CNWRA

NOPAL 1 PETROGRAPHY

+10 LEVEL

RANDOM SAMPLES

PENA BLANCA, CHIHUAHUA, MEXICO

Supplemental Material, Technical Activity
Supporting Documentation: Experimental Data
for CNWRA Nopal 1 Petrography +10 Level
Random Samples Pena Blanca, Chihuahua,
Mexico (03/03/1993 through 4/26/1993)

pgh

NOPAL I PETROGRAPHY

Sample No. 26.85/11.65-TS1

Description of matrix and alteration: Fine grained quartz & feldspar. Most of the feldspar has been replaced by kaolinite intergrown with uranophane. Cryptocrystalline iron oxide is found throughout the sample

Description of phenocrysts/lithoclasts and alteration: Kaolinite has replaced feldspar phenocrysts. Some euhedral quartz grains. Ilmenite, zircon

Degree of fracturing or brecciation: none slight moderate (extreme)

Description of fracture-filling material: Uranophane fills most of the fractures and voids, appears to have replaced phenocrysts. Coarse grain quartz and amorphouse iron oxide fill some fractures along with the uranophane

Degree of kaolinization: none slight moderate (extreme)

Degree of hematization

Description of mineralization:
Euhedral uranophane and uranophane intergrown with the kaolinite replacing felalspars. Pyrite replaced by hematite & magnitite

Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	65%	euhedral	
Soddyite			
Weeksite/ Boltwoodite			
Others			

Iron oxides Amorphous & Crystalline

Other minerals

pgh

NOPAL I PETROGRAPHY

Sample No. 26.85/11.65 TS2

Description of matrix and alteration: Highly brecciated - matrix of fine grained quartz/feldspar is being replaced by clay and/or uranophane intergr w/ kaolinite. Cryptoxtilline Fe oxide also in matrix

Description of phenocrysts/lithoclasts and alteration: Kaolinite replaced phenocrysts Ilminite, zircon and corroded quartz

Degree of fracturing or brecciation: none slight moderate extreme

Description of fracture-filling material: Kaolinite, kaolinite intergrown w/ uranophane & Fe oxide fill fracture

Degree of kaolinization: none slight moderate extreme

✓ ✓ hematization

Description of mineralization:

all uraninite has been replaced by uranophane

Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	60%	euhedral and intergrown w/ kaolinite	
Soddyite			
Weeksite/ Boltwoodite			
Others			

Iron oxides

Other minerals

PHOTOGRAPHY

Photographer: PS

Type of photography:

Date: 4/23/93

Microscope: Nikon

Camera: Nikon

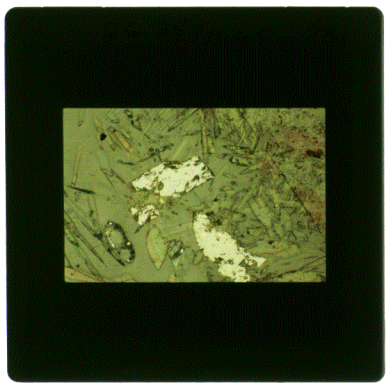
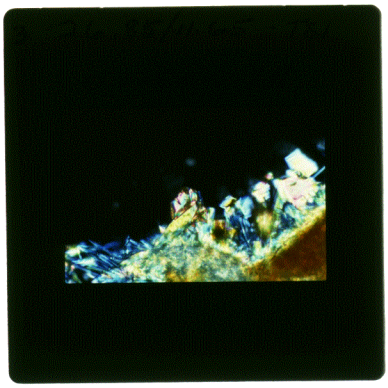
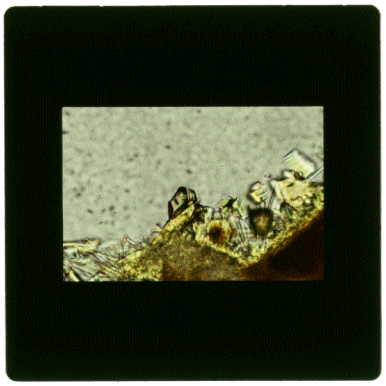
Film: Ektachrom 100

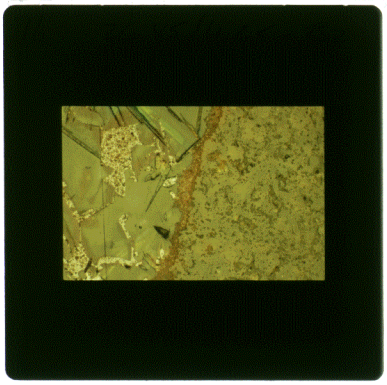
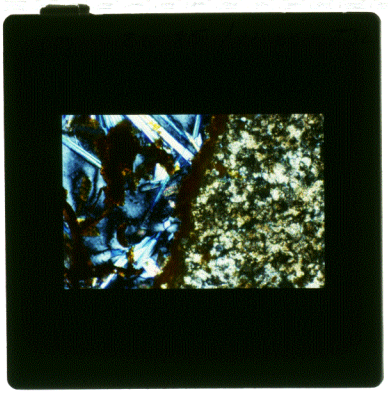
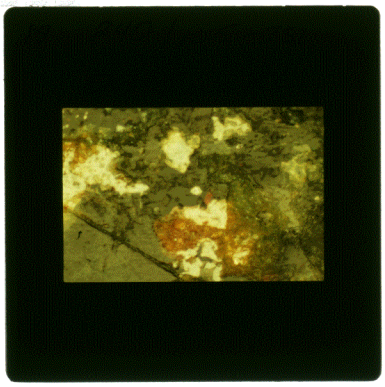
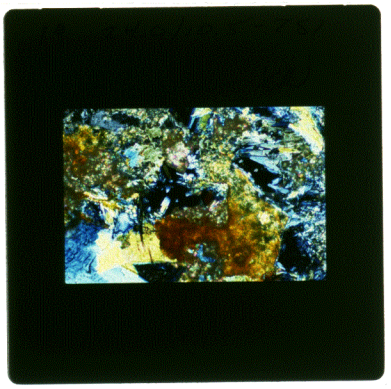
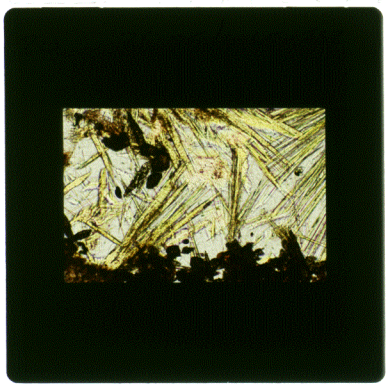
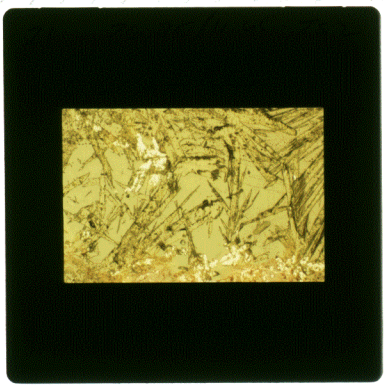
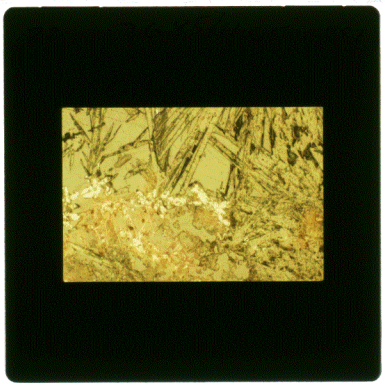
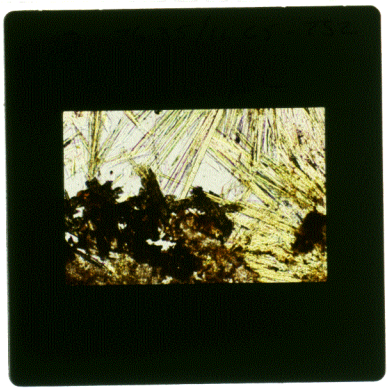
Photo No.	Sample No. and description	Obj.	FOV	Light
1.	Z6.85 /11.65 - TS1 shows xtl faces & birefringence	40x	0.325	XN
2.	Same as #1	40x	0.325	RL
3.	"	40x	"	~~RL~~ XN
4.	"	40x	"	RL
5.	"	40x	"	PL
	Autoradiographic #10			
6.	upper right corner	5x		
7.	" Left side ob fracture top	10x		
8	" Left side bottom	10x		
9	" Right side bottom	20x		
10	" Right side top	10x		
	Autoradiographic #13			
11	upper left corner	5x		
12.	Rt side ob fracture top	10x		
13	" - bottom	10x		
14	left side - top	10x		
15	" - bottom	10x		

PHOTOGRAPHY

Photographer: PSh
Microscope: Nikon
Type of photography: TS
Camera: Nikon
Date: 4/26/93
Film:

Photo No.	Sample No. and description	Obj.	FOV	Light
16	26.85/11.65 - TS2 Shows the difference between Fe oxide and wulfenite	20x	0.65mm	RL
17.	SAME AS 16	20x	0.65mm	XN
18.	24.0/10.5 - TS1 Shows the 2 minerals (Fe oxide & wulfenite) closly associated	40x	0.325mm	RL
		40x	0.325mm	XN
19	SAME as 18			
20	~~26~~ 26.85/11.65 - TS2 Plane light photo of manophane wulfenite & Fe oxide	20x	0.65mm	PL
21	SAME as 20	20x	0.65mm	RL
22.	Another view	20x	0.65mm	RL
23	11	20x	0.65mm	PL
24	11	20x	0.65mm	XN

NOPAL I PETROGRAPHY

Sample No. Z 6.85 / 11.65 - TS3

Description of matrix and alteration: Highly brecciated - matrix being replaced by clay and or kaolinite/uranophane intergrowth. Cryptalline hematite intergrown with booklets of kaolinite are also form.

Description of phenocrysts/lithoclasts and alteration: Same as previous sample

Degree of fracturing or brecciation: none slight moderate (extreme)

Description of fracture-filling material: Filled with Fe oxides, xtlline Hematite and Uranophane
Uranophane & Kaolinite intergrowths act as nucleating points for spherules of uranophane

Degree of kaolinization: none slight moderate ~~extreme~~

Description of mineralization:
Uranophane fills fracture & vugs

Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	~~80~~ 10%		
Soddyite			
Weeksite/ Boltwoodite			
Others			

Iron oxides Cryptalline hematite ≈ ~~30~~ 10%
Fe oxide ≈ ~~20~~ 10%

Other minerals

pgh

NOPAL I PETROGRAPHY

Sample No. 26.85/11.65 - TS 4

Description of matrix and alteration: Same as previous sample Partially oxidized much less brecciation. Iron oxide front in matrix is observed.

