

## THIN SECTION PETROGRAPHY

~~Original~~  
~~Ant~~  
~~Ant~~  
~~Ant~~  
~~Ant~~

Pan Am Hoodoo Lake Unit #2

2070-2100

Litharenite, fine grained,  
 detrital grains; volcanic rock fragments (45%), volcanic glass (20%),  
 quartz (15%), biotite (5%), glauconite (5%), amphibole (5%),  
 feldspar (5%)  
 no observable porosity,  
 slightly compacted,  
 pores filled with clinoptilolite.

2100-2130

Feldspathic litharenite, fine to medium grained,  
 detrital grains; volcanic rock fragments (50%), feldspar (30%), quartz  
 (15%), minor amphibole, glauconite, biotite and volcanic glass,  
 no observable porosity,  
 moderately compacted,  
 grains coated with montmorillonite,  
 pores filled with clinoptilolite.

2520-2550

Litharenite, very fine to fine grained,  
 detrital grains; volcanic rock fragments (60%), volcanic glass (10%),  
 feldspar (20%), quartz (10%),  
 no observable porosity,

severely compacted,  
smectite cement.

3000-3030

Litharenite, coarse grained,  
detrital grains; volcanic rock fragments (70%), feldspar (20%), quartz  
(5%), volcanic glass (5%), minor glauconite,  
porosity less than 1%, secondary,  
slightly compacted,  
chlorite pore fill and rim cement,  
clinoptilolite replacement and cementation.

3610-3630

Litharenite, medium to coarse grained,  
detrital grains; volcanic rock fragments (65%), volcanic glass (10%),  
feldspar (10%), quartz (10%), glauconite (5%), minor chert,  
no observable porosity,  
severely compacted,  
laumontite pore fill,  
chlorite cement,  
calcite replacement of detrital grains.

4460-4480

Litharenite, medium to coarse grained,  
detrital grains; volcanic rock fragments (70%), feldspar (15%), volcanic  
glass (10%), quartz (5%), minor glauconite,  
porosity less than 1%, secondary,

severely compacted,  
smectite cement,  
chlorite pore fill,  
minor zeolite pore fill.

4480-4500

Litharenite, very coarse grained,  
detrital grains; volcanic rock fragments (80%), feldspar (10%), quartz  
(5%), minor glauconite (5%), minor volcanic glass,  
no observable porosity,  
severely compacted,  
smectite cement,  
zeolite pore fill and replacement of volcanic rock fragment.

4920-4940

Litharenite, fine to coarse grained,  
detrital grains; volcanic rock fragments (65%), feldspar (15%), quartz  
(10%), glauconite (10%),  
no observable porosity,  
severely compacted,  
chlorite and smectite cement,  
patchy carbonate cement,  
brown opaque material infilling pores.

4940-4960

Litharenite, very fine grained,  
detrital grains; volcanic rock fragments (70%), glauconite (15%),

feldspar (5%), quartz (5%), volcanic glass (5%),  
no observable porosity,  
severely compacted.

5280-5300

Litharenite, very fine to fine grained,  
detrital grains; volcanic rock fragments (75%), feldspar (10%), quartz  
(5%), volcanic glass (5%), glauconite (5%),  
no observable porosity,  
severely compacted,  
laumontite pore fill,  
carbonate replacement of detrital grains.

6000-6010

Litharenite, medium grained,  
detrital grains; volcanic rock fragments (65%), feldspar (20%), quartz  
(15%),  
no observable porosity,  
severely compacted,  
fractures filled with calcite,  
feldspar altered to kaolinite.

6960-6980

Feldspathic litharenite, fine to medium grained,  
detrital grains; volcanic rock fragments (55%), feldspar (30%), quartz  
(15%),  
porosity less than 1%, fracture,

severely compacted,  
feldspar altered to kaolinite,  
smectite cement.

7560-7570

Litharenite, medium to coarse grained,  
detrital grains; volcanic rock fragments (70%), feldspar (20%), quartz  
(10%),  
no observable porosity,  
severely compacted,  
carbonate cement and replacement of detrital grains.

7570-7580

Feldspathic litharenite, fine to medium grained,  
detrital grains; metamorphic and volcanic rock fragments (40%), altered  
feldspar (40%), quartz (20%),  
no observable porosity,  
severely compacted,  
blocky calcite and chlorite cement,  
feldspar replaced by calcite.

