CNWRA

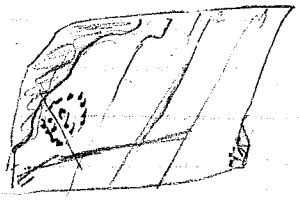
FLUID INCLUSION DATA

PENA BLANCA, CHIHUAHUA, MEXICO

308 --- Q200408300017
Supplemental Material, Technical Activity
Supporting Documentation: Experimental
Data for Fluid Inclusion Data Pena Blanca,
Chihuahua, Mexico (10/15/1992)

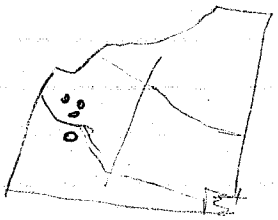
SAMPLE 393 - 7.5/33.8 CALCITE (almost no solid inclusions)

Chip 2



Fracture with f.E., 2-5% V

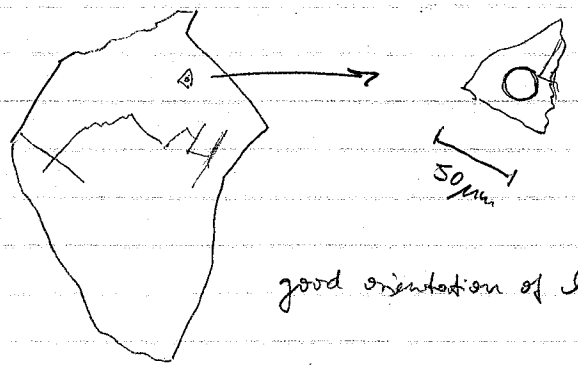
Chip 1



2-5 Vol% 50 μm

2 mm

most f.i. "empty"



good orientation of chips

393-7.5/33.8
CALCITE

FLUID INCLUSION WORKSHEET

Comments: (calcite ?)

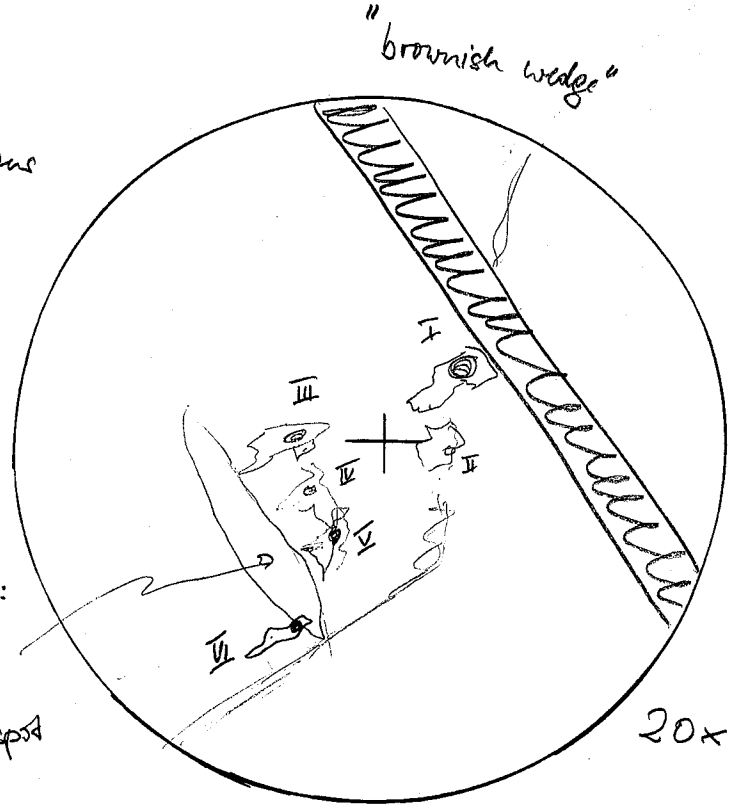
Unfortunately more solid inclusions in GROWTH ZONES than f.i. (there are exploded f.i. with / around precipitated carbonate (?))

checked several clips: it seems to be Cc

? ~ primary fluids (growth zone f.i./solid i.:

CO_2-fluid

secondary: ± no CO_2

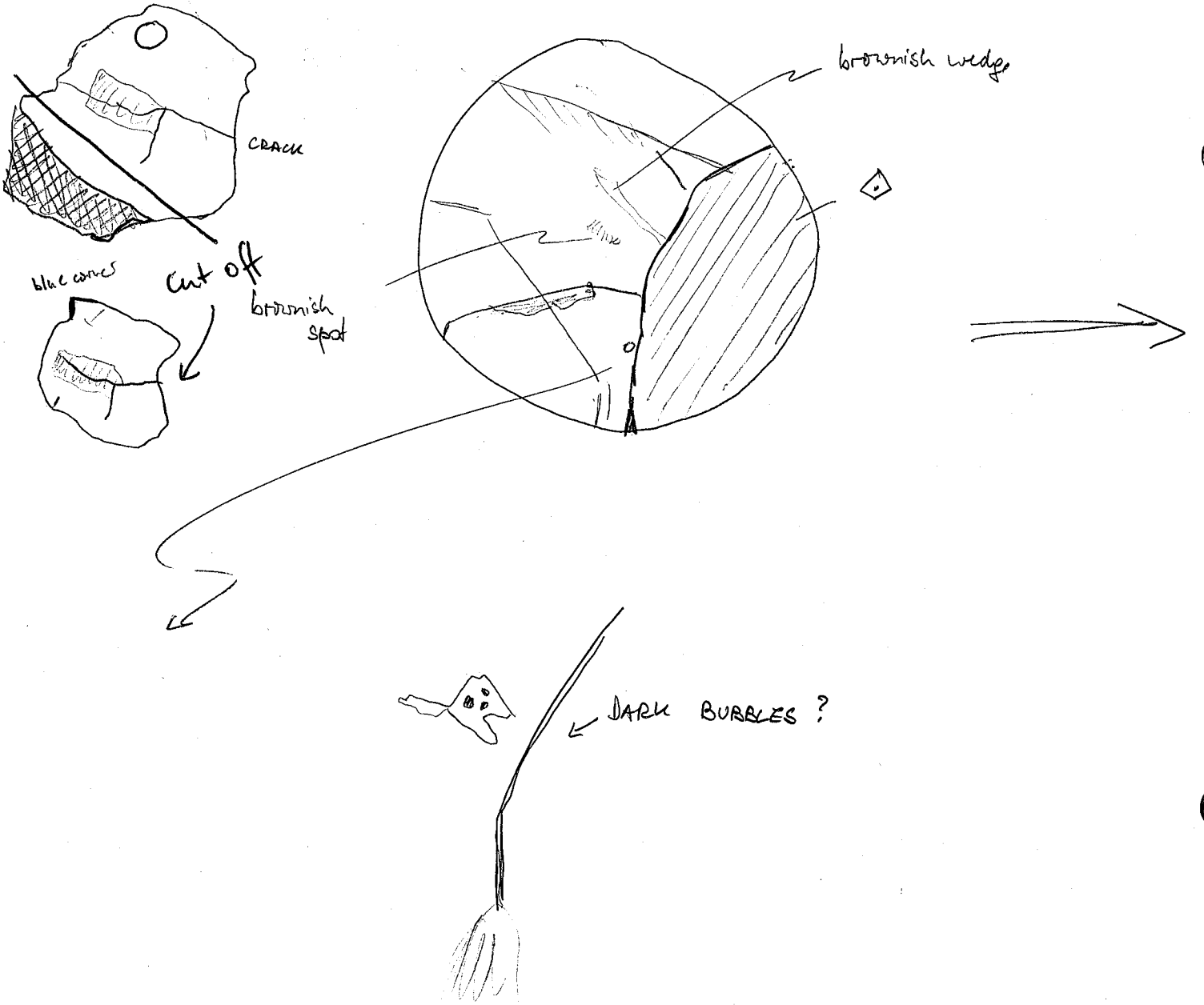


Inclusion No.	Size (LxW)	Type	P/S/PS	L/V ratio	T_i	T_h	T_{fm}	Salinity (wt% NaCl eq)	Remarks
I	50 × 35		S	15	-47	+238L	-0.7		
II	30 × 30		S	5	bubble?	?			
III	75 × 40		S	30*	-46	?	Suspicious, bubble size doesn't change		bubbles stay round or oval; not possible to obtain Tm
IV	75 × 60		S	10*	-46	+295L			
V	120 × 40		S	15*	-46	~+200L	Decrepitated at +206		
VI	65 × 20		S	5-10	-44/-45	+152L	-0.6		

no N_2
no CH_4
no CO_2
no clathrates

Type I - undersaturated, liquid H_2O
Type II - vapor rich (must heat to be sure: T_h --> V)
Type III - saturated H_2O
Type IV - CO_2 bearing