Description of phenocrysts/lithoclasts and alteration: Same as previous sample

Degree of fracturing or brecciation: none ~~slight~~ moderate extreme

Description of fracture-filling material: Thin fractures filled with Uranophane

Degree of kaolinization: none slight moderate extreme

Description of mineralization:

Uranophane found ~~mostly~~ @ edges of the TS. Also intergrown with kaolinite in matrix.

Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	10%		
Soddyite			
Weeksite/ Boltwoodite			
Others			

Iron oxides Crystalline Fe and amorphous Fe Oxides

Other minerals

pgl

NOPAL I PETROGRAPHY

Sample No. 2685/11.65 - TS5

Description of matrix and alteration: Matrix of quartz / feldspar is being replaced by kaolinite/uranophane intergrowth and/or clay.

Description of phenocrysts/lithoclasts and alteration: Kaolinite has replaced most phenocrysts, corroded quartz, ilmenite w/ zircon can also be found. Several large Fe oxide phenocrysts (possibly replaced pyrite)

Degree of fracturing or brecciation: none slight moderate (extreme)

Description of fracture-filling material: Fractures filled with β uranophane, the unidentified mineral and Fe oxides

Degree of kaolinization: none slight moderate (extreme)

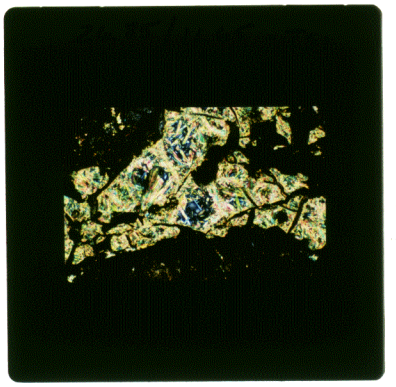
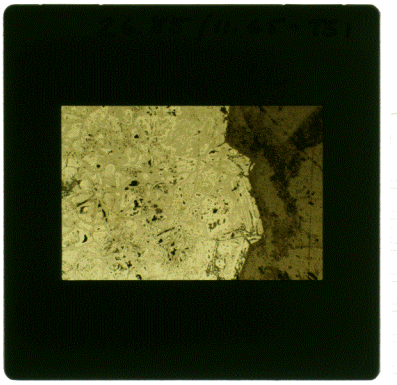
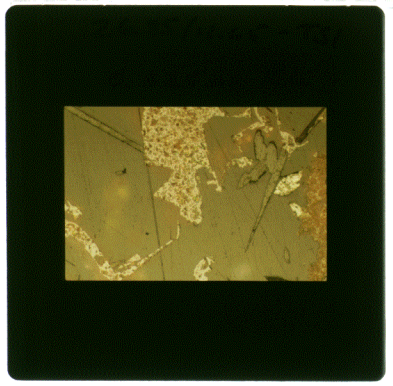
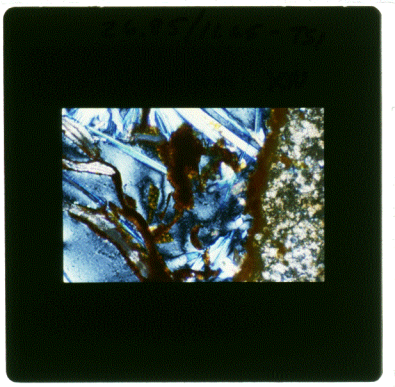
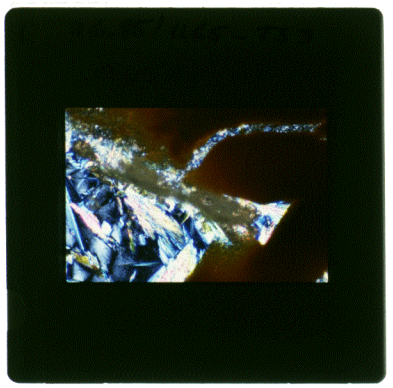
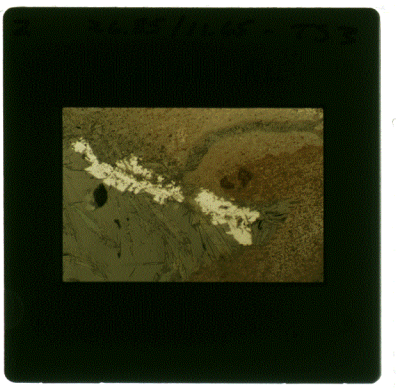
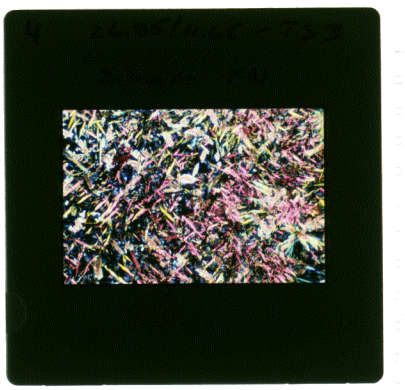
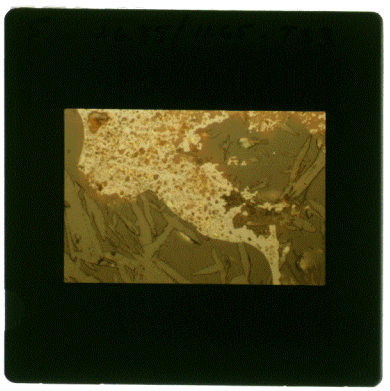
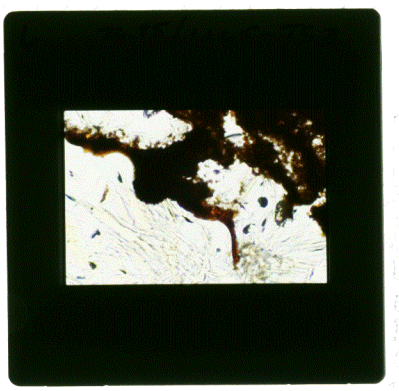
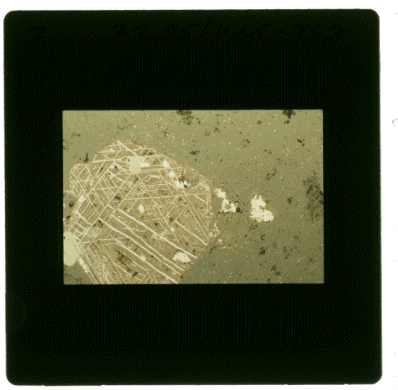
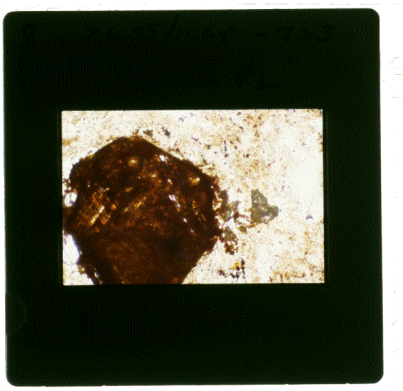
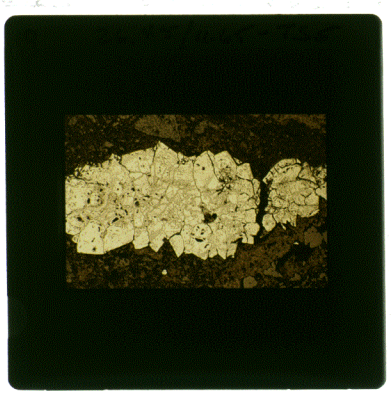
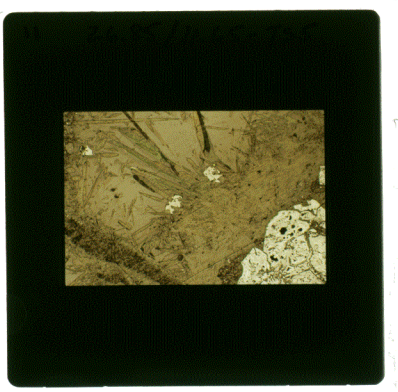
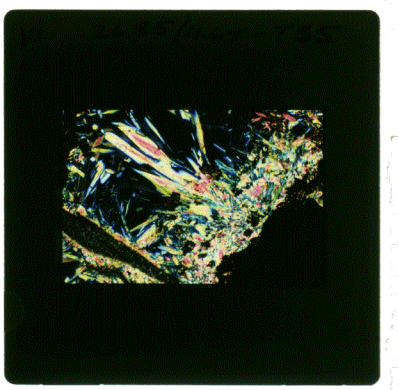
Description of mineralization:

Uranophane is the only uranium mineral

Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	4%		
Soddyite			
Weeksite/ Boltwoodite			
Others			

