regions translucent deep orange-brown (resembling "root-beer glass"). All X-rayed samples are dominantly amorphous (hisingerite?) with different proportions of saponite. Some matte-textured particles in some samples contain minor amounts of arsenic- and iron- and copper-bearing phases, for example loellingite, westerveldite, and metadomeykite.

Type 1b – Matte to resinous or waxy-textured, microgranular, commonly ovoid to amoeboid in shape, medium to dark gray to greenish-gray. All X-rayed samples are dominantly saponite. Like type 1a particles, some of the type 1b particles contain minor amounts of the above-named metallic minerals.

****Type 2a*** – Tiny (avg. about 0.3 mm), thin-shelled, hollow, opaline spheroids and amoeboids. Colorless, vitreous, translucent to nearly transparent. Confined to Region 1 solids.

****Type 2b*** – Same as type *2a*, but opaque and pure matte white. Confined to Region 1 solids.

****Type 2c*** – Same as type *2b*, but matte, mottled, pale yellowish-white to orange-white through light-medium, slightly yellowish-gray. Coloration due to trace to minor amounts of earthy iron oxide (limonite). Confined to Region 1 solids.

****Type 2d*** – Same as type *2b*, but matte, mottled, dark yellowish to brownish-gray. Some of these particles are filled with earthy, microgranular opal plus limonite. Confined to Region 1 solids.

****Type 2e*** – Same as type 2b, but matte, mottled, bright to subdued, medium orange- to reddish-brown. Opal of these particles is heavily impregnated and coated with limonite. Confined to Region 1 solids.

*Note – Type 2 particles account for up to 80% of the Region 1 samples, but are absent from Region 2 samples

Type 3 – "Pseudo-pumice". Mottled, vitreous to matte-textured, filamentous, very porous, pale yellowish-white glass or opal fragments. Typically larger than other particles in a give sample (up to at least 4 mm in length or diameter). Confined to region 1 solids.

Type 4 – "Mini-desert roses". Solid, sparkling, crystalline barite spheroids (avg. ~ 0.7 mm in dia.) and grape-like, irregular spheroid clusters (up to 4 mm in dia.). Translucent, colorless to pale grayish-yellow through rich light grayish-brown.

Type 5 – Laminated opal and metallic phases. Commonly tarnished and otherwise modified to a matte to submetallic dark gray coloration. Particles commonly anomalously large (up to 7 X 7 X 3 mm; typically much smaller), and ranging from chunky to platy aspects. Opaline laminae mostly solid and vitreous, light to medium translucent to opaque gray or colorless. Metallic laminae vary from sample to sample. One type is pale pinkish-gray to grayish-rose, commonly with a "peacock" iridescence. This is mostly metadomeykite (copper arsenides). Other metallic laminae are bright, light, slightly yellowish gray, and could be iron arsenides.

Type 5b particles occur only in the SCU solids from Region 2. They intricately branched, crystalline-appearing metallic particles, up to 0.5 mm in diameter, which resemble "wire silver", except that they have the "peacock" iridescence of the copper arsenide described above (not enough type 5b particles for XRD, but they are probably metadomeykite).

Type 6 – Very rare, probably insignificant. Anomalously large particles (up to 4 X 4 X 2 mm), consisting of conspicuous of variously vitreous to spongy-textured opal interlaminated with limonite and greenish- to brownish-black hisingerite (?). The latter laminae are texturally similar to type *1a* particles.

Type 7 – Flat gray plates of dense vitreous opal interlaminated with silvery metallic minerals (some with peacock iridescence) occurring only in Region 2 samples. Samples X-rayed to date show the presence of allargentum (AgSb) and metadomeykite.

Type 8 – Uncommon, and present only in Region 1 samples. Limonite, dense to porous and earthy, opaque, orange-brown through brick red to resinous dark brown. May include traces of metallic minerals (small speckles, medium gray; not enough for XRD.

Type 9a – Laminated to finely banded, dense, porcellaneous to rarely spongy-textured opal. Transparent to opaque, colorless to white through shades of brown and gray. Laminations vary from flat to convoluted. Particles commonly anomalously large (up to 7 X 5 X 3 mm; typically smaller).

Type 9b – Present only Region 2 samples. Similar to type 9a, but much darker (gray), and with less prominent laminations. XRD shows only opal.

Type 9c – Present only in Region 2 samples. Transparent, hackly-fractured, prominently vitreous opal. Colorless to shades of very light gray, brown, and yellow, the latter reminiscent of amber.

Type 10 – Massive, nonlaminated, vitreous opal. Vague lath-like aspect perpendicular to larger flat surfaces, which are pebbly to bubble-concave (the obverse of the pebbly texture) in appearance. Translucent white, light gray, or pale yellowish gray.

Type 11 – Probable cement. Microgranular, matte, speckled light gray and pale brown (rarely black). Uncommon, and found only in Region 1 samples.

Type 12 – Microporous, spongy-textured opal ± barite and very minor fluorite. Opaque, but translucent microscopically. White, yellowish-white, light gray, light brownish-orange (coloration likely due to limonite staining. Uncommon in Region 1 samples. Dominant in Region 2 samples.

Type 13 – Clastic quartz sand grains. Frosted, mostly rounded, some with thin shells of opal and limonite. Very rare, and apparently present only in Region 1 samples.

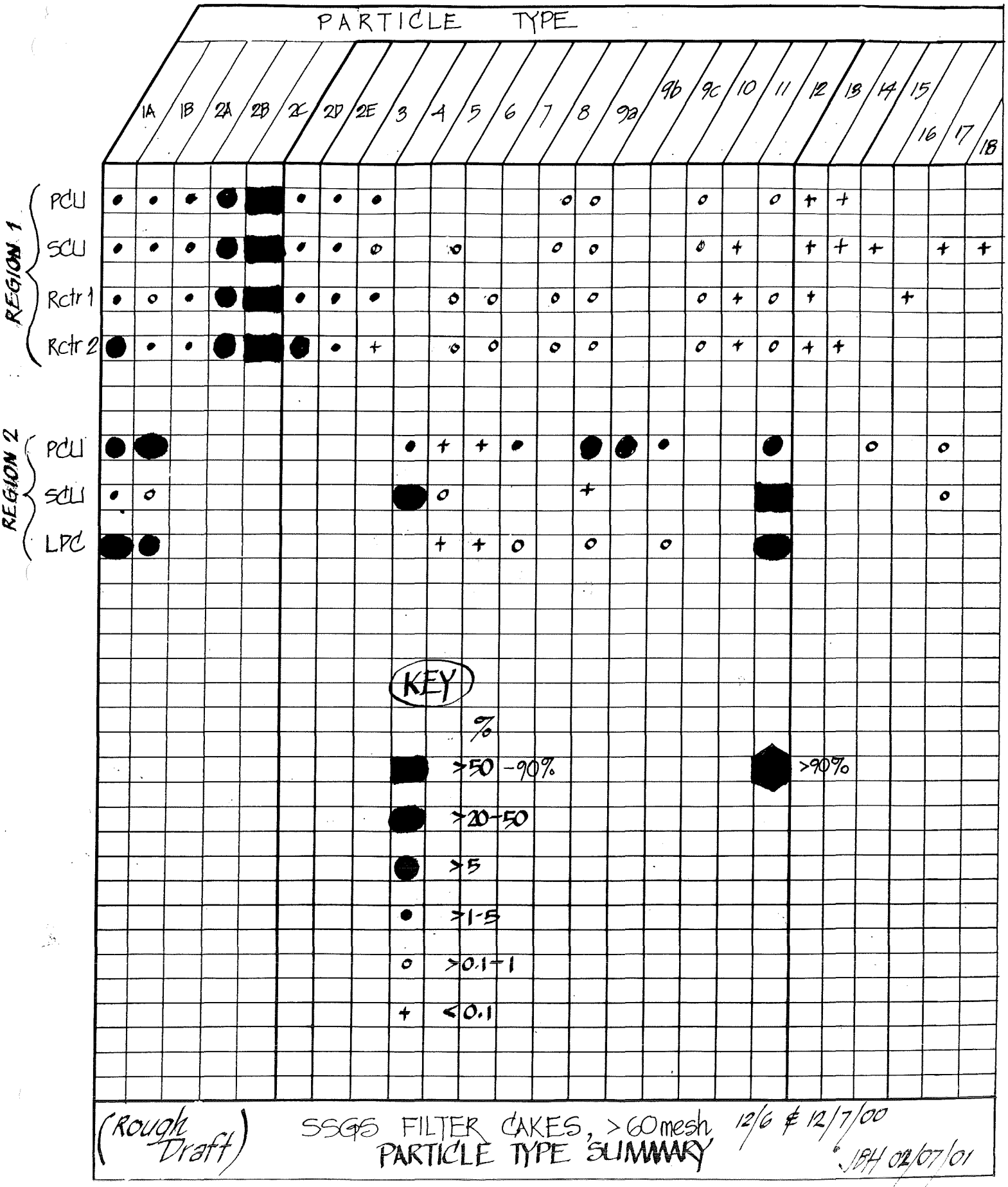
Type 14 – Silica (?) spheroids and amoeboids, some with single filamentous "tails". Definitely appear artificial. Absolutely colorless, transparent, and inclusion-free. Extremely rare, found only in one sample from Region 1.

Type 15 – A "catch-all" category for rare traces of particles not easily assigned to the other particle types of this classification. Probably insignificant. Never more than one or two particles in any given >60 mesh fraction. Variously limonitic, manganiferous (? dull dark gray grains and bands), opaline, or submetallic. Insufficient amounts for analysis. All examples mounted on the study sections prepared for this investigation.

Type 16 – Trace, only in one sample from Region 1. Flat, medium yellowish-gray, irregular opaque grains with a waxy texture. Suspect these are simply a variant of type *1b*.

Type 17 – Earthy opaline grains with disseminated metallic phases. Rare to uncommon. Can be thought of as variations of type 12 grains. Opaque white, light gray, yellowish gray, orange-gray, and brownish-orange grains (color differences reflecting different amounts of limonite) with disseminated speckles of a pale pinkish-gray to medium gray metallic mineral or minerals. Not enough for XRD, but some of the metallic substance is peacock-iridescent, and could be metadomeykite.

Type 18 – "Silver ribbons". Present only in the Region 1 SCU solids sample. Ultrathin strips, up to 3 mm long and 0.3 mm wide, only microns thick. Light, slightly pinkish gray, dull metallic luster. SEM indicates that these are native silver, patchily encrusted with a silver-antimony mineral, possibly allargentum or dyscrasite.



(Rough Draft) SSGS FILTER CAKES, >60 mesh 12/6 & 12/7/00
PARTICLE TYPE SUMMARY
JBH 02/07/01

Classification and Description of Particle Types in Sieved (>60 mesh) Filter Cakes and Allied Solids from Region 1 and Region 2 in the Salton Sea Geothermal Field

Jeffrey B. Hulen
Energy & Geoscience Institute (EGI), University of Utah
423 Wakara Way, Suite 300, Salt Lake City, UT 84108
(801)-581-8497 jhulen@egi.utah.edu

Introduction – Seven sieved samples of filter cakes and allied solid residues from the brine clarification units for Region 1 and Region 2 in the Salton Sea field were shipped to EGI in late November 2000 by CalEnergy Operating Company (CEOC) Geochemist Will Osborn. The samples were furnished to EGI for detailed characterization, description, and particle classification as well as judiciously applied X-ray diffraction (XRD) scanning electron microscopy (SEM), and electron microprobe (EMP). The overall aim of this work was to identify any textural, mineralogical, or geochemical differences between solids from the two regions that might help explain why the Region 1 samples, but not those from Region 2, contained small but still unacceptably high levels of citric-acid-leachable arsenic. This note addresses principally the initial descriptive phase of the project. At a later date, the descriptions will be integrated with results of the various instrumental methods noted above. At that time, we should have much clearer insight into causes for the elevated leachable arsenic concentrations in the Region 1 vs Region 2 solids.

General Description of Unsieved Samples – CEOC submitted seven samples for this work – four from Salton Sea geothermal field Region 1; three from Region 2. The Region 1 samples comprise solids from Reactor No. 1, Reactor No. 2, the Primary Clarifier underflow, and the Secondary Clarifier underflow.

All four samples from Region 1, washed and dried but unsieved, are pale, slightly brownish to orange gray, and have the consistency of face powder. A small proportion of the dried material forms thin flakes colored a more intense pale orange. Disseminated throughout the powdery solids are a few per cent speckles and grains, up to a few mm in diameter (but generally <0.5 mm), most of which are dark gray to greenish gray and

vitreous, resinous, or waxy-textured. Traces of other particle types will be described in more detail below.

The three Region 2 solids, from the Low-Pressure Crystallizer as well as the Primary and Secondary Clarifier underflows, are powdery and texturally similar to their counterparts from Region 1, but have a slightly more yellow-gray and less orange-buff appearance. These Region 2 solids also appear to contain fewer of the dark-colored "speckles" described for the Region 1 samples.

Sieved Samples – Initial efforts to describe the unsieved solid materials described above proved largely ineffectual. Therefore, subsamples were collected at each of the seven vessels by directing solids-containing brine through 60-mesh sieves for periods ranging from 30 minutes to 4 hours. The subsamples contain significantly more dark or otherwise anomalously colored and textured particles, and it is these on which we have focused our efforts.

Particle Types – Binocular microscopic examination of the >60-mesh fractions of the seven solids samples from Region 1 and Region 2 revealed the presence of 19 distinctly different and readily recognizable particle types (**Table 1**). Only a few of the particle types are common to all seven samples, and many are present in extremely small amounts. Detailed descriptions of the particles, with significant departures from the norm noted as necessary, are as follows:

Type 1

These generally dark gray or greenish-gray particles are among the few types present in all seven samples. Type 1 particles account for only a few percent of the sieved fractions from all samples except the PCU from Region 2. In this sample, type 1 fragments account for about two-thirds of the yield (**Table 1**).

There are two main subtypes for this particle category. *Type 1a* particles are angular to platy, transparent through translucent to opaque dark greenish-gray, vitreous to resinous in texture, and display conchoidal fracture. Some grains have a vague sheaf-like or fibrous texture, with the "sheaves" oriented perpendicular to larger flat surfaces. The flatter surfaces of some chips have subdued botryoidal textures. The particles range in maximum dimension up to at least 5 mm, but average much less than this.

Type 1a particles from Region 2 are commonly very glassy-appearing, transparent (especially thinner fragments), and colored a beautiful olive to bottle green. Those from Region 1, by contrast, are much more likely to be opaque, and deep gray to black with only local tinges of green or "root-beer-glass" colors at thin edges. Some type 1a particles are blotchy and mottled translucent and opaque, with the latter sections probably representing alteration. The transparent type 1a particles are tentatively identified as amorphous hydrous iron silicate (like hisingerite), although they are amorphous to X-rays; the opaque types are typically shown by XRD to be dominantly ferroan saponite, a trioctahedral swelling clay.

Type 1b particles are microgranular, matte to resinous-textured, and medium to dark gray to yellowish-gray or greenish-gray. Similar in size to type 1a fragments, they are commonly suffused partially with brick red to brownish-orange iron oxide stain. These particles, many with a subdued lobate texture, are readily crushed with light pressure, yielding a distinctly waxy texture and a lighter greenish- or yellowish-gray color. XRD reveals that these particles are dominantly or entirely ferroan saponite. Note that type 1b particles are particularly abundant in the sieved fraction from the Region 1 PCU (**Table 1**).

Type 2

Particles of *type 2*, small, hollow, opaline spheroids, ovoids, and lobate amoeboid masses, account for the bulk of all sieved samples from Region 1, but are absent from the Region 2 samples (**Table 1**). This is actually the principal difference between the two sample

suites (in addition to the uniquely abundant type 1 particles in the Region 2 PCU sieved fraction).

These thin-shelled particles occur commonly both intact and broken. Intact ones are mostly 0.1 to 0.7 mm in diameter, but a few are as large as 1 mm in diameter. The shells of these hollow particles are typically < 10 microns thick, accounting for their common breakage. Some are "shell-in-shell" grains. A few contain loose, earthy, microgranular opal ± "limonite" (earthy hydrous iron oxide). Distinctive subtypes of these particles are as follows:

(2a) . . . Vitreous, translucent to nearly transparent. Intact grains are 0.1 mm to 0.6 mm (average about 0.2 mm) in diameter. A few of the smaller grains may be solid. These grains are shown by XRD and SEM to be nearly pure opal-A (mostly amorphous to X-rays).

(2b) . . . Same as *2a*, but pure matte white, and (for intact grains) up to 1.3 mm (avg. 0.3 mm) in diameter.

(2c) . . . Same as *2b*, but pale yellowish-gray to orange-gray through light to medium, slightly yellowish-gray. These are by far the most abundant type 2 particles, and depart from type 2b in being variously stained by trace to minor amounts of limonite.

(2d) . . . Same as *2c*, but mottled, medium to dark yellowish to orange gray to dull gray. A few of these grains have surficial, dull purplish-brown patches. Some are partially to completely filled with loose, earthy, microgranular yellowish to orange-gray material (probably limonitic opal). Rarely, a few of these filled type 2d shells contain trace amounts of a bright reddish-orange substance, possibly realgar (insufficient sample to identify by EMP or SEM).

(2e) . . . Same as *2c*, but mottle, bright to subdued, medium brownish-orange to brownish-red to brownish-maroon. These grains are also opal for the most part, but are relatively heavily coated with earthy iron oxide (limonite).

Type 3

Found only in the Region 1 samples, *type 3* particles are translucent to opaque, vesicular and filamentous, matte-textured to vitreous, and slightly yellowish white to pale yellowish gray. They are angular to highly irregular, up to 3 mm in maximum dimension (generally much smaller), and strongly resemble tube pumice. A large proportion of these fragments are conspicuously larger than others in a given sample.

Type 4

These particles occur only in the Region 2 samples (Table 1). They are sparkling spheroids to ovoids from 0.3 to 1.3 mm in diameter, commonly forming grape-like aggregates up to 3-4 mm in diameter or length. Colors of these *type 4* particles range from translucent pale neutral gray through pale yellowish gray to rich light grayish brown. Where discernible, the crystals making up these particles are stubby euhedral prisms up to 50 microns long and 15 microns wide; terminations are typically blunt to low-pyramidal. The individual particles are commonly very spherical, and many have been eroded to a relatively smooth surface.

Type 5

These dark-colored particles, though partially formed of opaline silica, are distinctly metallic, and all three instrumental analytical techniques reveal the presence of arsenic. The particles can be anomalously large, up to 7 X 7 X 3 mm (typically much smaller). They are characteristically crudely to delicately banded, with opal alternating with obviously metallic laminae. The metallic portions are variable in color. Many of these are bright, very pale pinkish-gray to grayish-rose, commonly with a greenish to bluish "peacock" iridescence. A few of these fragments are dulled by tarnish to a flat, slightly

Binocular Microscopic Description

Sample Location – Salton Sea geothermal field

Sample Designation – Suc-0106

Sample Type – Disaggregated filter cake, +50 mesh (collected on/washed through 50 mesh screen)

Examiner – J. Hulen

Date – November 28, 2000

Description

(1a) . . . ~7% matte to dull-resinous, dark gray grains, opaque to barely translucent, commonly with faint greenish cast. Grains and chips shinier on newly broken surfaces, with some chips almost vitreous in appearance. Crushed grains are waxy-appearing and light greenish-gray in color – suspect that they are a layer silicate (smectite?). Some grains, even though resinous-appearing overall, have a vague sheaf-like fibrous texture. Grains range from subequant-angular shapes to thin chips (most common) with width or length (up to 1.5 mm) to thickness ratios >10. Flat surfaces of chips and some surfaces of angular grains have subdued botryoidal textures.

(1b) . . . ~2% matte to resinous-appearing, dark gray grains, mostly subequant-angular to crudely ovoid, up to 1 mm in diameter or length, with pebbly-appearing surfaces. Interiors of these grains are microgranular, but visually appear to be the same material that makes up the *1a*-type (above) grains.

(2) . . . ~81% thin-shelled, hollow spheroids, ovoids, and amoeboid masses, both intact and broken. Intact ones are mostly 0.1 to 0.7 mm in diameter, but a few are as small as 0.03 mm in diameter, and a few are as large as 1.5 mm in diameter. The shells of these hollow masses are typically <10 microns thick, so they are readily broken. Some are "shell-in-shell" grains. A few contain loose, earthy,

microgranular material (see more below). Distinctive types of these hollow masses are as follows:

(2a) . . . ~20% vitreous, translucent to nearly transparent. Intact grains are 0.1 mm to 0.6 mm (avg. ~0.2 mm) in diameter. A few of the smaller grains appear to be solid. These hollow grains are almost certainly pure or nearly pure opal.

(2b) . . . ~35% same as *2a*, but pure matte white, and (for intact grains) up to 1.3 mm (avg. 0.3-0.4 mm) in diameter.

(2c) . . . ~20% same as *2b* but matte, mottled, pale yellowish-white to orange-white through light-medium, slightly yellowish-gray.

(2d) . . . ~5% same as 2*c*, but matte, mottled, medium to dark yellowish-gray. A few of these grains have surficial, dull purplish-brown patches. ***Note*** – A small number of these are partially to completely filled with loose, earthy, microgranular yellowish-gray material. An even smaller number of these filled *2d*-type shells also contain trace to minor amounts of a microcrystalline (<5 microns), ***bright reddish-orange substance***, which could well be ***realgar***.

(2e) . . . ~1% same as *2c*, but matte, mottled, bright to subdued, medium brownish-orange. These grains appear, based on their colors, to be enriched in iron oxide.