* hard to estimate, f.i. seem to be very flat

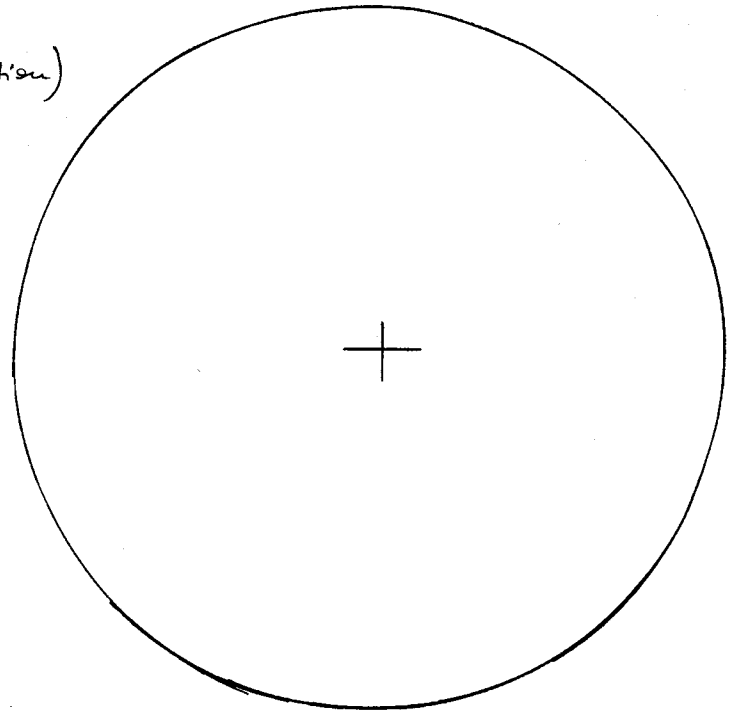

CRACK
blue cones
cut off
brownish spot
brownish wedge
DARK BUBBLES ?

393-7.5/33.8
CALCITE
"large chip"

FLUID INCLUSION WORKSHEET

Comments:

(Areas (3) and (4) without f.i. description)



Inclusion No.	Size (LxW)	Type	P/S/PS	L/V ratio	T_i	T_h	T_{fm}	Salinity (wt% NaCl eq)	Remarks
					1. -47 2. -50	*	?		No N_2 No CH_4
1A	60×25	I	PS	~10		+80 L	?		No CO_2, no clathrates
no observations possible during freezing run 1B	50×50	I	PS	~10		?			bubble (?) doesn't seem to change at all
2	100×25	I	P	10-15	bubble increased while/after freezing				
5A	75×35	I	S	~10	? no bubble	2× +146 → L	-1.5	(bubble reappearance)	no N_2, CH_4, CO_2 no clathrates
5B	65×60	I	S	~10	-4.9 another melting event: -36	?	-0.2		5B: bubble size increased after freezing run
other f.i.			PS-S			+124 L			

Type I - undersaturated, liquid H_2O
Type II - vapor rich (must heat to be sure: T_h --> V)
Type III - saturated H_2O
Type IV - CO_2 bearing

* Strange homogenization behavior: brownish bubble doesn't seem to get smaller but thinner and seems to retreat into a "hole" or deeper part within cavity; elongate speck, disappears at +80°C

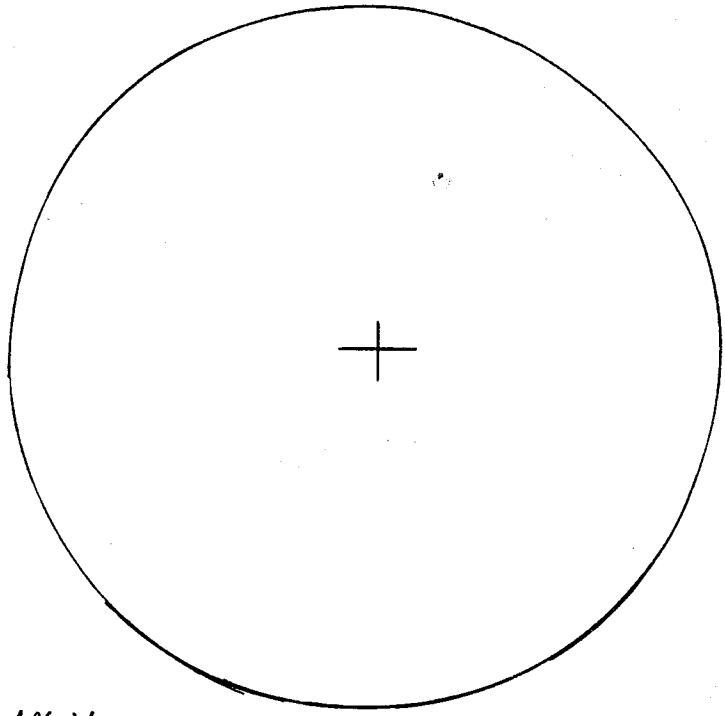
393 - 7.5/33.8
Calcite

→ over →

FLUID INCLUSION WORKSHEET

Comments:

in f. i. ①:
precipitation of solids after freezing run
in f. i. ②:
precipitation of solid during heating



Inclusion No.	Size [μm] (LxW)	Type	P/S/PS	Vol% V ~~L/V ratio~~	T_i	T_h	T_{fm}	Salinity (wt% NaCl eq)	Remarks
①	60 × 35	2-	isolated PS	10-15	?	—	?		no N_2, no CO_2, no indication for clathrates
②	20 × 20	2-	isolated PS	40/10	~-55	—	-0.4		
③	45 × 10	2-	PS	10-15	? + 274 L ?				no changes during freezing

OBSERVATIONS DURING HEATING:

→ ① no change in bubble size; inclusion darkenes at T >>250°C, bubble moved at ~400°C

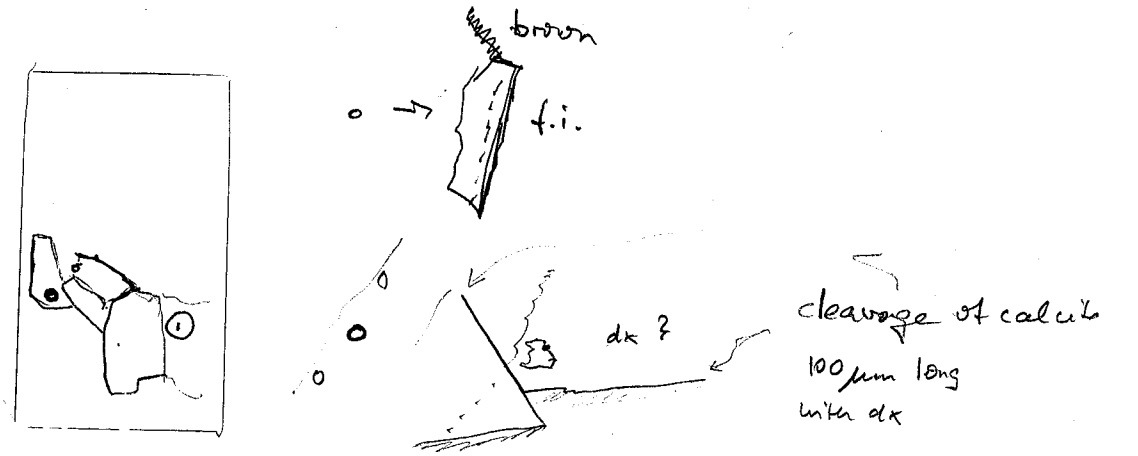
→ ② no change in bubble size till the end of heating run (+415°C)

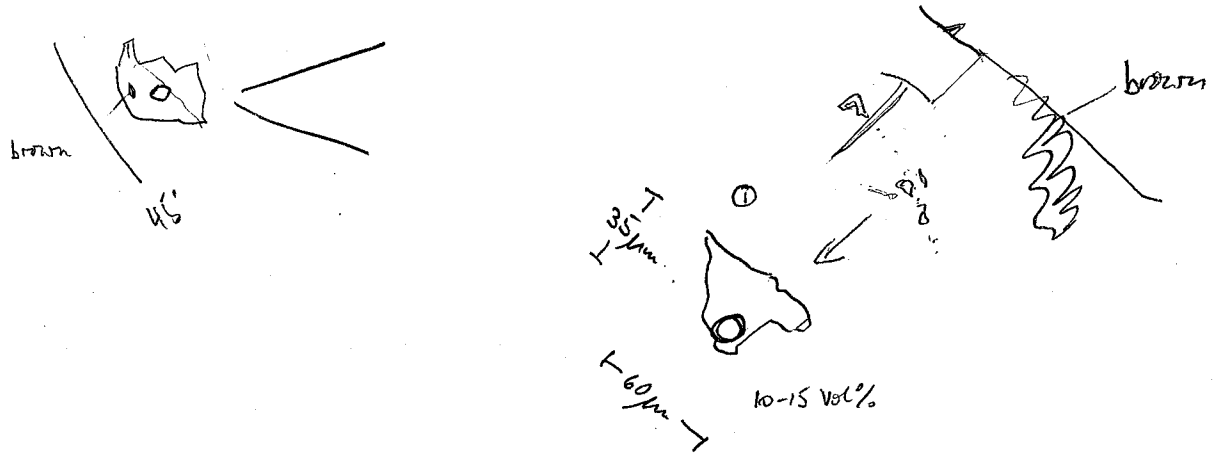
→ ③ bubbles stays dark like a burned solid, triangular shape, but homogenizes; decrepitates later

darkening, decrepitation and leaking made observation difficult → quit at +415°C

Type I - undersaturated, liquid H_2O
Type II - vapor rich (must heat to be sure: T_h --> V)
Type III - saturated H_2O
Type IV - CO_2 bearing

