325-7069

AUGUST 25, 1993

TARGET RESERVOIR ANALYSIS

REPORT ON
UNIVERSAL RESOURCES CORPORATION
BLAND NO. 1-33
FOR BOB POWELL

Sec. 33, T. 21 N., R. 9 W.
Major Co., Oklahoma

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LOG INTERPRETATION

Dual Induction Laterolog (DIL), Spectral Density, Dual Spaces Neutron (SD-N), MicroElectric (MEL) and CAST Logs were run to a total depth of 9,321 feet on the Universal Resources Corporation Bland #1-33 well in Section 33, T21N-R9W of Ames Field, Major County, Oklahoma. Total depth for the logs was 139 feet shy of the driller's total depth. Only the DIL and SD-N Logs were provided for analysis.

This well is located on the eastern part of the central rebound feature of the Ames Impact Crater. This feature is composed primarily of granite breccia which provides a prolific reservoir as well as the uplifted rim of the crater. As shown in Figure 1, this rebound feature is apparent at the Sylvan shale level. The rebound feature is a circular feature centrally located inside of the crater. The uplifted rim can be recognized, beginning on the west, as a ring of southward extending noses apparent north of Section 3 T20N-R10W, northward through Sections 34, 27, 22, 14 and northeastward through Sections 11 and 12 of T21N-R10W, then eastward through 6,5,4, and then southeastward through sections 3, 11, 14, and southward through 23, 25 and 36 of T21N-R9W, then south and southwestward through Sections 1,2,10,11,15,16,17 and 20 of T20N-R9.

In the same fashion, the rim of the central rebound feature can be traced from Sections 26 and 24 of T21N-R10W on the west, northeastward and eastward through Sections 19,20,17 and then southward through Section 4, 28, 27, 33 and 34 of T21N-R9W.

The reason the crater floor morphology can be traced relatively to the crater rim is because of differential compaction of different breccias involved. Both Arbuckle dolomite and granite breccias were created as part of an upward rebound after release of tremendous compressive forces on a transient crater floor. Both were thrown upward and became part of the fallback that substantially filled the crater. The granite breccia was derived from and extends into basement at the center of the crater and remains centrally located. Arbuckle dolomite breccia filled in between the granite breccia and the uplifted rim. The dolomite breccia underwent extensive dissolution, karsting and compaction. By contrast, the granite breccia underwent much less of these processes and compacted relatively little compared to the dolomite breccia. This left the dolomite breccia forming a "moat" around the now higher granite breccia in the central rebound feature. This differential compaction process continued over extensive geological time, causing the crater rim and floor morphology to be expressed upsection. Figure 2 is mapped at the base of the Woodford and shows the same morphological features as Figure 1. Figure 3, at the base of the Checkerboard shows these features smoothed out but still reflects compaction of the breccias within the crater through checkerboard time.

Figure 4 shows the origin of the granite breccia in the central rebound feature. The analog Manson crater is about twice the size as the Ames Crater but the morphologies of craters in the 7+ kilometers in diameter range is classic. Some of the rebound material apparently became subject to intense heat, either on the bottom of the transient crater as overhead pressures decreased to the point where material was no longer being excavated outward and upward along the crater walls, but prior to rebound, or during rebound up into a "fireball." This heat generated pseudopyroclastic material. Other fine material was generated from the impact. The fine material surrounded the crater and was available to infiltrate porosity in breccias in the crater. This infiltration is more pronounces in lows. Typically the resulting interclast porosity is apparent on logs and in core.

The most apparent indicator of the granite breccia is the gamma ray log. Local granite breccias approximate 150 API units, typical for the potassium-rich alkali feldspars-orthoclase, anorthoclase and microcline. The solid granite has somewhat higher values, grain densities - less dense than quartz at 2.65 gm/cc, and PE values somewhat higher than quartz at near 2.0. The porosity logs show a sandstone profile when a limestone matrix is assumed to compute porosity. However porosity is actually somewhat less than usually assumed for sandstone porosity due to the less dense feldspars. Heavy minerals, primarily pyrite, offset the lighter feldspars to some extent. Note grain densities from core analysis average 2.65 gm/cc.