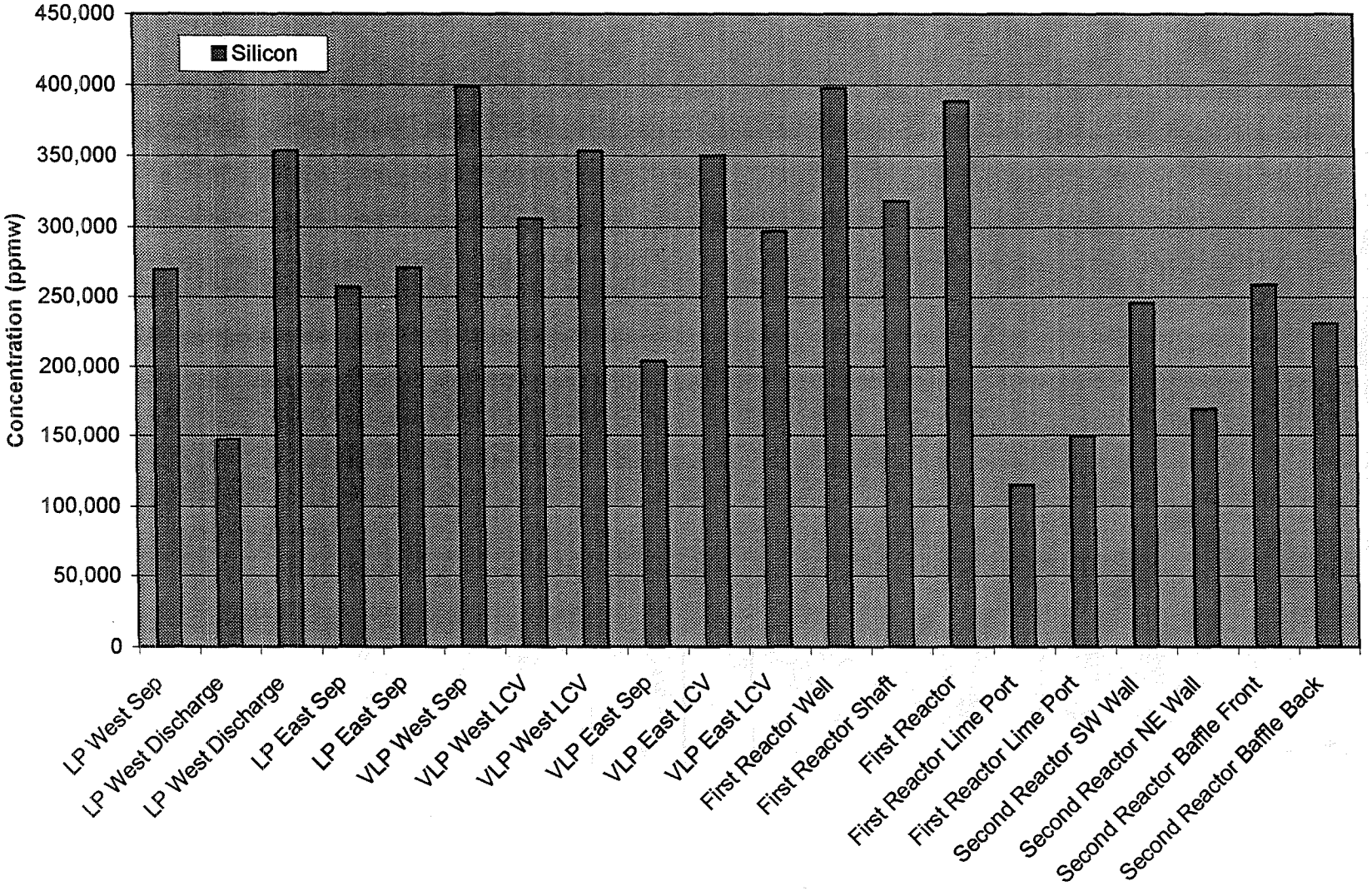
(3) . . . ~10% translucent to opaque, mottled vitreous to matte-textured, slightly yellowish white, porous and filamentous glass or opal grains. These are angular to highly irregular, and look very much like pumice. A large proportion of these grains are conspicuously larger than others in the sample. These pumiceous-appearing grains average about 1 mm in diameter, and some reach 3 mm in diameter.

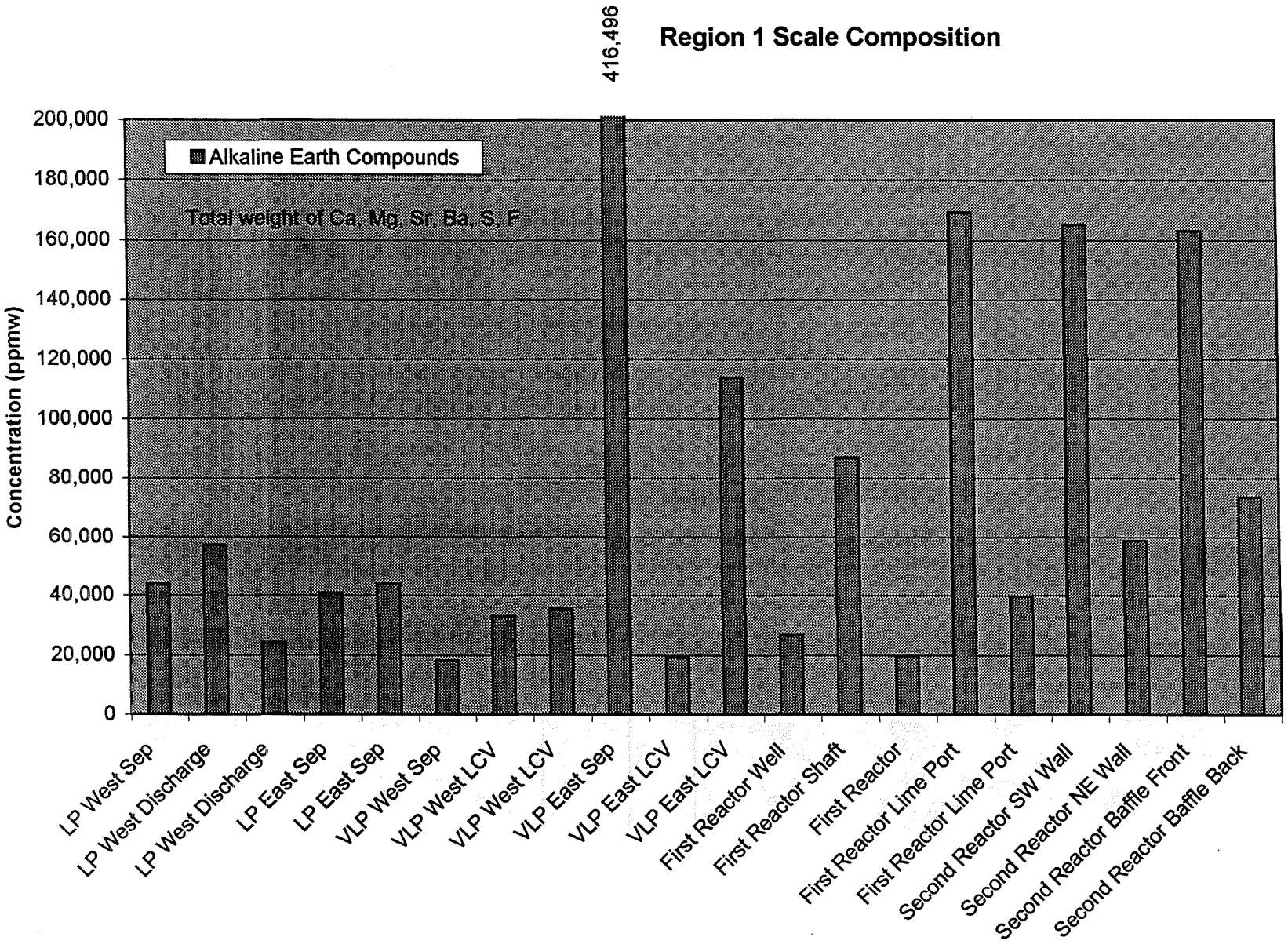
(4) . . . Trace composite grains, silica (?)-cemented aggregates of <20 micron spheroids similar to type *2* (mostly types *2a* and *2b*).

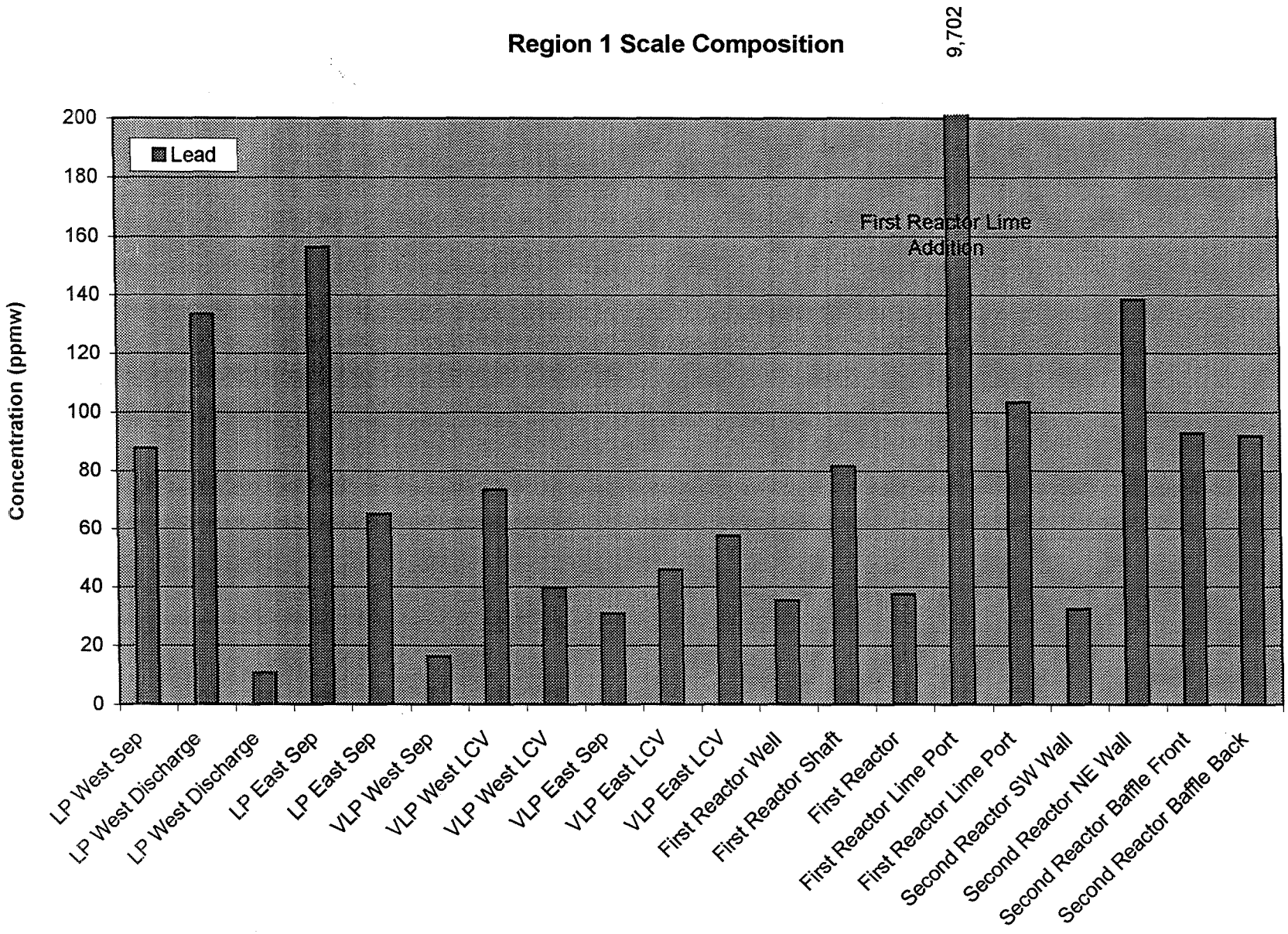
	Site	Stream	Sample Code	Si	O	As	Cu	As/Cu	Pb	Na	K	Cl
1	Region 1	LP West Sep	PUS990120011430	269,455	362,495	220	795	0	88	72,945	17,173	209,009
2	Region 1	LP West Discharge	PUS990120011610	146,989	119,626	3,811	619	6	134	197,118	25,818	324,766
3	Region 1	LP West Discharge	PUS990115011300	353,096	420,052	8,246	464	18	11	32,324	9,735	64,922
4	Region 1	LP East Sep	PUS990121011655	256,694	318,488	1,118	1,306	1	156	113,590	14,251	172,959
5	Region 1	LP East Sep	PUS990121011431	270,627	330,809	3,079	1,969	2	65	83,518	16,253	158,081
6	Region 1	VLP West Sep	PUS990121011750	399,129	455,724	1,891	1,566	1	16	20,054	6,204	40,493
7	Region 1	VLP West LCV	PUS990120011156	305,999	350,842	463	108	4	74	73,968	18,313	182,119
8	Region 1	VLP West LCV	PUS990120011155	353,371	446,423	79	75	1	40	41,523	9,124	105,475
9	Region 1	VLP East Sep	PUS990120011720	204,053	295,205	1,483	502	3	31	8,556	4,294	7,370
10	Region 1	VLP East LCV	PUS990120011200	350,068	421,291	480	83	6	46	47,937	11,428	113,161
11	Region 1	VLP East LCV	PUS990120011201	297,335	377,253	97	43	2	58	53,163	13,711	133,983
12	Region 1	First Reactor Well	PUS040121010730	397,713	508,086	249	150	2	35	8,633	4,142	12,526
13	Region 1	First Reactor Shaft	PUS040121010731	318,384	366,863	2,665	25,527	0	81	55,783	9,759	104,981
14	Region 1	First Reactor	PUS040121010701	387,959	433,179	121	46	3	38	44,581	8,286	98,535
15	Region 1	First Reactor Lime Port	PUS040121011045	115,036	269,955	5,846	2,079	3	9,702	67,450	17,585	176,417
16	Region 1	First Reactor Lime Port	PUS040121011050	149,680	310,176	3,958	2,101	2	103	77,929	20,733	196,630
17	Region 1	Second Reactor SW Wall (18)	PUS050121010705	245,675	270,048	9,754	144,980	0	33	9,980	2,713	21,026
18	Region 1	Second Reactor NE Wall (19)	PUS050121010701	169,203	180,881	10,070	47,824	0	139	186,901	46,241	259,659
19	Region 1 (20)	Second Reactor Baffle Fron	PUS050121010702	258,887	363,693	7,033	17,832	0	93	26,270	5,747	65,277
20	Region 1 (21)	Second Reactor Baffle Back	PUS050121010703	230,673	286,786	19,036	220,750	0	92	13,905	2,767	31,606
	Region 2	HP	PVS990129011005	208,971	462,617	263	61	4	29	19,952	8,977	33,835
	Region 2	HP	PVS990129011030	44,109	435,942	26	181,336	0	0	5,095	2,024	2,473
	Region 2	HP Scrubber (24)	PVS990129011000	17,155	486,511	9,165	2,827	3	38,096	0	268	1,789
	Region 2	SP	PVS990131011530	362,298	484,638	2,873	177	16	0	19,120	12,714	23,652
	Region 2	SP	PVS990131011531	332,699	498,631	116	43	3	26	18,653	15,765	21,830
	Region 2	SP	PVS990131011532	360,365	507,348	132	62	2	10	23,829	19,580	19,419
	Region 2	SP	PVS990131011533	314,545	501,762	81	32	3	7	25,880	25,245	15,794
	Region 2	SP	PVS990131011600	348,401	500,892	166	81	2	18	25,400	18,472	33,763
	Region 2	SP	PVS990131011601	142,836	454,348	10,952	6,610	2	45,375	1,863	941	4,348
	Region 2	LP	PVS990129011100	318,976	530,713	94	55	2	33	24,812	29,575	9,936
	Region 2	LP	PVS990129011105	316,918	525,653	59	114	1	0	26,705	28,745	11,640

Site	Stream	Description		Date/Time	Description	ID
Region 1	LP West Sep	V-5212 sep floor, spongy grey		1/20/01 14:30	1	8108
Region 1	LP West Discharge	V-5212 upstream of acid nozzle, on bottom (salt)	NaCl	1/20/01 16:10	2	8167
Region 1	LP West Discharge	V-5212 discharge line, upstream of acid (washed)		1/20/01 12:13	14	8153
Region 1	LP East Sep	V-5213 sep floor; FC2354		1/21/01 16:55	3	8110
Region 1	LP East Sep	V-5213 Sep; FC2355		1/21/01 14:31	4	8168
Region 1	VLP West Sep	V-5214 Sep. (washed)		1/21/01 17:50	5	8155
Region 1	VLP West LCV	V-5214 LCV upstream @ bottom of line	seed	1/20/01 11:56	7	8114
Region 1	VLP West LCV	V-5214 LCV Upstream at blind flange		1/20/01 11:55	12	8162
Region 1	VLP East Sep	V-5215 Sep. (washed)	SiO2/CaF2	1/20/01 17:20	6	8156
Region 1	VLP East LCV	V-5215 LCV base of pipe upstream	seed	1/20/01 12:00	8	8115
Region 1	VLP East LCV	V-5215 LCV upstream wall 1" thick		1/20/01 12:01	11	8118
Region 1	First Reactor Well	reaction well wall under inlet pipe @ 5'		1/21/01 7:30	15	8125
Region 1	First Reactor Shaft	impeller shaft @ 1'		1/21/01 7:31	16	8126
Region 1	First Reactor	brine inlet pipe, exterior, outside well		1/21/01 7:01	17	8127
Region 1	First Reactor Lime Port	lime addition port east side (Higgins)	hi pH O-S	1/21/01 10:45	25a	8128
Region 1	First Reactor Lime Port	(Higgins)		1/21/01 10:50	26a	8129
Region 1	Second Reactor SW Wall	SW wall 4' (washed)		1/21/01 7:05	18	8154
Region 1	Second Reactor NE Wall	NE wall @ 6"; FC2352		1/21/01 7:01	19	8122
Region 1	Second Reactor Baffle Fron	west baffle, front; FC2350		1/21/01 7:02	20	8120
Region 1	Second Reactor Baffle Back	west baffle, back; FC2351		1/21/01 7:03	21	8121
Region 2	HP	V-2201 brine discharge (washed)		1/29/01 10:05	23	8149
Region 2	HP	V-2201A downstream of acid feed (washed)	CuFeS2	1/29/01 10:30	24	8150
Region 2	HP Scrubber	V-2222 HP scrubber nozzle (washed)	Fe-Zn-S	1/29/01 10:00	22	8157
Region 2	SP	SP at steam/brine interface		1/31/01 15:30		8173
Region 2	SP	SP vortex cluster		1/31/01 15:31		8172
Region 2	SP	SP at brine discharge		1/31/01 15:32		8175
Region 2	SP	SP discharge pipe, 2nd horizontal elbow		1/31/01 15:33		8171
Region 2	SP	SP ladder		1/31/01 16:00		8174
Region 2	SP	SP scrubber floor	Fe-O	1/31/01 16:01		8170
Region 2	LP	V-2312 brine Inlet (washed)		1/29/01 11:00	25	8151
Region 2	LP	V-2313 brine Inlet (washed)		1/29/01 11:05	26	8152