① growth zones in calcite
outlined by dark appearing rims of tiny crystals





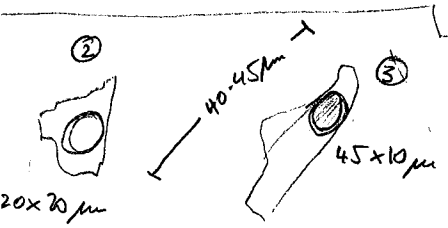
①

no N_2 — no T_H CO_2

no T_m CO_2 — no indication for clathrates

T_i ? — no indication for freezing; T_f ?

no change till +34



no N_2
no CO_2,
no
−0.4 T_f
(not reproducible)

no changes

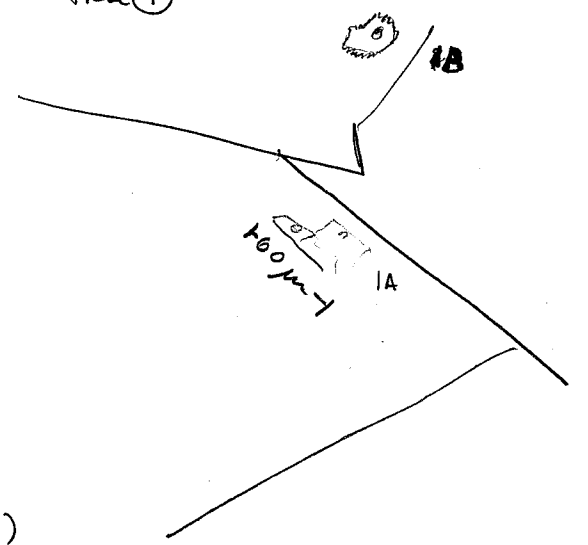
②
bubble expanded after second freezing ring; shrunk back again while solid phases have precipitated within cavity; after that T_f is not reproducible
(Vapor in the beginning 40 vol%, now 10%)

393-7.5/33.8

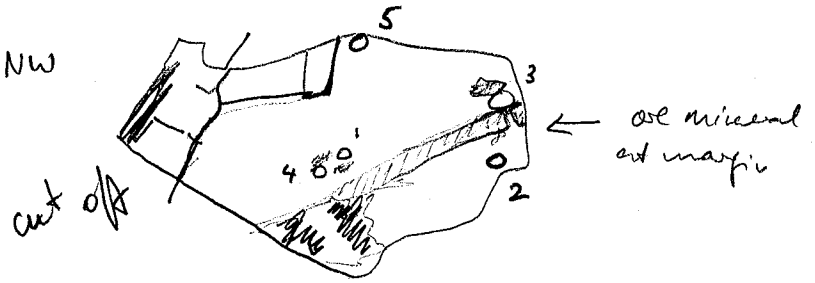
CALCITE

light brown

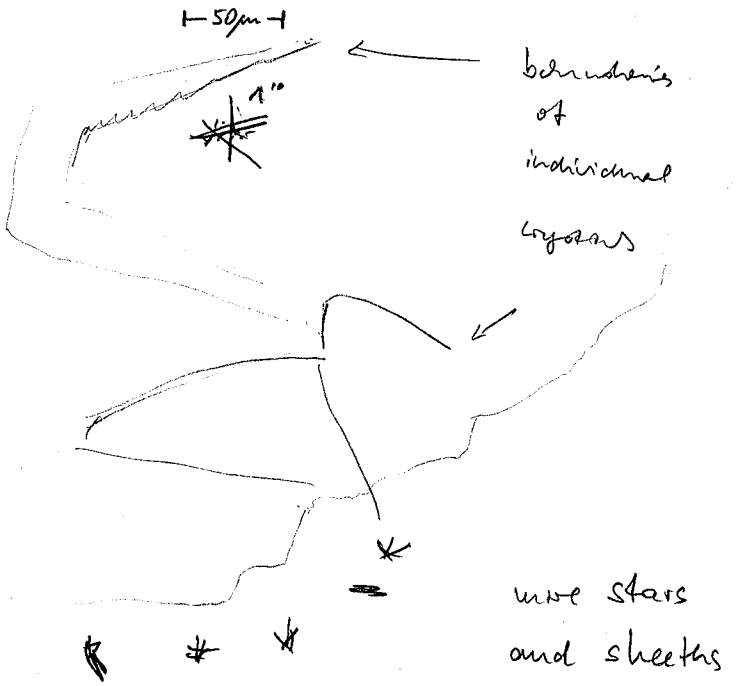
Area 1



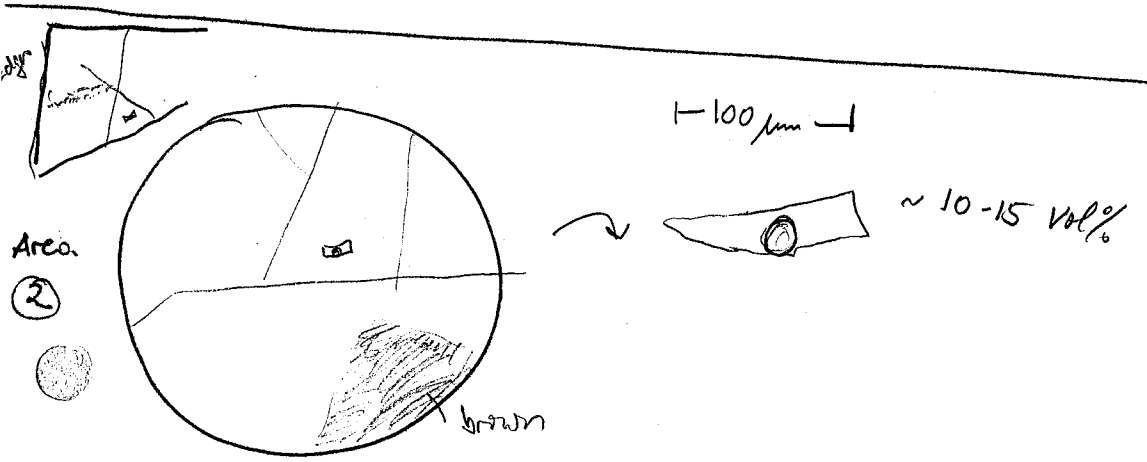
large chip (~1")



Area 1 ○ heap of acicular ore minerals (needle-like) ilmenite? English thinks it might be hematite

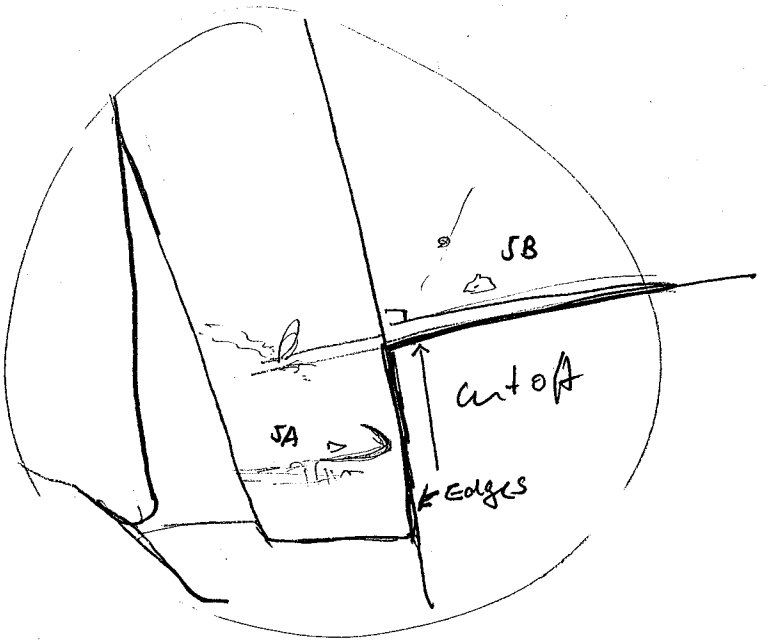


[Chip in NE Position]

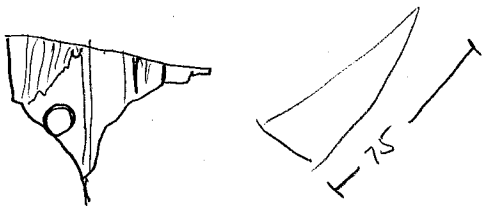


Area 4 ?