7580-7590

Lithic arkose, fine to medium grained,  
detrital grains; feldspar (50%), rock fragments (30%), quartz (20%),  
no observable porosity,  
severely compacted,

smectite cement,  
feldspar altered to kaolinite and calcite.

7590-7600

Feldspathic litharenite, very fine grained,  
detrital grains; feldspar (40%), rock fragments (40%), quartz (10%),  
unidentified dark opaque material (10%),  
no observable porosity,  
severely compacted,  
feldspar altered to kaolinite.

7690-7700

Litharenite, very fine to fine grained,  
detrital grains; metamorphic and volcanic rock fragments (50%), quartz  
(25%), feldspar (20%), biotite (5%),  
no observable porosity,  
severely compacted,  
feldspars altered and replaced by calcite.

7700-7710

Lithic arkose, coarse to very coarse grained,  
detrital grains; monocrystalline and polycrystalline quartz (50%),  
feldspar (30%), metamorphic and volcanic rock fragments (20%),  
no observable porosity,  
severely compacted,  
smectite cement,  
calcite replacement of feldspar.

7710-7720

Litharenite, medium grained,  
detrital grains; metamorphic and igneous rock fragments (65%), feldspar  
(20%), monocrystalline and polycrystalline quartz (15%),  
no observable porosity,  
severely compacted,  
smectite cement,  
minor calcite replacement of feldspar.

7720-7730

Feldspathic litharenite, medium to coarse grained,  
detrital grains; rock fragments (40%), monocrystalline and  
polycrystalline quartz (20%), feldspar (30%), calcite (10%),  
no observable porosity,  
severely compacted,  
carbonate and smectite cement,  
feldspar altered to kaolinite and calcite.

7730-7740

Feldspathic litharenite, fine to medium grained,  
detrital grains; volcanic rock fragments (40%), monocrystalline and  
polycrystalline quartz (30%), feldspar (30%), minor unidentified  
dark opaque material,  
no observable porosity,  
severely compacted,  
feldspar severely altered,

smectite cement,  
carbonate replacement of detrital grains.

7950-7960

Litharenite, medium to coarse grained,  
detrital grains; volcanic rock fragments (50%), quartz (30%), feldspar  
(10%), calcite (10%),  
no observable porosity,  
severely compacted,  
smectite grain rims,  
microquartz and kaolinite pore filling,  
calcite fracture filling.

7960-7970

Litharenite, medium to very coarse grained,  
detrital grains; plutonic and volcanic rock fragments (50%),  
polycrystalline quartz (30%), chert (10%), feldspar (10%),  
no observable porosity,  
severely compacted,  
quartz overgrowths,  
calcite and quartz fracture filling,  
calcite replacement of feldspar.

7970-7980

Litharenite, medium to coarse grained,  
detrital grains; plutonic and volcanic rock fragments (50%),  
polycrystalline and monocrystalline quartz (20%), feldspar (20%),

chert (10%),  
no observable porosity,  
severely compacted,  
10% calcite cement,  
feldspars altered to calcite.

8190-8200

Litharenite, coarse to very coarse grained,  
detrital grains; rock fragments (80%), feldspar (10%), quartz (10%),  
no observable porosity,  
severely compacted,  
feldspar altered and replaced by calcite,  
unidentified black opaque material common,  
smectite cement.

8520-8530

Litharenite, very fine to fine grained,  
detrital grains; rock fragments (80%), quartz (10%), feldspar (10%),  
minor unidentified black opaque material,  
no observable porosity,  
severely compacted,  
sericite cement,  
chlorite rims,  
carbonate replacement of detrital grains.

8530-8540

Lithic arkose, fine to medium grained,

detrital grains; quartz (40%), feldspar (30%), rock fragments (20%),  
calcite (10%),  
no observable porosity,  
severely compacted,  
sericite and chlorite cement.

9000-9010

Litharenite, very fine grained,  
detrital grains; rock fragments (80%), calcite (10%), unidentified dark  
opaque material (5%), feldspar (5%), minor quartz,  
no observable porosity,  
severely compacted,  
sericite matrix.

9400-9410

Calc-litharenite, fine grained,  
detrital grains; calcite (55%), quartz (15%), feldspar (15%), rock  
fragments (15%),  
no observable porosity,  
severely compacted,  
carbonate cement.