Iron oxides Cryptalline Fe ≈ 10% amorphous ≈ 15%

Other minerals

PHOTOGRAPHY

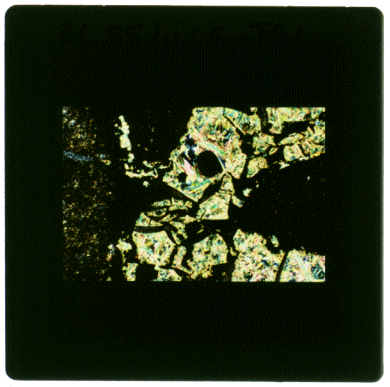
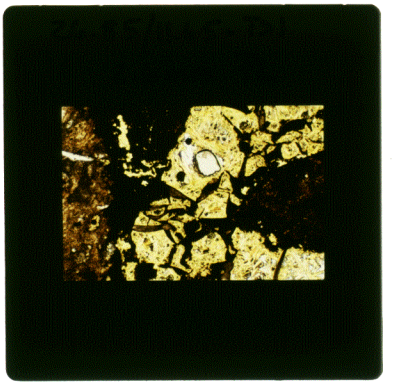
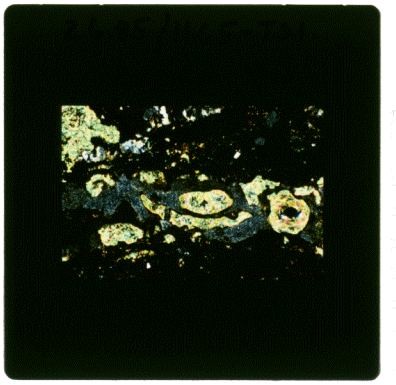
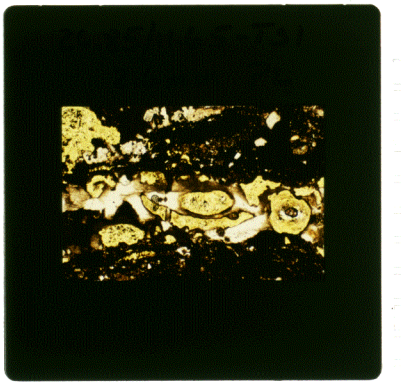
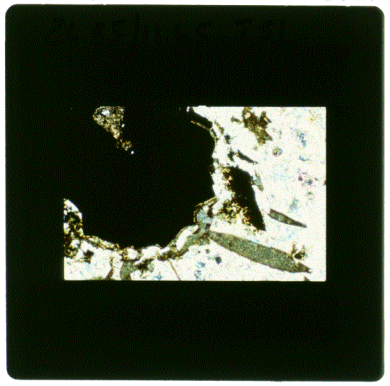
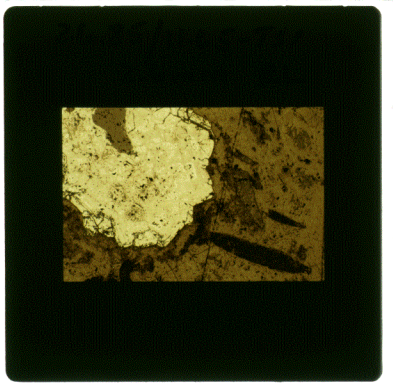
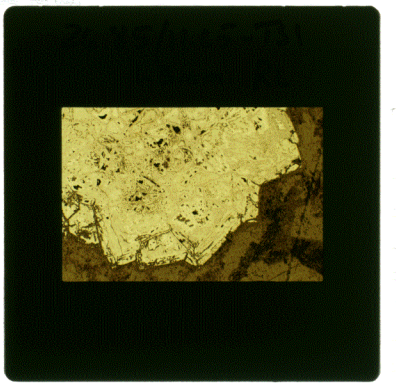
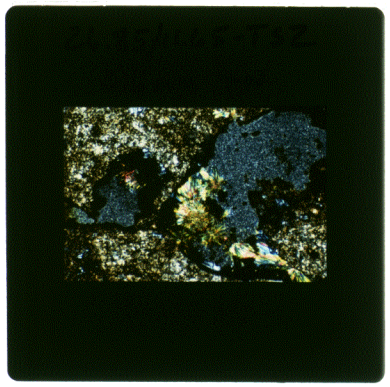
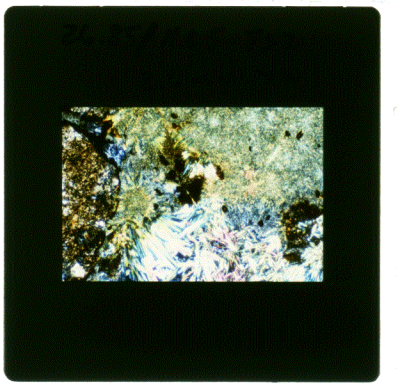
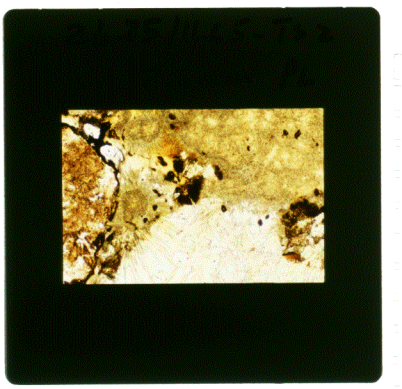
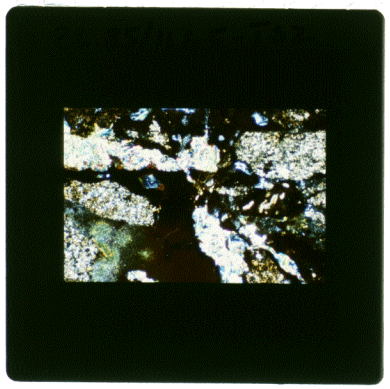
Photographer: PSL
Microscope: Nikon
Type of photography: TS
Camera: Nikon
Date: 2/2/93
Film: Ektachrome 100

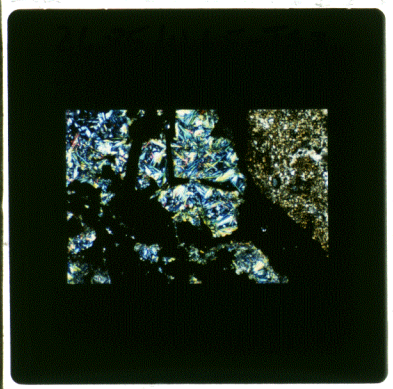
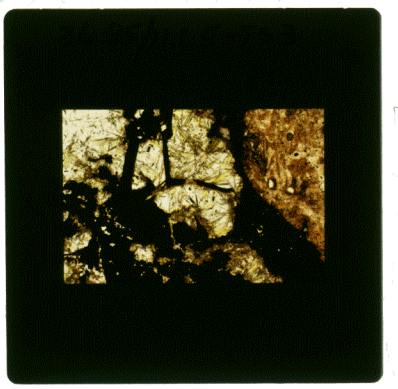
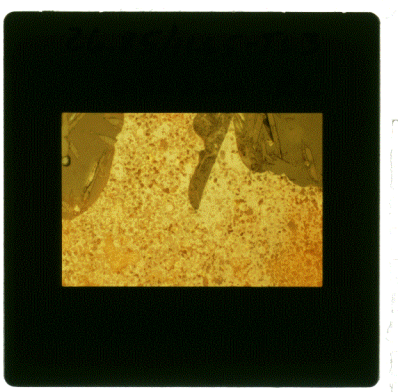
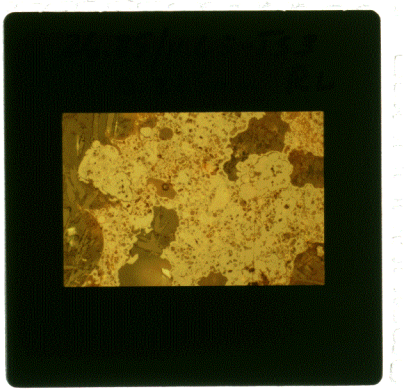
Photo No.	Sample No. and description	Obj.	FOV	Light
	NOPI-ECP-1-TS9			
16.	Fracture lined with uraninite followed by dickite then soddyite	10x	1.3mm	XN
17.	Close up of 16	20x	0.65	RL
	NOPI-ECP-1-TS10			
18.	RL view of cryptocrystalline pyrite and uraninite	40x	0.325	RL
19.	Fracture filled with Fe oxide showing uranophane and soddyite	10x	1.3mm	XN
	2685/11.65-TS1			
20.	Group of uranophane replaced phenocrysts	20x	0.65mm	XN
21.	Uranophane filling fracture	~~10~~ 5x	2.6mm	XN
22.	Large pyrite replaced by hematite ?/or magnetite	10x	1.3mm	RL
23	~~Uraninite~~ Iron Oxide (?) intergrown with kaolinite	40x	0.325mm	RL
24.	Same as 23	20x	0.65mm	XN

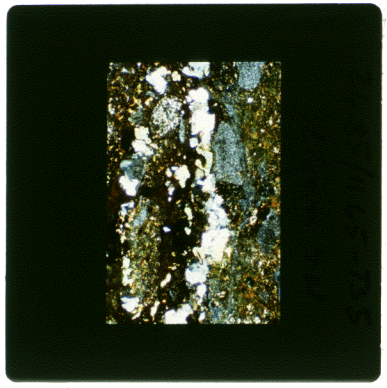
PHOTOGRAPHY

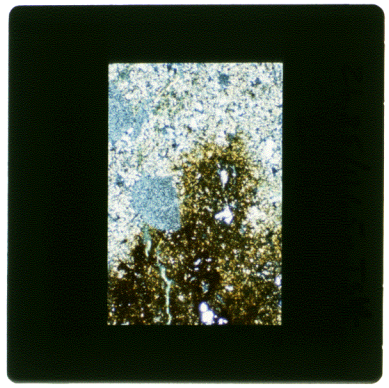
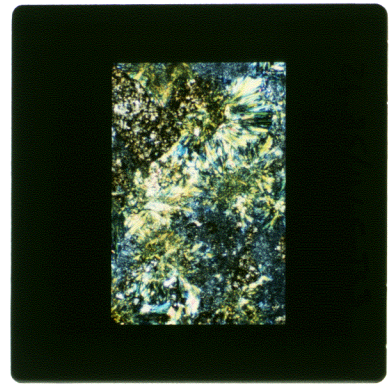
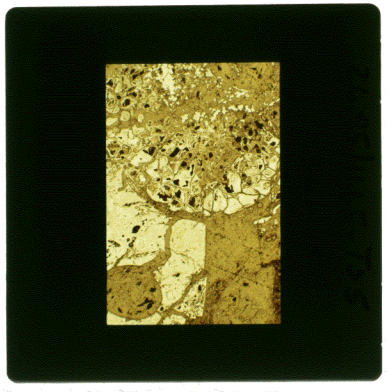
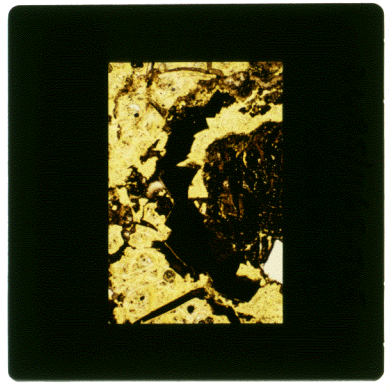
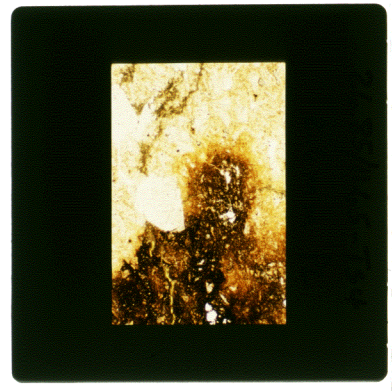
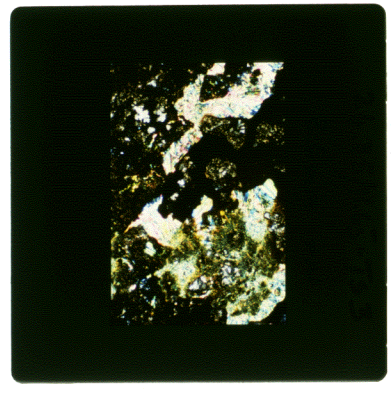
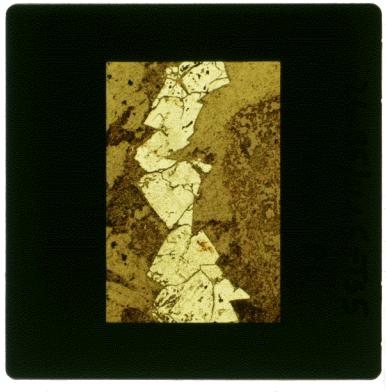
Photographer: pgh
Microscope: Nikon
Type of photography: TS
Camera: Nikon
Date: 2/5/93
Film: Ektachrome 100