Area 5

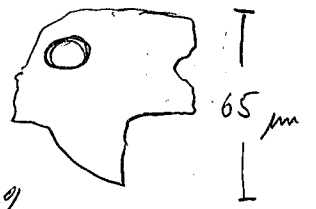


5A



~ 10 Vol%

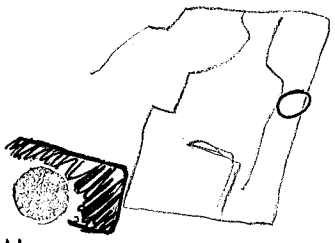
5B



~ 10 Vol-%

60 µm

more f.i. in the neighborhood



CHIP 1 group of f.i.

Measurements made prior to H/F stage calibration!

393-7.5/33.8 fragments of "early" calcite

FLUID INCLUSION WORKSHEET

Heating element

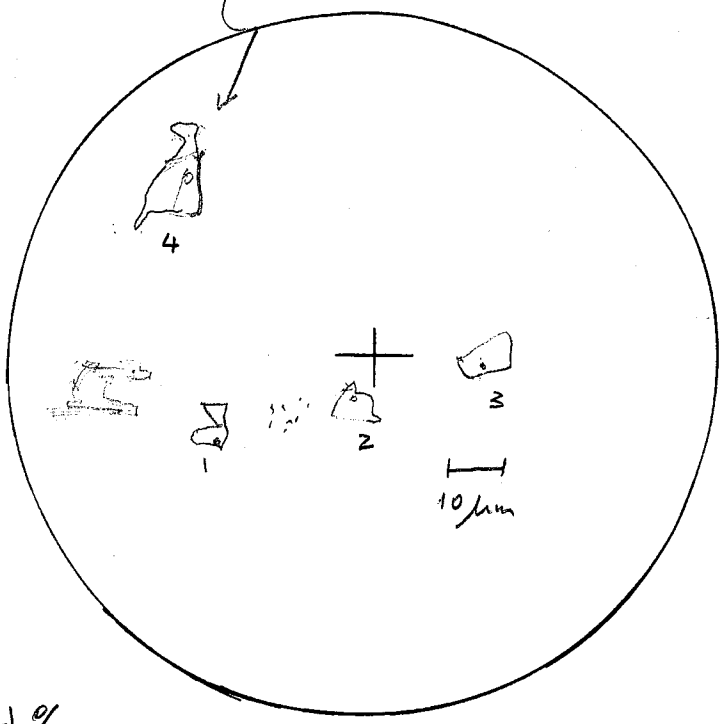
Comments:

Chip 1: on fracture, presum. secondary

all 4 on same fracture

Chip 2: on fracture, almost all 2-

another plane of focus



June 18:

	Inclusion No.	Size (LxW)	Type	P/S/PS	Vol % L/V ratio	T_i	T_h	T_{fm}	Salinity (wt% NaCl eq)	Remarks
CHIP 1	1-3	10x10	I	S	< 1%		~ +45°C → L			after 2 hrs: bubbles have not returned;
	4				< 1%		about the same			heated up a second time to +80°C, no return.
CHIP 2: 1		50x15	I	S	1-2%		+49.6 → L			Again, none of the bubbles returned. (MONDAY, June 21)
2		20x20	I	S	1-2%		~ +46 → L			
3		15x10	I	S	1-2%		~ +46 → L			
4		20x20	I	S	1-2%		~ +46 → L		"T_h → L" ~ +218°C	

no observed phase change during freezing run*.

Type I - undersaturated, liquid H_2O

Type II - vapor rich (must heat to be sure: T_h --> V)

Type III - saturated H_2O

Type IV - CO_2 bearing

in f.i.* 4 and another two

* Bubbles appeared during second freezing run, they shrank upon warming (formation of ice squeezing them?) and expanded at about 1°C below T_f, that was recorded at -0.2°C, 0.0°C, -0.2°C. No clear indication for chaotropic, although bubble showed suspicious deformation at T between -27 and -5°C.

At temp ≥ 250°C typically many cracks appear at f.i.-points. Shapes change. Occasional implosions

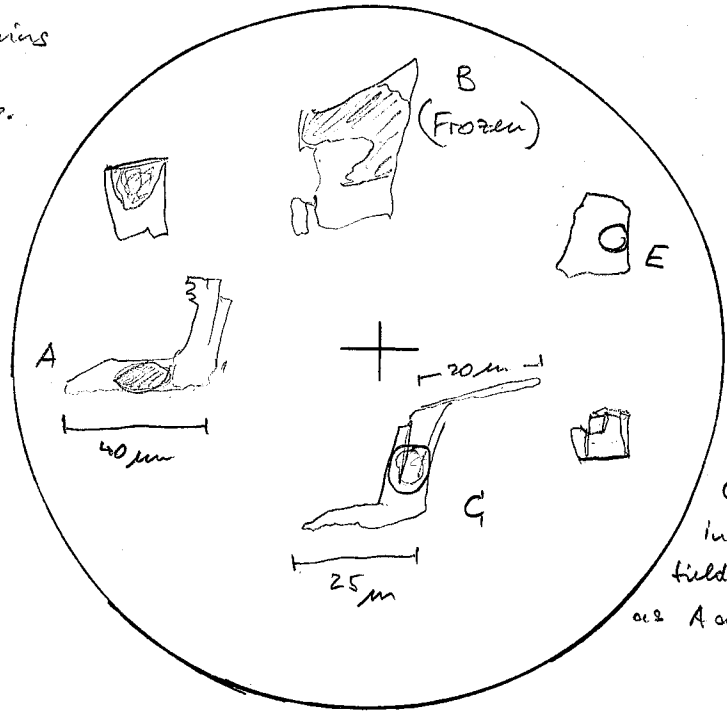
393 - 5.5/32.7
Calcite

over →

FLUID INCLUSION WORKSHEET

Comments:
large (several mm at least) calcite grains stained with iron oxides, not two different kinds or generations of calcite.

Feeling that lots of bubbles appeared AFTER freezing runs.



C not in same field of view as A and B

Inclusion No.	Size (LxW)	Type	P/S/PS	L/V ratio	T_i ↓	~~T_h~~	T_{fm}	Salinity (wt% NaCl eq)	Remarks	T_H
A	40×20		P/PS	20 Vol.%	between			-0.3		
B	60×25		"	? 40 Vol%	-40°C			-0.3		
C	25×25×20		"	25 Vol%	and -36°C			-0.1		between +195° and +200° → L
E	20×10		P/PS	15 Vol.%	no observations made during freezing runs					+165° → L
F	15×15		P/PS	15-20 Vol.%						+185 → L

Type I - undersaturated, liquid H_2O
Type II - vapor rich (must heat to be sure: T_h --> V)
Type III - saturated H_2O
Type IV - CO_2 bearing

* corrected values after checking with Standard #4 and new "zero" setting

Still glue attached,
put it in methylene chloride

* After checking the "zero" setting the next day, I corrected those values by using the temps by +0.3°C.

large 2-phase cavities, surrounded by monophase f.i. with irregular shapes, pointed extended "corners".

→ check for N_2, CO_2

FIRST RUN

inclusion (A) : -42 ice freezing out
-75 dark spots at interface
no N_2
no CO_2-ice melting
ice rims soften ~ -40°C
T_f -0.6°C to -0.4 *
Test for clathrates negative

(B): crystals (?) detached from interface at ~ -30°C,
T_{en} < -30°C ?
at T above -20 hard to see distinct margin of bubble/water (?) interface smoothens
T_f -0.6°C to -0.4°C *
no clathrates (CO_2-H_2O)

SECOND RUN

T_i between -40 and -36°C: bubble shape changes
T_f = -0.6°C * -0.3°C

T_i between -40 and -36°: rims retreat
T_f = -0.6°C * -0.3°C

T_f in two other inclusions ("C" and "D")

(C) T_m -0.4°C * -0.1°C

D T_m ? no changes observed

test for CO_2-H_2O clathrates in C and D: both negative

- gas bubble expanded - all gas now

A and B collapsed after/during the freezing runs, before T above +12°C were obtained.