9800-9810

Litharenite, very fine to fine grained,  
detrital grains; quartz (40%), rock fragments (30%), feldspar (15%),  
calcite (10%), biotite (5%),  
no observable porosity,

severely compacted,  
sericite matrix.

10000-10010

Arkose, fine grained,  
detrital grains; feldspar (45%), quartz (30%), biotite (10%), amphibole  
(5%), calcite (5%), rock fragments (5%),  
no observable porosity,  
severely compacted,  
chlorite cement,  
quartz overgrowths.

10380-10390

Arkose, fine grained,  
detrital grains; feldspar (55%), quartz (30%), amphibole (10%), rock  
fragments (5%),  
no observable porosity,  
severely compacted,  
hematite cement.

10390-10400

Lithic arkose, fine grained,  
detrital grains; quartz (35%), feldspar (30%), rock fragments (20%),  
biotite (5%), calcite (5%), amphibole (5%),  
no observable porosity,  
severely compacted.

10440-10450

Lithic arkose, very fine to medium grained,  
detrital grains; feldspar (25%), rock fragments (20%), quartz (40%),  
biotite (5%), calcite (5%), amphibole (5%),  
no observable porosity,  
severely compacted,  
sericite matrix,  
feldspars altered,  
albite fracture filling.

10460-10470

Arkose, very fine to medium grained,  
detrital grains; feldspar (45%), quartz (20%), amphibole (15%), biotite  
(5%), rock fragments (5%),  
no observable porosity,  
severely compacted,  
feldspars altered,  
biotite altered to chlorite.

10470-10480

Arkose, very fine grained,  
detrital grains; feldspar (65%), quartz (20%), amphibole (10%), rock  
fragments (5%),  
no observable porosity,  
severely compacted,  
feldspars altered,  
chlorite cement.

11000-11010

Arkose, fine to medium grained,  
detrital grains; feldspar (80%), quartz (20%), calcite (5%), rock  
fragments (5%),  
no observable porosity,  
severely compacted,  
feldspar severely altered,  
brown opaque material infilling pores.

11100-11110

Arkose, fine grained,  
detrital grains; feldspar (30%), quartz (50%), biotite (5%), amphibole  
(5%), calcite (5%), rock fragments (5%),  
no observable porosity,  
severely compacted.

11240-11243

Arkose, fine grained,  
detrital grains; feldspar (50%), quartz (25%), calcite (10%), amphibole  
(5%), biotite (5%), rock fragments (5%),  
no observable porosity,  
severely compacted,  
feldspar severely altered,  
brown opaque material replacing calcite.

## THIN SECTION PETROGRAPHY

Pan Am David River No. 1-A

2240-2270

Litharenite, very coarse grained,  
detrital grains; volcanic rock fragments, volcanic glass, plagioclase,  
quartz,  
friable,  
uncompacted,  
chlorite rims on grains.

4620-4650

Feldspathic litharenite, fine grained,  
detrital grains; volcanic rock fragments (30%), altered plagioclase  
(30%), monocrystalline and polycrystalline quartz (20%), carbonate  
matrix (20%),  
porosity less than 1%, secondary,  
severely compacted  
plagioclase altered to kaolinite.

4650-4680

Litharenite, very coarse grained,  
detrital grains; volcanic rock fragments, volcanic glass, quartz,  
plagioclase,  
porosity undetermined,  
uncompacted,

RECEIVED  
1968/11/14  
U.S. GEOLOGICAL SURVEY  
WASHINGTON, D.C.

plagioclase replaced by calcite,  
smectite rims,  
calcite cement.

4970-4990

Lithic arkose, coarse grained,  
detrital grains; quartz (50%), feldspar (30%), rock fragments (10%),  
no observable porosity,  
severely compacted,  
25% of feldspars were altered to kaolinite and calcite,  
zeolite in fibrous bundles.

5890-5920

Feldspathic litharenite, fine grained,  
detrital grains; quartz (30%), volcanic rock fragments (30%), feldspar  
(20%), chert (10%), volcanic glass (10%),  
no observable porosity,  
severely compacted,  
chlorite and calcite cement,  
plagioclase altered to kaolinite.

6750-6760

Litharenite, very fine grained,  
detrital grains; volcanic rock fragments (40%), quartz (20%), feldspar  
(20%), volcanic glass (10%), biotite (5%), opaque material (5%),  
no observable porosity,

severely compacted,  
plagioclase altered.