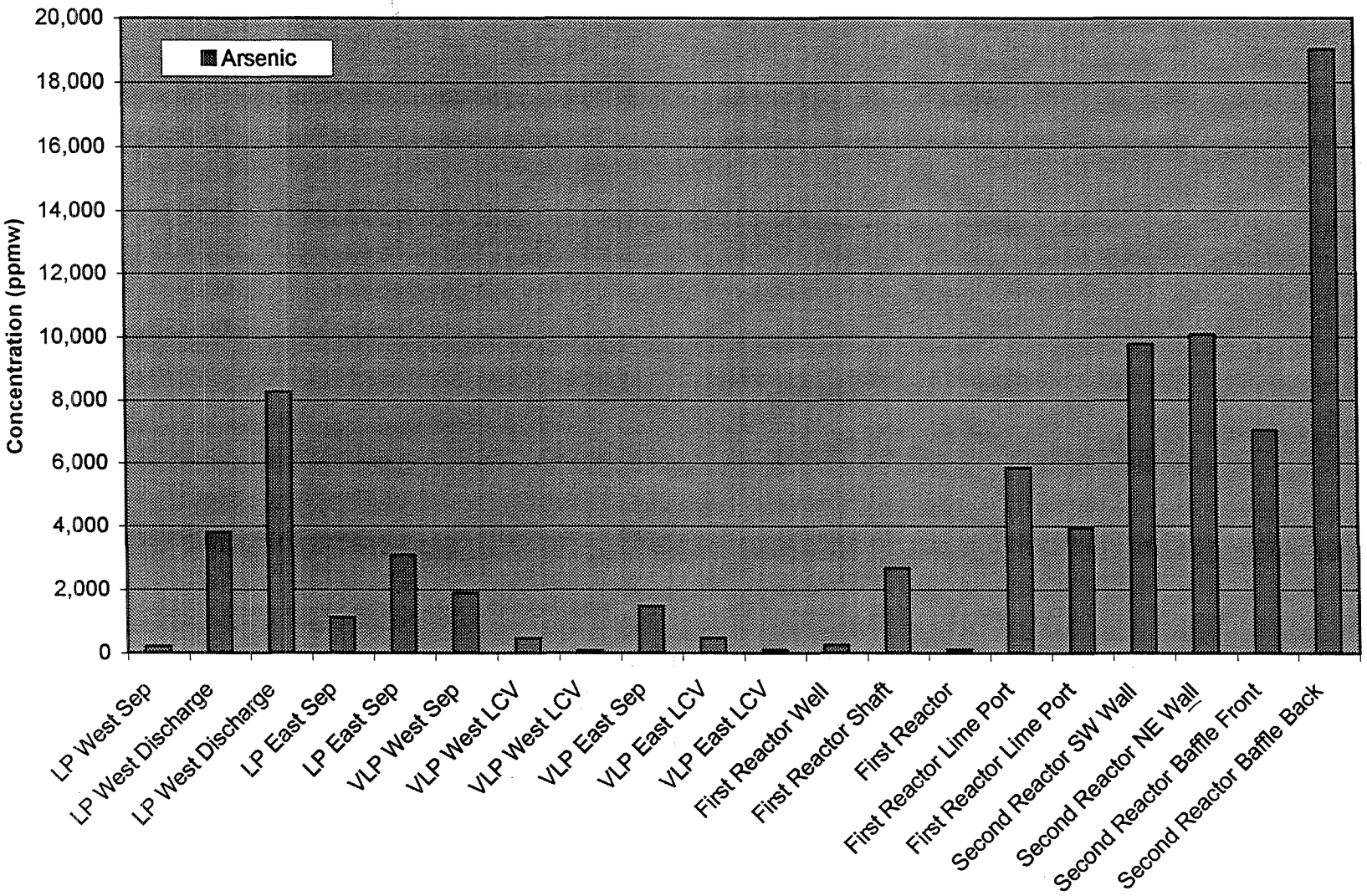
Region 1 Scale Composition



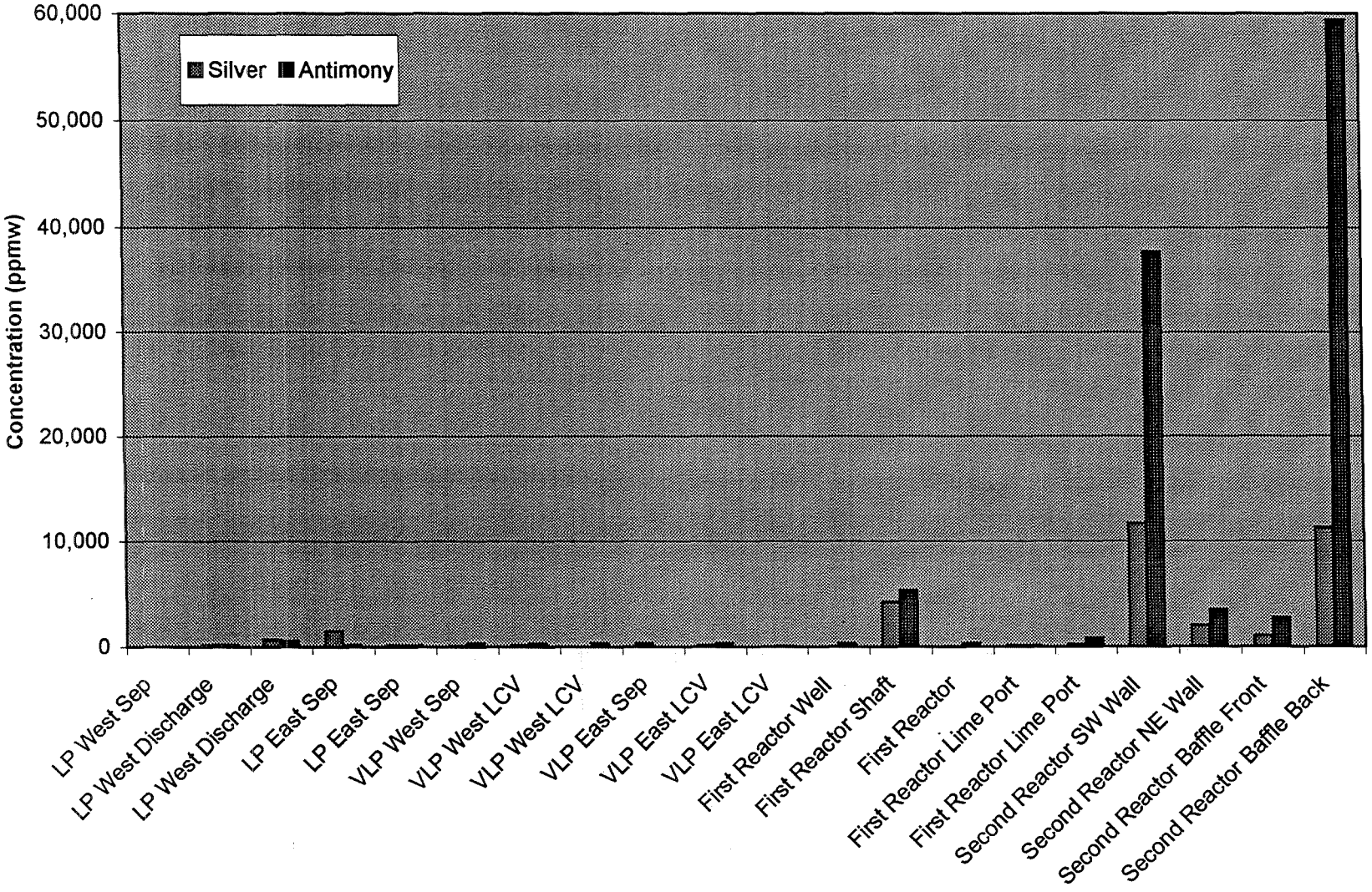

Region 1 Scale Composition
416,496
Alkaline Earth Compounds
Total weight of Ca, Mg, Sr, Ba, S, F
Concentration (ppmw)
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
LP West Sep
LP West Discharge
LP West Discharge
LP East Sep
LP East Sep
VLP West Sep
VLP West LCV
VLP West LCV
VLP East Sep
VLP East LCV
VLP East LCV
First Reactor Well
First Reactor Shaft
First Reactor
First Reactor Lime Port
First Reactor Lime Port
Second Reactor SW Wall
Second Reactor NE Wall
Second Reactor Baffle Front
Second Reactor Baffle Back

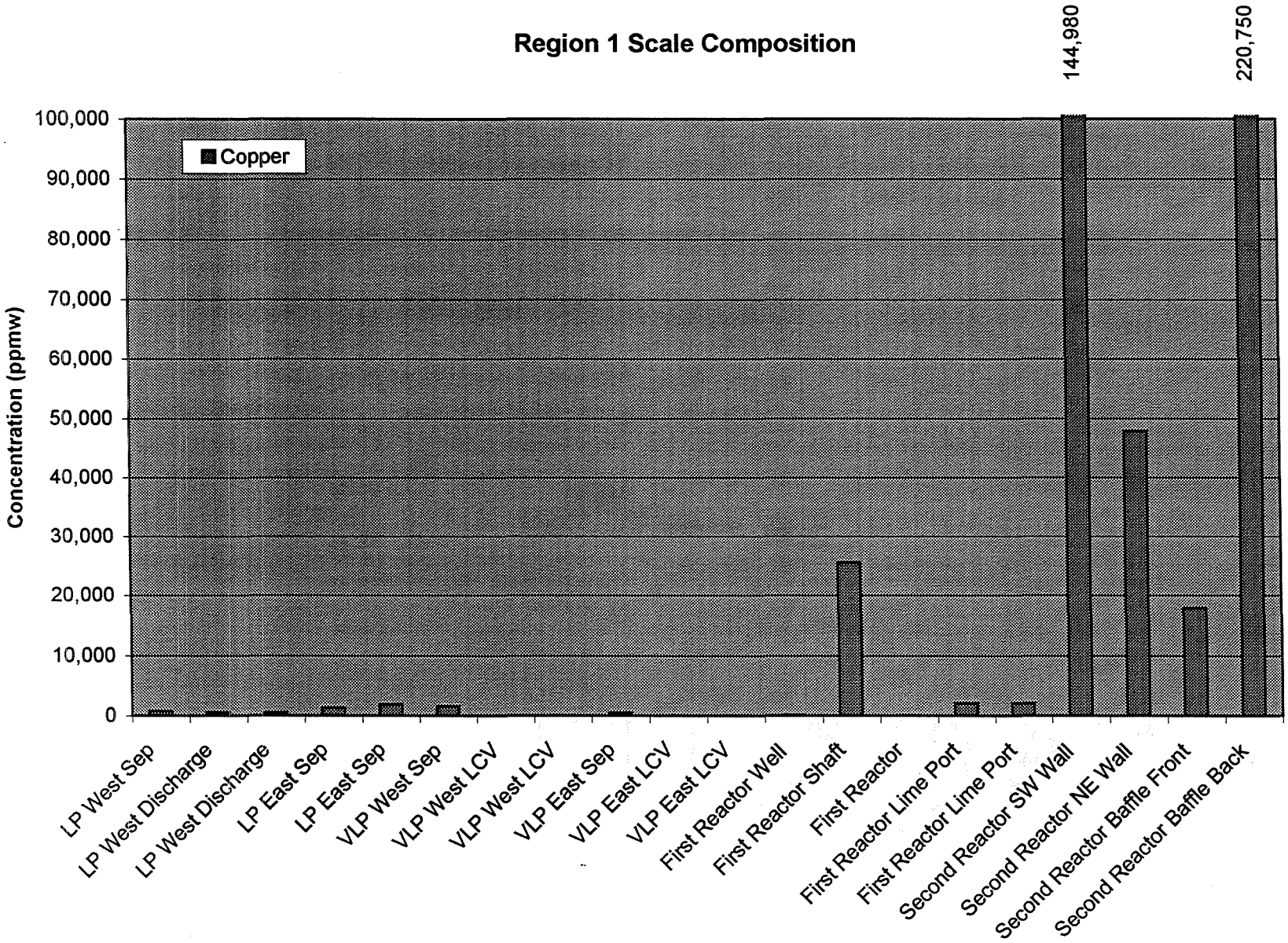

Region 1 Scale Composition
9,702
Lead
First Reactor Lime Addition
Concentration (ppmw)
200
180
160
140
120
100
80
60
40
20
0
LP West Sep
LP West Discharge
LP West Discharge
LP East Sep
LP East Sep
VLP West Sep
VLP West LCV
VLP West LCV
VLP East Sep
VLP East LCV
VLP East LCV
First Reactor Well
First Reactor Shaft
First Reactor
First Reactor Lime Port
First Reactor Lime Port
Second Reactor SW Wall
Second Reactor NE Wall
Second Reactor Baffle Front
Second Reactor Baffle Back

Region 1 Scale Composition

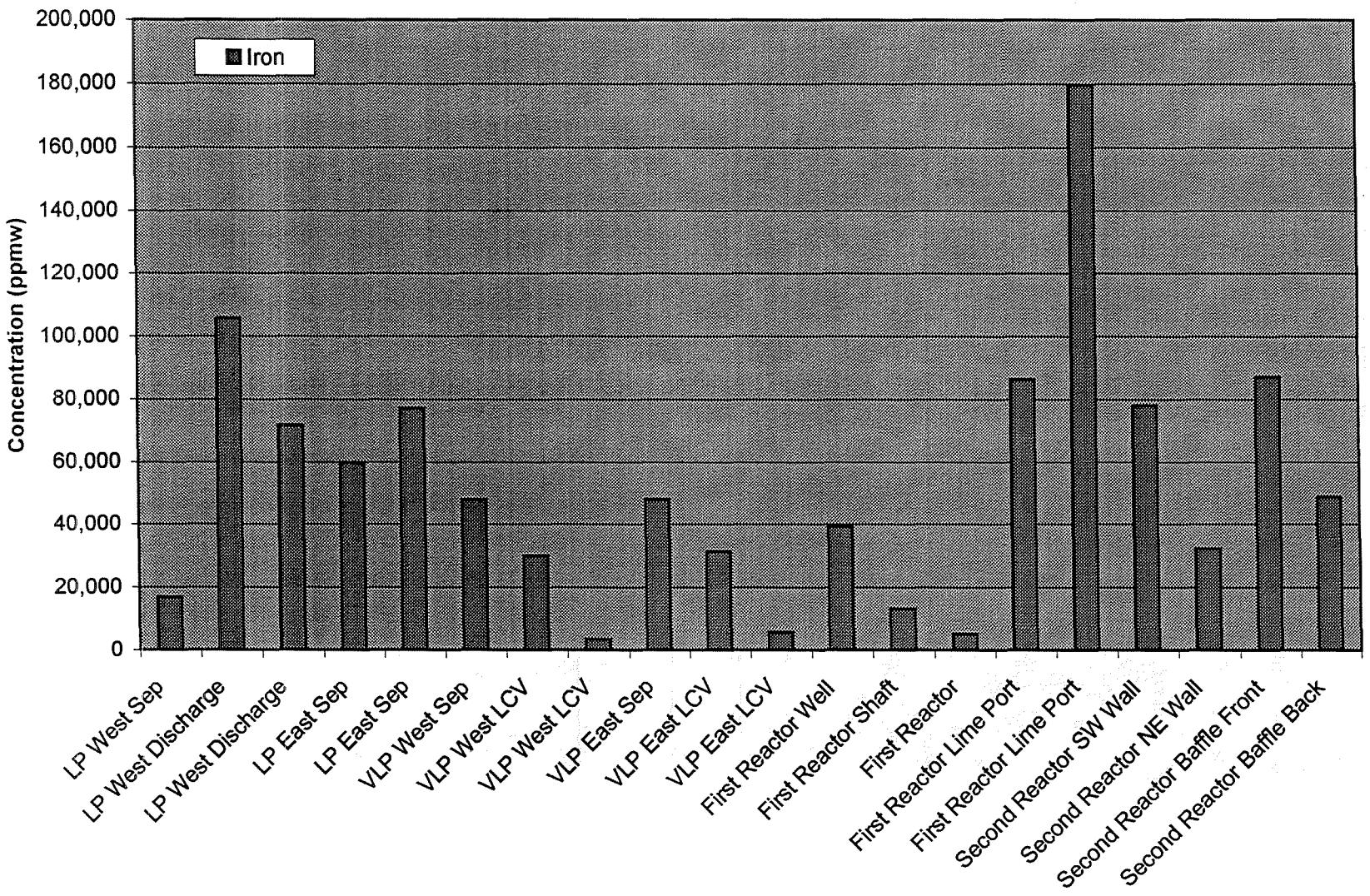


Region 1 Scale Composition




Region 1 Scale Composition
144,980
220,750
Copper
Concentration (ppmw)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
LP West Sep
LP West Discharge
LP West Discharge
LP East Sep
LP East Sep
VLP West Sep
VLP West LCV
VLP West LCV
VLP East Sep
VLP East LCV
VLP East LCV
First Reactor Well
First Reactor Shaft
First Reactor
First Reactor Lime Port
First Reactor Lime Port
Second Reactor SW Wall
Second Reactor NE Wall
Second Reactor Baffle Front
Second Reactor Baffle Back

Region 1 Scale Composition



Binocular Microscopic Description

Sample Location – Salton Sea geothermal field

Sample Designation – Region No. 1, Reactor No. **2**

Sample Type – Dried/washed solids (CalEnergy label) – >60 mesh fraction (washed through 60 mesh screen – Collected by CalEnergy on November 20, 2000

Examiner – J. Hulen

Date – December 2, 2000

Description

(1a) . . . ~5% matte to resinous, opaque to translucent medium to dark gray grains commonly with faint greenish or "root-beer-glass" cast. Grains and chips vitreous on fresh surfaces. Crushed grains are waxy-appearing and light greenish-gray in color – suspect that they are composed of a clay mineral or an amorphous iron-silicate precursor. Some grains, even though resinous-appearing overall, have a vague sheaf-like fibrous texture, with the "sheaves" oriented perpendicular to larger flat surfaces. Grains range from subequant-angular to subrounded shapes, up to at least 3 mm in diameter or length, to thin chips with width or length (up to 1.5 mm) to thickness ratios >10. Flat surfaces of chips and some surfaces of angular grains have subdued botryoidal textures. Some of these surfaces, in addition, have obvious dessication cracks.

(1b) . . . ~1% matte to resinous-appearing, dark gray grains, mostly subequant-angular to crudely ovoid, up to 1 mm in diameter or length, with pebbly-appearing surfaces. Interiors of these grains are microgranular, but visually appear to be the same material that makes up the *1a*-type (above) grains. Note – suspect that in this sample, many of the grains identified as type *4* could actually be type *1b* that are slightly more porous, and commonly impregnated irregularly with a brick red iron-oxide (?).

(2) . . . ~87% thin-shelled, hollow spheroids, ovoids, and amoeboid masses, both intact and broken. Intact ones are mostly 0.1 to 0.7 mm in diameter, but a few are as small as 0.03 mm in diameter, and a few are as large as 1 mm in diameter. The shells of these hollow masses are typically <10 microns thick, so they are readily broken. Some are "shell-in-shell" grains. A few contain loose, earthy, microgranular material (see more below). Distinctive types of these hollow masses are as follows:

(2a) . . . ~20% vitreous, translucent to nearly transparent. Intact grains are 0.1 mm to 0.6 mm (avg. ~0.2 mm) in diameter. A few of the smaller grains appear to be solid. These hollow grains are almost certainly pure or nearly pure opal.

(2b) . . . ~15% same as *2a*, but pure matte white, and (for intact grains) up to 1.3 mm (avg. 0.3-0.4 mm) in diameter.

(2c) . . . ~40% same as *2b* but matte, mottled, pale yellowish-white to orange-white through light-medium, slightly yellowish-gray.

(2d) . . . ~7% same as *2c*, but matte, mottled, medium to dark yellowish-gray

(2e) . . . ~5% same as *2c*, but matte, mottled, bright to subdued, medium brownish-orange to brick red. These grains appear, based on their colors, to be enriched in iron oxide.

(3) . . . Trace filamentous opal (?) grains, highly porous, angular to highly irregular, reminiscent of pumice. Grains avg. about 0.5 mm in diameter. Grains typically stained with powdery-appearing brownish-red to brownish-orange iron oxide.

(4) . . . 2-3% matte to slightly waxy-appearing, microgranular grains, medium to dark gray to slightly yellowish through reddish-gray, commonly mottled with dark brick red. Grains commonly broken. Intact ones avg. ~ 0.5 mm in diameter, and are ovoid to amoeboid-equant; a few are highly irregular. Grains crush readily to a slightly more yellowish-gray waxy appearance.

(5) . . . ~0.2% grayish, flat plates, all anomalously large, with the largest measuring 7 X 7 X 0.7 mm. The plates are "sandwiches", with 10-20 micron outer rinds of translucent yellowish-gray opal enclosing a ***metallic interior***. The metallic portion is bright, very pale pinkish-gray to grayish-rose colored, very locally with a bright green to blue "peacock" iridescence. The flat opaline surfaces of the plates are pebbly-appearing and rough on a micron scale, with relief <5-10 microns.

(6) . . . ~0.1% (but all as one large fragment) brightly black-, gray-, and red-banded opal. This single fragment measured about 4 X 4 X 1.2 mm, with the banding subparallel to the larger flat surfaces. Bands are described convex-outward, from the interior: **(A)** pale yellowish-white, spongy-textured, microgranular translucent opal, 0.1 mm thick; **(B)** same as 1, but pale amber, 0.1 mm thick; **(C)** vitreous, opaque, very dark-brown to black dense opal or iron-rich clay, 0.1 mm; **(D)** spongy-appearing, translucent, light-gray to slightly yellowish-gray microgranular opal, with abundant, disseminated, powdery bright reddish-orange material (brighter than band F – see below); **(E)** alternating bands, three each of deep yellowish-gray and light gray, translucent microgranular, spongy-appearing to locally dense and vitreous opal – all bands with sparsely disseminated, angular black flecks <5 microns in diameter – total thickness of the six bands about 0.5 mm; **(F)** light gray to yellowish gray and pale orange translucent, microgranular, spongy-appearing opal, with abundant, disseminated

stringers, blebs, flakes, and specks of bright reddish-orange material (visually appears more like powdery hematite than an arsenic-bearing phase).

(7) . . . 1-2% mottled dark brownish-red and maroon, variably vitreous/submetallic to porous-earthy-microgranular, conspicuously, anomalously large grains, angular, but with vestiges of <5 micron-thick pebbly to microbotryoidal shells of translucent, medium-gray opal. Grain fragments up to 3 mm in diameter, but some of the inferred, disaggregated grains possibly much larger. Although dominantly the two colors and textures noted above, the grains also contain scattered, irregular patches of porous, microgranular, translucent pale gray opal, with speckles of the darker material. Also, just inside the opaline shells is a 10-30 micron band of porous, microgranular, bright brownish-orange, iron-rich (?) opal.

(8) . . . Trace irregularly mottled dark gray to black, brick red, and white to light gray grains, also anomalously large (even fragments), with whole grains reaching 2 mm in diameter. White to light gray portions are porous, microgranular, translucent opal. Brick red portions are powdery- to earthy-textured, except where suffused into the aforementioned opal (rendered bright orange-red as a result). Black portions are of two types – larger irregular clots, with matte to vitreous luster, and a few speckles <5 microns in diameter embedded in the translucent opal.

(9) . . . ~0.5% plates and chips of dense, vitreous to matte-textured, laminated opal, anomalously large, up to 5 X 7 X 1.5 mm. Opaline bands are botryoidal (though on a subdued scale), up to 0.1 mm in thickness (avg. much less), and range in color from dark translucent gray to translucent white.

(10) . . . ~0.5% plates of massive, nonlaminated, vitreous opal, same size range as *(9)* above. Vague lath-like aspect perpendicular to the larger flat sides of the plates. Pebbly to bubble-concave (the obverse of pebbly) textures on the surfaces of the larger flat plates. Colors uniformly pale and translucent, white, light gray, and pale yellowish-gray (each plate is a single color).

(11) . . . ~0.5% (but only one large grain) cement (?). Grain was 10 X 10 X 4 mm prior to its breakage. Microgranular, matte, speckled light gray, light yellowish gray, and pale brown (rare black) massive substance resembling borehole cement. Grain is thinly (<10 microns) coated with a matte to resinous-appearing dark gray, slightly rough-surfaced opal (?).

(12) . . . ~0.5% (also only one large grain) massive, porous, microgranular, translucent white to yellowish-white opal. Prior to it breakage, chip about 12 X 9 X 4 mm in size. Flat surfaces of the chip stained pale brownish-orange with apparent FeOx.

(13) . . . Trace medium (0.6 mm) clastic sand grains, frosted, mostly rounded, exclusively quartz. Some have thin shells of opal and earthy reddish-brown iron oxide.

(14) . . . Trace (one grain) colorless, transparent, perfectly spherical grains of glass, opal, or plastic, 0.3 mm in diameter.

Region 1, Reactor 2

Dec 8, 00 ①.
SEM
w/ Barb

Particle 13
all silica - opal - uniform fine grained.
less than 1 μm

Particles 5
Cu - and some As - all diffuse - Mg + Fe in Si glass
can't find any discrete, crystalline phases with Cu or As.
~~Cat fur photos~~ - □ squarish.

Particles 2c
broken eggs - all Si - uniform fine grained.
2c image 12-10-00

Particles 2e
Fe + Si but still all uniform opal
another - smoother - a little less Fe

another 2e
clay! ~~nontronite~~ chlorite — making a picture of: images
EDS: Mg ≈ Fe < Si, still O > Ce
clay, platy.
round spherules
long splinters - plates

so eggs filled with chlorite - low mgn 300x Twoge 12-11-00

area of chlorite + big plates

smectitic to chloritic clay?
curved to platy
most look platy.

balls - same elemental analysis as big image

2e

EDS of 12-11-00 big plate has Fe, Mg > Ca (less aluminum) = chlorite

Dec 8.00
(2)
SEM
w/Barb.