22.5 / 10.4 - TS 3

Quartz-phenocrysts

→ OVER →

FLUID INCLUSION WORKSHEET

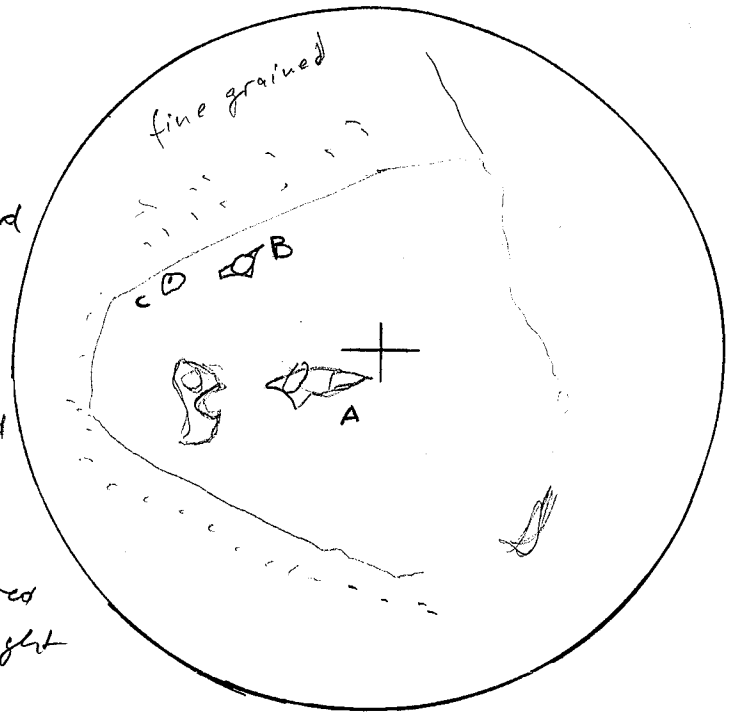
Comments:

A no N_2, CH_4, CO_2
no clathrate

*1 T_i -54°; -40°C ?

could not be verified during 2. and 3rd freezing runs

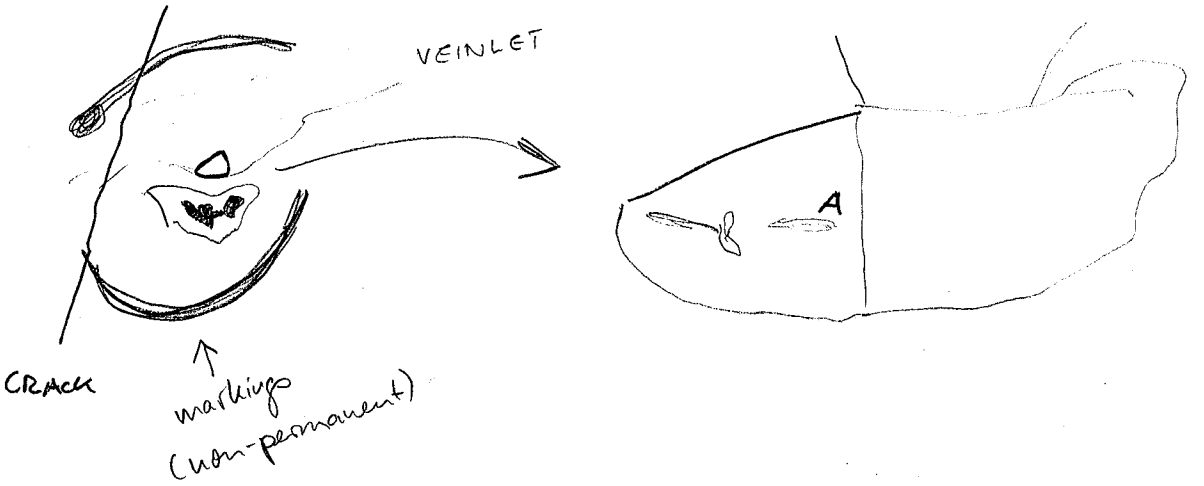
elongate green crystals (no Δn) appear during first run, persist, don't grow upon repeated cooling; crystals seem to get thinner at T > +160°C, heated further to +350. ** change shape, but are still there. Cooled down. No change in appearance compared to +350°C, but different from appearance right after freezing run.



Inclusion No.	Size (LxW)	Type	P/S/PS	~~LV~~ Vol gas ratio	T_i	T_h	T_{fm}	Salinity (wt% NaCl eq)	Remarks
A	25x		PS ?	~40 Vol%	*1				
B	8x8		P?	~60 Vol%	?	no changes			
C	5x5		P?	~3 Vol-%	?	? +100 - +120°C			

Type I - undersaturated, liquid H_2O
Type II - vapor rich (must heat to be sure: T_h --> V)
Type III - saturated H_2O
Type IV - CO_2 bearing

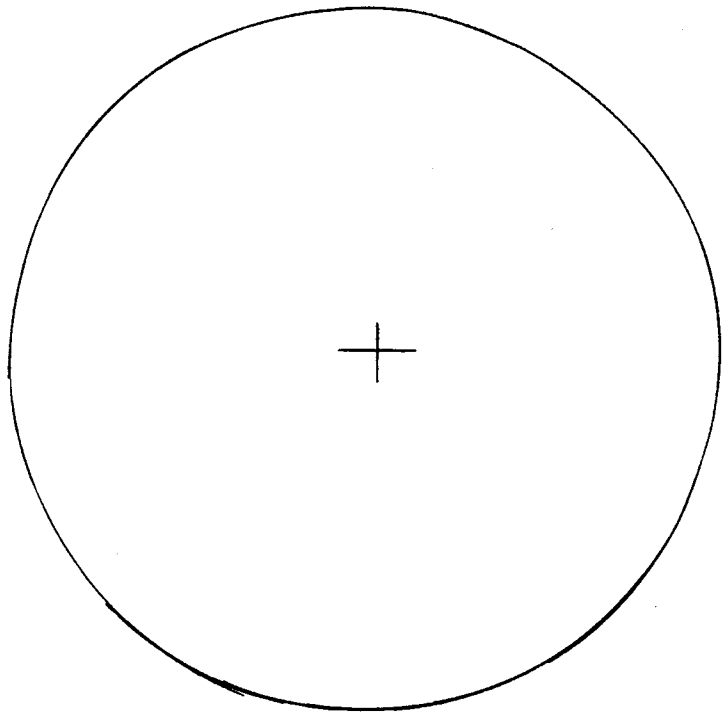
Epoxy starts to swell at T +280°C and gets brown; at +350°C it starts running all over the chip → stopped heating run


VEINLET
A
CRACK
markings
(non-permanent)

22.25 / 17.15 - TS3 "Kaolinized Tu tuff" → over →
Thin section (#21)

FLUID INCLUSION WORKSHEET

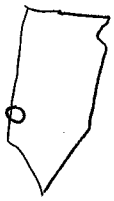
Comments:



Inclusion No.	Size (LxW)	Type	P/S/PS	L/V ratio	T_i	T_h	T_{fm}	Salinity (wt% NaCl eq)	Remarks
	3μm	isolated							

Type I - undersaturated, liquid H_2O
Type II - vapor rich (must heat to be sure: T_h --> V)
Type III - saturated H_2O
Type IV - CO_2 bearing

22.25/17.15 – TS3



"TEST AREA" for inclusions: – solid ? or – fluid ?

heated up to +255°C

at 220° some kind of popping → ? epoxy bubbles
similar to decrepitation

Sample gets brownish at T > +210°C
surface appears wizened → layer of epoxy ?

– tried to watch one f.i. (~3 μm); I did not realize its bubble before cooling down from 1. heating run
during 2. heating run sample became so brown and increasingly opaque that no clear observations could be made. Heated up till +302°C

Guesses: $T_H \to L$ at T > 220°C, bubble does not seem to return but seemed to have reappeared at T < +100°C

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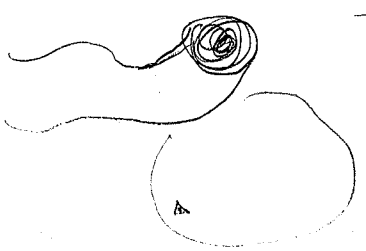
rhombodric crystal

SECOND TEST RUN, other chip.



CYCLING:

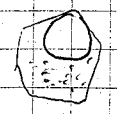
up to +212°C down to +110°C
+250 " " room temp

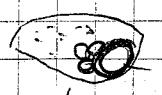
→ all seemed to be solid inclusions

Tertiary Nopal

22.5 / 10.4 - TS 3 Kaolinized Tu tuff with URANYL Silicates

Qz phenocrysts with apatite inclusions containing several melt ? inclusions
M.I.

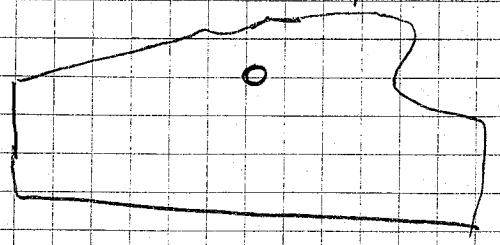




high relief
high An

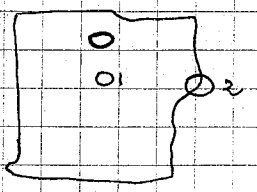
40-50 μm

Qz xx in irregular veinlet, with high An
with potential f.I. // or also M.I. ?