6770-6780

Feldspathic litharenite, very coarse grained,  
detrital grains; quartz, feldspar, volcanic rock fragments, volcanic  
glass,  
no observable porosity,  
severely compacted,  
smectite rims on grains,  
carbonate cement.

6780-6790

Litharenite, very fine grained,  
detrital grains; volcanic rock fragments (45%), quartz (20%), volcanic  
glass (15%), feldspar (10%), biotite (5%), opaques (5%),  
no observable porosity,  
severely compacted,  
feldspars altered,  
opaque mineral occurs as streaks through the rock and as discrete grains,  
smectite and calcite cement.

6850-6860

Feldspathic litharenite, fine grained,  
detrital grains; quartz (30%), feldspar (30%), volcanic rock fragments  
(30%), volcanic glass (10%),  
no observable porosity,

severely compacted,  
chlorite cement.

6860-6890

Lithic arkose, coarse to very coarse grained,  
detrital grains; monocrystalline and polycrystalline quartz (30%),  
feldspar (25%), calcite (20%), rock fragments (15%), volcanic glass  
(5%), opaques (5%),  
no observable porosity,  
severely compacted  
plagioclase altered.

6890-6920

Litharenite, coarse grained,  
detrital grains; volcanic rock fragments (45%), volcanic glass (20%),  
quartz (20%), feldspar (10%), calcite (5%),  
no observable porosity,  
severely compacted,  
zeolite replacement of volcanic rock fragment,  
calcite cement.

6940-6970

Feldspathic litharenite, medium to very coarse grained,  
detrital grains; volcanic rock fragments (45%), polycrystalline and  
monocrystalline quartz (30%), feldspar (15%), volcanic glass (5%),  
calcite (5%),  
no observable porosity,

severely compacted,  
micritic calcite cement.

7070-7160

Litharenite, coarse grained,  
detrital grains; volcanic rock fragments (45%), volcanic glass (15%),  
quartz (15%), chert (15%), feldspar (5%),  
no observable porosity,  
severely compacted,  
carbonate cement.

7220-7250

Litharenite, fine grained,  
detrital grains; volcanic rock fragments (60%), quartz (20%), volcanic  
glass (10%), feldspar (10%),  
no observable porosity,  
severely compacted,  
lithic clast altered to zeolite.

7250-7280

Litharenite, medium to coarse grained,  
detrital grains; metamorphic and volcanic rock fragments (45%),  
monocrystalline and polycrystalline quartz (20%), feldspar (15%),  
calcite (10%), volcanic glass (10%),  
no observable porosity,  
severely compacted,

feldspars severely altered,  
calcite cement.

7280-7310

Lithic arkose, medium grained,  
detrital grains; feldspar (40%), quartz (30%), rock fragments (20%),  
biotite (10%),

no observable porosity,  
severely compacted,  
calcite and kaolinite cement.

7310-7340

Lithic arkose, medium grained to granular,  
detrital grains; feldspar (30%), quartz (30%), rock fragments (20%),  
volcanic glass (10%), calcite (10%),

no observable porosity,  
severely compacted,  
calcite cement.

7340-7370

Feldspathic litharenite, medium grained,  
detrital grains; rock fragments (40%), feldspar (20%), monocrystalline  
and polycrystalline quartz (20%), volcanic glass (10%), chert (10%),  
no observable porosity,  
severely compacted,

feldspar severely altered,  
calcite and smectite cement.

#### 7400-7430

Feldspathic litharenite, fine to medium grained,  
detrital grains; rock fragments (40%), feldspar (30%), quartz (25%),  
volcanic glass (5%),  
no observable porosity,  
severely compacted,  
carbonate cement.

#### 7430-7460

Litharenite, very fine grained,  
detrital grains; rock fragments (40%), quartz (40%), volcanic glass  
(10%), feldspar (10%),  
no observable porosity,  
severely compacted,  
brown opaque cement.

#### 7460-7490

Lithic arkose, fine to medium grained,  
detrital grains; feldspar (40%), rock fragments (30%), quartz (20%),  
volcanic glass (10%),  
no observable porosity,  
severely compacted,  
smectite cement.

7490-7500

Feldspathic litharenite, fine to medium grained,  
detrital grains; rock fragments (35%), quartz (25%), feldspar (35%),  
volcanic glass (5%),  
no observable porosity,  
severely compacted,  
feldspar replaced by calcite and kaolinite,  
smectite cement.