Porosities measured by core analysis over the upper part of the granite breccia vary from 1.2 to 5.1%. Much of the interbreccia space is filled. The higher porosity is associated with open vugs within the infilling material. Logs indicate that porosity systematically improves downward below the cored material. This would be consistent with decreasing infiltration of fine material from above into the open granite breccia.

Sharp high-resistivity spikes appear on the laterolog. These spikes are not as apparent on the induction logs. They are apparent on the porosity logs but sharper on the density log than they are on the neutron log. These spikes are interpreted as large pieces of granite breccia-large enough to encircle most of the hole. As such, they should not be regarded as reservoir seals or even anything more than very local barriers to vertical flow near the borehole. For example, the resistive and low porosity spike centered at 9,221 feet may provide little protection from water below.

Invasion profiles are good indicators of permeability and open interbreccia space. When all the resistivity curves agree on the same values - the interpretation is that no invasion was possible. Examples are centered at 9185, 9192, and 9216 feet. Lack of invasion is supported by absence of mud cake on the caliper. While a microlog was run, it was not provided for analysis, but should also confirm lack of mud cake. These intervals are more likely to provide some type of local barrier to flow near the bore hole than the tight spikes described above. Thus, if water coning from below 9,221 feet is not stopped by the low porosity spike at 9,221 feet, a retainer could be set at 9,215 feet above the non-invaded interval at 9,216 and the zone below squeezed.

It is important to determine the nature of the low-invasion/low-permeability zones. Could they result from stratified infiltrated fines at some early ground water level?

What is their lateral extent and continuity? How will they affect secondary and tertiary recovery efforts?

A 100% water level is apparent below 9,270 feet where 10% porosity checks with an $Rt=R_0$ of 3 ohm meters using R_w=0.03 assuming "A"=1 and "m"=2.0. No special core analysis has been done to obtain values of "A", "m" and "n" for use in water saturated equations in this granite breccia. However, a hydrocarbon column is present in the upper part of the 9,222 to 9,244 foot relatively uniform porosity zone. The column appears to transition from 3 X R_0 upward to 7 X R_0, indicating commercial production may be obtainable from the very top of the zone. Normally such a long transition would imply low permeability. However there is considerable evidence of natural leakage of hydrocarbons in the geological past, perhaps due to rupture in the Oil creek shale seal, possibly from differential compaction. It is very probable the hydrocarbons below 9,222 feet are residual from such natural leakage. The lowest interval recommended for testing is from 9,200 to 9,212 feet. Here resistivities average 100 ohm-meters (some 30 X R_0) and should produce water free.

The CAST log should be interpreted as to vertical grading of granite breccia clasts and shapes. In some areas the arrangement of the granite breccia suggests the occurrence of talus slides from a higher structure. Any paleotopographic high of granite breccia can be sealed by Oil Creek shale and form a separate trap for hydrocarbons, almost independent of structural position. Therefore it is important to do detailed analysis of the image logs both for offset potential and for implications of barriers to fluid flow.