Photo No.	Sample No. and description	Obj.	FOV	Light
	26.85/11.65 – TS3			
1.	a highly birefringent mineral possibly monazite	20 x	0.65mm	XN
2.	It is not opaque, but is white in reflected light	20 x		RL
3.	Spherulites of uranophane/kaolinite intergrowths	5 x	2.6mm	XN
4.	Large vug filled with uranophane	5 x	2.6mm	XN
5.	Crystalline hematite intergrown w/kaolinite	40 x	0.325mm	RL
6.	#5 in plane light	20 x	0.65mm	PL
7.	Illminite with ex solution of hematite (?), zircons and unidentified mineral	20x	0.65mm	RL
8.	Same as #7	20x	0.65	PL
	26.85/11.65 – TS5			
9.	Fe replaced pyrite?	5x	2.6mm	RL
10.	Uranophane in fracture	10x	1.3mm	XN
11.	Same as 10	10x	1.3mm	RL



PHOTOGRAPHY

Photographer: Microscope:

Type of photography: Camera:

Date: Film:

Photo No.	Sample No. and description	Obj.	FOV	Light
	17.1/15.2 - TS2			
9	Kaolinite fracture with dissolved pyrites replaced by U-silicate	5X	2.6mm	XN
10	Same as #9 in PL	5X	2.6mm	PL
	16.0/14.4 - TS1			
11	Uraniphane filled fracture cutting through a kaolinite replaced Feldspar phenocryst.	5X	2.6mm	XN
12	Close up of #11 showing acicular U-silicate in fracture.	10X	2.6mm	XN
	26.85/11.65 - TS1			
13	Brecciated oxidized ore - uraniphane filling fracture. Iron oxide rich breccia.	5X	2.6mm	XN
14	Same as #13	5X	2.6 mm	PL
15	Fracture in iron oxide rich ore cutting kaolinite followed by late uraniphane.	5X	2.6mm	XN
16	Same as #15	5X	2.6mm	PL

PHOTOGRAPHY

Photographer: Microscope:

Type of photography: Camera:

Date: Film:

Photo No.	Sample No. and description	Obj.	FOV	Light
	26.85/11.65-TS1			
17	Fracture with mesophase, kaolinite, and oxidized clump of pyrite	5x	2.6mm	+N
18	Same as #17 showing iron oxides replacing pyrite clump	5x	2.6mm	RL
19	Clump of #18 showing pyrite replacement by hematite + goethite.	10x	1.3mm	RL
	26.85/11.65-TS2			
20	Brecciated oxidized ore - fracture with kaolinite + iron oxides produced by pyrite oxidation + mesophase	5x	2.6mm	+N
21	Fracture with intergrown clay/ mesophase + coarse mesophase oxidized pyrite.	5x	2.6mm	+N
22	Same as #21	5x	2.6mm	PL
23	Breccia with iron oxides migrating into kaolinite in fracture. Mesophase	5x	2.6mm	+N
24	Same as #23	5x	2.6mm	PL

PHOTOGRAPHY

Photographer: JP

Type of photography: TS

Date: 3/4/93

Microscope: Nikon

Camera: Nikon

Film: Ektachrome 100

Photo No.	Sample No. and description	Obj.	FOV	Light
	26.85/11.65 - TS3			
1	Brecciated oxidized ore - iron oxides ~~[illegible]~~ intergrown Kaolinite in fracture. Unmophase	5x	2.6mm	XN
2	Same as #1	5x	2.6mm	PL
3	Closeup of crystalline iron oxides ~~[illegible]~~ intergrown Kaolinite in fracture	40x	0.325mm	RL
4	Closeup of crystalline iron oxides intergrown with kaolinite in fracture.	40x	0.325mm	RL
5	Brecciated ore - Unmophase and Kaolinite in fractures	5x	2.6mm	XN
6	Brecciated ore with iron oxides intergrown with kaolinite + unmophase.	5x	2.6mm	XN
	26.85/11.65 - TS4			
7	Iron oxide front moving through matrix of tuff	5x	2.6mm	XN
8	Same as #7	5x	2.6mm	PL

PHOTOGRAPHY

Photographer: Microscope:

Type of photography: Camera:

Date: Film:

Photo No.	Sample No. and description	Obj.	FOV	Light
	26.85/11.65-TS5			
9	Fracture in highly brecciated ore with kaolinite-morphe-iron oxide + iron oxides replacing pyrite.	5X	2.6mm	XN
10	Same as #9	5X	2.6mm	PL
11	Closer look at iron oxides replacing pyrite	10X	1.3mm	RL
12	Large fracture with morphine + iron oxide replacing pyrite	5X	2.6mm	XN
13	Closer look showing iron oxide.	10X	1.3mm	RL
14	Vein that contains late quartz along with iron oxide + morphine	5X	2.6mm	XN
	24.0/10.5-TS1			
15	Fracture in oxidized ore cutting both α + β morphine	5X	2.6mm	XN
16	Same as #15	5X	2.6mm	PL

pgh

NOPAL I PETROGRAPHY

Sample No. 26.75/11.25 - TS1

Description of matrix and alteration: Quartz & feldspar are in the matrix and is replaced by clays. Cryptocrystalline Fe oxide is found in matrix also

Description of phenocrysts/lithoclasts and alteration: Kaolinite has replaced most phenocrysts. Corroded quartz, ilmenite, zircon

Degree of fracturing or brecciation: ~~none~~ slight moderate extreme

Description of fracture-filling material: Only a few fractures which are very small. Uranophane is in a few of them.

Degree of kaolinization: none slight ~~moderate~~ ~~extreme~~

Description of mineralization:

Uranophane is the on U mineral and it comprises < 1% of the slide

Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	< 1%		
Soddyite			
Weeksite/ Boltwoodite			
Others			

Iron oxides

Other minerals

pf

NOPAL I PETROGRAPHY

Sample No. 26.75/11.25-TS2

Description of matrix and alteration: Quartz/feldspar matrix being replaced by clays. Fe is also found in matrix, Both cryptocrystalline and amorphous

Description of phenocrysts/lithoclasts and alteration: Kaolinite has replaced most feldspar phenocrysts - Corroded quartz, zircon & zircon are also found.

Degree of fracturing or brecciation: none slight ~~moderate~~ extreme

Description of fracture-filling material: Fractures filled with Fe oxide and uranophane

Degree of kaolinization: none slight moderate extreme

Degree of hematization 0

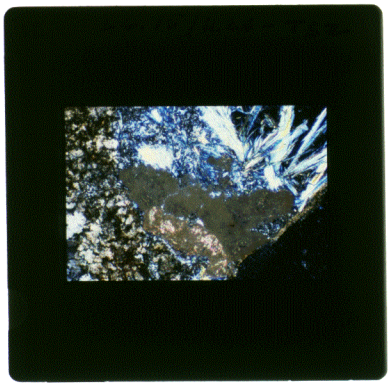
Description of mineralization:

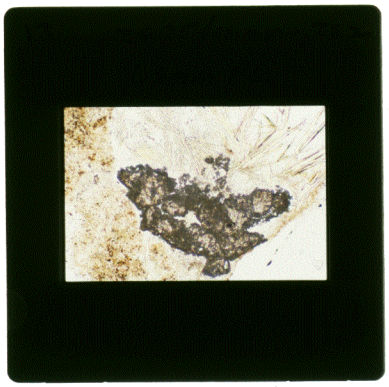
Uranophane found filling fracture and vugs

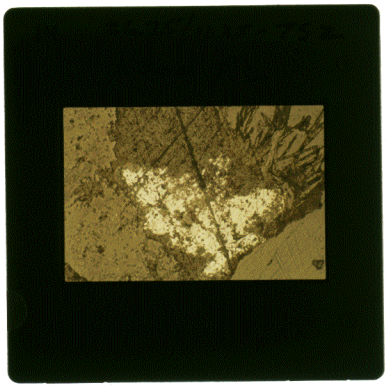
Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	<2%		
Soddyite			
Weeksite/ Boltwoodite			
Others			

Iron oxides Crystalline & Amorphous

Other minerals







PHOTOGRAPHY

Photographer: Microscope:

Type of photography: Camera:

Date: Film:

Photo No.	Sample No. and description	Obj.	FOV	Light
	26.75/11.25 - TS2			
12.	Sphene like mineral associated with uranophane	10x	1.3mm	XN
13.	Same as #12	10x	1.3mm	PL
14	Same as #12	10x	1.3mm	RL
15.	Both α & β Uranophane filling vug 24.0/10.5 - TS1	10x	1.3mm	XN
16.	Shows uranophane replacing silicified matrix	10x	1.3mm	XN
17.	Same as 16- adjusted light 24.0/10.5 - TS2	10x	1.3mm	XN
18.	Uranophane replaced phenocryst 22.2/9.5 TS2	10x	1.3mm	XN
19.	Uranophane / kaolinite intergrowth in matrix	10x	1.3	XN

pgf

NOPAL I PETROGRAPHY

Sample No. 240/10.5 - TS1

Description of matrix and alteration: Silicified matrix - coarse grained quartz in some areas, but mostly chert. Uranophane filling vugs & filling fractures. Kaolinite/uranophane intergrowth in some areas. A little cryptocrystalline Fe oxide

Description of phenocrysts/lithoclasts and alteration:
phenocrysts have all been replaced by kaolinite, chert or uranophane. Ilmenite, zircon & corroded quartz is present.

Degree of fracturing or brecciation: none slight moderate (extreme)

Description of fracture-filling material: Fe oxides, kaolinite/uranophane, uranophane (β & α) are the main fracture filling materials

Degree of kaolinization: none slight moderate (extreme)

Description of mineralization:

Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	20%		
Soddyite			
Weeksite/ Boltwoodite			
Others			

Iron oxides Crystalline & amorphous

Other minerals

pf

NOPAL I PETROGRAPHY

Sample No. 24.0/10.5 - TS2

Description of matrix and alteration: fine to very fine quartz being replaced by kaolinite and uranophane. Cryptocrystalline iron oxide throughout sample. Coarse grained quartz fills some vugs

Description of phenocrysts/lithoclasts and alteration:
Kaolinite has replaced ~~almost~~ all feldspar phenocrysts. Uranophane replaced iron oxide.