Particles 1a

conchoidal fractures - square pieces

EDS: O > Fe < Si all uniform texture

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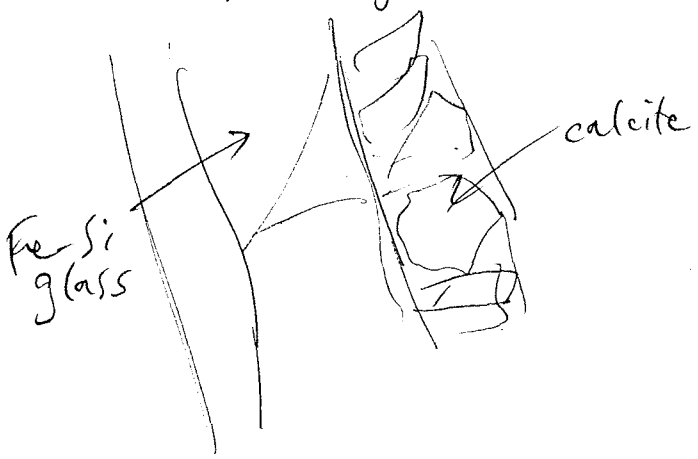
another 1a:

smooth glass with rind of calcite? rhombs



EDS: Ca + Fe + Si (from glass)

image

---

rind of Fe-rich fibrous stuff

1a image:

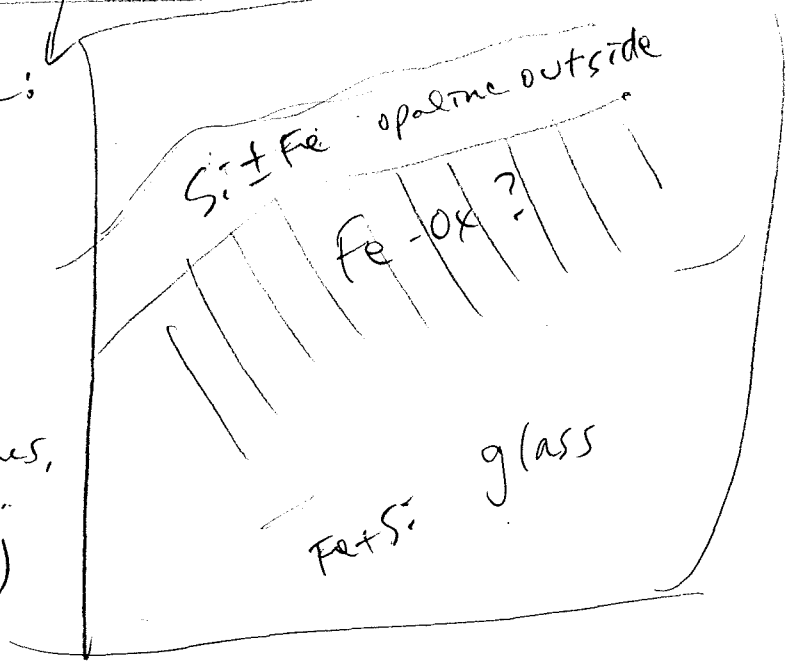
EDS: Fe ± Si

but no As or Cu

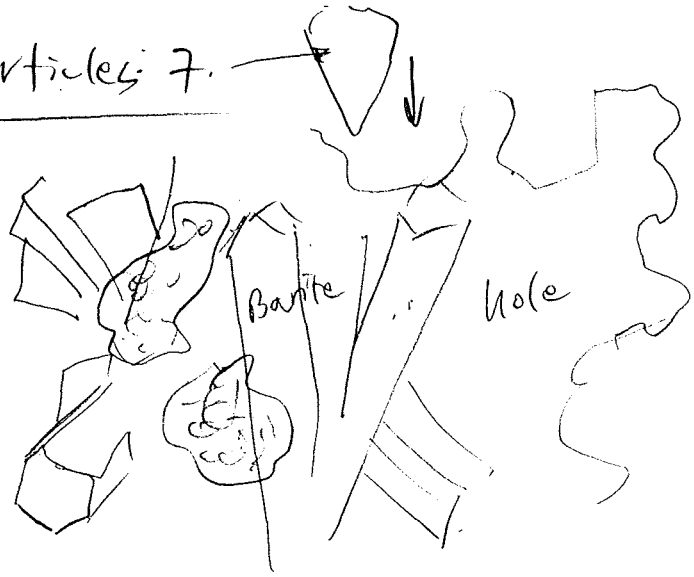
suspect iron oxide coating gives glass dark color.

and big image of conchoidal fractures, etc.

200x (rind to NW)



Particles 7.



Dec 8.00
(3)
SEM

spot EDS: Ba1° Ba2°
S ≈ ~~Ti~~ > ~~Ca~~ = 0
subequal peak heights

← image

barite

radiating.
prismatic, hexagonal? crystals intergrown with fine opal?
weird EDS, but ~~titanium~~ barium and sulfur peaks right on
← trying to point out [not]

big prisms - spot EDS definately S + ~~Ti~~ Ba

balls are Fe+Si - (no ~~Ti~~ Ba or S)
Euhedral rounded aggregates

Particles 4

looks like clay and radiating bundles of fibrous to prismatic crystals -

[image]

maybe fibrous Fe-silicate altering to smectitic clay?

clays. O ≥ Si > Fe ≥ Mg > Al >> K

if Fe-Si glass altering to clay - does it lose the As? (As-bearing)

← close up [image] of webby smectitic clay

---

back to Particles 5.

Dec 8 00
④
SEM

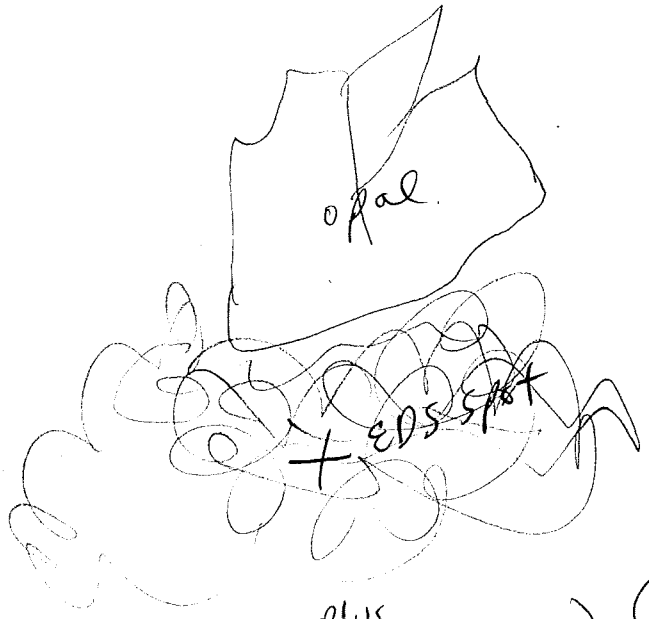
Particles 5:
Searching for areas that have CutAs
found - image of general area

Now looking for separate phase
looks like mg glass with Fe+Si+Mg glass with traces of
Ca + ~~Ba~~ + ~~Ti~~ + S
Ba + Ba

spot: O > Fe ≈ Si ≳ Mg > Cu > As ≥ S, Ca, ~~Ti~~ ~~Ba~~ Ba Ba

CutAs in grunge = spot = Fe ≈ ~~Mg~~ As > Cu > As
EDS little O or Si

taking image of the grunge down below more opelme stuff
very fine-grained (< 1 μm)



close-up EDS
~~Mg~~ As > Fe > Cu ≳ As

plus another unident. peak ≈ Copper (Cu La 1,2)

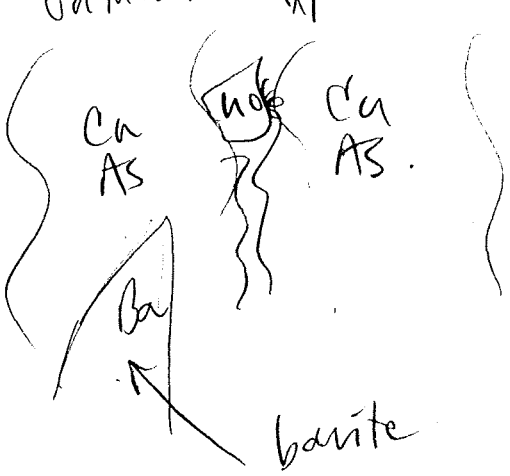
Kα
Mg peak overlies (almost) the As La 1,2 (biggest As peak)

close-up image of grunge (7000x = 4 minutes)

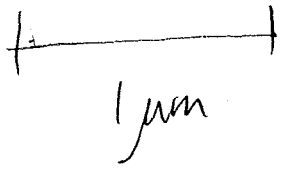
so probably iron-copper arsenide -

Dec 800
SEM
(5)

moved over a little – unidentified EDS peak ~5 Cu.

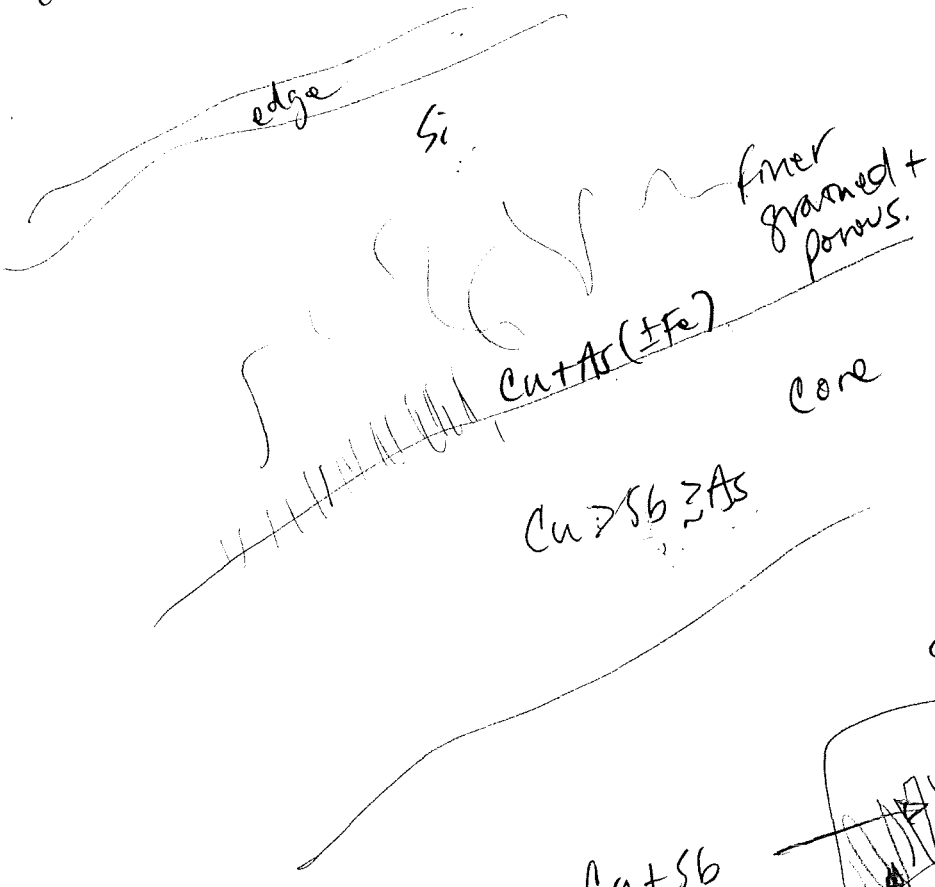


close up image

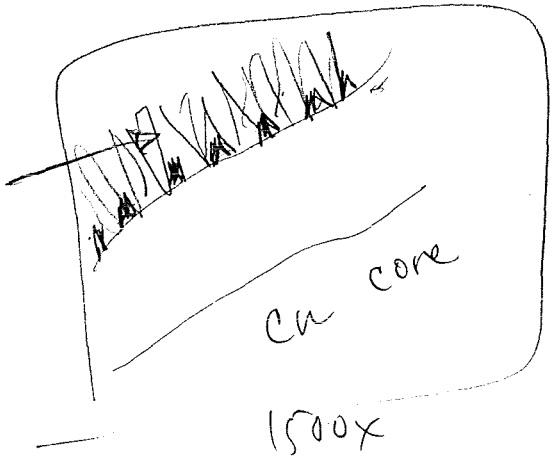


EDS still:
As > Fe ≳ Cu

one low-mgn view showing zoning.



close-up image of bands.



Dec 11.00
SEM
w/Barb

Particles 13

smooth, very fine grained opal

Si ~ Fe traces of Mn, Ca, K, Cl, Al

EDS image

solid? eggs

low mgn image 200x

---

another 13 –

cracked – dehydration cracks. image

tungsten element blew ~ 24 hours Matt Delony
filament. will change

900K images – 28 of them – Tiff files

Binocular Microscopic Description

Sample Location – Salton Sea geothermal field

Sample Designation – Region 2, **PCU**, collected by CalEnergy 12/6/00

Sample Type – Disaggregated filter cake, >50 mesh (washed in DI water through 50 mesh screen).

Examiner – J. Hulen

Date – December 7, 2000

Description – This >50 mesh fraction accounts for only a trace of whole sample. Obtained an estimated 50-60 particles only from >50% of the original, ~1 liter sample. Said sample, dried, is a very pale, slightly grayish to yellowish brown (buff). It is conspicuously less pigmented than, say, the medium grayish-orange filter cake from Region 1, Reactor #2 (R1-R2). Unlike the latter sample, this PCU sample has no conspicuous larger and darker grains scattered through the dominant powder. The 50-60 particles obtained on the 50 mesh screen for this PCU sample are as follows, designated by the types established for describing the +50 mesh fraction of the R1-R2 sample)

(1a) . . . ~ 35% resinous- to vitreous textured, transparent (most common) to subopaque, medium to dark olive to olive-gray to gray grains. The transparent varieties are a conspicuous bright olive green, and have conchoidal fracture. The grains are <0.5 mm in diameter, and are typically sharply angular (many are spalls and chips).

(1b) . . . ~30% matte to resinous-appearing, medium to dark gray to yellowish-gray. These grains appear to aggregates, and have distinctive "warty" or pebbly surfaces. Many of the grains have a subdued lobate aspect. The grains are mostly <0.3 mm in diameter. They are soft, and crush readily to a lighter yellowish-gray waxy texture.

(2e) . . . ~5% bright brownish-orange to reddish-brown, matte-textured, thin-shelled, hollow spheroids and spheroid fragments, <0.5 mm in diameter. These appear to be mostly opal, but with a significant earthy iron oxide component.

(9) . . . ~10% <0.5 mm flakes, chips, and angular fragments of dense, vitreous to matte-textured, laminated opal, with the laminae mostly opaque to translucent white, but ranging to medium gray.

(12) . . . ~20% <5 mm angular to subrounded fragments of massive, matte-textured, microporous, white to very light yellowish-gray opal.

Binocular Microscopic Description

Sample Location – Salton Sea geothermal field

Sample Designation – Region 2, **LPC**, collected by CalEnergy 12/6/00

Sample Type – Disaggregated filter cake, >50 mesh (washed in DI water through 50 mesh screen).

Examiner – J. Hulen

Date – December 7, 2000

Description

This >50 mesh fraction accounts for only a trace of the whole sample from which it was sieved (~70% of a ~1 liter). That sample is powdery and very light grayish yellow to grayish buff in color. It appears very homogeneous, lacking conspicuous, anomalously large and/or different colored grains. The particles making up the >50 mesh fraction are described below, numbered according to the classification derived for the >50 mesh fraction from Region 1, Reactor #2 (coll. 11/20/00).

(1a) . . . ~15% matte through resinous to vitreous, translucent to subopaque, medium to dark olive-gray to gray grains, angular to subangular, commonly with conchoidal fracture.

(1b) . . .~10% matte to resinous-appearing, microgranular, medium to dark gray to yellowish-gray grains. These are soft and easily crushed to a lighter yellowish-gray waxy aspect. They have pebbly to "warty" surfaces, with the projections <10 microns in breadth and height.

(9) . . . ~5% <0.5-2 mm (up to 5 mm) flakes, chips, and angular fragments of dense, vitreous to matte-textured, laminated opal, with the laminae mostly opaque to translucent white, but ranging to medium gray. One large chip has outer laminae of (apparently) the same porous opal described under *12a*, below.

(12a) . . . ~65% massive to subtly laminated, porous, spongy-textured microgranular opal grains, up to 7 mm in maximum dimension, but typically <2 mm in diameter. Grains are angular to subangular and rough-surfaced. Their color is bright white to very light gray to slightly yellowish very light gray. Grains commonly have <20 micron-thick laminae of same opal but denser and more porcellaneous in appearance, separating much thicker laminae of the dominant spongy-textured variety.

(12b) . . . ~5% same as 12a, but mottled with deeper brownish yellow to pale orange (some grains colored entirely in these hues).

Binocular Microscopic Description

Sample Location – Salton Sea geothermal field

Sample Designation – Region 2, **SCU**, collected by CalEnergy 12/6/00

Sample Type – "Disaggregated" filter cake, ≥50 mesh (washed in DI water through 50 mesh screen).

Examiner – J. Hulen

Date – December 8, 2000

Description – In spite of prolonged washing of this sample through the 50 mesh screen, the resulting >50 mesh fraction is >99% undisaggregated, dried filtercake, occurring as rounded clumps and clots up to 2 mm in diameter. Among these clumps and clots are traces of the following particle types, together accounting for <1% of the >50 mesh fraction: **(1a)** . . . a resinous to vitreous dark gray substance; **(2e)** . . . <0.5 mm-dia. hollow spheroids of opal (?), colored medium to deep brownish orange, presumably by iron oxide; **(12a)** . . . pure white, porous, spongy-appearing, microgranular opal fragments, <0.5 mm in diameter; (12b) . . . same as *12a*, but colored medium brownish yellow to orange. ***Note*** – These particle types are the ones described for classification of the >50 mesh fraction for Region 1, Reactor #2 (coll. 11/20/00).

CalEnergy Company, Inc.

(760) 348-4000

SHIPPING NOTICE

SHIP TO: University of Utah Energy & GeoScience
423 Wakara Way Suite 300
Salt Lake City, Ut 84108
Attn: Jeffrey Huken

DATE	PURCHASE ORDER CONTRACT NO.
1-8-01	
O.S. & D. NO.	RELEASE NO.
RETURN TAG NO.	SHIPPING NOTICE NO.
	4097

NAME OF VENDOR ON P.O. / CONTRACT	RETURNED FOR	*RETURN TO:
801-581-8497	☐ CREDIT	CalEnergy Company, Inc.
VENDOR NO.	☐ REPAIR & RETURN*	7030 Gentry Road
	☐ REPLACE*	Calipatria, CA 92233
		(760) 348-4000

SHIP: PREPAID ☐ COLLECT ☐	SHIP VIA	SHIPPING DATE	NO. OF CARTONS	WEIGHT	SHIPPING
	Fed ex	1/8/01	1	2	

REASON FOR RETURN:

Item No.	Area Store	Distribution/Cost Elem. Stock Code	Quantity	Unit	DESCRIPTION	Unit Price	Accounting Use Only
			1 Lot		Scale Samples		
					=		
					Attn: Jeffrey B Huken		

ORIGINATOR	BUYER	COMPLETED BY
Lou Osborn	Frank A Rosky	

The above material received

or _____ by _____ Date _____

(Name of Company)

IMPERIAL PRINTERS -- 71448

CalEnergy Operating Company
950 W. Lindsey Rd.
Calipatria, CA 92233
Phone: (760)348-4000

1. Geothermal Scale

2. Composition (Average concentration)

Major Elements	Probable Compounds	(Percent)
Silicon (Amorphous)	(SiO_2+Silicates)	50
Iron	(Fe_3O_4+Fe_2O_3+$FeSiO_4$+Fe+$FeCO_3$)	18
Copper	(Cu+$CuCl_2$+CuS)	10
Sodium	(NaCl)	5
Calcium	($CaSO_4$+$CaCO_3$)	3
Potassium	(KCL)	3

Minor Elements	Probable Compounds	(PPM)
Aluminum	(Silicate)	10,000
Manganese	(MnS+$MnSO_4$)	10,000
Strontium	($SrSO_4$)	10,000
Magnesium	($MgCO_3$)	7,500
Arsenic	(As+$FeAs_2$)	30,000
Barium	($BaSO_4$)	5,000
Bismuth	(Bi_2S_3)	1,500
Lead	(PbS)	1,000
Antimony	(Sb+SbS)	1,000

Trace Elements	Probable Compounds	(PPM)
Silver	(Ag+AgS)	750
Cadmium	(Cd+CdS)	500
Chromium	($Cr_2(SO_4)_3$)	500
Cobalt	(CoS_2)	500
Zinc	(ZnS)	400
Beryllium	(Be)	100
Gold	(Au)	2
Radium 226	($RaSO_4$)	60 pCi/g
Radium 228	($RaSO_4$)	45 pCi/g
Other Metals		<100

3. Chemical and Physical Properties

Appearance: Scale is a very heterogenous substance, composition will vary. Color ranges from light brown to black with greenish areas.

Density: Average - 2300 lbs./cubic yard

Solubility in water: Insoluble in water

Odor: None have been noticed

7. Handling Precautions and Protective Equipment

These recommended precautions are intended for use during normal operating conditions. Emergency/upset conditions could require additional precautions. (For an explanation of the low, moderate and high potential exposure categories or specific recommendations for your specific operation, contact the Safety Department.)

Eye

Low - Use Safety glasses
Moderate/High - Use chemical goggles

Skin

Low - No precautions other than clean body covering clothing;
Moderate/High - Use boots and gloves

Inhalation

Low/Moderate/High - Atmospheric levels should be maintained below the exposure guidelines. Use respiratory protection when in scale handling operations and areas. Clean or dust clothing, boots and gloves before leaving work area.

Ingestion

Use good personal hygiene. Do not consume or store food and drink in the work area. Wash hands before smoking or eating. Clean body covering clothing, boots and gloves after handling.

Ventilation

Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines.

Protective Equipment Information

There is no respirator test data available for this material. Data for related materials indicate that the following should be effective types of air-purifying respirators: dusts and radionuclides.

8. Emergency Treatment and Medical Notes

Eye

Irrigate immediately with water for at least 15 minutes.

Skin

Wash off in flowing water or shower

Ingestion

Refer to Physician

Inhalation

Refer to Physician

9. Potential Health Effects

This section includes possible adverse effects which could occur if this material is not handled in the recommended manner.

Eye

May cause moderate eye irritation

Skin

May cause moderate skin irritation

Ingestion

May cause toxic effects

Acute Inhalation

Vapors are unlikely due to physical properties. Excessive exposure may cause irritation of the eyes, upper respiratory tract and lungs.

Chronic Effects/Carcinogenicity

The following components of scale are known to the State of California to cause cancer: Arsenic, Cadmium, Beryllium and Radium (decay chain).

Teratogenic Effects

There are some positive animal teratogenic tests for several of the components of scale.

Reproductive Effects

Lead is known to the State of California to cause reproductive toxicity.

Mutagenicity

There are some positive mutagenicity tests for several of the components of scale.

10. Environmental and Disposal Information

Action to take for releases:

Reclaim all the material which was released. For any Scale releases refer to the CalEnergy Operating Co. Business Plan for local agency notification. If more than 200 lbs. of scale (fine particles) have been released to the environment, then EPA also has to be notified within 24 hours at 1-800-424-8802 (The National Response Center).

Disposal Method:

Scale should not be disposed of, but reclaimed and stored in a safe and proper manner. If scale needs to be disposed of, contact CalEnergy Operating Company's Environmental Manager.

Subject: Revised XRD analysis
Date: Mon, 19 Feb 2001 10:53:47 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: Will Osborn <will.osborn@calenergy.com>

Will --

The new results for sample No. 20 (Reactor 2, West Baffle Front), are consistent with the XRF numbers, but very different from the first results I reported ("same as No. 21"). I suspect in the rush to get these done, I substituted a duplicate of No. 21 for No. 20. Anyway, screw-up now corrected, and results follow below.