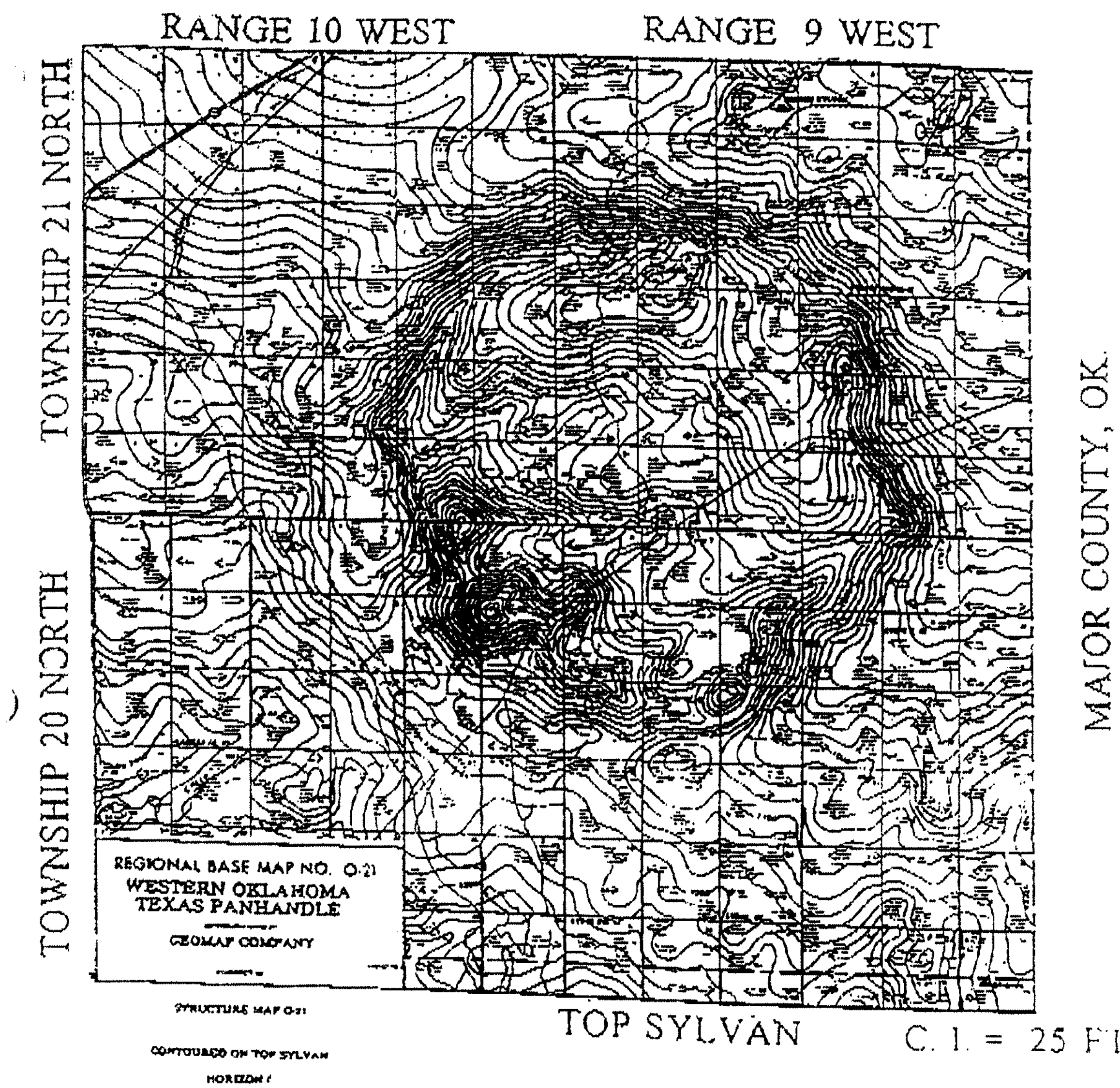


FIGURE 1

Structure map on top of Sylvan shale shows in detail of 25 foot contours the large circular feature known as the Ames Crater. The -7,000 foot contour approximates the crater diameter relative to -6,800 feet contours on the rim. The uplifted rim becomes more apparent when regional SW dip is removed and surface projected in 3-D - see cover article in the *OK Geology Notes*, Vol. 52, No. 6, December, 1992. Morphology of crater and granite breccia in central rebound feature forming inner circle is classic for impact craters of this size.