Degree of fracturing or brecciation: none slight (moderate) extreme

Description of fracture-filling material: Uranophane kaolinite intergrowth fills most of the fracture with several areas filled with euhedral α uranophane

Degree of kaolinization: none slight moderate (extreme)

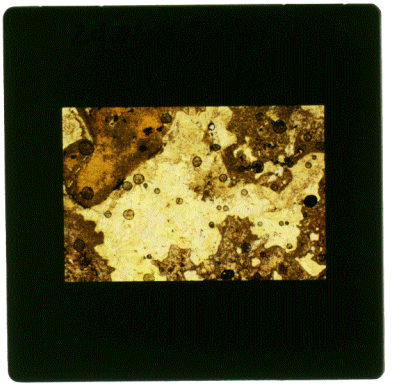
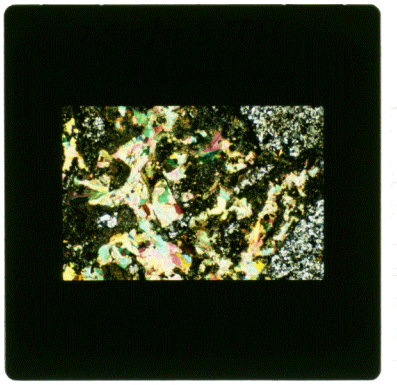
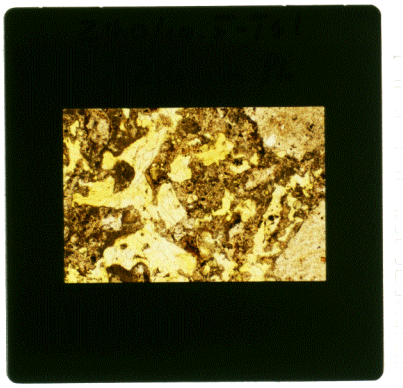
Degree of hematitization 0

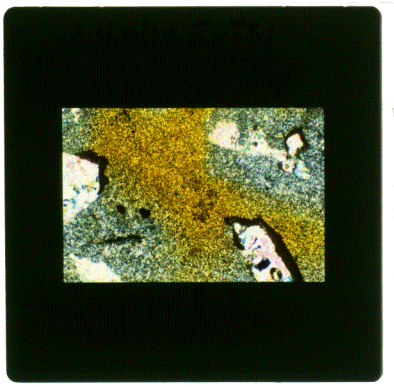
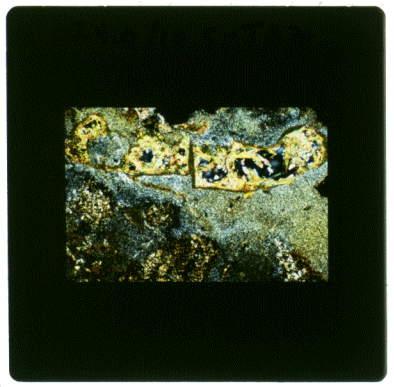
Description of mineralization: Kaolinite/uranophane intergrowth in fracture and matrix and α & β uranophane found in fractures.

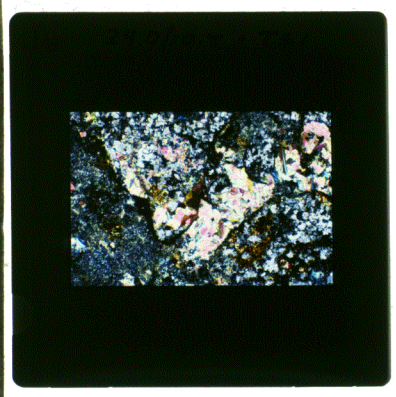
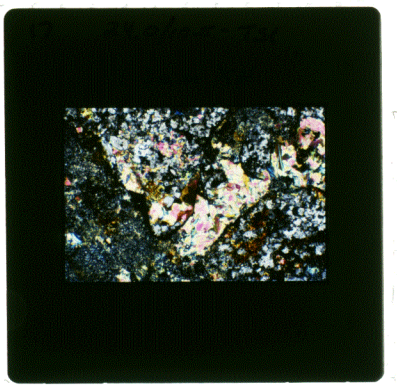
Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	20		
Soddyite			
Weeksite/ Boltwoodite			
Others			

Iron oxides < 1% amorphous Fe oxide

Other minerals

PHOTOGRAPHY

Photographer: Microscope:

Type of photography: Camera:

Date: Film:

Photo No.	Sample No. and description	Obj.	FOV	Light
	26.85/11.65-TS5			
9	Fracture in highly brecciated ore with kaolinite-muscovite-iron oxide + iron oxides replacing pyrite.	5X	2.6mm	XN
10	Same as #9	5X	2.6mm	PL
11	Closer look at iron oxides replacing pyrite	10X	1.3mm	RL
12	Large fracture with muscovite + iron oxides replacing pyrite	5X	2.6mm	XN
13	Closer look showing iron oxides.	10X	1.3mm	RL
14	Vein that contains late quartz along with iron oxides + muscovite	5X	2.6mm	XN
	24.0/10.5-TS1			
15	Fracture in oxidized ore cutting both α + β muscovite	5X	2.6mm	XN
16	Same as #15	5X	2.6mm	PL

PHOTOGRAPHY

Photographer: Microscope:

Type of photography: Camera:

Date: Film:

Photo No.	Sample No. and description	Obj.	FOV	Light
	24.0/10.5-TS1			
17	Fracture containing kaolinite + mostly B-birefringence	5X	2.6mm	+N
18	Same as #17	5X	2.6mm	PL
19	Birefringence rimmed by iron oxides in kaolinite filled fracture. May be pyrite replaced texture.	5X	2.6mm	+N
20	Closer look at pyrite + ilmenite dissolved crystals filled by birefringence	10X	1.3mm	+N
	24.0/10.5-TS2			
21	Brecciated oxidized ore - Kaolinite + birefringence + iron oxides in fracture	~~5X~~	2.6mm	+N
22	Same as #21	5X	2.6mm	PL
23	Pyrite crystal replaced by Birefringence	5X	2.6mm	+N
24	Same as #23 but closer	10X	1.3mm	+N

PHOTOGRAPHY

Photographer: Microscope:

Type of photography: Camera:

Date: Film:

Photo No.	Sample No. and description	Obj.	FOV	Light
	26.75/~~4.25~~ · TS2			
12.	Sphene like mineral associated with uranophane	10×	1.3mm	XN
13.	Same as #12	10×	1.3mm	PL
14	Same as #12	10×	1.3mm	RL
15.	Both α & β Uranophane filling vug 24.0/10.5 - TS1	10×	1.3mm	XN
16.	Shows uranophane replacing silicified matrix	10×	1.3mm	XN
17.	Same as 16- adjusted light 24.0/10.5 · TS2	10×	1.3mm	XN
18.	Uranophane replaced phenocryst	10×	1.3mm	XN
	22.2/9.5 · TS2			
19.	Uranophane / kaolinite intergrowth in matrix	10×	1.33	XN

pf

NOPAL I PETROGRAPHY

Sample No. 22.2/9.5 - TS1

Description of matrix and alteration: fine to very fine quartz being replaced by kaolinite uranophane intergrowth in some areas. Cryptocrystalline Fe oxide seen in RL are less abundant in areas with uranophane intergrowth. Coarse grained quartz has filled in some vugs & fractures

Description of phenocrysts/lithoclasts and alteration: Kaolinite has replaced all phenocrysts. Uranophane ~~also~~ being to replace some kaolinite phenocrysts. Corroded quartz found. Dominate Zircon are less abundant. Fe Oxide (possibly replaced pyrite)

Degree of fracturing or brecciation: none slight (moderate) extreme

Description of fracture-filling material: Kaolinite fills smaller fracture. ~~A few~~ Larger fractures filled with kaolinite uranophane intergrowth with areas of euhedral β uranophane.

Degree of kaolinization: none slight moderate (extreme)

Degree of hematization: O

Description of mineralization:

β uranophane replaces some Fe oxide phenocrysts, also found in vugs within fractures and as intergrowth with kaolinite

Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	10%	euhedral and as intergrowth	
Soddyite			
Weeksite/ Boltwoodite			
Others			

Iron oxides Crystalline Fe oxide more abundant than Amorphous Fe

Other minerals

pb2

NOPAL I PETROGRAPHY

Sample No. 22.2/9.5-TS2

Description of matrix and alteration: fine grained quartz matrix with intergrowth of kaolinite and uranophane. Cryptocrystalline Fe oxide can be seen in RL throughout the matrix.

Description of phenocrysts/lithoclasts and alteration: Kaolinite / corroded quartz, ilmenite and zircon.

Degree of fracturing or brecciation: none slight ~~moderate~~ extreme

Description of fracture-filling material: Kaolinite, intergrowth of kaolinite & uranophane and coarse grained quartz fill the fractures euhedral uranophane in very small fracture and open areas with kaolinite/uranophane intergrowths

Degree of kaolinization: none slight moderate ~~extreme~~

Degree of hematization: 0

Description of mineralization:

Uranophane found mostly as intergrowth with kaolinite in matrix and fractures

Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	5%	fine grained intergrowth	
Soddyite			
Weeksite/ Boltwoodite			
Others			

Iron oxides 10% Crystalline & amorphous

Other minerals

JP

NOPAL I PETROGRAPHY

Sample No. 23.3/9.8 - TS1 + 23.3/9.8 - TS2

Description of matrix and alteration: Cryptocrystalline qtz/feldspar. Remnant volcanic textures can be seen in PL. Some amorphous areas - generally around replaced phenocrysts of feldspar.

Description of phenocrysts/lithoclasts and alteration: Feldspars totally replaced by Kaolinite. Quartz show some corrosion along grain boundaries. Ilmenite with zircon. Magnetite. Some replaced feldspars are iron rich - amorphous hematite.

Degree of fracturing or brecciation: none (slight) moderate extreme

Description of fracture-filling material: Kaolinite ± iron oxides. Some late fractures contain uranophane. All fractures are very small

Degree of kaolinization: none slight moderate extreme
Degree of hematization

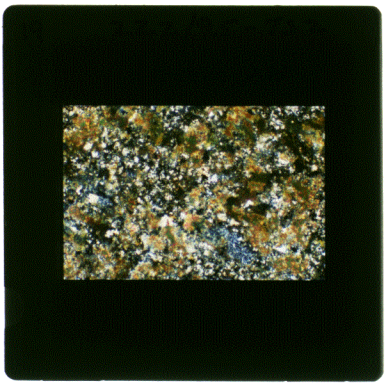
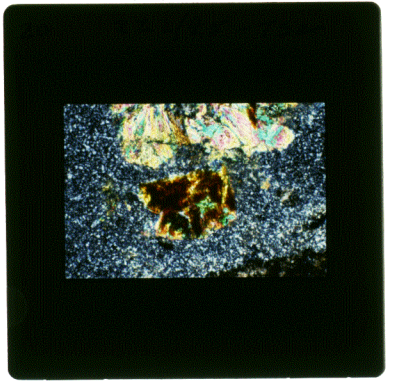
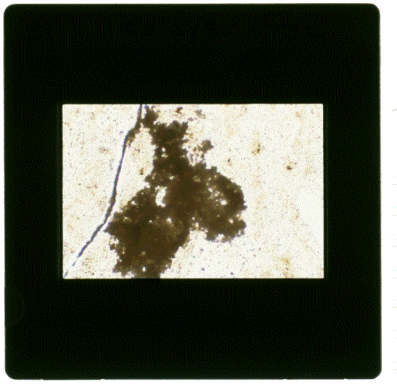
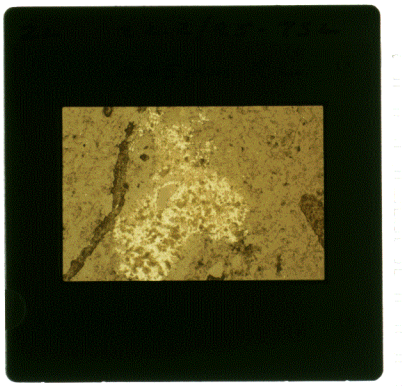
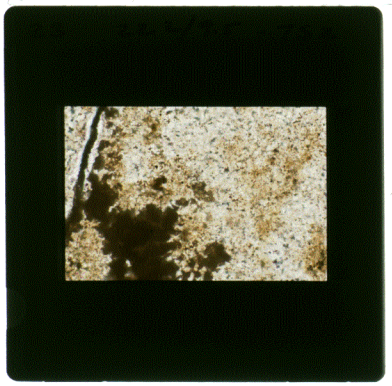
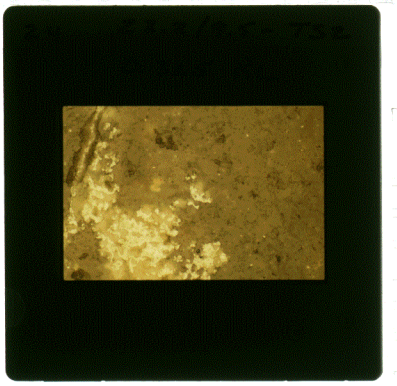
Description of mineralization:

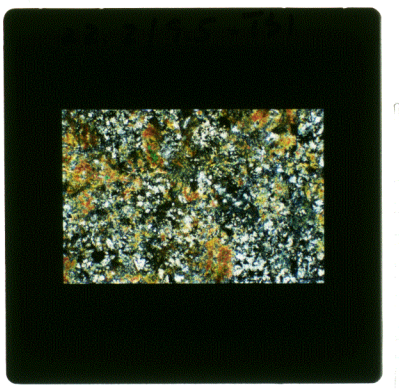
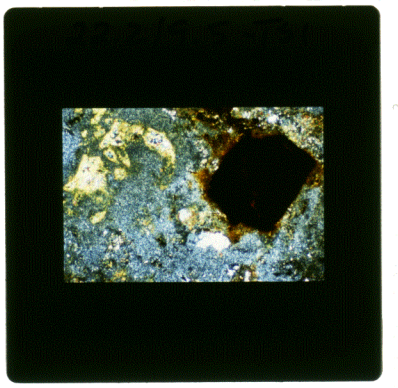
Uranophane occurs in late fractures

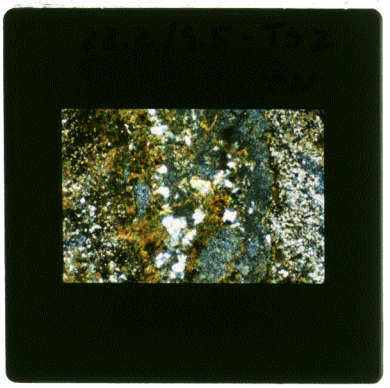
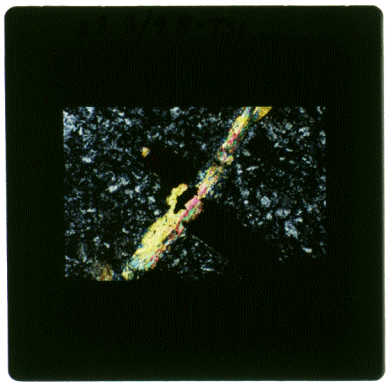
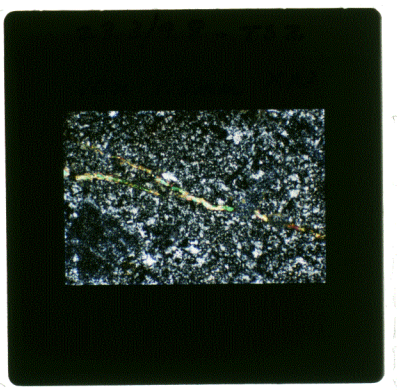
Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	1%	Relatively coarse crystals.	
Soddyite			
Weeksite/ Boltwoodite			
Others			

Iron oxides Amorphous

Other minerals

PHOTOGRAPHY

Photographer: Microscope:

Type of photography: Camera:

Date: Film:

Photo No.	Sample No. and description	Obj.	FOV	Light
26.	[illegible]/11.25 - TS2			
12.	Sphene like mineral associated with uranophane	10x	1.3mm	XN
13.	Same as #12	10x	1.3mm	PL
14	Same as #12	10x	1.3mm	RL
15.	Both α & β Uranophane filling vug 24.0/10.5 - TS1	10x	1.3mm	XN
16.	Shows uranophane replacing silicified matrix	10x	1.3mm	XN
17.	Same as 16- adjusted light 24.0/10.5 - TS2	10x	1.3mm	XN
18.	Uranophane replaced phenocryst	10x	1.3mm	XN
	22.2/9.5 - TS2			
19.	Uranophane / kaolinite intergrowth in matrix	10x	1.33	XN

PHOTOGRAPHY

Photographer: pfh
Microscope: Nikon
Type of photography: TS
Camera: Nikon
Date: 2/5/93
Film: Ectachrome 100

Photo No.	Sample No. and description	Obj.	FOV	Light
	22.2/9.5 - TS 2			
20.	Uranophane Replacing an Fe oxide phenocrypt	20X	0.65mm	XN
21.	Unidentified mineral	20X ~~40X~~	0.65 ~~0.325~~ mm	PL ~~XN~~
22	Same as 21.	20X	0.65	RL
23.	Close up @ edge	40X	0.325	PL
24.	Same as 23	40X	0.325	RL

PHOTOGRAPHY

Photographer: [illegible]
Microscope: Nikon

Type of photography: TS
Camera: Nikon

Date: 3/4/93
Film: Ektachrome 100

Photo No.	Sample No. and description	Obj.	FOV	Light
	22.2/9.5-TS1			
1	B-morphs intergrown with clay in matrix + fracture	5X	2.6mm	XN
2	Closeup of #1	10X	1.3mm	XN
3	Fracture in oxidized ore with kaolinite, morphs + oxidized pyrite.	5X	2.6mm	XN
4	Closeup of iron oxide replaced pyrite	10X	1.3mm	RL
	22.5/9.5-TS2			
5	Fracture with kaolinite, B-morphs, + quartz. B-morphs also intergrown with kaolinite in matrix.	10X	~~2.6mm~~ 1.3	XN
	NOP1-ECP-1-TS1			
6	Contact between reduced and oxidized ore. Granular uraninite replaced by oxidized ore minerals - morphs + soddyite.	5X	2.6mm	XN
7.	Oxidized fracture with kaolinite intergrown with U-silicates and former open space filled by smectite - iron oxide + soddyite + kaolinite	5X	2.6mm	XN
8	Same as #7	5X	2.6mm	PL

PHOTOGRAPHY

Photographer: PSh/JP
Microscope: Nikon

Type of photography: Microscope
Camera: Nikon

Date: 2/18/93
Film: Ektachrom 100

Photo No.	Sample No. and description	Obj.	FOV	Light
13	Sep 5 -	5x	2.6mm	XN
14	Same as 13 - different focus	10x	1.3mm	XN
15	Same as 13 - different focus	10x	1.3mm	XN
16	Sep 5 - Shows uranophane inside opal	10x	1.3mm	RL
17	Sep 5 - binocular	?		
18	Sep 5 - another grouping of uranophane inclusions	1.5x	≈ 9 mm	
19	Sep 6 - lots of substrat	1x	11.0mm	
20	23.3/9.8 - TS1 Uranophane filling fracture cutting an ilmenite phenocryst	20x	0.65mm	XN
21	23.3/9.8 - TS2 Uranophane fill fracture in qtz/fold matrix. Replaced flds.	10x	1.3mm	XN

NOPAL I PETROGRAPHY

Sample No. 19.6/14.5-TS1 Brecciated ore.

Description of matrix and alteration: ~~Silicified~~ Breccia fragments cemented by kaolinite and uranyl silicates. Fragments - quartz with kaolinite and uranyl silicates which have replaced feldspars. Iron oxides - amorphous are associated with kaolinite in fractures and with fragments.

Description of phenocrysts/lithoclasts and alteration: Some areas are very iron oxide rich. Iron comes from oxidation of pyrites which are intergrown with clay in fractures.

Degree of fracturing or brecciation: none slight moderate extreme

Description of fracture-filling material: Kaolinite, iron oxides (some crystalline that replace pyrites) and uranyl silicates.

Degree of kaolinization: none slight moderate extreme
Degree of hematite

Description of mineralization: Uranyl silicates uranophane + weeksite occur in matrix of fragments + in fractures. Some intergrown with kaolinite and others in open space - acicular habit.

Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	15%	fine-equant intergrown with clay coarser - acicular in fractures	
Soddyite			
Weeksite/ Boltwoodite	5%	appear to form after uranophane	
Others			

Iron oxides Crystalline replacing pyrite. Mostly amorphous.

Other minerals

SP

NOPAL I PETROGRAPHY

Sample No. K.6/14.5-TS2

Description of matrix and alteration: Same as previous sample

Description of phenocrysts/lithoclasts and alteration:

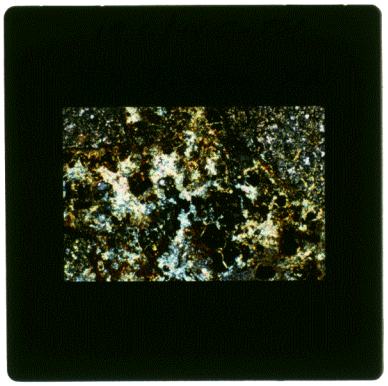
Degree of fracturing or brecciation: none slight moderate extreme