Halite -- M
Barite -- m
Fluorite -- mm
Magnetite -- m
Metadomeykite -- m (?) peaks overlapped by those of barite even at slower scan, higher sensitivity.
Amorphous (Opal-A for the most part) -- MM

Also, a rescan of the V5212 sample at slow speed and high sensitivity shows no difference from the first scan. Unambiguously no loellingite or westerveldite.

Talk to you soon.

Jeff

TerraTek

TerraTek Inc.

February 16, 2001

Mr. Jeff Hulen
Energy and Geoscience Institute
University of Utah
423 Wakara Way, Suite 300
Salt Lake City, UT 84108

Subject: *SEM Analysis – Scale Samples*
TerraTek Project No. 5055

Dear Jeff:

Enclosed please find two CD-ROM copies of the final report presenting results of SEM analyses. Included is a document summarizing the results in tabular format, as well five document files (Plates 1, 2, etc.) presenting the digital SEM images. Very interesting samples!

It has been a pleasure working with you on this project. Please let me know if there is anything else I can do for you or if I can print out a hard copy for you.

Sincerest regards,

TerraTek, Inc.

Barbara A. Marin
Petrology Supervisor

Subject: Additional comments
Date: Fri, 16 Feb 2001 12:45:47 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: Will Osborn <will.osborn@calenergy.com>

Will --

I went back to V5212 scan again, just in case I'd spaced the interpretation in some way. There are no reflections corresponding to loellingite or westerveldite, meaning that if they're present, they account for less than 1% (each) of the sample (this is a typical XRD detection limit). Since this sample was an XRF plug, maybe you could send the unground scale. Sometimes fine-grinding will destroy the crystallinity of certain minerals (usually clays, but who knows in this environment?). Also, there may be bands in the scale that can be isolated for more focused analysis. In the meantime, I'm going to have V5212 and two other samples rescanned at higher sensitivity and slower speed to see if anything surfaces. Doubt it, but we could get lucky. Have a good weekend. Are the wildflowers out down there yet?

Jeff

Subject: RE: Progress
Date: Mon, 22 Jan 2001 11:42:35 -0600
From: "Osborn, Will" <Will.Osborn@calenergy.com>
To: "'Jeff Hulen'" <jhulen@egi.utah.edu>

I collected samples this weekend from the entire Unit 5 brine train. Only two areas peaked my interest. The first looks like black scale originating in the HP separators and depositing episodically in the LP separator. However, I suspect this is Fe-Si. The other is the wall of the Second Reactor, which was free of the silicate scale that is deposited almost everywhere else. I'll send a couple of sample to you this week after I see the XRF results. I'll limit samples to you to As and Cu-rich materials.

-----Original Message-----
From: Jeff Hulen [mailto:jhulen@egi.utah.edu]
Sent: Monday, January 22, 2001 8:44 AM
To: Osborn, Will
Subject: Progress

Dear Will --

Our approach is paying off. Got in this morning to find the latest batch of XRDs of hand-picked particles from Region 1 and Region 2. Beautiful patterns, the best yet by a long shot. I have to finish a draft of the Salton Sea rhyolite paper for Fred and Dennis to review today, but will begin interpreting the patterns this evening. There are clearly copper arsenides in great abundance. Also saponite, opal, and probably more than one amorphous phase (opal-A; hisingerite?), as well as many other substances yet to be identified. Terra Tek is SEM-ing the latest batch, and I believe we're close to wrapping up the observation and analytical phase of the project. Reporting, documentation, to follow, pending approval of requested additional CEOC funding. I'm sending to you, in the next day or two, (1) about a hundred vials of hand-picked >60-mesh particles from the two Regions; (2) our "microfossil" slides on which all particle types for both regions are clearly displayed as a reference set; (3) a general description of each particle type, with significant departures from the norm as noted; and (4) all your original material (minus what's necessary to complete the analytical work).

Thanks for your patience. In the middle of the filter cake project, my colleagues chose me to be the PI for all our geothermal projects. This entailed many all-nighters to get budgets straight and continuation proposals written, as well as way too much phone haggling with DOE-Idaho. Pretty much finished with that bureaucratic crap now; we got our award (for 4 more years); and I can concentrate on Stanford and the filter cake study. Along those lines, Sue will be sending you a draft of our Stanford scale paper shortly. With all that's transpired, I haven't been able to contribute a great deal so far beyond editing and kibitzing. The paper would benefit greatly from your input with respect to specific geochemical rationales for why certain scale types precipitate in one envirinoment, and why totally different scales form in another. We'll have until late February for the absolute final version, so there's plenty of time for revisions.

Give me a call to let me know how things are going down there. Did you ever collect scales from the drained reactor vessel?

Best wishes --

Jeff

Subject: Progress
Date: Mon, 22 Jan 2001 09:43:41 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: will.osborn@calenergy.com

Dear Will --

Our approach is paying off. Got in this morning to find the latest batch of XRDs of hand-picked particles from Region 1 and Region 2. Beautiful patterns, the best yet by a long shot. I have to finish a draft of the Salton Sea rhyolite paper for Fred and Dennis to review today, but will begin interpreting the patterns this evening. There are clearly copper arsenides in great abundance. Also saponite, opal, and probably more than one amorphous phase (opal-A; hisingerite?), as well as many other substances yet to be identified. Terra Tek is SEM-ing the latest batch, and I believe we're close to wrapping up the observation and analytical phase of the project. Reporting, documentation, to follow, pending approval of requested additional CEOC funding. I'm sending to you, in the next day or two, (1) about a hundred vials of hand-picked >60-mesh particles from the two Regions; (2) our "microfossil" slides on which all particle types for both regions are clearly displayed as a reference set; (3) a general description of each particle type, with significant departures from the norm as noted; and (4) all your original material (minus what's necessary to complete the analytical work).

Thanks for your patience. In the middle of the filter cake project, my colleagues chose me to be the PI for all our geothermal projects. This entailed many all-nighters to get budgets straight and continuation proposals written, as well as way too much phone haggling with DOE-Idaho. Pretty much finished with that bureaucratic crap now; we got our award (for 4 more years); and I can concentrate on Stanford and the filter cake study. Along those lines, Sue will be sending you a draft of our Stanford scale paper shortly. With all that's transpired, I haven't been able to contribute a great deal so far beyond editing and kibitzing. The paper would benefit greatly from your input with respect to specific geochemical rationales for why certain scale types precipitate in one envirinoment, and why totally different scales form in another. We'll have until late February for the absolute final version, so there's plenty of time for revisions.

Give me a call to let me know how things are going down there. Did you ever collect scales from the drained reactor vessel?

Best wishes --

Jeff

Subject: an observation
Date: Wed, 17 Jan 2001 19:39:04 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: will.osborn@calenergy.com

Will --

I've hand-picked the entire Region 1 +60 mesh suite, submitted selected subsamples for XRD and SEM. TerraTek has the latter, and should begin shortly. XRD in house.

Have begun doing the same thing with the Region 2 samples. Just gave a quick look to the Region 2 PCU yield. The principal obvious differences I can see between this sample and the samples from Region 1are these: (1) In the Region 2 PCU sample, there are very few type 2 particles [the little hollow opal spheroids of different colors, subtypes 2a, 2b, 2c, 2d, and 2e; (2) Also in the Region 2 sample, there is a predominance of type 1a and 1b particles. The type 1a particles are conspicuously clearer than those from Region 1, and are commonly transparent to translucent deep olive to bottle green in color.

Just a wild thought: Could the opal spheroids be forming around tiny vapor bubbles in a vigorously boiling fluid? The flashing itself would promote silica precipitation, and the first place it might do so is at the wall of a newly formed steam bubble. The impression I get from the Region 2 vs Region 1 particles is that the former seem to have precipitated under relatively quiescent conditionst. If the Region 1 samples were forming in a more energetic environment, this conceivably could also have something to do with precipitation of the excess leachable arsenic in this system.

Talk to you soon --

Jeff

Osborn, Will

From: Castanieto, Henry R
Sent: Wednesday, January 03, 2001 9:39 AM
To: Osborn, Will
Cc: Sonneville, Allen L
Subject: Region 1 VLPSep Solids

On 1/2/01 Ernie Dagdagan sampled the region 1 VLP 5214 and VLP5215 brine using mesh screens to capture solids.

	(1) V5214	(2) V5215
Gallons Brine	158	713
Residue (gr)	0.016	0.423
Mesh size (micometers)	53	75
Time Total (min)	120	540
Flow rate (ml/min)	5000	5000

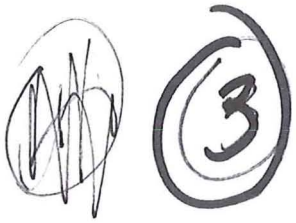
Shipped to EGT 1/5/01

The screens with residue were rinsed with hot DI water. The residue was then captured and dried. I will ask Ernie to repeat the test expecially V5214 since we were only able to get very little residue.

Osborn, Will

From: Castanieto, Henry R
Sent: Thursday, January 04, 2001 4:09 PM
To: Osborn, Will
Subject: Region 1 Solids taken 1/03/01 from 1815hrs to 0145hrs.

Solids were taken from the V5214 brine taken through a No. 270 screen (53 micrometer) the brine ran for 450 minutes at a rate of 3000 ml/min. Total flow was 357 gallons. The sample weight was 0.1831 gr



Subject: Region 1, Reactor 1
Date: Tue, 09 Jan 2001 07:11:10 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: sjlutz@egi.utah.edu

Good Morning,, Sue J. --

I believe you were interested in nailing down the clay species in the dark fragments in scale and filter cake from SSGS. Louise X-rayed a concentrate of particle type "1a-2" yesterday, and it's definitely trioctahedral smectite (060 = 1.54A). I'm apalled I've thought nontronite trioctahedral since 1983, and appreciate your aprising me of the blunder. I guess this particular clay, then, is likely to be saponite. Not all the peaks are present, but certainly the big ones. The basal spacing is about 13A, which, as I understand it, could indicate a fair amount of sodium in the interlayer position. Do you have time to have a look at these patterns? Also some minor stuff I haven't tracked down.

Thanks,

Jeff

Subject: SCU Region 1
Date: Mon, 08 Jan 2001 18:16:12 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: will.osborn@calenergy.com

Will --

I just poured a measure of the SCU +60 mesh (12/07/00; 4 hr) into a watch glass and am looking at it under the binocular scope. I thought you might like to know there's more ugly pinkish-white metallic crap in this sample than in anything I've examined so far. One unique particle type, not found in any of the others, is a frothy bright brownish orange, earthy limonitic materical with abundant, disseminated pinkish-white metallic (identical to what we've identified as the Fe and Cu arsenide mix). There's less of the anomalous (dark/limonitic/metallic, etc.) in this sample than the others, but a far larger proportion is what will certainly turn out the be the prime offender.

I doubt there's enough of this stuff to X-ray, so it might be very useful for our project to catch a bigger sample of the +60 mesh from this SCU (>12 hr?). We can certainly examine it with SEM, however.

Back to smallville . . .

Cheers,

Jeff

423 Wakara Way: Suite 300; Salt Lake City, UT – Tel: 801-581-5126 Fax: 801-585-3540

Energy & Geoscience Institute

EGI

To:	Will Osborn	**From:**	Sue Lutz 801 585-9688
Fax:	760 348-4217	**Pages:**	13 + 13 (SEM) (including this page)
Phone:		**Date:**	Dec 21, 2000
Re:		**CC:**	

Dec 22
2 faxes

busy? both days
sent by mail Dec 26th?

Will,

Here are probe images and data from the PCU sample for your holiday amusement. Hope that you'll be able to see these images in the faxed copies.

The egi_9 ascuteABS.tiff image shows a clot of Cu-Fe-arsenide similar to what we observed with the SEM of particle type 5 – Reactor 2 → (see print images + COX) See that silver-bearing Cu-arsenide surrounds more porous Fe-arsenide in the center of the clots.

The quantitative analysis indicates the highest arsenic content (up to 53.8 wt%) is associated with the Fe-arsenide. The As content of the Cu (±Ag) arsenide ranges from 29 to about 38 wt% (not calculated as an oxide).

I'll be in the office off and on tomorrow (Friday), otherwise – hope to talk to you in the new year (millenium).

Cheers! Sue

December 17, 2000

Will –

XRD results attached. We're on the right track, for sure. May I call your attention to the first two fragment analyses for the Reg. 1, Rctr. 2 bulk sieved samples? Definitely arsenides. I hope this is of immediate help, and will continue the quest at top speed.

Best –

Jeff

Subject: **Re: loellingite**
Date: Thu, 14 Dec 2000 17:45:24 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: "Osborn, Will" <Will.Osborn@calenergy.com>

Will --

Sorry to take so long to get back to you, but more meetings (I love meetings). I can't recall offhand where the borehole loellingite scale was precipitated, but I believe it was on a hangdown string (?) in an RR-area production well. Anyway, I'll drag up another copy of the report I sent to you earlier this year and re-send it electronically.

Having the larger sieved samples is enabling us to obtain concrete (no, I mean firm) information about the actual phases present in, as an example, the Region 1, Reactor 2 solids. I want to go over the patterns again tonight (Sue's done a preliminary interpretation) to make dead certain of the picks, but here's the list as of now. (1) One or all of the three Cu arsenides domeykite, metadomeykite, and algodonite (very similar patterns, and imperfectly crystallized in this sample, so "ratty" (broad, subdued) reflections, and some scope for ambiguity or overlap with other peaks. (2) barite (3) fluorite (5) halite (6) randomly-interstratified mixed-layer smectite/chlorite (smectite dominant) (7) anhydrite (8) calcite (9) magnetite (10) goethite (11) probable loellingite (but minor). (12) chlorite (13) possible covellite. (14) possible tenorite. The last two are very tentative identifications.

I propose that we probe the ones that contain the arsenides and other metallic phases, in order to ascertain their actual chemical compositions. Sue's gone to Tuscon to see her sister graduate (at the top of the class) from law school, but has reserved next Wednesday to work with the probe guy to get this done. I'll have the samples prepared in her absence, so that she can get right to it. I'd do the whole works myself, but I have to refine the work plan and budget for our group's 2001 DOE/geothermal work.

Talk to you tomorrow.

Jeff

"Osborn, Will" wrote:

> *Did you mention to me that you have identified loellingite in the injection*
> *or production well scales?*
>
> *Bulk analyses of the sieved fractions yield arsenic concentrations far*
> *outweighing copper on a mole for mole basis. There must be something*
> *significant beside copper arsenide, like loellingite.*
>
> *Here's a partial analysis of a relevant sample, all ppm, in a silica matrix:*
>
> *Na 6465*
> *K 8310*
> *Ca 32135*
> *Fe 273054*
> *Mn 9342*
> *Zn 744*
> *Mg 16086*
> *Al 19504*

Subject: loellingite
Date: Thu, 14 Dec 2000 16:25:50 -0600
From: "Osborn, Will" <Will.Osborn@calenergy.com>
To: "Sue Lutz (E-mail)" <sjlutz@egi.utah.edu>
CC: "Jeffrey B Hulen (E-mail)" <jhulen@egi.utah.edu>,
"Featherstone, John L" <John.Featherstone@calenergy.com>

Did you mention to me that you have identified loellingite in the injection or production well scales?

Bulk analyses of the sieved fractions yield arsenic concentrations far outweighing copper on a mole for mole basis. There must be something significant beside copper arsenide, like loellingite.

Here's a partial analysis of a relevant sample, all ppm, in a silica matrix:

Na 6465
K 8310
Ca 32135
Fe 273054
Mn 9342
Zn 744
Mg 16086
Al 19504
S 2570
V 158
Cr 74
Cu 2290
As 13272
Sr 500
Mo 7
Ag 800
Sb 697
Ba 5587
Pb 40
F 0

Dec 13, 2000

Jeff

I think we have it - or at least within a narrow group of possibilities -

CuAs with major peaks at ~ 2.00 and 2.05 Å
(koutekite, Domeykite, or Metadomeykite. sga.)

I think the sample that was just one fragment is most representative -
now it looks like the iron in the EDS may represent admixed goethite in with the copper arsenide - → Also there are no Fe - Cu arsenides (only Cu-Fe arsenosulfide minerals which we don't have peaks for anyway. see pgs 300 + 39.

See my pec & notes (crude drawing) with the core of Type 5 mostly Cu > Sb + As - the finer grained, porous material seems to contain more iron.

Not really done interpreting the XRD but thought you'd like to know the latest development!

Cheers! Sue

Subject: **Re: Hisingerite Mineral Data**
Date: Wed, 13 Dec 2000 11:51:38 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: "Osborn, Will" <Will.Osborn@calenergy.com>

Yes but thanks.

"Osborn, Will" wrote:

> *You may already be aware that this is generally the form of the iron*
> *silicate*
>
> *http://www.webmineral.com/data/Hisingerite.shtml*
> *<<Hisingerite Mineral Data.url>>*
>
> *---*
>
> *Hisingerite Mineral Data.urlName: Hisingerite Mineral Data.url*
> *Type: Internet Shortcut (application/x-unknown-conte*

Subject: **The mineral safflorite**
Date: Wed, 13 Dec 2000 12:20:04 -0600
From: "Osborn, Will" <Will.Osborn@calenergy.com>
To: "Jeffrey B Hulen (E-mail)" <jhulen@egi.utah.edu>, "Sue Lutz (E-mail)" <sjlutz@egi.utah.edu>

Looks by this description that it would still be loellingite unless there was substantial Co present.

http://www.minerals.net/mineral/sulfides/loelling/safflori.htm
<<The mineral safflorite.url>>

The mineral safflorite.url	**Name:** The mineral safflorite.url **Type:** Internet Shortcut (application/x-unknown-content-type-InternetShortcut)

Subject: [Fwd: Sample 5]
Date: Wed, 13 Dec 2000 09:08:21 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: will.osborn@calenergy.com

Will --

Forwarded for your assessment are SEM images of particle type 5, region 1, reactor 1. Sue thinks that the mineral safflorite may be present, but it's clear there are other phases as well. We're doing XRD of the dark fragments in a split of the coarse fraction (from the larger sample you just sent), but curiously, I could locate no obvious particle 5s in that coarse fraction (remember that there was only a miniscule amount in the 11/20/00 sample). I suspect we'll locate more, as the obviously metallic part of the particle was sandwiched between more opaline layers. Anyway, this looks like our bad boy, and we're continuing efforts to find out just what it is.

Jeff

Subject: Sample 5
Date: Tue, 12 Dec 2000 17:35:59 -0700
From: Barbara Marin <bmarin@terratek.com>
Organization: TerraTek, Inc.
To: Jeff Hulen <jhulen@egi.utah.edu>

Hi, Jeff.

I've just been playing around with the SEM images from yesterday and today. Attached are a few non-annotated images from the sample you were most interested in (#5 - the most arsenic-rich). Please note the polymineralic nature of the fragment shown on Plate 3. I'm not sure if this is the format I will use in the final report...

Hope these are of interest to you.

Thanks,
Barbara

TerraTek

---

example_SEM.DOC	**Name:** example_SEM.DOC **Type:** Winword File (application/msword) **Encoding:** base64

Barbara Marin <bmarin@terratek.com>
Geology/Petrology Supervisor
TerraTek, Inc.
Core Analysis Division

Subject: more info
Date: Mon, 11 Dec 2000 09:52:49 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: will.osborn@calenergy.com

Will --

Attached are descriptions for the Region 2 samples (along with slight revisions on the older stuff). I haven't talked to Sue yet about the Region 1, Reactor 2 SEM, but will get back to you with details after I do. We have an unavoidable emergency meeting at 9 your time. I'll call you when it's done. The express package should arrive at your office by 10 your time.

As you'll see from the descriptions, the Region 2 samples are distinctly cleaner than those from Region 1.

What a fantastic voyage (or magic-bus ride)!

Talk to you soon.

Jeff

Subject: package
Date: Fri, 08 Dec 2000 14:09:51 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: will.osborn@calenergy.com

Will --

This afternoon, we're sending to you a package containing examples, in small vials, of each of the particle types recognized in the filter cake from Region 1, Reactor #2 (coll. 11/20/00). These are the particle types which are beginning to be examined by SEM-EDX today (in progress for about an hour now). We'll have at least preliminary results this afternoon, and certainly more detailed results by Monday afternoon. With the vials in hand for your meeting, you and the group will know exactly what particle type we're talking about when we convey the SEM info to you. We'll follow this format with the other samples (including the three received today). Also in the package is a slightly revised binocular microscopic description of the Region 1, Reactor #2 particle types.

Talk to you soon,

Jeff

Subject: more samples
Date: Fri, 8 Dec 2000 15:32:07 -0600
From: "Osborn, Will" <Will.Osborn@calenergy.com>
To: "'jhulen@egi.utah.edu'" <jhulen@egi.utah.edu>
CC: "Featherstone, John L" <John.Featherstone@calenergy.com>

Today we shipped +50 mesh fractions from Region 1 and Region 2. Samples were sieved from unmeasured, large volumes of sample brine at the sample point (not in the lab). Region 1 samples include (in process order) Reactor 1, Reactor 2, Primary Clarifier and Secondary Clarifier. Region 2 samples include Low Pressure Crystallizer, Primary Clarifier and Secondary Clarifier.

Subject: Region 2 samples
Date: Thu, 7 Dec 2000 12:35:21 -0600
From: "Osborn, Will" <Will.Osborn@calenergy.com>
To: "Jeffrey B Hulen (E-mail)" <jhulen@egi.utah.edu>
CC: "Featherstone, John L" <John.Featherstone@calenergy.com>

Three samples being shipped to you today. These are bulk filtrate samples from Region 2: 1) Low Pressure Crystallizer (LPC); 2) Primary Clarifier Underflow (PCU); 3) Secondary Clarifier Underflow (SCU). These samples were filtered from brine in the lab, then washed with hot DIW and dried overnight.

The function of the Region 2 LPC is analagous to Region 1 Reactor 1 and Reactor 2 combined.

Subject: Reactor #2
Date: Mon, 04 Dec 2000 16:53:19 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: will.osborn@calenergy.com

Will --

Attached is the finished description for the coarser fraction of the material from reactor #2, region 1. Check out particle types 5 (particularly) and 6. It's my understanding that a very small amount of the As in these samples is soluble to that citric acid leach. If so, it would seem that even a very small amount (as in this sample) of an arsenide or arsenic-bearing sulfide could be responsible for the miniscule excess.

All these descriptions, plus an overview, and all data tabulated, and SEM photomicrographs and EDX readouts, will be included in a detailed EGI report to you on the results of this investigation.

See you.