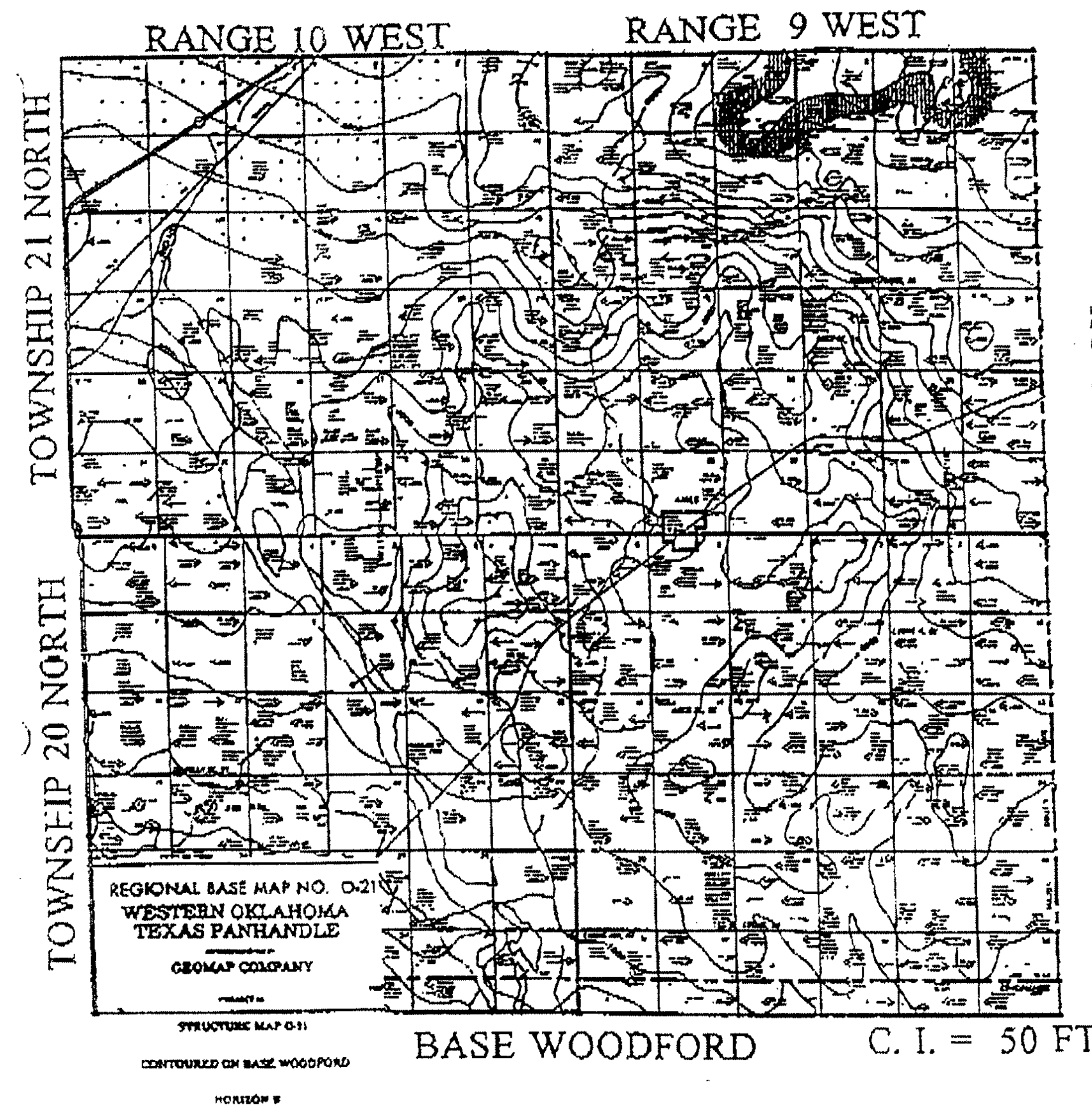


FIGURE 2

Structure map on base of Woodford shale about 100 feet above the Sylvan. Fifty-foot contours show shape and size of crater at Arbuckle level. Impact craters are commonly expressed upsection as breccia fill compacts under load of overburden. The similarity of the Woodford and Sylvan contours suggests much of the compaction occurred post Hunton.