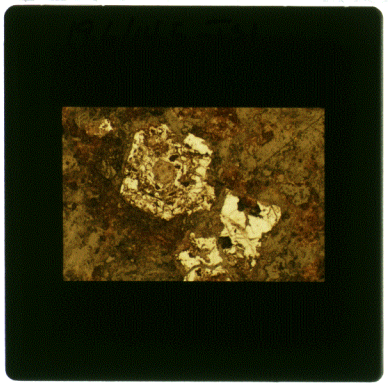
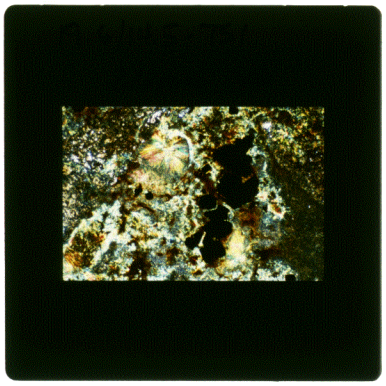
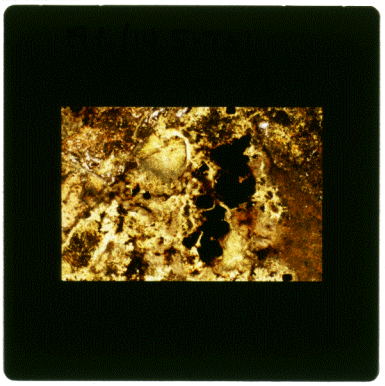
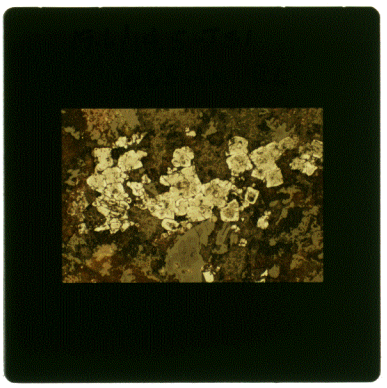
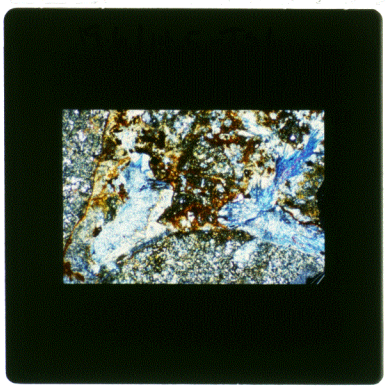
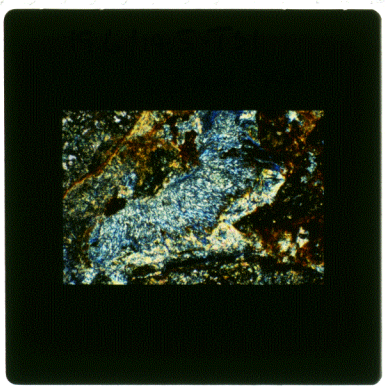
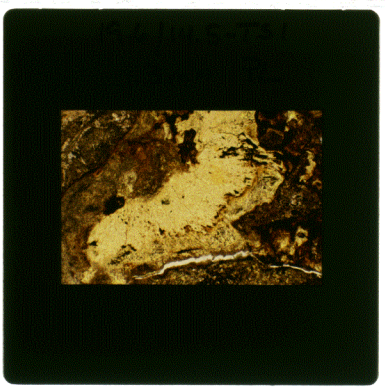
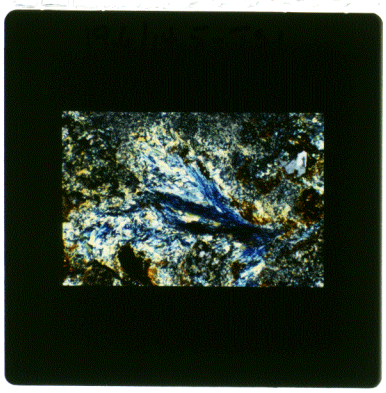
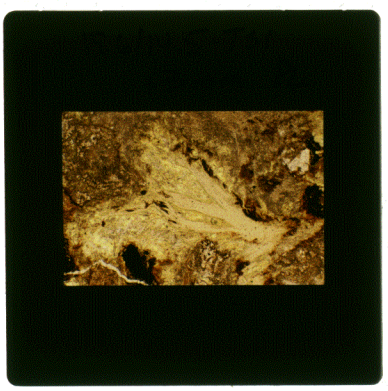
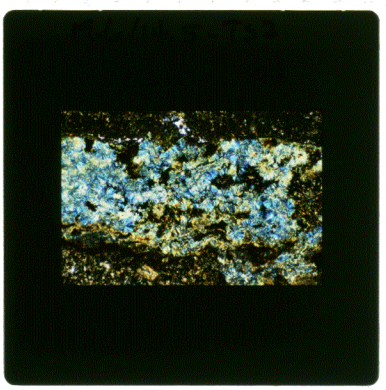
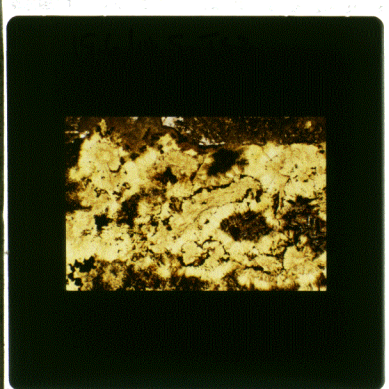
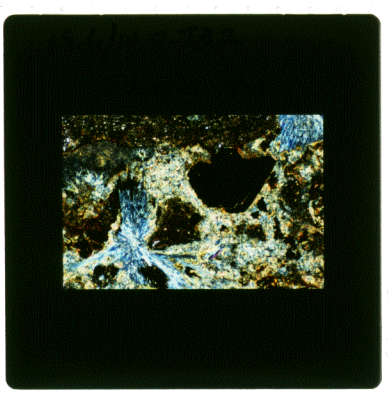
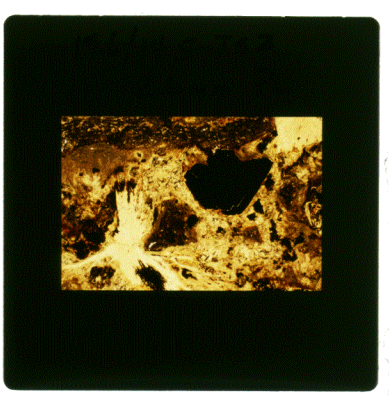
Description of fracture-filling material:

Degree of kaolinization: none slight moderate extreme

Description of mineralization:

Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane			
Soddyite			
Weeksite/ Boltwoodite			
Others			
Iron oxides			
Other minerals			



PHOTOGRAPHY

Photographer: Microscope:

Type of photography: Camera:

Date: Film:

Photo No.	Sample No. and description	Obj.	FOV	Light
	19.6/14.5-TS1			
22.	Mangl silicates in open space. Iron rich. Iron appears to predate mangl silicates and is intergrown with kaolinite in adjacent matrix.	5X	2.6mm	XN
23	Large grains containing kaolinite mangl silicates, and replaced pyrites (oxidized)	5X	2.6mm	+N
24	Same as #23	5X	2.6mm	PL

PHOTOGRAPHY

Photographer: JP

Type of photography: TS

Date: 2/23/93

Microscope: Nikon

Camera: Nikon

Film: Ektachrome 100

Photo No.	Sample No. and description	Obj.	FOV	Light
	19.6/14.5-TS1			
1	Pyrites replaced by hematite/goethite	20x	0.65mm	RL
2	Fracture cutting vugh silicates, kaolinite, and oxidized pyrites	5x	2.6mm	xN
3	Same as #2	5x	2.6mm	PL
4	Pyrites in fracture replaced by goethite (grey) + hematite (white)	20x	0.65mm	RL
5	Fracture cutting vugh silicates, kaolinite, + iron oxides. Notice blue mineral that may be weathered replacing vugh	5x	2.6mm	xN
6.	Closeup of #5 showing one vugh silicate replacing another	10x	1.3mm	xN
7	Same as #6	10x	1.3mm	PL
8	Vugh silicates in fracture - again shows replacement of one U-silicate by another	10x	1.3mm	xN
9	Same as #8	10x	1.3mm	PL

PHOTOGRAPHY

Photographer: Microscope:

Type of photography: Camera:

Date: Film:

Photo No.	Sample No. and description	Obj.	FOV	Light
	19.6/14.5-TS2			
10	Radiating cluster of weeksite in a fracture.	5X	2.6mm	XN
11	Close up of cluster of weeksite	10X	1.3mm	XN
12	Same as #11	10X	1.3mm	PL
13	Fracture containing vanadosilicates, kaolinite, euhedral pyrite	5X	2.6mm	XN
14	Same as #13	5X	2.6mm	RL
	17.1/15.2 - TS1			
~~15~~	~~Amorphous, crystalline & colloform Fe oxide~~	10X	1.3mm	RL
16	Vug filled with Uranophane & possibly weeksite. The weeksite is the finer grained blue crystals	20X	0.65mm	XN
17.	Same as 16. Notice the weeksite area does not ~~show~~ have pleochroism	20X	0.65	PL

NOPAL I PETROGRAPHY

Sample No. 17.1/15.2 - TS1

Description of matrix and alteration:
Fe oxide both cryptallin and amorphous throughout sample.
Goethite also present in matrix. Very iron oxide rich.

Description of phenocrysts/lithoclasts and alteration:
euhedral quartz phenocrysts and kaolinite phenocrysts
can be seen, Feldspar replaced by clay

Degree of fracturing or brecciation: none (slight) moderate extreme

Description of fracture-filling material: Kaolinite, iron oxide,
U-silicates

Degree of kaolinization: none slight moderate (extreme)
Degree of hematization
Description of mineralization:
Uranophane & weeksite found in rasp often
intergrown

Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	5%		
Soddyite			
Weeksite/ Boltwoodite	2%		
Others			

Iron oxides 75% cryptallin & amorphon Fe Oxide
Hematite & goethite

Other minerals

NOPAL I PETROGRAPHY

Sample No. 17.1/15.2 -TS 2

Description of matrix and alteration: Same as previous sample.

Description of phenocrysts/lithoclasts and alteration:

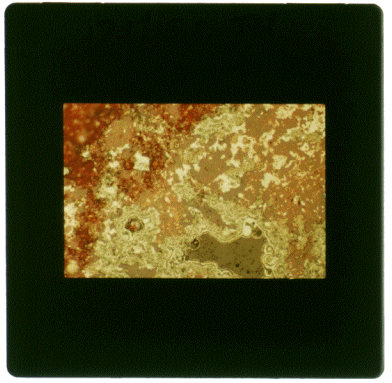
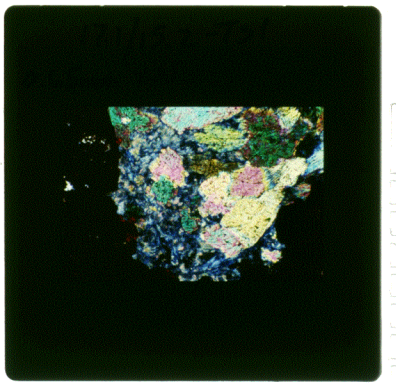
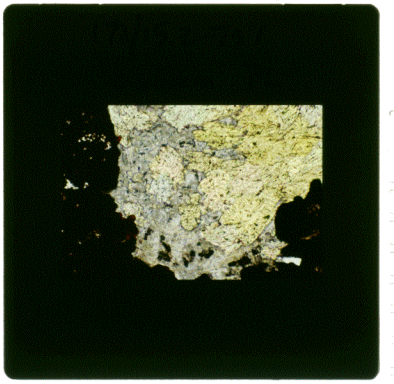
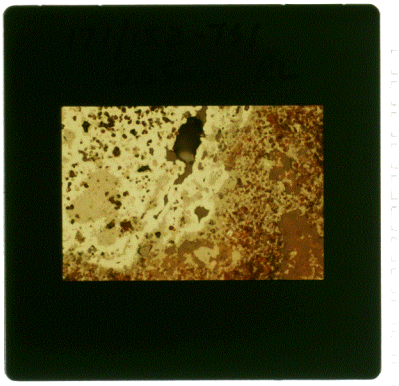
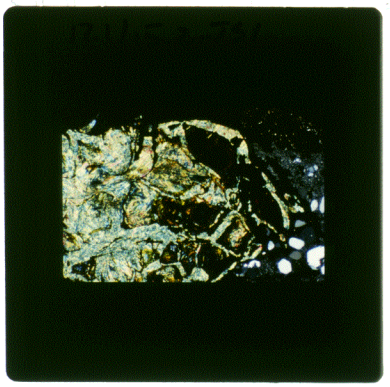
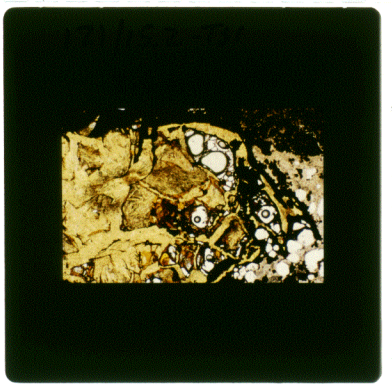
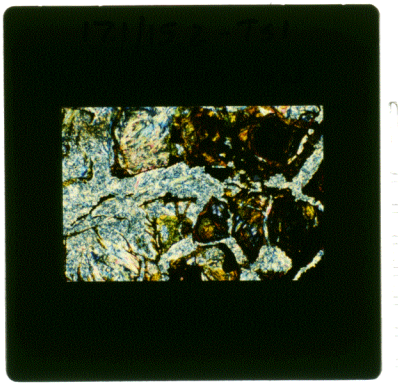
Degree of fracturing or brecciation: none slight moderate extreme