Jeff

rct#2,reg.1,+50mesh.doc	**Name:** rct#2,reg.1,+50mesh.doc **Type:** unspecified type (application/octet-stream) **Encoding:** base64

CalEnergy Operating Company
950 West Lindsey Road
Calipatria, California 92233

from:
Frank A. Robles
Purchasing Agent
Telephone (760) 348-4228
Fax (760) 348-7868

To:

Name	Date
Jeff Hulen	11-30-00
Company	**Fax Number**
Energy & Geoscience Institute	801-585-3540

Reference:

Subject

Comments:

Jeff,

P.O # J-23564

As Per Phone Conversation Do

Thank

2

Page 1 of 2

CalEnergy Company, Inc.

Purchase Requisition

REQ-IV 54027

Page No. 1 of 1

Date: 11/20/00

P. O. No. I-23564

Description of Items: filter cake characterization Requestor: OSBORN

Confirming to: _____ Date: _____ F.O.B.: Calipatria Ship Via: _____ Terms: _____

Accounting Flex-Fields

Item No.	Co No.	Resp Ctr.	Account No.	Proj No.	AFE Number
1	18	352	4270	180	9—

Suggested Vendor: Energy and Geoscience Institute

Address: 423 Wakara Way Suite 300
SLC, UT 84108

Tax Rate: _____

Phone: 801 -- 581-8497

Fax: 801 -- 585-3540 Contact: Jeff Hulen

Item No.	Item Description	Scheduled Delivery Date	Quantity Unit	Quantity Amount	Unit Totals	Extended Totals
1	Detailed characterization of failed Region 1 filter cake and related solids using conventional microscopy, XRD, SEM, electron microprobe and other methods, as required.		lot	1	$20,000	$20,000

Subtotal	20,000.00
Tax	
Total	

To be used for: _____

Date Needed: A.S.A.P.

NW Limiting: Yes: _____ No: X (check one)

Budgeted: Yes: X No: _____ (check one)

Approved By: _____ Requestor / R/C Manager / Superintendent

Approved By: _____ General Manager, Facility / General Manager

Approved By: _____ President CEOC / President /C.O.O.

Subject: Cakes
Date: Tue, 28 Nov 2000 10:19:40 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: will.osborn@calenergy.com

Will --

Received the four samples. Have made arrangements for SEM (usual one broken down, had to find one in another department. Should have answers by week's end, Monday at latest. We still haven't received the P.O., and I misplaced the number that Mr. Robles gave me last week. Could you do me a favor and have him e-mail it?

Thanks,

Jeff

Subject: Re: filter cake characterization
Date: Tue, 21 Nov 2000 09:20:01 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: "Osborn, Will" <Will.Osborn@calenergy.com>

Will --

Thanks!

It'll be a pleasure to work with on a practical problem with real immediacy. I have your two samples sent last week, and look forward to the others' arrival. I'll work over the weekend on this, but suspect realistically that the SEM and 'probe work will take 7-10 days to arrange and comkplete. Anwers as soon as humanly possible, though.

Take care --

Jeff

"Osborn, Will" wrote:

> *I issued a purchase requistion for $20K for your work on the filter cake.*
> *We'll be shipping addt'l samples tomorrow. Thanks for your help on this*
> *critical issue.*

Subject: filter cake characterization
Date: Mon, 20 Nov 2000 19:20:16 -0600
From: "Osborn, Will" <Will.Osborn@calenergy.com>
To: "Jeffrey B Hulen (E-mail)" <jhulen@egi.utah.edu>

I issued a purchase requistion for $20K for your work on the filter cake. We'll be shipping addt'l samples tomorrow. Thanks for your help on this critical issue.

Subject: RE: filter cake
Date: Fri, 17 Nov 2000 16:46:55 -0600
From: "Osborn, Will" <Will.Osborn@calenergy.com>
To: "'Jeff Hulen'" <jhulen@egi.utah.edu>

Let's talk Monday. We can fund this stuff immediately.

Will Osborn
CalEnergy
7030 Gentry Rd
Calipatria, CA 92233
(760) 348-4214
(760) 348-4217 fax
(760) 996-1058 cell

-----Original Message-----
From: Jeff Hulen [mailto:jhulen@egi.utah.edu]
Sent: Friday, November 17, 2000 1:17 PM
To: Osborn, Will
Subject: filter cake

Dear Will --

My phone's been on the blink for a couple of days. Help on the way, but in the meantime, I did finally get your message about the filter cake. I'd be happy to look into this for you in more detail (not sure what Sue's reported to you to date). With sufficient sample and necessary accompanying information, we can characterize the cake in exquisite detail, petrographically, mineralogically, texturally, temporally, and chemically.

Would it be possible for CalEnergy to fund this study on a proprietary basis? We can do odd jobs, like the 'probe work Sue did for you, from time to time as part of our western U.S. systems grant, but the grant's main emphasis has to be on geologic modeling, such as we discussed last May. Separate, proprietary funding would also ensure my immediate focus on the scaling issue.

Could you give me your new telephone number again?

Thanks, Will. I'll look forward to hearing from you.

Jeff

CALENERGY
OPERATING CORPORATION
A MIDAMERICAN ENERGY HOLDINGS COMPANY AFFILIATE

Analytical Services
7030 Gentry Rd
Calipatria, CA 92233
Ph: (760) 348-4000
Fax: (760) 348-4222

FACSIMILE TRANSMISSION COVER SHEET

Date: 2/19/01

To: Jeff Haden

Company: EGI

Fax #: 801-585-3540

From: Will Osborn

Company: CEOC

This facsimile contains 7 page(s) including the cover,
if you have difficulty receiving this transmittal,
please call (760)348-4000

Transmitted By:_____ Date:_____

Technical Memorandum
Unocal Corporation
Brea, California

Post-it Fax Note 7671 | Date 2/16 | # of pages 6
To JOHN FEATHERSTON
Fax#
From D. Gallup
Phone#
FYI

UNOCAL

To:	D. P. Hoyer, Santa Rosa	**Memo:**	ENV 93-321
From:	[redacted]	**Date:**	July 21, 1993
Department:	Environmental Technology	**Project:**	324521-S1 (WO#)
Subject:	LEAD & ARSENIC IN SCALE DEPOSITS - BRAWLEY & SALTON SEA GEOTHERMAL FIELDS	**Manager:**	M. M. Hatter, I

cc: Library (2)
Patent
P. H. Messer, Santa Rosa
E. D. Steger, Santa Rosa

Per your recent request, summarized below is information on the forms of lead and arsenic detected in scale deposits retrieved from the Brawley and Salton Sea geothermal fields.

Lead in these scale deposits is present primarily as galena, PbS. Galena comprised a significant portion of the total scale that accumulated at Brawley. Galena formed mainly in production wells and near-wellhead piping. Other lead scales that have been observed at both fields include lead oxychlorides and elemental lead.

The compounds of lead that have been detected in scales are quite insoluble in water. Lead chloro-compounds are the most water-soluble of the scales. However, these lead scales are moderately soluble in leach solutions employed for toxicity characterization.

The form of arsenic in Brawley scales is unknown since this metal was only occasionally detected above 1000 ppm. When arsenic was present above this level, the scale tested amorphous to x-rays. In one instance arsenic sulfide, AsS, was detected. We believe that the bulk of the arsenic found in Brawley scales may have been present as poorly-crystalline iron arsenate, $FeAsO_4$. Arsenic in Salton Sea scales is present primarily as the native metal (zero oxidation state) in intermetallic compounds with iron or copper such as FeAs, $FeAs_2$, Cu_2As and Cu_3As. The iron arsenides are found in production wells, while the copper arsenides are found in injection line scales. Traces of iron

arsenate may also be present in high temperature Salton Sea scales. Similar to lead, arsenic in these scale deposits is quite insoluble in water, but more soluble in leach solutions.

Brines from these fields contain lead in concentrations ranging from 14 - 250 ppm. Lead in brine is believed to be present as a chloro-complex, e.g., $PbCl_4^{2-}$. Lead concentrations in brines were generally higher at the Brawley field. Salton Sea brines average about 60 ppm Pb.

Arsenic concentrations in these brines range from 0.3 - 15 ppm, with Salton Sea brines typically yielded the highest concentrations. The form of arsenic in the brine is believed to be arsenite (AsO_3^{3-}) and arsenate (AsO_4^{3-}).[1]

Based on these analyses and assumptions, soils contaminated with lead and arsenic-laden scale deposits are expected to contain primarily PbS, and Fe_xAs_y or Cu_xAs_y, respectively. Where soils have been contaminated with brines, the form of lead is probably $PbCl_2$ (a rather water soluble compound), and the forms of arsenic are probably Na_xAsO_3 and Na_xAsO_4.

The attached Table provides most of my references to lead and arsenic scale and brine analyses.

Darrell L. Gallup
Principal Scientist

DLG/cls
Attachment

[1] J. M. Ballantyne and J. N. Moore (1988) Arsenic geochemistry in geothermal systems. Geochim. Cosmochim. Acta, 52, 475-483.

TABLE

Doc #	Date	Author	Subject	Results
PROD 79-28M	3/15/79	Jost	Tow -1 Downhole Scale	PbS 4-22%; As < 0.1%
ARS 80-101M	3/14/80	Wheatley	IV Brine Summary	Pb 14-280 ppm; As 0-4 ppm
REF 80-19M	3/19/80	Gallup	Veysey 2,9,10 DH Scale	PbS 0.2-60%; As < 0.1%
REF 80-08M	4/10/80	Gallup	Veysey 10 Scales	PbS 0-78%; As < 0.1%
REF 80-56M	6/9/80	Gallup	IID-5 Scales	PbS 0-51%; As < 0.1%
PD 80-39M	7/15/80	Wong	Sin-15 Scales	PbS 0-97%; As < 0.1%
REF 80-84M	8/5/80	Gallup	Brawley SGS Scales	Major PbS; No As detected
REF 80-111M	9/29/80	Gallup	Brawley SGS Scales	Major PbS; As < 0.1%
PD 80-68M	10/15/80	Wong	Sin-13 Scales	PbS 0-60%; As < 0.1%
REF 80-131M	11/3/80	Gallup	Brawley SGS Scales	Minor PbS; No As
REF 80-144M	11/13/80	Gallup	Brawley SGS Scales	Moderate PbS; No As
REF 80-157M	12/16/80	Gallup	Brawley SGS Scales	Traces PbS; No As
REF 81-5M	1/14/81	Gallup	Brawley SGS Scales	Traces PbS; No As
REF 81-12M	2/17/81	Gallup	Brawley SGS Scales	PbS 0-90%; As < 0.1%
REF 81-16M	3/3/81	Anderson	IV Brine Summary	same as ARS 80-101M
REF 81-22M	3/16/81	Gallup	Brawley SGS Scales	Traces PbS; No As
REF 81-28M	3/18/81	Gallup	IID-5 Scales	Minor PbS & PbOHCl; No As
REF 81-36M	4/10/81	Gallup	Brawley SGS Scales	Traces PbS; No As
REF 81-54M	5/21/81	Gallup	IID-5 Scales	Traces PbS; No As
REF 81-53M	5/22/81	Gallup	Brawley SGS Scales	Traces PbS, PbOHCl; No As
REF 81-68M	6/19/81	Gallup	Brawley SGS Scales	Moderate PbS; No As
REF 81-70M	7/6/81	Gallup	Kruger-1 Scale	Traces PbS; No As
REF 81-79M	7/15/81	Gallup	Brawley SGS Scales	Traces PbS; No As
REF 81-97M	8/5/81	Gallup	Brawley SGS Scales	Moderate PbS; As < 0.1%
REF 81-96M	8/26/81	Gallup	Brawley Power Plant Scales	PbS ~1%; As~0.1%
REF 81-98M	8/26/81	Gallup	IID-5 Scales	Moderate PbS; No As
REF 81-104M	9/22/81	Gallup	Brawley SGS Scales	No Pb or As
REF 81-106M	10/12/81	Gallup	Brawley SGS Scales	No Pb or As
REF 81-107M	10/12/81	Gallup	As in Brawley Soils	As below TTLC & STLC
REF 82-15	1/11/82	Gallup	As in Brawley Salt Deposits	Pb 0-500 ppm; As 0 -335 ppm
REF 82-23M	2/17/82	Gallup	Brawley SGS Scales	Moderate PbS; No As
REF 82-24M	2/19/82	Gallup	Veysey-9 Scales	Minor PbS; No As
REF 82-26M	2/19/82	Gallup	Veysey-10 Scales	Major PbS; No As
REF 82-32M	2/25/82	Gallup	IID-5 Scales	Minor PbS; No As

Pb As References

TABLE

REF 82-60M	4/22/82	Gallup	Brawley SGS Scales	Moderate PbS; No As
PD 82-26M	5/4/82	Wong	Sin-25 Scales	Moderate PbS; No As
to LRH	5/2/82	Gritters	Brawley Brines	Pb 1-280 ppm; As 0-4 ppm
REF 82-85M	7/2/82	Gallup	Brawley SGS Scales	Major PbS; No As
REF 82-92M	7/2/82	Gallup	Veysey 10 Scale	Major PbS
REF 82-95M	7/6/82	Gallup	Brawley Power Plant Scales	As 0.15-0.3%
PD 82-42M	7/8/82	Wong	Sin-20 Scales	Trace PbS
REF 82-96M	7/9/82	Gallup	PbOHCl Scale	Characteristics
REF 82-105M	7/23/82	Gallup	Brawley SGS Scales	Major PbS; No As
REF 82-122M	9/10/82	Gallup	Salton Sea SGS Scales	Trace PbS; No As
REF 82-139M	9/29/82	Gallup	Brawley SGS Scales	Moderate PbS; No As
REF 82-174M	11/15/82	Gallup	Salton Sea SGS Scales	Moderate PbS; As 0-5%
REF 83-26R	1/24/83	Gallup	Salton Sea SGS Scales	Minor PbS; As 0-33%
REF 83-29R	1/26/83	Gallup	Brawley SGS Scales	Moderate PbS; No As
REF 83-63R	3/16/83	Gallup	Brawley SGS Scales	Moderate PbS; No As
REF 83-84R	3/29/83	Gallup	Salton Sea SGS Scales	Moderate PbS; No As
REF 83-138R	6/17/83	Gallup	Brawley SGS Scales	Trace PbS; No As
REF 83-143R	6/30/83	Gallup	Salton Sea SGS Scales	Moderate PbS; As 0-3.2%
REF 83-161R	8/10/83	Gallup	Salton Sea SGS Scales	PbS & Pb 0-19%; As 0-1%
to LRH	9/15/83	Gritters	IV Brine Summary	same ranges as given above
REF 83-188R	9/23/83	Gallup	Brawley SGS Scales	Moderate PbS; As 0-3%
REF 83-222R	11/17/83	Gallup	Salton Sea SGS Scales	PbS,PbOHCl, As 0-6.7%
REF 83-228R	12/7/83	Gallup	Brawley SGS Scales	Traces PbS; No As
REF 83-232R	12/12/83	Wong	Scale Piles B & SS	Pb & As exceed TTLC
REF 84-80R	4/27/84	Gallup	Brawley SGS Scales	Traces PbS; No As
REF 84-91R	5/4/84	Gallup	Salton Sea SGS Scales	Trace PbS; FeAs2 in wells
REF 84-150R	7/2/84	Gallup	Salton Sea SGS Scales	Traces PbS; Pb 9%; No As
REF 84-176R	8/7/84	Gallup	Brawley SGS Scales	Traces PbS; No As
REF 84-200R	9/6/84	Wong	SS Scale Piles	Pb & As exceed TTLC
REF 84-207R	9/12/84	Gallup	Brawley SGS Scales	PbS wide range; As 0-9%
GEOL 84-22R	10/11/84	Gallup	Veysey-12 Scale	PbS Mineralogy
REF 84-240R	10/26/84	Gallup	Salton Sea SGS Scales	Minor PbS; No As
GEOL 85-1R	1/14/85	Smith	IID-12 FeAs Scale	FeAs Alloys
REF 85-31R	2/14/85	Gallup	Brawley SGS Scales	PbS Well Scale; No As
REF 85-39R	2/27/85	Gallup	Salton Sea SGS Scales	PbS, Pb, FeAs2 in Well Scale
REF 85-154M	9/20/85	Gallup	IV Well Scales	PbS @ Brawley; No As

Pb As References

TABLE

REF 86-17M	1/31/86	Gallup	Sin-15 Scale	Trace PbS; No As
REF 86-70M	5/6/86	Gallup	IV Well Scales	FeAs2 in IID-12
REF 86-160R	7/21/86	Gallup	Salton Sea SGS Scales	No Pb or As
REF 86-232R	11/12/86	Gallup	Salton Sea SGS Scales	Pb and As 0-1%
REF 86-195M	12/12/86	Gallup	IID-12 & Sin-20 Brines	Pb~55 ppm; As~10 ppm
GEOL 87-4M	1/19/87	Rinie	Scale Geochemistry	PbS and FeAs in Well Scales
REF 87-25R	2/4/87	Gallup	Salton Sea SGS Scales	Trace PbS; No As
REF 87-66M	4/3/87	Gallup	SS Pond Sludge	PbOHCl 0-3%
REF 87-76R	4/29/87	Gallup	Salton Sea SGS Scales	Pb7O6Cl2, Pb, PbO, FeAs2
REF 87-106R	6/22/87	Gallup	Salton Sea SGS Scales	IID-11 - Cu3As; As 0-23%
REF 87-158R	9/28/87	Gallup	Salton Sea SGS Scales	CuAs2, FeAs2
PMR 88-75M	5/13/88	Gallup	SS Injectors	Cu3As
PMR 88-164M	11/28/88	Gallup	IID-12 Scale	FeAs2 on bottom joint
PMR 89-15M	1/17/89	Wong	Pb in Sludges	Pb and PbS Review
PMR 89-35M	2/13/89	Gallup	SS Scales	Trace PbS; No As
PMR 89-51M	3/13/89	Gallup	SS Scales	Trace PbS
PMR 89-59M	3/14/89	Gallup	Von-1 & Sin-10 Brines	As ~ 15 ppm
PMR 89-62R	4/20/89	Gallup	SS Scales	No Pb; As 0-0.2%
PMR 89-98R	7/11/89	Gallup	SS U-3 Power Plant Scales	AsS; As 0-5%
PMR 89-128R	8/16/89	Gallup	SS Sludges	Pb and As exceed TTLC
PMR 89-148R	10/20/89	Gallup	SS Scales	No Pb or As
PMR 89-159R	10/20/89	Gallup	SS Scales	Cu3As
PMR 89-170R	10/30/89	Gallup	Line Mine Scales	Cu3As
PMR 89-216M	12/15/89	Gallup	SS Scales	No Pb; Cu3As
PMR 90-13M	1/12/90	Gallup	SS Scales	No Pb; Cu3As
PMR 90-71M	5/1/90	Obando	SS Scales	Trace PbS; No As
PMR 90-82M	5/22/90	Gallup	Line Mine Scales	Cu3As
PMR 90-83M	5/22/90	Gallup	Von-1 Scale	No Pb or As
PMR 90-97M	6/19/90	Obando	U-3 Scales	PbS and Cu3As
PMR 90-116M	7/13/90	Obando	Line Mine Scales	Cu3As
PMR 90-142M	9/4/90	Gallup	Line Mine Scales	Cu3As
PMR 90-144M	9/6/90	Gallup	Line Mine Scales	Pb & As exceed STLC
PMR 90-178M	11/27/90	Gallup	Sin-21 Scales	No Pb or As
PMR 90-185M	12/7/90	Gallup	SS Scales	No Pb; Cu3As
PMR 91-11M	1/18/91	Gallup	Pb in Brawley Soils	Pb exceeds STLC
PMR 91-12M	1/24/91	Gallup	Pb in Brawley Soils	Pb fixed by Geocrete

Pb As References

TABLE

PMR 91-31M	3/7/91	Obando	Line Mine Scales	Cu3As
PMR 91-38M	4/3/91	Gallup	U-2 Scales	No Pb; Minor Cu3As
ENV 91-48	9/20/91	Gallup	Sin-10 Brine	Pb~60 ppm; As~10 ppm
ENV 91-59	10/3/91	Obando	Line Mine Scales	Cu3As
ENV 91-91	11/4/91	Obando	Line Mine Scales	Cu3As
ENV 92-1	1/10/92	Obando	SS Scales	No Pb or As
ENV 92-2	1/14/92	Obando	Line Mine Scales	Cu3As
ENV 92-13	1/22/92	Obando	Various Scales & Soils	As in Veysey Soils > TTLC
ENV 92-46	3/5/92	Obando	Line Mine Scales	Cu3As
ENV 92-98	3/27/92	Gallup	Line Mine Scales	Cu3As
ENV 92-96	3/27/92	Flint	NORMs Abatement	Cu3As uninhibited by NORMs
ENV 92-119	4/16/92	Obando	SS Scales	Cu3As
ENV 92-192	7/29/92	Gallup	SS Scales	Cu3As; No Pb
ENV 92-193	7/29/92	Gallup	Sin-10 Scale	No Pb or As
ENV 92-194	7/30/92	Gallup	Sin-22 Scales	Traces Pb and As
ENV 92-196	7/31/92	Gallup	Sin-21 Scales	Trace As
ENV 92-206	8/21/92	Gallup	Sin-15 Scales	Trace As
ENV 93-221	5/17/93	Gallup	SS Soil Analyses	Low As

Pb As References

EmplID	Employee Name	---- Current Pay ---- Period	F-Y-T-D	Remaining Obligation	PAN Distr End Date	--- Acct Charge --- Period	F-Y-T-D	Advance Deferral	Comments
Account Code: 01-00059-50500716-50800-0									
00106808 0	HULEN,JEFFREY B		5,038.24				5,038.24		
	Totals:		5,038.24				5,038.24		
Account Code: 01-00059-50500716-50800-1									
00106808 0	HULEN,JEFFREY B		1,521.58				1,521.58		
00058118 0	LUTZ,SUSAN JUCH		3,311.16				3,311.16		
	Totals:		4,832.74				4,832.74		
	Total Salary and Wages		9,870.98				9,870.98		

********** BENEFITS (DEPARTMENT CONTRIBUTION) **********

EmplID	Employee Name	STATE/TIAA RET Period	F-Y-T-D	------- LTD ------- Period	F-Y-T-D	----- LIFE INS ----- Period	F-Y-T-D	-- MED/DENTAL -- Period	F-Y-T-D	-- OTHER FEES -- Period	F-Y-T-D	TOTAL F-Y-T-D
Account Code: 01-00059-50500716-59000-0												
00106808 0	HULEN,JEFFREY B		715.42		7.69		7.00		335.36		2.80	1,068.27
	TOTALS		715.42		7.69		7.00		335.36		2.80	1,068.27
Account Code: 01-00059-50500716-59000-1												
00106808 0	HULEN,JEFFREY B		216.06		2.71		2.46		118.16		1.35	340.74
00058118 0	LUTZ,SUSAN JUCH		470.21		9.83		8.94		583.20		4.69	1,076.87