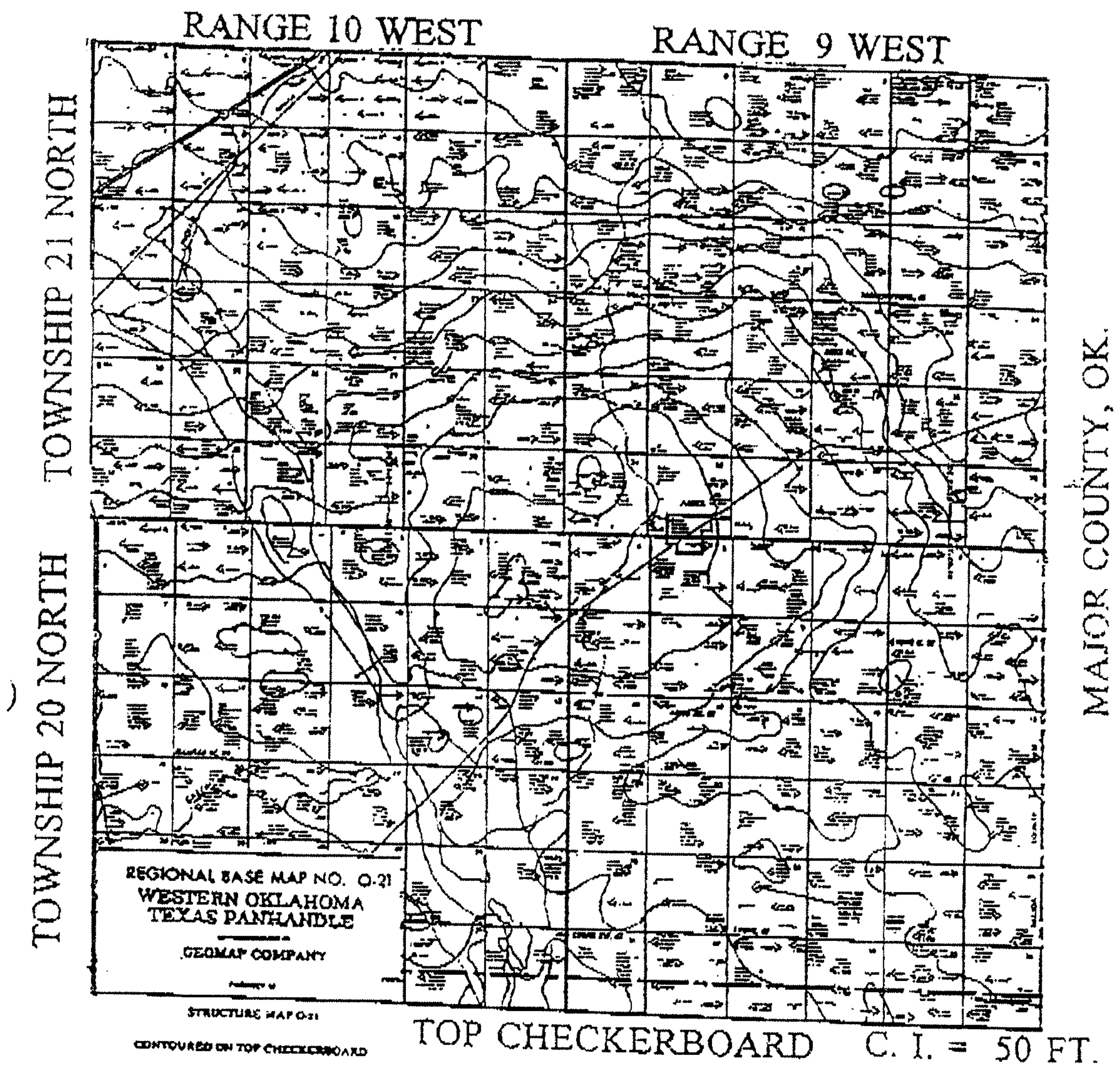


FIGURE 3

Structure map at top of the Checkerboard marker about 700 feet above the Sylvan shale. Fifty foot contours continue to copy the shape and slightly smooth the rim of the crater at the Arbuckle level. A surface lineament study suggests the crater is expressed all the way to the surface.