(*21) THIN SECTION: with microcrystalline kao pseudomorph after most phenocrysts
sometimes together with veins / networks / rims of fibrous
looks like symplectitic growth

22.25 / 17.15 - TS 3 Kaolinized Tu tuff



Qz - phenocrysts with melt inclusions
with spherical solids

other Qz - x (smaller) with many 1?-phase (Vapor) f.i., up to 6 μm

triangular "phenocryst" replaced by fine grained quartz

brownish interior cores
with clear rims → larger decrypt. f.i. (space) 5-10 μm

smaller (~2 μm) elliptical f.i. "everywhere" or are these tiny minerals?
probably solids

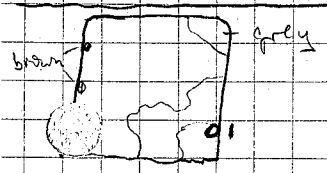
2 phase f.i.

7 μm

mostly at / in clear margins,
occurring together with monophase ? or VVV ?

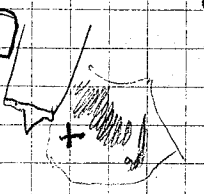
Or clear part with neg to ellipt. f.I 5-10-15 μm, monos
next to a rhombic or cubic phenocryst (Kaolinized feldspar) / probably solid accessory minerals

Or same as above, but close to the rim of the clip / larger solids with assemblages of melt inclusions (3-4 xx)



brown
grey

Or several 2 phase (in margin →
with neg-monos



margin of clip

o more monos, some elongate and not so dark; in worm-shaped aggregate

NOPI-ECP-39-FI

Qtz

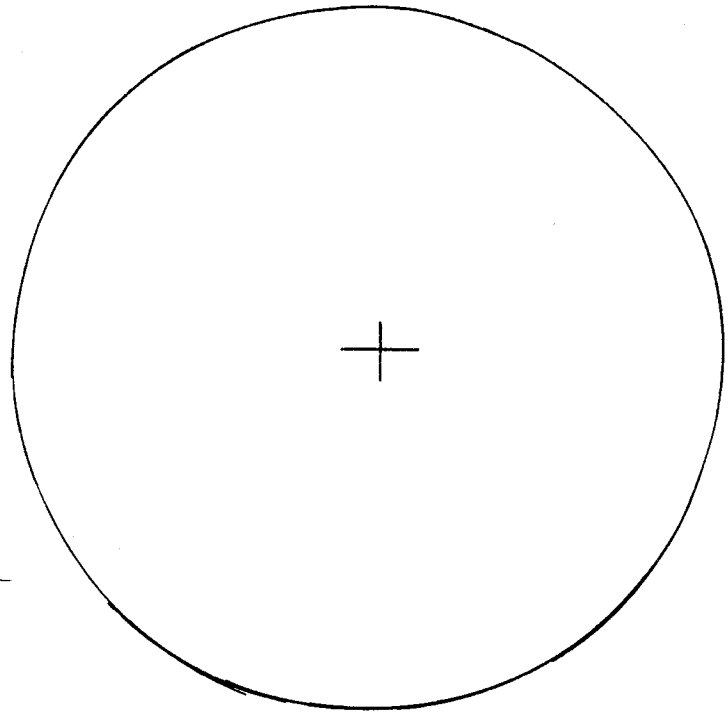
FLUID INCLUSION WORKSHEET

Comments:

(Description on other sheet)

Most of the bubbles collapse and do not return in time (during freezing runs)!

Many f.i. have bubbles after heating!



Inclusion No.	Size (LxW)	Type	P/S/PS	~~L/V~~ ratio vol % Gas	T_i	T_h	T_{fm}	Salinity (wt% NaCl eq)	Remarks
Tu									
— (3)	130 x 25	I	on crack S	10-15 %	-51				(above 0°C, bubble does not return below 0°C)
— (6)		I	S		-53/-52				bubble collapses, doesn't return after 2. run: f.i. is decrepitated
— (2)		Monos?	S	: no N_2, no CO_2, no CH_4					
no change observed (till +250°C) (2)	~~120~~ 40	I	S	80-90% or Mono		between -0.6 and -0.4			No N_2, CH_4, CO_2
+120 L (2)	10-15 µm	I	S	5%					bubbles collapse most of the time, no observations during freezing runs
+133 L after 180 L (2)	120	I	S	25%	at least -51, softer at -57/-56			-1.0	no N_2, CH_4, CO_2
+235 L									

Type I - undersaturated, liquid H_2O
Type II - vapor rich (must heat to be sure: T_h --> V)
Type III - saturated H_2O
Type IV - CO_2 bearing

NOPI-ECP 39 -FI
("the sandwich")

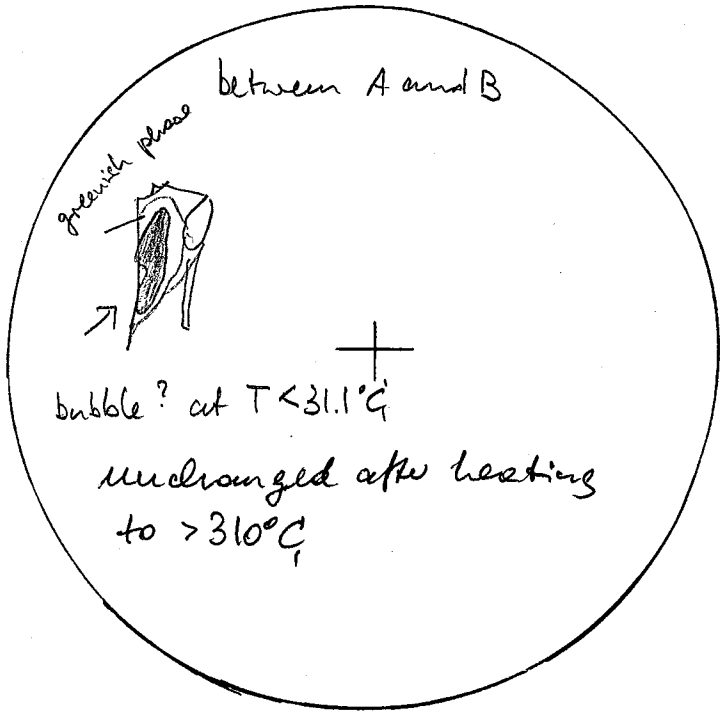
(C wafers should be thicker)

FLUID INCLUSION WORKSHEET

Comments:

All bubbles (A-D) blink out during freezing, at -42°C

no N_2, no CH_4
no CO_2, no clathrates



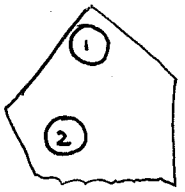
Inclusion No.	Size (LxW)	Type	P/S/PS	L/V ratio	T_i	T_h	T_{fm}	Salinity (wt% NaCl eq)	Remarks
			bubble is round at -2.0 expands appreciably till -1.6					returns at	T_H between +135 and +145 L
A	30 × 25	I	P	5% G	bubble	Still not there after 4 days. doesn't return after freezing only			
B	30 × 18	I	P	5% G	-55		-1.9*		T_H + 310 L
C	30 × 18	I	P	5% G	bubble doesn't return after freezing only, not even after 4 days				
D	30 × 12	I	P	5% G	?		-2.6*		

bubble expanded after heating only

Type I - undersaturated, liquid H_2O
Type II - vapor rich (must heat to be sure: T_h --> V)
Type III - saturated H_2O
Type IV - CO_2 bearing

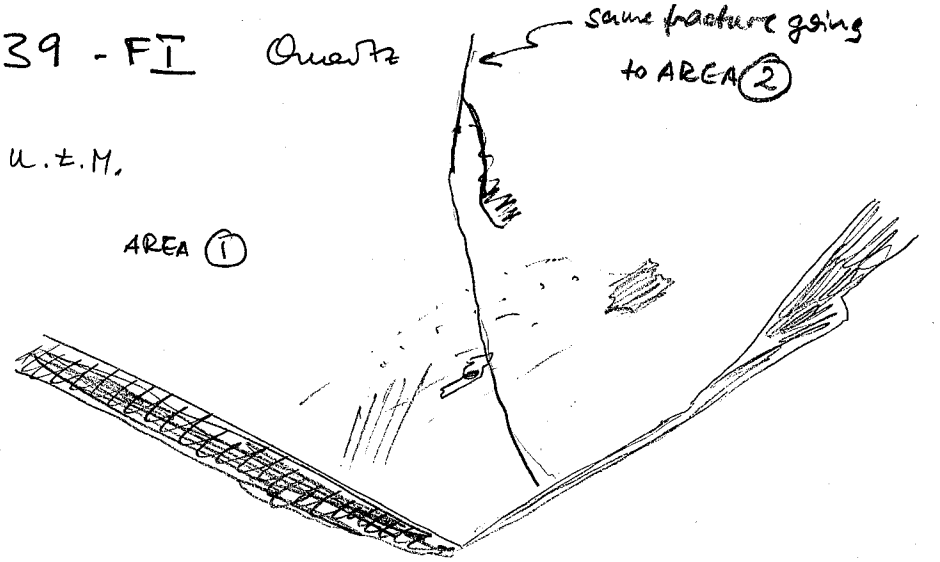
* T_m measured when bubble relaxed, got round again (values are reproducible)

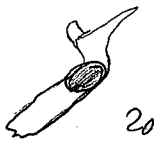
NOPI- ECP - 39 - FI Quartz



ONE CRYSTAL

U.t.M.