BENEFITS
(DEPARTMENT CONTRIBUTION)

EmplID	Employee Name	STATE/TIAA RET Period	STATE/TIAA RET F-Y-T-D	LTD Period	LTD F-Y-T-D	LIFE INS Period	LIFE INS F-Y-T-D	MED/DENTAL Period	MED/DENTAL F-Y-T-D	OTHER FEES Period	OTHER FEES F-Y-T-D	TOTAL F-Y-T-D
	TOTALS		686.27		12.54		11.40		701.36		6.04	1,417.61

TAXES
(DEPARTMENT CONTRIBUTION)

EmplID	Employee Name	FICA Period	FICA F-Y-T-D	FICA-MEDHI Period	FICA-MEDHI F-Y-T-D	WORKER'S COMP Period	WORKER'S COMP F-Y-T-D	UNEMP. INS Period	UNEMP. INS F-Y-T-D	TOTAL F-Y-T-D	TOTALS BENEFITS + TAXES Period	TOTALS BENEFITS + TAXES F-Y-T-D
Account Code: 01-00059-50500716-59000-0												
00106808 0	HULEN,JEFFREY B		310.63		72.64		10.28		8.32	401.87		1,470.14
	TOTALS		310.63		72.64		10.28		8.32	401.87		1,470.14
Account Code: 01-00059-50500716-59000-1												
00106808 0	HULEN,JEFFREY B		94.00		21.99		3.10		2.52	121.61		462.35
00058118 0	LUTZ,SUSAN JUCH		202.18		47.28		6.75		5.42	261.63		1,338.50
	TOTALS		296.18		69.27		9.85		7.94	383.24		1,800.85

Total Taxes and Benefits to GL: **0.00**

University of Utah
Financial Management Report
B A L A N C E S H E E T
For the Period Ending 06/30/2001

Report ID: USGLH006
Run Date: 07/19/2001
Report Pg: 14383

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856C03000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

Account	Description	Previous Balance	Current Month Changes	Current Balance
10500	CLAIM ON CASH	3,587.04-	1,105.87-	4,692.91-
	Total Assets	3,587.04-	1,105.87-	4,692.91-
30000	Fund Balance	3,587.04	1,105.87	4,692.91
	Total Liabilities & Fund Balance	3,587.04	1,105.87	4,692.91

IF YOU HAVE ANY QUESTIONS, PLEASE CALL 581-5832

University of Utah
Financial Management Report
S U M M A R Y O F R E V E N U E A N D E X P E N S E
For the Period Ending 06/30/2001

Report ID: USGLH006
Run Date: 07/19/2001
Report Pg: 14384

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: N0NE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

Account	Description	Budget	Current Month Inc / Exp	Project to Date Inc / Exp	Current Encumbrance	Balance Available
40106	CONTRACTS AND GRANTS-NONGOVERN	0.00	0.00	16,322.00	0.00	16,322.00-
	Total Revenue	0.00	0.00	16,322.00	0.00	16,322.00-
50800	OTHER SALARIES	9,200.00	627.71	9,870.98	0.00	670.98-
59000	EMPLOYEE BENEFITS	2,491.00	239.64	3,270.99	0.00	779.99-
	Total Personal Services	11,691.00	867.35	13,141.97	0.00	1,450.97-
63700	SHIPPING/FREIGHT	99.00	0.00	20.31	0.00	78.69
64300	UNIVERSITY SERVICES	3,896.00	0.00	0.00	0.00	3,896.00
66300	OTHER SERVICES	0.00	0.00	320.00	0.00	320.00-
66303	OTHER SERVICES	0.00	0.00	3,000.00	0.00	3,000.00-
	Total Non-Personal Services	3,995.00	0.00	3,340.31	0.00	654.69
	Total Direct Costs	15,686.00	867.35	16,482.28	0.00	796.28-
89900	FACILITIES & ADMIN. COST	4,314.00	238.52	4,532.63	0.00	218.63-
	Total Expenditures	20,000.00	1,105.87	21,014.91	0.00	1,014.91-

IF YOU HAVE ANY QUESTIONS, PLEASE CALL 581-5832

University of Utah
Financial Management Report
D E T A I L T R A N S A C T I O N S
For the Period Ending 06/30/2001

Report ID: USGLH006
Run Date: 07/19/2001
Report Pg: 14385

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

OrgID	Date	A U	SRC	Journal ID	Line Reference	Account	Description	Current Month Budget	Current Month Actuals	Current Month Encumbrances
00059	30-JUN-2001		ALO	CASH000001		10500		0.00	1,105.87-	0.00
					Total	10500	CLAIM ON CASH	0.00	1,105.87-	0.00
00059	15-JUN-2001		PAY	SE001A0001		50800	P/R ACTUALS	0.00	627.71	0.00
					Total	50800	OTHER SALARIES	0.00	627.71	0.00
00059	15-JUN-2001		PAY	SE001A0001		59000	P/R ACTUALS	0.00	239.64	0.00
					Total	59000	EMPLOYEE BENEFITS	0.00	239.64	0.00
00059	25-JUN-2001		ALO	FAEX062501	FAEXPENSE	89900	FA EXPENSE	0.00	238.52	0.00
					Total	89900	FACILITIES & ADMIN. COST	0.00	238.52	0.00

NOTE: ENCUMBRANCE DETAIL WILL INCLUDE FUTURE MONTH TRANSACTIONS UP TO THE DATE THE REPORT IS RUN.

University of Utah
Financial Management Report
B A L A N C E S H E E T
For the Period Ending 05/31/2001

Report ID: USGLH006
Run Date: 06/11/2001
Report Pg: 15674

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

Account	Description	Previous Balance	Current Month Changes	Current Balance
10500	CLAIM ON CASH	8,536.14	12,123.18-	3,587.04-
	Total Assets	8,536.14	12,123.18-	3,587.04-
30000	Fund Balance	8,536.14-	12,123.18	3,587.04
	Total Liabilities & Fund Balance	8,536.14-	12,123.18	3,587.04

IF YOU HAVE ANY QUESTIONS, PLEASE CALL 581-5832

University of Utah
Financial Management Report
S U M M A R Y O F R E V E N U E A N D E X P E N S E
For the Period Ending 05/31/2001

Report ID: USGLH006
Run Date: 06/11/2001
Report Pg: 15675

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

Account	Description	Budget	Current Month Inc / Exp	Project to Date Inc / Exp	Current Encumbrance	Balance Available
40106	CONTRACTS AND GRANTS-NONGOVERN	0.00	0.00	16,322.00	0.00	16,322.00-
	Total Revenue	0.00	0.00	16,322.00	0.00	16,322.00-
50800	OTHER SALARIES	9,200.00	5,038.24	9,243.27	0.00	43.27-
59000	EMPLOYEE BENEFITS	2,491.00	1,470.14	3,031.35	0.00	540.35-
	Total Personal Services	11,691.00	6,508.38	12,274.62	0.00	583.62-
63700	SHIPPING/FREIGHT	99.00	0.00	20.31	0.00	78.69
64300	UNIVERSITY SERVICES	3,896.00	0.00	0.00	0.00	3,896.00
66300	OTHER SERVICES	0.00	0.00	320.00	0.00	320.00-
66303	OTHER SERVICES	0.00	3,000.00	3,000.00	0.00	3,000.00-
	Total Non-Personal Services	3,995.00	3,000.00	3,340.31	0.00	654.69
	Total Direct Costs	15,686.00	9,508.38	15,614.93	0.00	71.07
89900	FACILITIES & ADMIN. COST	4,314.00	2,614.80	4,294.11	0.00	19.89
	Total Expenditures	20,000.00	12,123.18	19,909.04	0.00	90.96

IF YOU HAVE ANY QUESTIONS, PLEASE CALL 581-5832

University of Utah
Financial Management Report
D E T A I L T R A N S A C T I O N S
For the Period Ending 05/31/2001

Report ID: USGLH006
Run Date: 06/11/2001
Report Pg: 15676

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

OrgID	Date	AU	SRC	Journal ID	Line Reference	Account	Description	Current Month Budget	Current Month Actuals	Current Month Encumbrances
00059	31-MAY-2001		ALO	CASH000001		10500		0.00	9,123.18-	0.00
00059	11-MAY-2001		AP	VP00093142		10500		0.00	3,000.00-	0.00
					Total	10500	CLAIM ON CASH	0.00	12,123.18-	0.00
00059	10-MAY-2001		AP	AP00093005		20099		0.00	3,000.00-	0.00
00059	11-MAY-2001		AP	VP00093142		20099		0.00	3,000.00	0.00
					Total	20099	AP VOUCHERS PAYABLE	0.00	0.00	0.00
00059	31-MAY-2001		PAY	SE001A0001		50800	P/R ACTUALS	0.00	5,038.24	0.00
					Total	50800	OTHER SALARIES	0.00	5,038.24	0.00
00059	31-MAY-2001		PAY	SE001A0001		59000	P/R ACTUALS	0.00	1,470.14	0.00
					Total	59000	EMPLOYEE BENEFITS	0.00	1,470.14	0.00
00059	10-MAY-2001		AP	AP00093005	00543674	66303	CQ00089570 TERRATEK INC	0.00	3,000.00	0.00
					Total	66303	OTHER SERVICES	0.00	3,000.00	0.00
00059	14-MAY-2001		ALO	FAEX051401	FAEXPENSE	89900	FA EXPENSE	0.00	825.00	0.00
00059	31-MAY-2001		ALO	FAEX060701	FAEXPENSE	89900	FA EXPENSE	0.00	1,789.80	0.00
					Total	89900	FACILITIES & ADMIN. COST	0.00	2,614.80	0.00

NOTE: ENCUMBRANCE DETAIL WILL INCLUDE FUTURE MONTH TRANSACTIONS UP TO THE DATE THE REPORT IS RUN.

University of n
Financial Management Report
B A L A N C E S H E E T
For the Period Ending 01/31/2001

Report ID: USGLH006
Run Date: 02/09/2001
Report Pg: 15358

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

Account	Description	Previous Balance	Current Month Changes	Current Balance
10500	CLAIM ON CASH	0.00	25.90-	25.90-
	Total Assets	0.00	25.90-	25.90-
30000	Fund Balance	0.00	25.90	25.90
	Total Liabilities & Fund Balance	0.00	25.90	25.90

IF YOU HAVE ANY QUESTIONS, PLEASE CALL 581-5832

University of Utah
Financial Management Report
S U M M A R Y O F R E V E N U E A N D E X P E N S E
For the Period Ending 01/31/2001

Report ID: USGLH006
Run Date: 02/09/2001
Report Pg: 15359

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

Account	Description	Budget	Current Month Inc / Exp	Project to Date Inc / Exp	Current Encumbrance	Balance Available
50800	OTHER SALARIES	9,200.00	0.00	0.00	0.00	9,200.00
59000	EMPLOYEE BENEFITS	2,491.00	0.00	0.00	0.00	2,491.00
	Total Personal Services	11,691.00	0.00	0.00	0.00	11,691.00
63700	SHIPPING/FREIGHT	99.00	20.31	20.31	0.00	78.69
64300	UNIVERSITY SERVICES	3,896.00	0.00	0.00	0.00	3,896.00
	Total Non-Personal Services	3,995.00	20.31	20.31	0.00	3,974.69
	Total Direct Costs	15,686.00	20.31	20.31	0.00	15,665.69
89900	FACILITIES & ADMIN. COST	4,314.00	5.59	5.59	0.00	4,308.41
	Total Expenditures	20,000.00	25.90	25.90	0.00	19,974.10

IF YOU HAVE ANY QUESTIONS, PLEASE CALL 581-5832

University of n
Financial Management Report
D E T A I L T R A N S A C T I O N S
For the Period Ending 01/31/2001

Report ID: USGLH006
Run Date: 02/09/2001
Report Pg: 15360

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

OrgID	Date	AU	SRC	Journal ID	Line Reference	Account	Description	Current Month Budget	Current Month Actuals	Current Month Encumbrances
00059	31-JAN-2001		ALO	CASH000001		10500		0.00	25.90-	0.00
					Total	10500	CLAIM ON CASH	0.00	25.90-	0.00
00059	31-JAN-2001		MB2	SE05700001		63700	MAILING BUREAU - FX DETAIL	0.00	20.31	0.00
					Total	63700	SHIPPING/FREIGHT	0.00	20.31	0.00
00059	31-JAN-2001		ALO	FAEX013101	FAEXPENSE	89900	FA EXPENSE	0.00	5.59	0.00
					Total	89900	FACILITIES & ADMIN. COST	0.00	5.59	0.00

NOTE: ENCUMBRANCE DETAIL WILL INCLUDE FUTURE MONTH TRANSACTIONS UP TO THE DATE THE REPORT IS RUN.

University, Utah
Financial Management Report
B A L A N C E S H E E T
For the Period Ending 02/28/2001

Report ID: USGLH006
Run Date: 03/10/2001
Report Pg: 15196

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

Account	Description	Previous Balance	Current Month Changes	Current Balance
10500	CLAIM ON CASH	25.90-	0.00	25.90-
	Total Assets	25.90-	0.00	25.90-
30000	Fund Balance	25.90	0.00	25.90
	Total Liabilities & Fund Balance	25.90	0.00	25.90

IF YOU HAVE ANY QUESTIONS, PLEASE CALL 581-5832

University of Utah
Financial Management Report
SUMMARY OF REVENUE AND EXPENSE
For the Period Ending 02/28/2001

Report ID: USGLH006
Run Date: 03/10/2001
Report Pg: 15197

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

Account	Description	Budget	Current Month Inc / Exp	Project to Date Inc / Exp	Current Encumbrance	Balance Available
50800	OTHER SALARIES	9,200.00	0.00	0.00	0.00	9,200.00
59000	EMPLOYEE BENEFITS	2,491.00	0.00	0.00	0.00	2,491.00
	Total Personal Services	11,691.00	0.00	0.00	0.00	11,691.00
63700	SHIPPING/FREIGHT	99.00	0.00	20.31	0.00	78.69
64300	UNIVERSITY SERVICES	3,896.00	0.00	0.00	0.00	3,896.00
	Total Non-Personal Services	3,995.00	0.00	20.31	0.00	3,974.69
	Total Direct Costs	15,686.00	0.00	20.31	0.00	15,665.69
89900	FACILITIES & ADMIN. COST	4,314.00	0.00	5.59	0.00	4,308.41
	Total Expenditures	20,000.00	0.00	25.90	0.00	19,974.10

IF YOU HAVE ANY QUESTIONS, PLEASE CALL 581-5832

REVISED

HULEN,JEFFREY B
00059 - ENERGY & GEOSCIENCE INSTITUTE
0856003000 - 423 WAKARA WAY
Project: 50500716 FILTER CAKE CHARACTERIZATION Fund: 5000

UNIVERSITY OF UTAH
PAYROLL EARNINGS, BENEFITS, & TAXES REPORT
Projects - Pay Period End Date: 30-APR-2001

Report Page:7271
Program: USHRP005
Run Date: 05/17/2001

EmplID	Employee Name	---- Current Pay ---- Period	F-Y-T-D	Remaining Obligation	PAN Distr End Date	--- Acct Charge --- Period	F-Y-T-D	Advance Deferral	Comments
Account Code: 01-00059-50500716-50800-1									
00106808 0	HULEN,JEFFREY B		1,521.58				1,521.58		
00058118 0	LUTZ,SUSAN JUCH					1,805.78			PAR 8007-51 31-DEC-2000
00058118 0	LUTZ,SUSAN JUCH					1,805.78			PAR 8007-53 31-DEC-2000
00058118 0	LUTZ,SUSAN JUCH		2,683.45				2,683.45		
			=====			=====	=====		
	Totals:		4,205.03				4,205.03		
	Total Account 50800 to GL:					**2,683.45**			
	Total Salary and Wages		4,205.03			2,683.45	4,205.03		

********** BENEFITS (DEPARTMENT CONTRIBUTION) **********

EmplID	Employee Name	STATE/TIAA RET Period	F-Y-T-D	------- LTD ------- Period	F-Y-T-D	----- LIFE INS ----- Period	F-Y-T-D	-- MED/DENTAL -- Period	F-Y-T-D	-- OTHER FEES -- Period	F-Y-T-D	TOTAL F-Y-T-D
Account Code: 01-00059-50500716-59000-1												
00106808 0	HULEN,JEFFREY B		216.06		2.71		2.46		118.16		1.35	340.74
00058118 0	LUTZ,SUSAN JUCH	381.07	381.07	8.19	8.19	7.44	7.44	485.80	485.80	4.09	4.09	886.59
		=====	=====	=====	=====	=====	=====	=====	=====	====	=====	=====
	TOTALS	381.07	597.13	8.19	10.90	7.44	9.90	485.80	603.96	4.09	5.44	1,227.33

		TAXES (DEPARTMENT CONTRIBUTION)									TOTALS	
		FICA		FICA-MEDHI		WORKER'S COMP		UNEMP. INS		TOTAL	BENEFITS + TAXES	
EmplID	Employee Name	Period	F-Y-T-D	Period	F-Y-T-D	Period	F-Y-T-D	Period	F-Y-T-D	F-Y-T-D	Period	F-Y-T-D
Account Code: 01-00059-50500716-59000-1												
00106808 0	HULEN,JEFFREY B		94.00		21.99		3.10		2.52	121.61		462.35
00058118 0	LUTZ,SUSAN JUCH	164.04	164.04	38.36	38.36	5.47	5.47	4.40	4.40	212.27	1,098.86	1,098.86
	TOTALS	164.04	258.04	38.36	60.35	5.47	8.57	4.40	6.92	333.88	1,098.86	1,561.21

Total Taxes and Benefits to GL: **1,098.86**

EmplID	Employee Name	---- Current Pay ---- Period	F-Y-T-D	Remaining Obligation	PAN Distr End Date	--- Acct Charge --- Period	F-Y-T-D	Advance Deferral	Comments
Account Code: 01-00059-50500716-50800-1									
00106808 0	HULEN,JEFFREY B					1,521.58			Reall-8006/18
00106808 0	HULEN,JEFFREY B		1,521.58				1,521.58		
	Totals:		1,521.58				1,521.58		
	Total Account 50800 to GL:					1,521.58			
	Total Salary and Wages		1,521.58			1,521.58	1,521.58		

BENEFITS
(DEPARTMENT CONTRIBUTION)

EmplID	Employee Name	STATE/TIAA RET Period	F-Y-T-D	------- LTD ------- Period	F-Y-T-D	----- LIFE INS ----- Period	F-Y-T-D	-- MED/DENTAL -- Period	F-Y-T-D	-- OTHER FEES -- Period	F-Y-T-D	TOTAL F-Y-T-D
Account Code: 01-00059-50500716-59000-1												
00106808 0	HULEN,JEFFREY B	216.06	216.06	2.71	2.71	2.46	2.46	118.16	118.16	1.35	1.35	340.74
	TOTALS	216.06	216.06	2.71	2.71	2.46	2.46	118.16	118.16	1.35	1.35	340.74

		TAXES (DEPARTMENT CONTRIBUTION)									TOTALS	
		-------- FICA --------		---- FICA-MEDHI ----		- WORKER'S COMP -		---- UNEMP. INS ----		TOTAL	BENEFITS + TAXES	
EmplID	Employee Name	Period	F-Y-T-D	Period	F-Y-T-D	Period	F-Y-T-D	Period	F-Y-T-D	F-Y-T-D	Period	F-Y-T-D
Account Code: 01-00059-50500716-59000-1												
00106808 0	HULEN,JEFFREY B	94.00	94.00	21.99	21.99	3.10	3.10	2.52	2.52	121.61	462.35	462.35
	TOTALS	94.00	94.00	21.99	21.99	3.10	3.10	2.52	2.52	121.61	462.35	462.35

Total Taxes and Benefits to GL: **462.35**

EmplID	Employee Name	Current Pay Period	Current Pay F-Y-T-D	Remaining Obligation	PAN Distr End Date	Acct Charge Period	Acct Charge F-Y-T-D	Advance Deferral	Comments
Account Code: 01-00059-50500716-50800-1									
00106808 0	HULEN,JEFFREY B		1,521.58				1,521.58		
00058118 0	LUTZ,SUSAN JUCH					1,805.78			PAR 8007-51 31-DEC-2000
00058118 0	LUTZ,SUSAN JUCH					~~1,805.78~~ 877.67			PAR 8007-53 31-DEC-2000
00058118 0	LUTZ,SUSAN JUCH		2,683.45				2,683.45		
	Totals:		4,205.03				4,205.03		
	Total Account 50800 to GL:					2,683.45			
	Total Salary and Wages		4,205.03			2,683.45	4,205.03		

BENEFITS
(DEPARTMENT CONTRIBUTION)

EmplID	Employee Name	STATE/TIAA RET Period	STATE/TIAA RET F-Y-T-D	LTD Period	LTD F-Y-T-D	LIFE INS Period	LIFE INS F-Y-T-D	MED/DENTAL Period	MED/DENTAL F-Y-T-D	OTHER FEES Period	OTHER FEES F-Y-T-D	TOTAL F-Y-T-D
Account Code: 01-00059-50500716-59000-1												
00106808 0	HULEN,JEFFREY B		216.06		2.71		2.46		118.16		1.35	340.74
00058118 0	LUTZ,SUSAN JUCH	381.07	381.07	8.19	8.19	7.44	7.44	485.80	485.80	4.09	4.09	886.59
	TOTALS	381.07	597.13	8.19	10.90	7.44	9.90	485.80	603.96	4.09	5.44	1,227.33

TAXES (DEPARTMENT CONTRIBUTION)

EmplID	Employee Name	FICA Period	FICA F-Y-T-D	FICA-MEDHI Period	FICA-MEDHI F-Y-T-D	WORKER'S COMP Period	WORKER'S COMP F-Y-T-D	UNEMP. INS Period	UNEMP. INS F-Y-T-D	TOTAL F-Y-T-D	TOTALS BENEFITS + TAXES Period	TOTALS BENEFITS + TAXES F-Y-T-D
Account Code: 01-00059-50500716-59000-1												
00106808 0	HULEN,JEFFREY B		94.00		21.99		3.10		2.52	121.61		462.35
00058118 0	LUTZ,SUSAN JUCH	164.04	164.04	38.36	38.36	5.47	5.47	4.40	4.40	212.27	1,098.86	1,098.86
	TOTALS	164.04	258.04	38.36	60.35	5.47	8.57	4.40	6.92	333.88	1,098.86	1,561.21