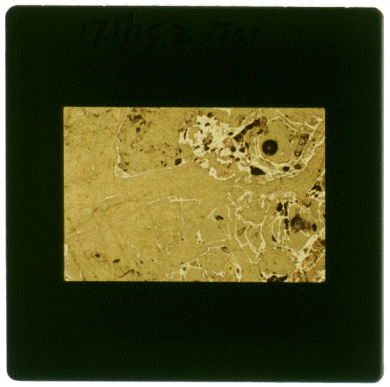
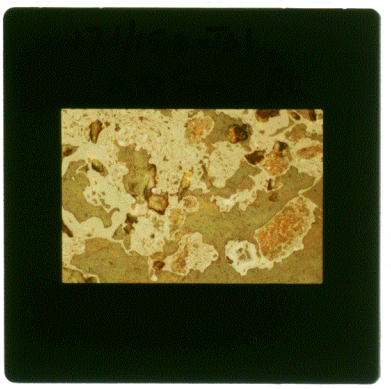
Description of fracture-filling material:

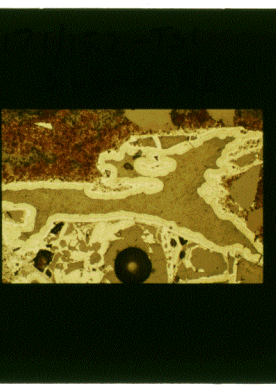
Degree of kaolinization: none slight moderate extreme

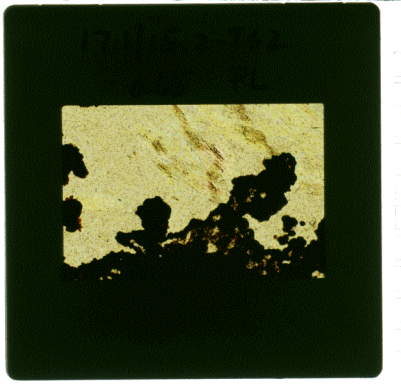
Description of mineralization: Appears that weeksite replaced uranophane in some instances.

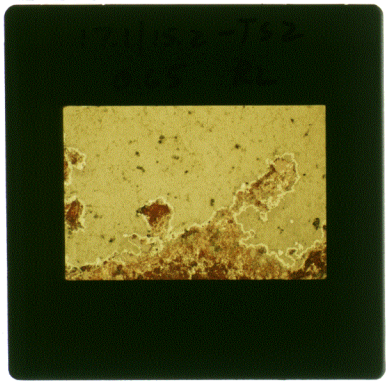
Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane			
Soddyite			
Weeksite/ Boltwoodite			
Others			
Iron oxides			
Other minerals			

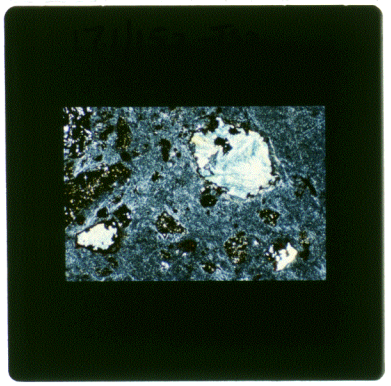








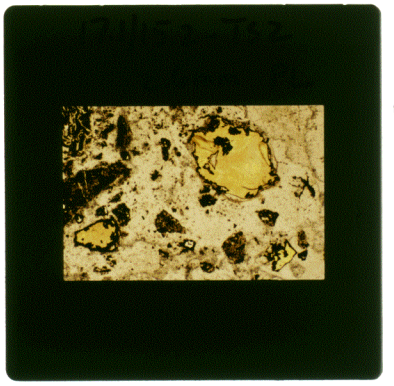



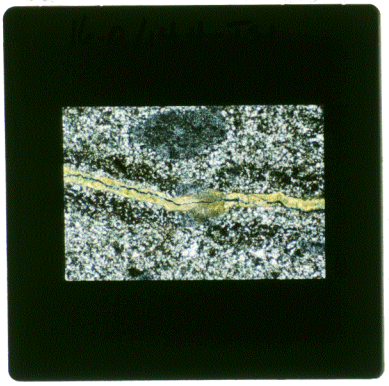


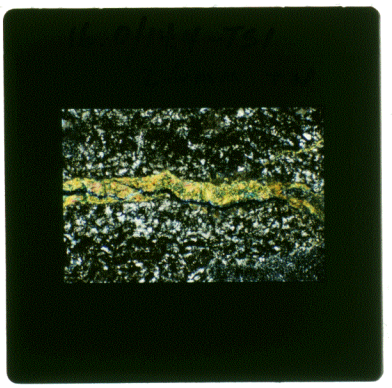












NOPAL I PETROGRAPHY

Sample No. 16.0/14.4-TS1 & TS2

Description of matrix and alteration: Intergrown qtz / feldspar. Feldspar in matrix being replaced by kaolinite. Under PL remnant volcanic textures are somewhat preserved

Description of phenocrysts/lithoclasts and alteration: Feldspar replaced by Kaolinite. Quartz. Magnetite/ilmenite.

Degree of fracturing or brecciation: none (slight) moderate extreme

Description of fracture-filling material: Fracture filled by kaolinite followed by uranophane. Some fractures are monomineralic uranophane

Degree of kaolinization: none slight moderate (extreme)

Degree of kaolinization

Description of mineralization: Uranophane filled fractures. Acicular crystals.

Uranium minerals	%	crystal size/habit	remarks
Uraninite			
Schoepite			
Ianthinite			
Uranophane	3%		
Soddyite			
Weeksite/ Boltwoodite			
Others			

Iron oxides /

Other minerals /

PHOTOGRAPHY

Photographer: **Microscope:**

Type of photography: **Camera:**

Date: **Film:**

Photo No.	Sample No. and description	Obj.	FOV	Light
	19.6/14.5-TS2			
10	Radiating cluster of weeksite in a fracture.	5X	2.6mm	XN
11	Close up of cluster of weeksite	10X	1.3mm	XN
12	Same as #11	10X	1.3mm	PL
13	Fracture containing unidentified silicate, kaolinite, opaque pyrite	5X	2.6mm	XN
14	~~Same as #13~~	5X	2.6mm	RL
	17.1/15.2 - TS1			
15	Amorphous, crystalline & colloform Fe oxide	10X	1.3mm	RL
16	Vug filled with Uranophane & possibly weeksite. The weeksite is the finer grained blue crystals	20X	0.65mm	XN
17.	Same as 16. Notice the weeksite area does not show (have) pleochroism	20X	0.65	PL

PHOTOGRAPHY

Photographer: Microscope:

Type of photography: Camera:

Date: Film:

Photo No.	Sample No. and description	Obj.	FOV	Light
	17.1/15.2 - 751			
18.	Colloform hematite and goethite potion kaolinite intergrowths	40X	0.325mm	RL
19 -	Fracture contains U-silicates (uranophane, weeksite) and replaced pyrite. Some iron oxides around replaced pyrite Also Natrie kaolinite + quartz in fracture.	5X	2.6mm	XN
20	Same as #19	5X	2.6mm	PL
21	Closeup showing U-silicates + iron oxides.	10X	1.3mm	XN
22	Same as #21	10X	1.3mm	PL
23	Same as 21 + 22 showing iron oxides around pyrite crystals.	10X	1.3mm	RL
24	Closeup showing iron oxides intergrown with kaolinite. Both hematite (white) and goethite (gray). Natrie colloform texture	40X	0.325mm	RL

PHOTOGRAPHY

Photographer: JF
Microscope: Nikon
Type of photography: TS
Camera: Nikon
Date: 3/3/93
Film: Ektachrome 100

Photo No.	Sample No. and description	Obj.	FOV	Light
	17.1/15.2-TS1			
①	U-silicate in open space rimmed by iron oxides while reflective pyrite	20x	0.65mm	+N
2	Same as #1 but showing colloform iron oxides Hematite (white) followed by goethite (grey)	20x	0.65mm	RL
3	Closeup of #2 showing kaolinite in matrix + iron oxides	40x	0.325	RL
	17.1/15.2-TS2			
④	Kaolinite fracture in iron oxide rich matrix. Open spaces filled by U-silicate in fracture + vugs.	5x	2.6mm	+N
5	Open space in kaolinite filled fracture filled by U-silicate	5x	2.6mm	+N
6	Closeup show U-silicate	10x	1.3mm	+N
7	Closeup showing diff between U-silicate - color + habit	20x	0.625mm	PL
8	Same as #7 but showing colloform iron oxides rimming U-silicate filled vug	20x	0.625mm	RL

PHOTOGRAPHY

Photographer: Microscope:

Type of photography: Camera:

Date: Film:

Photo No.	Sample No. and description	Obj.	FOV	Light
	17.1/15.2-TS2			
9	Kaolinite fracture with dissolved pyrites replaced by U-silicate	5X	2.6mm	XN
10	Same as #9 in PL	5X	2.6mm	PL
	16.0/14.4-TS1			
11	Uranophane filled fracture cutting through a kaolinite replaced Feldspar phenocryst.	5X	2.6mm	XN
12	Closeup of 11 showing acicular U-silicate in fracture.	10X	2.6mm	XN
	26.85/11.65-TS1			
13	Brecciated oxidized ore - uranophane filling fractures. Iron oxide rich breccia.	5X	2.6mm	XN
14	Same as #13	5X	2.6 mm	PL
15	Fracture in iron oxide rich ore cutting kaolinite followed by late uranophane.	5X	2.6mm	XN
16	Same as #15	5X	2.6mm	PL