1 

20 Vol %

100 - 120 μm

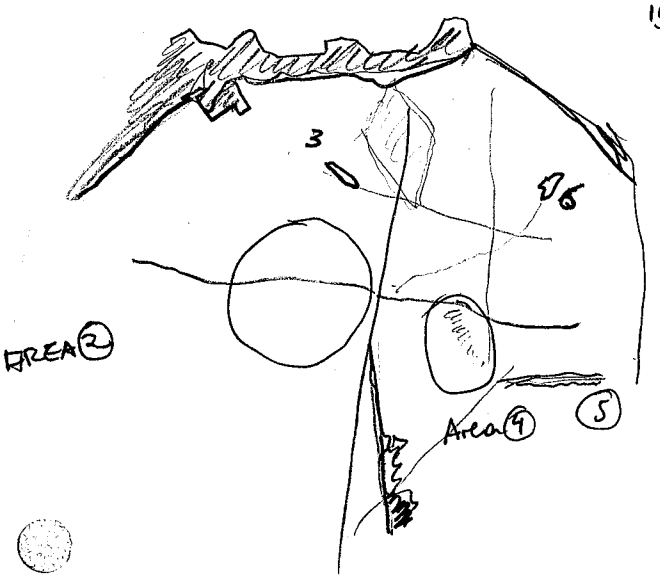
PS

probably decrepitated
would yield too high a T_H
usefull for freezing?

2 Secondary on hairline curved fractures

smaller
10 - 15 μm ; 5 Vol% in most cases

larger
15 - 40 μm ; 20 vol%



3

S
on Crack
10-15 Vol-%
130 μm

(6)

might be necked
S

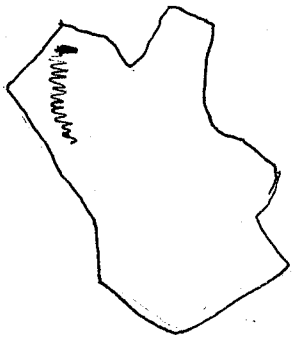
4 more Secondary
5

OVER
Another wafer

Another chip NOPI-ECP-39-FI Quartz

the "sandwich" (thinner thick section)

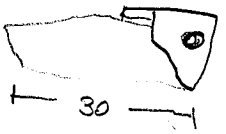
primary growth zone ?



A

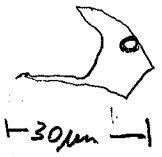
5 Vol %

B



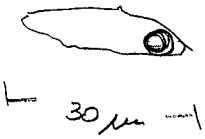
5 Vol %

C



5 Vol %

D



5 Vol %

Note, Oct 18:

A similar sample (NOPI-20-28/1)
"vapor-phase qtz" according to Linda Kovach

English used prepared NOPI-ECP-39 by immersing it for "a couple of days" into oxalic acid.

"Quartz Chips - Peña Blanca"
Similar to
NOPI-EGP-39 FI"

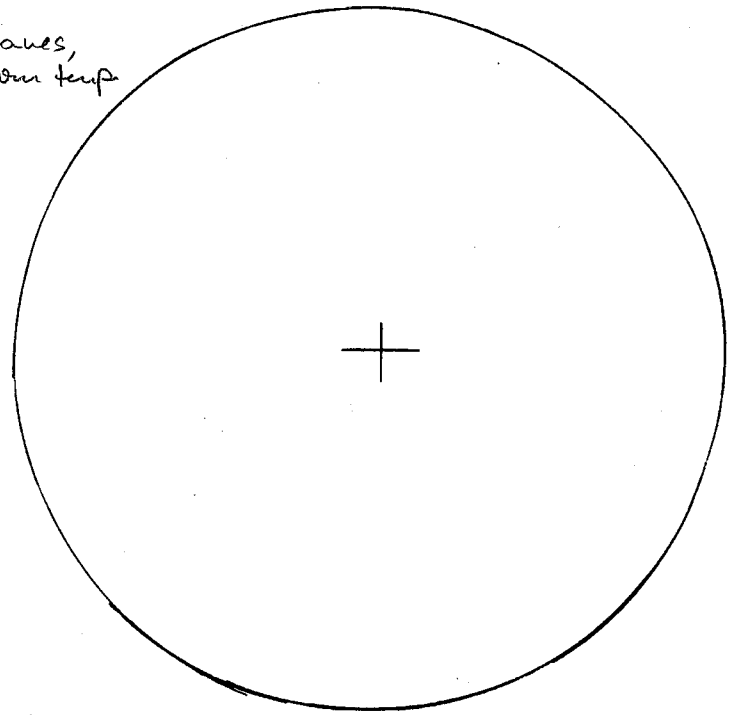
"Qtz-xx from vesicles on the +20m level of Nopal I, Nopal Fm."

FLUID INCLUSION WORKSHEET

Comments:
Most f.i. on irregular and curved planes, and almost all are monophase at room temp

bubbles in large inclusions (in smaller also?) tend to enlarge after freezing runs!

Quartz is turning partially green at T > +210°C, than orange and light brown

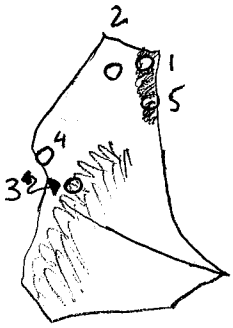


Inclusion No.	Size (LxW) [μm]	Type	P/S/PS	Vol % Gas ~~LV ratio~~	T_i	~~T_h~~	T_{fm}	Salinity (wt% NaCl eq)	T_h	Remarks
5A	35x	2-	PS?	45	-45? -33		-2.6		+273 L (bubble did not return)	No N_2 No CO_2
5B	25x	2-	PS?	15-20	≤ -32?		-2.4		+229 L *	
1	60x	isolated 2-	P?	5-10	-37?		-2.2		+135-140 L	(no clathrates)
2	12x8	mono!	S	N/A	?		-1.6/-1.5 *		—	
—	30x20	cluster 2-	P?	20			-2.0		+185 L	
other fragment	45x40	2-	PS?S	15	no freezing runs done				+167 L	possibly necked

Type I - undersaturated, liquid H_2O
Type II - vapor rich (must heat to be sure: T_h --> V)
Type III - saturated H_2O
Type IV - CO_2 bearing

*no real value, no gas phase present

*a solid seems to have precipitated after first T_h (+231°C), and T_h seems to drop every time (4. run: +229)



1

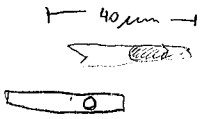
isolated
primary?
5-10 Vol%

2

Cluster of monos
secondary?
intracrystalline

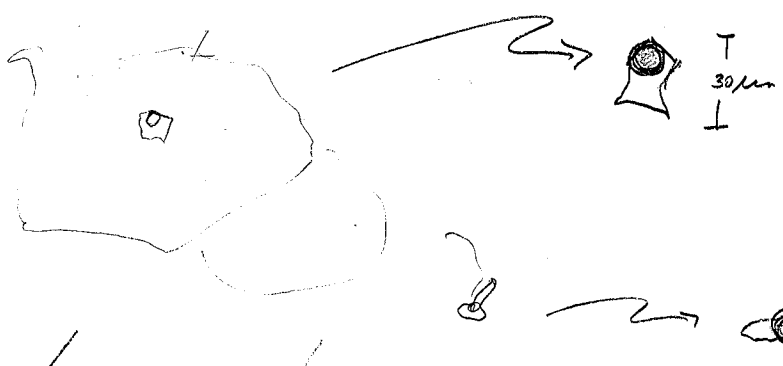
and other larger
irregular monos,
with necks and
off-shoots; also
intracrystalline