Total Taxes and Benefits to GL: **1,098.86**

EmplID	Employee Name	Current Pay Period	Current Pay F-Y-T-D	Remaining Obligation	PAN Distr End Date	Acct Charge Period	Acct Charge F-Y-T-D	Advance Deferral	Comments
Account Code: 01-00059-50500716-50800-0									
00106808 0	HULEN,JEFFREY B		5,038.24				5,038.24		
	Totals:		5,038.24				5,038.24		
Account Code: 01-00059-50500716-50800-1									
00106808 0	HULEN,JEFFREY B		1,521.58				1,521.58		
00058118 0	LUTZ,SUSAN JUCH					627.71			PAR 8029-40 31-MAR-2001
00058118 0	LUTZ,SUSAN JUCH		3,311.16				3,311.16		
	Totals:		4,832.74				4,832.74		
	Total Account 50800 to GL:					**627.71**			
	Total Salary and Wages		9,870.98			627.71	9,870.98		

********** BENEFITS (DEPARTMENT CONTRIBUTION) **********

EmplID	Employee Name	STATE/TIAA RET Period	STATE/TIAA RET F-Y-T-D	LTD Period	LTD F-Y-T-D	LIFE INS Period	LIFE INS F-Y-T-D	MED/DENTAL Period	MED/DENTAL F-Y-T-D	OTHER FEES Period	OTHER FEES F-Y-T-D	TOTAL F-Y-T-D
Account Code: 01-00059-50500716-59000-0												
00106808 0	HULEN,JEFFREY B		715.42		7.69		7.00		335.36		2.80	1,068.27
	TOTALS		715.42		7.69		7.00		335.36		2.80	1,068.27

********** BENEFITS **********
(DEPARTMENT CONTRIBUTION)

EmplID	Employee Name	STATE/TIAA RET Period	STATE/TIAA RET F-Y-T-D	------- LTD ------- Period	------- LTD ------- F-Y-T-D	----- LIFE INS ----- Period	----- LIFE INS ----- F-Y-T-D	-- MED/DENTAL -- Period	-- MED/DENTAL -- F-Y-T-D	-- OTHER FEES -- Period	-- OTHER FEES -- F-Y-T-D	TOTAL F-Y-T-D
Account Code: 01-00059-50500716-59000-1												
00106808 0	HULEN,JEFFREY B		216.06		2.71		2.46		118.16		1.35	340.74
00058118 0	LUTZ,SUSAN JUCH	89.14	470.21	1.64	9.83	1.50	8.94	97.40	583.20	0.60	4.69	1,076.87
	TOTALS	89.14	686.27	1.64	12.54	1.50	11.40	97.40	701.36	0.60	6.04	1,417.61

********** TAXES ********** TOTALS
(DEPARTMENT CONTRIBUTION)

EmplID	Employee Name	-------- FICA -------- Period	-------- FICA -------- F-Y-T-D	---- FICA-MEDHI ---- Period	---- FICA-MEDHI ---- F-Y-T-D	- WORKER'S COMP - Period	- WORKER'S COMP - F-Y-T-D	---- UNEMP. INS ---- Period	---- UNEMP. INS ---- F-Y-T-D	TOTAL F-Y-T-D	BENEFITS + TAXES Period	BENEFITS + TAXES F-Y-T-D
Account Code: 01-00059-50500716-59000-0												
00106808 0	HULEN,JEFFREY B		310.63		72.64		10.28		8.32	401.87		1,470.14
	TOTALS		310.63		72.64		10.28		8.32	401.87		1,470.14
Account Code: 01-00059-50500716-59000-1												
00106808 0	HULEN,JEFFREY B		94.00		21.99		3.10		2.52	121.61		462.35
00058118 0	LUTZ,SUSAN JUCH	38.14	202.18	8.92	47.28	1.28	6.75	1.02	5.42	261.63	239.64	1,338.50
	TOTALS	38.14	296.18	8.92	69.27	1.28	9.85	1.02	7.94	383.24	239.64	1,800.85

Total Taxes and Benefits to GL: **239.64**

EmplID	Employee Name	---- Current Pay ---- Period	F-Y-T-D	Remaining Obligation	PAN Distr End Date	--- Acct Charge --- Period	F-Y-T-D	Advance Deferral	Comments
Account Code: 01-00059-50500716-50800-0									
00106808 0	HULEN,JEFFREY B					5,038.24			PAR 8022-48 31-MAR-2001
00106808 0	HULEN,JEFFREY B		5,038.24				5,038.24		
	Totals:		5,038.24				5,038.24		
	Total Account 50800 to GL:					**5,038.24**			
Account Code: 01-00059-50500716-50800-1									
00106808 0	HULEN,JEFFREY B		1,521.58				1,521.58		
00058118 0	LUTZ,SUSAN JUCH		2,683.45				2,683.45		
	Totals:		4,205.03				4,205.03		
	Total Salary and Wages		9,243.27			5,038.24	9,243.27		

BENEFITS
(DEPARTMENT CONTRIBUTION)

EmplID	Employee Name	STATE/TIAA RET Period	F-Y-T-D	------- LTD ------- Period	F-Y-T-D	----- LIFE INS ----- Period	F-Y-T-D	-- MED/DENTAL -- Period	F-Y-T-D	-- OTHER FEES -- Period	F-Y-T-D	TOTAL F-Y-T-D
Account Code: 01-00059-50500716-59000-0												
00106808 0	HULEN,JEFFREY B	715.42	715.42	7.69	7.69	7.00	7.00	335.36	335.36	2.80	2.80	1,068.27
	TOTALS	715.42	715.42	7.69	7.69	7.00	7.00	335.36	335.36	2.80	2.80	1,068.27

UNIVERSITY OF UTAH
PAYROLL EARNINGS, BENEFITS, & TAXES REPORT
Projects - Pay Period End Date: 31-MAY-2001

BENEFITS
(DEPARTMENT CONTRIBUTION)

EmplID	Employee Name	STATE/TIAA RET Period	STATE/TIAA RET F-Y-T-D	LTD Period	LTD F-Y-T-D	LIFE INS Period	LIFE INS F-Y-T-D	MED/DENTAL Period	MED/DENTAL F-Y-T-D	OTHER FEES Period	OTHER FEES F-Y-T-D	TOTAL F-Y-T-D
Account Code: 01-00059-50500716-59000-1												
00106808 0	HULEN,JEFFREY B		216.06		2.71		2.46		118.16		1.35	340.74
00058118 0	LUTZ,SUSAN JUCH		381.07		8.19		7.44		485.80		4.09	886.59
	TOTALS		597.13		10.90		9.90		603.96		5.44	1,227.33

TAXES
(DEPARTMENT CONTRIBUTION)

EmplID	Employee Name	FICA Period	FICA F-Y-T-D	FICA-MEDHI Period	FICA-MEDHI F-Y-T-D	WORKER'S COMP Period	WORKER'S COMP F-Y-T-D	UNEMP. INS Period	UNEMP. INS F-Y-T-D	TOTAL F-Y-T-D	TOTALS BENEFITS + TAXES Period	TOTALS BENEFITS + TAXES F-Y-T-D
Account Code: 01-00059-50500716-59000-0												
00106808 0	HULEN,JEFFREY B	310.63	310.63	72.64	72.64	10.28	10.28	8.32	8.32	401.87	1,470.14	1,470.14
	TOTALS	310.63	310.63	72.64	72.64	10.28	10.28	8.32	8.32	401.87	1,470.14	1,470.14
Account Code: 01-00059-50500716-59000-1												
00106808 0	HULEN,JEFFREY B		94.00		21.99		3.10		2.52	121.61		462.35
00058118 0	LUTZ,SUSAN JUCH		164.04		38.36		5.47		4.40	212.27		1,098.86
	TOTALS		258.04		60.35		8.57		6.92	333.88		1,561.21

Total Taxes and Benefits to GL: **1,470.14**

University of Utah
Financial Management Report
B A L A N C E S H E E T
For the Period Ending 04/30/2001

Report ID: USGLH006
Run Date: 05/09/2001
Report Pg: 15296

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

Account	Description	Previous Balance	Current Month Changes	Current Balance
10500	CLAIM ON CASH	433.90-	8,970.04	8,536.14
	Total Assets	433.90-	8,970.04	8,536.14
30000	Fund Balance	433.90	8,970.04-	8,536.14-
	Total Liabilities & Fund Balance	433.90	8,970.04-	8,536.14-

IF YOU HAVE ANY QUESTIONS, PLEASE CALL 581-5832

University of Utah
Financial Management Report
S U M M A R Y O F R E V E N U E A N D E X P E N S E
For the Period Ending 04/30/2001

Report ID: USGLH006
Run Date: 05/09/2001
Report Pg: 15297

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

Account	Description	Budget	Current Month Inc / Exp	Project to Date Inc / Exp	Current Encumbrance	Balance Available
40106	CONTRACTS AND GRANTS-NONGOVERN	0.00	16,322.00	16,322.00	0.00	16,322.00-
	Total Revenue	0.00	16,322.00	16,322.00	0.00	16,322.00-
50800	OTHER SALARIES	9,200.00	4,205.03	4,205.03	0.00	4,994.97
59000	EMPLOYEE BENEFITS	2,491.00	1,561.21	1,561.21	0.00	929.79
	Total Personal Services	11,691.00	5,766.24	5,766.24	0.00	5,924.76
63700	SHIPPING/FREIGHT	99.00	0.00	20.31	0.00	78.69
64300	UNIVERSITY SERVICES	3,896.00	0.00	0.00	0.00	3,896.00
66300	OTHER SERVICES	0.00	0.00	320.00	0.00	320.00-
	Total Non-Personal Services	3,995.00	0.00	340.31	0.00	3,654.69
	Total Direct Costs	15,686.00	5,766.24	6,106.55	0.00	9,579.45
89900	FACILITIES & ADMIN. COST	4,314.00	1,585.72	1,679.31	0.00	2,634.69
	Total Expenditures	20,000.00	7,351.96	7,785.86	0.00	12,214.14

IF YOU HAVE ANY QUESTIONS, PLEASE CALL 581-5832

University of Utah
Financial Management Report
D E T A I L T R A N S A C T I O N S
For the Period Ending 04/30/2001

Report ID: USGLH006
Run Date: 05/09/2001
Report Pg: 15298

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

OrgID	Date	AU	SRC	Journal ID	Line Reference	Account	Description	Current Month Budget	Current Month Actuals	Current Month Encumbrances
00059	30-APR-2001		ALO	CASH000001		10500		0.00	8,970.04	0.00
					Total	10500	CLAIM ON CASH	0.00	8,970.04	0.00
00059	20-APR-2001		DD	DD20060420	38	40106	312	0.00	16,322.00-	0.00
					Total	40106	CONTRACTS AND GRANTS-NONGOVERN	0.00	16,322.00-	0.00
00059	15-APR-2001		PAY	SE001A0001		50800	P/R ACTUALS	0.00	1,521.58	0.00
00059	30-APR-2001		PAY	SE001A0001		50800	P/R ACTUALS	0.00	2,683.45	0.00
					Total	50800	OTHER SALARIES	0.00	4,205.03	0.00
00059	15-APR-2001		PAY	SE001A0001		59000	P/R ACTUALS	0.00	462.35	0.00
00059	30-APR-2001		PAY	SE001A0001		59000	P/R ACTUALS	0.00	1,098.86	0.00
					Total	59000	EMPLOYEE BENEFITS	0.00	1,561.21	0.00
00059	23-APR-2001		ALO	FAEX042301	FAEXPENSE	89900	FA EXPENSE	0.00	545.58	0.00
00059	30-APR-2001		ALO	FAEX050701	FAEXPENSE	89900	FA EXPENSE	0.00	1,040.14	0.00
					Total	89900	FACILITIES & ADMIN. COST	0.00	1,585.72	0.00

NOTE: ENCUMBRANCE DETAIL WILL INCLUDE FUTURE MONTH TRANSACTIONS UP TO THE DATE THE REPORT IS RUN.

University of [illegible]
Financial Management Report
B A L A N C E S H E E T
For the Period Ending 03/31/2001

Report ID: USGLH006
Run Date: 04/10/2001
Report Pg: 15464

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

Account	Description	Previous Balance	Current Month Changes	Current Balance
10500	CLAIM ON CASH	25.90-	408.00-	433.90-
	Total Assets	25.90-	408.00-	433.90-
30000	Fund Balance	25.90	408.00	433.90
	Total Liabilities & Fund Balance	25.90	408.00	433.90

IF YOU HAVE ANY QUESTIONS, PLEASE CALL 581-5832

University of Utah
Financial Management Report
S U M M A R Y O F R E V E N U E A N D E X P E N S E
For the Period Ending 03/31/2001

Report ID: USGLH006
Run Date: 04/10/2001
Report Pg: 15465

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

Account	Description	Budget	Current Month Inc / Exp	Project to Date Inc / Exp	Current Encumbrance	Balance Available
50800	OTHER SALARIES	9,200.00	0.00	0.00	0.00	9,200.00
59000	EMPLOYEE BENEFITS	2,491.00	0.00	0.00	0.00	2,491.00
	Total Personal Services	11,691.00	0.00	0.00	0.00	11,691.00
63700	SHIPPING/FREIGHT	99.00	0.00	20.31	0.00	78.69
64300	UNIVERSITY SERVICES	3,896.00	0.00	0.00	0.00	3,896.00
66300	OTHER SERVICES	0.00	320.00	320.00	0.00	320.00-
	Total Non-Personal Services	3,995.00	320.00	340.31	0.00	3,654.69
	Total Direct Costs	15,686.00	320.00	340.31	0.00	15,345.69
89900	FACILITIES & ADMIN. COST	4,314.00	88.00	93.59	0.00	4,220.41
	Total Expenditures	20,000.00	408.00	433.90	0.00	19,566.10

IF YOU HAVE ANY QUESTIONS, PLEASE CALL 581-5832

University o. ah
Financial Management Report
D E T A I L T R A N S A C T I O N S
For the Period Ending 03/31/2001

Report ID: USGLH006
Run Date: 04/10/2001
Report Pg: 15466

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

OrgID	Date	AU	SRC	Journal ID	Line Reference	Account	Description	Current Month Budget	Actuals	Encumbrances
00059	31-MAR-2001		ALO	CASH000001		10500		0.00	408.00-	0.00
					Total	10500	CLAIM ON CASH	0.00	408.00-	0.00
00059	20-MAR-2001		CO	C000242808		66300	GEOLOGY & GEOPHYSICS	0.00	320.00	0.00
					Total	66300	OTHER SERVICES	0.00	320.00	0.00
00059	22-MAR-2001		ALO	FAEX032201	FAEXPENSE	89900	FA EXPENSE	0.00	88.00	0.00
					Total	89900	FACILITIES & ADMIN. COST	0.00	88.00	0.00

NOTE: ENCUMBRANCE DETAIL WILL INCLUDE FUTURE MONTH TRANSACTIONS UP TO THE DATE THE REPORT IS RUN.

Subject: Accounting
Date: Tue, 09 Jan 2001 07:38:56 -0700
From: Jeff Hulen <jhulen@egi.utah.edu>
To: will.osborn@calenergy.com, sjlutz@egi.utah.edu

Will --

Here is an accounting to date for the filter cake study. All figures include University of Utah overhead.

Hulen, 8 days @ $500/day = $4,000
Lutz, 19 days @ $350/day = $6,650
Technician, 2 days @ $250/day = $500
Detailed geochemical analyses, 5 samples @ $240/smpl = $1,200
Polished thin sections, 5 @ $60/ea = $300
Microprobe, 8 hr @ $75/hr = $600
XRD, 15 samples (bulk) @ $100/smpl = $1500
SEM, 4 samples @ $375/smpl = $1,500
Miscellaneous costs (shipping, mailing, etc.) = (est) ~$100

TOTAL as of 01/09/01 = $16,500

When I communicated last with you, I hadn't taken into account Sue's time for December (my apologies), so the figure to date is a bit higher than initially stated. Realistically, to complete the study (with no additional samples) according to our work plan (and in the manner you've seen so far), I would estimate we'll need at least double the total shown above. This will cover a detailed report, fully illustrated, that Sue and I will prepare to document in detail all of our findings. Also reference particle sets for all the samples we've examined to date.

University of Utah
Financial Management Report
B A L A N C E S H E E T
For the Period Ending 12/31/2000

Report ID: USGLH006
Run Date: 01/10/200
Report Pg: 15275

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

Account	Description	Previous Balance	Current Month Changes	Current Balance
30000	Fund Balance	0.00	0.00	0.00
	Total Liabilities & Fund Balance	0.00	0.00	0.00

IF YOU HAVE ANY QUESTIONS, PLEASE CALL 581-5832

University of Utah
Financial Management Report
S U M M A R Y O F R E V E N U E A N D E X P E N S E
For the Period Ending 12/31/2000

Report ID: USGLH006
Run Date: 01/10/200
Report Pg: 15276

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

Account	Description	Budget	Current Month Inc / Exp	Project to Date Inc / Exp	Current Encumbrance	Balance Available
50800	OTHER SALARIES	9,200.00	0.00	0.00	0.00	9,200.00
59000	EMPLOYEE BENEFITS	2,491.00	0.00	0.00	0.00	2,491.00
	Total Personal Services	11,691.00	0.00	0.00	0.00	11,691.00
63700	SHIPPING/FREIGHT	99.00	0.00	0.00	0.00	99.00
64300	UNIVERSITY SERVICES	3,896.00	0.00	0.00	0.00	3,896.00
	Total Non-Personal Services	3,995.00	0.00	0.00	0.00	3,995.00
	Total Direct Costs	15,686.00	0.00	0.00	0.00	15,686.00
89900	FACILITIES & ADMIN. COST	4,314.00	0.00	0.00	0.00	4,314.00
	Total Expenditures	20,000.00	0.00	0.00	0.00	20,000.00

IF YOU HAVE ANY QUESTIONS, PLEASE CALL 581-5832

University of Utah
Financial Management Report
D E T A I L T R A N S A C T I O N S
For the Period Ending 12/31/2000

Report ID: USGLH006
Run Date: 01/10/2001
Report Pg: 15277

Project Title: FILTER CAKE CHARACTERIZATION HIGH TEMPERATURE HYDROTHERMAL SYSTEMS IN THE WESTERN UNITED STATES
Fund: 5000 - CONTRACTS AND GRANTS
Project: 50500716
Responsible Person: HULEN,JEFFREY B
Org ID: 00059 - ENERGY & GEOSCIENCE INSTITUTE
Location: 0856003000

Sponsor ID No.: P0123564
LOC No.: NONE
Overhead Rate: 27.5 %
Begin Date: 01-DEC-2000
End Date: 30-JUN-2001
Agency: CALENERGY OPERATING COMPANY

OrgID	Date	AU	SRC	Journal ID	Line Reference	Account	Description	Current Month Budget	Actuals	Encumbrances
00059	20-DEC-2000		RA	0000081420	42179	50800	OTHER SALARIES	9,200.00	0.00	0.00
					Total	50800	OTHER SALARIES	9,200.00	0.00	0.00
00059	20-DEC-2000		RA	0000081420	42179	59000	EMPLOYEE BENEFITS	2,491.00	0.00	0.00
					Total	59000	EMPLOYEE BENEFITS	2,491.00	0.00	0.00
00059	20-DEC-2000		RA	0000081420	42179	63700	SHIPPING/FREIGHT	99.00	0.00	0.00
					Total	63700	SHIPPING/FREIGHT	99.00	0.00	0.00
00059	20-DEC-2000		RA	0000081420	42179	64300	UNIVERSITY SERVICES	3,896.00	0.00	0.00
					Total	64300	UNIVERSITY SERVICES	3,896.00	0.00	0.00
00059	20-DEC-2000		RA	0000081420	42179	89900	FACILITIES & ADMIN. COST	4,314.00	0.00	0.00
					Total	89900	FACILITIES & ADMIN. COST	4,314.00	0.00	0.00

NOTE: ENCUMBRANCE DETAIL WILL INCLUDE FUTURE MONTH TRANSACTIONS UP TO THE DATE THE REPORT IS RUN.

CALENERGY OPERATING CORP.

SHIP TO
7030 Gentry Road
alipatria, CA 92233
United States

Purchase Order

PURCHASE ORDER NO.	REVISION	PAGE
I-23564	0	1

THIS PURCHASE ORDER NUMBER MUST APPEAR ON ALL INVOICES, PACKING LISTS, CARTONS AND CORRESPONDENCE RELATED TO THIS ORDER.

Vendor:
ENERGY & GEOSCIENCE INSTITUTE
423 WAKARA WAY SUITE 341
SALT LAKE CITY, UTAH 84108
Attn: Jeff Haley

BILL TO
CALENERGY OPERATING CORP.
302 S. 36TH STREET, SUITE 400
OMAHA, NE 68131
United States

DATE OF ORDER	BUYER
30-NOV-00	F ROBLES
DATE OF REVISION	BUYER

CUSTOMER ACCT. NO.	VENDOR NO.	PAYMENT TERMS	FREIGHT TERMS	F.O.B.	SHIP VIA
	20532	NET 30		SHIPG PT	

CONFIRM TO / TELEPHONE	REQUESTOR / DELIVER TO
JOSEPH MOORE (801) 585-6931	OSBORN, Mr. WILLIAM L (WILL)

LINE	PART NUMBER / DESCRIPTION	DELIVERY DATE	QUANTITY	UNIT	UNIT PRICE	EXTENSION	TAX
	THIS PURCHASE ORDER IS SUBJECT TO SALES & USE TAX AS FOLLOWS: STATE OF CALIFORNIA: 7 1/4%; IMPERIAL COUNTY: 1/2% ALL INVOICES SHALL INCLUDE PURCHASE ORDER NUMBER TO AID IN THE PROCESSING OF PAYMENTS FAILURE TO INCLUDE THESE NUMBERS WILL RESULT IN THE RETURN OF INVOICE FOR CORRECTION BY CONTRACTOR OR VENDOR WITHOUT COST TO CALENERGY. TO BE USED FOR FILTER CAKE 1E 100 4270 180 9 REQ. OSBORN 54027						
1	DETAILED CHARACTERIZATION OF FAILED REGION 1 FILTER CAKE AND RELATED SOLIDS USING CONVENTIONAL MICROSCOPY XRD, SEM, ELECTRAN MICROPROBE AND OTHER METHODS AS REQUIRED.	20-DEC-00				20,000.00	Y
	o SHIP TO: CALENERGY OPERATING CORP. 7030 GENTRY ROAD CALIPATRIA, CA 92233 United States	20-DEC-00					

Acct. No.
01-00059-5000 -
5050046

Please enter our order subject to terms and conditions on face and back hereof.

Total 20,000.00

AUTHORIZED SIGNATURE

ORIGINAL