7840-7860

Feldspathic litharenite, medium to coarse sand,  
detrital grains; rock fragments (25%), quartz (40%), feldspar (30%),  
volcanic glass (5%),  
no observable porosity,  
severely compacted,  
feldspars replaced by calcite.

7990-8000

Litharenite, coarse to very coarse grained,  
detrital grains; monocrystalline and polycrystalline quartz (40%),  
rock fragments (20%), feldspar (10%), calcite (10%), volcanic  
glass (5%), mica (5%),  
no observable porosity,  
severely compacted,  
feldspar replaced by calcite,  
smectite cement.

10680-10690

Litharenite, coarse grained,  
detrital grains; rock fragments (40%), quartz (30%), feldspar (20%),  
volcanic glass (10%),  
no observable porosity,  
severely compacted,  
chlorite and sericite cement,  
feldspars altered.

11640-11670

Lithic arkose, medium to coarse grained,  
detrital grains; feldspar (40%), rock fragments (30%), quartz (20%),  
volcanic glass (10%),  
no observable porosity,  
severely compacted,  
smectite and chlorite cement,  
some of the feldspars altered to calcite.

11670-11700

Feldspathic litharenite, coarse grained,  
detrital grains; rock fragments (35%), feldspar (35%), quartz (15%),  
unidentified black opaque mineral, ? pyrite (10%), volcanic glass  
(5%),  
no observable porosity,  
severely compacted,  
feldspars altered.

11700-11710

Lithic arkose, medium to coarse grained,  
detrital grains; feldspar (50%), rock fragments (30%), quartz (20%),  
minor volcanic glass,  
porosity less than 1%, fracture,  
severely compacted,  
chlorite cement,  
fractures partly filled by calcite.

11740-11750

Lithic arkose, very fine grained,  
detrital grains; feldspar (50%), rock fragments (30%), quartz (20%),  
no observable porosity,  
severely compacted,  
feldspars altered to kaolinite and calcite,  
fractures filled with micro quartz and calcite.

12120-12130

Lithic arkose, very fine grained,  
detrital grains; feldspar (50%), rock fragments (35%), quartz (15%),  
no observable porosity,  
severely compacted,  
feldspars severely altered,  
fractures filled with laumontite and calcite.

12210-12220

Arkose, coarse grained,

detrital grains; feldspar (60%), quartz (20%), rock fragments (20%),  
no observable porosity,  
severely compacted,  
chlorite cement.

12370-12390

Litharenite, fine to coarse grained,  
detrital grains; volcanic rock fragments (75%), feldspar (15%), quartz  
(10%),  
no observable porosity,  
severely compacted,  
fractures filled with quartz, calcite and laumontite,  
volcanic rock fragments replaced by natrolite.

12690-12700

Arkose, medium to very coarse grained,  
detrital grains; feldspar (60%), quartz (30%), rock fragments (10%),  
porosity less than 1%, fracture,  
severely compacted,  
chlorite and calcite cement,  
chlorite replacement of volcanic rock fragments.

12870-12880

Arkose, coarse to very coarse grained,  
detrital grains; feldspar (60%), quartz (30%), rock fragments (10%),  
no observable porosity,  
severely compacted,

chlorite cement,  
chlorite replacement of detrital grains,  
50% of feldspars altered.

13340-13360

Feldspathic litharenite, fine to very fine grained,  
detrital grains; rock fragments (60%), feldspar (30%), quartz (10%),  
no observable porosity,  
severely compacted,  
all of the rock fragments replaced by chlorite,  
chlorite cement,  
fractures filled with laumontite.

13360-13370

Feldspathic litharenite, very fine grained,  
detrital grains; rock fragments (60%), feldspar (25%), quartz (10%),  
unidentified black opaque material (5%),  
no observable porosity,  
severely compacted,  
all of the rock fragments replaced by chlorite,  
fractures filled with laumontite and calcite.

13480-13490

Arkose, coarse grained,  
detrital grains; feldspar (60%), quartz (30%), chlorite (10%),  
no observable porosity,  
severely compacted,

rock fragments replaced by chlorite,  
chlorite cement,  
feldspars altered and replaced by calcite.

13670-13700

Lithic arkose, medium to very coarse grained,  
detrital grains; feldspar (50%), quartz (10%), matrix (40%),  
porosity less than 1%, fracture,  
severely compacted,  
matrix consist of chlorite and deformed rock fragments.