3



5-10 Vol %

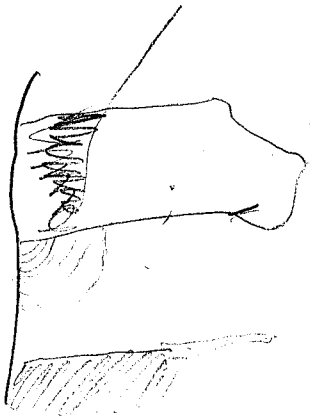
4

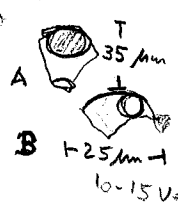


~50 Vol-%

~60 Vol%

5





and more 2-
in the neighborhood with 20-30 Vol %

45 Vol-% (larger one)

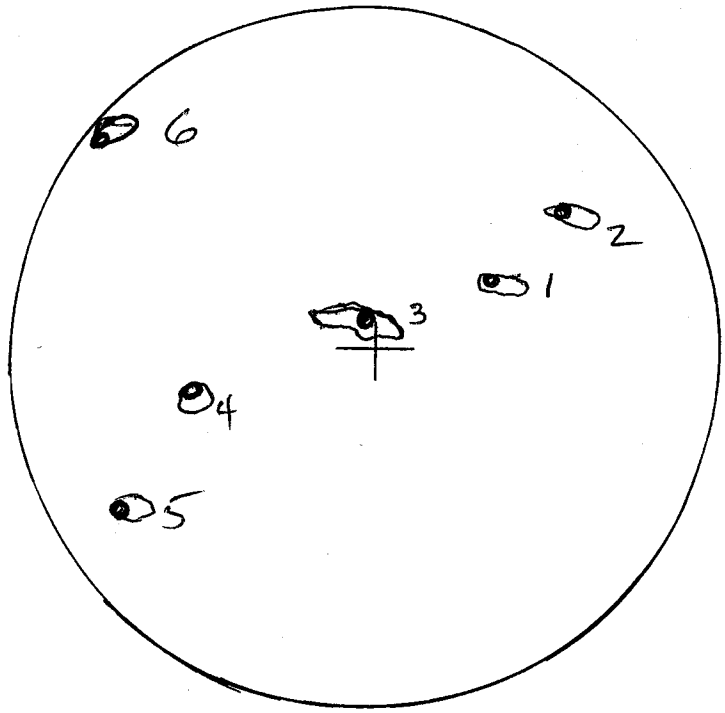
10-15 Vol%

FLUID INCLUSION WORKSHEET

Comments:

NOPI-ECP-39-FI1-A

Inclusion that appear to be along a growth plane. Most are 1 phase but several contain a gas bubble and will be measured.



Inclusion No.	Size (LxW) µm	Type	P/S/PS	L/V ratio	T_i	T_h °C	T_{fm} °C	Salinity (wt% NaCl eq)	Remarks
1	5 x 2	I	P	80/20		163.5	-1.5		
2	5 x 2	I	P	80/20		142.8	-1.4		
3	12 x 4	I	P	70/30		146.2	-1.3		
4	2 x 2	I	P	70/30		215.6	-1.3		
5	3 x 2	I	P	80/20		~~168.6~~			Bubble did not return after heating previous reading.
6	2 x 2	I	P	70/30		168.6	-1.4		

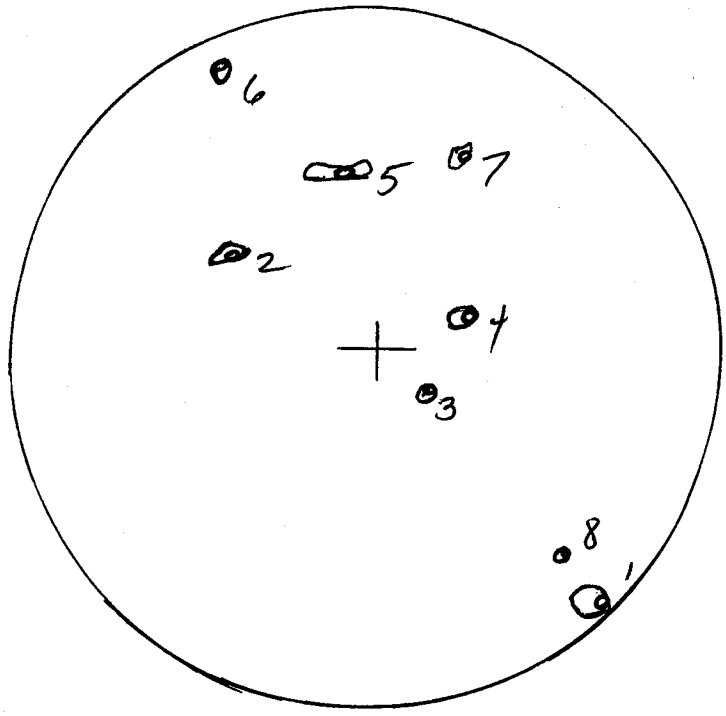
Type I - undersaturated, liquid H_2O
Type II - vapor rich (must heat to be sure: T_h --> V)
Type III - saturated H_2O
Type IV - CO_2 bearing

FLUID INCLUSION WORKSHEET

Comments: 10/15/92

NOPI-ECP-39-FI1-B1

Inclusions along a growth zone or fracture. Only a few have vapor bubbles & these will be measured



Inclusion No.	Size (LxW) µm	Type	P/S/PS	L/V ratio	T_i	T_h °C	T_{fm}	Salinity (wt% NaCl eq)	Remarks
1	4x4	I	?	85/15		134.8			
2	2x2	I		80/20		177.4		1.4	
3	1x1	I		60/40		225.5		1.3	
4	2x2	I		70/30		164.4		1.4	
5	7x1	I		80/20		137.3		1.2	
6	2x1	I		60/40		249.6		1.3	
7	1x1	I		80/20		151.6		1.5	
8	1x1	I		70/30		186.4			

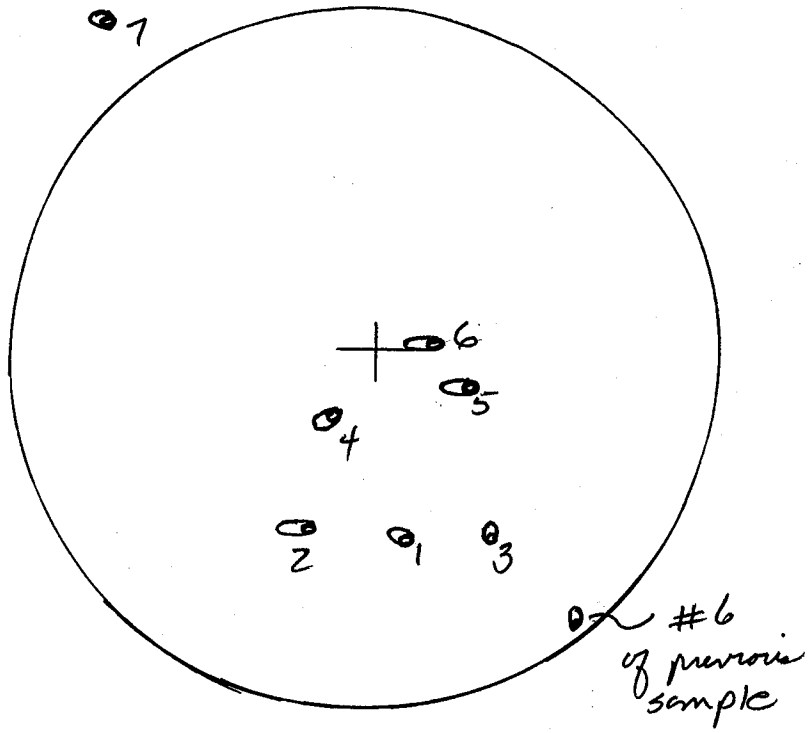
Type I - undersaturated, liquid H_2O
Type II - vapor rich (must heat to be sure: T_h --> V)
Type III - saturated H_2O
Type IV - CO_2 bearing

FLUID INCLUSION WORKSHEET

Comments: 10/15/92

NOPI-ECP-39-FI1-B2

This is another area on chip B - heating of 1st area caused many more bubbles to appear in this area ~~thus~~ but temperatures were ~~not~~ measured only on precisity bubbles.



Inclusion No.	Size (LxW)	Type	P/S/PS	L/V ratio	T_i	T_h °C	T_{fm}	Salinity (wt% NaCl eq)	Remarks
1	2x1	I	?	60/40		246.6			
2	3x1	I		70/30		204.8	1.4		
3	1x1	I		70/30		168.4	1.4		
4	3x1	I		80/20					
5	3x1	I		70/30					
6	3x1	I		70/30		207.4	1.5		
7	1x1	I		60/40		144.3			

Type I - undersaturated, liquid H_2O
Type II - vapor rich (must heat to be sure: T_h --> V)
Type III - saturated H_2O
Type IV - CO_2 bearing