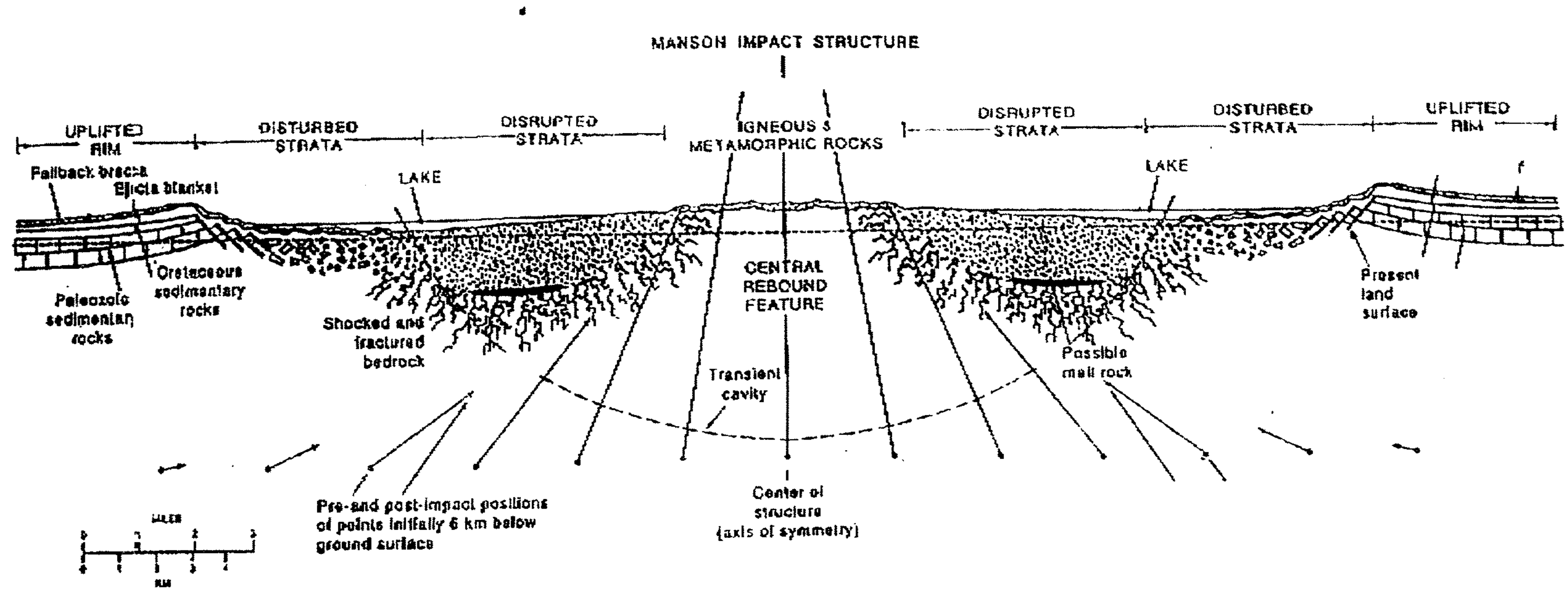


FIGURE 4
Interpretive cross section of a larger and younger, analogous impact crater near Manson, Iowa. The position of the transient cavity present during formation of the structure is indicated by the curved dashed line. Rough estimates of the movement of material required to fill the transient cavity and produce the central peak are indicated by the arrows. Arrows extending above the ground surface suggest some material in the rising central peak may have been airborne for a short time before crashing back to Earth and producing an impact breccia. (Modified from Hartung and other, 1990.)

UNIVERSAL RESOURCES CORPORATION
BLAND NO. 1-33
9189.1A FEET

GRANITE BRECCIA
SEC. 33 T21N-R9W
MAJOR COUNTY, OK

Granite Clast with Sandstone and Mudstone Matrix

This sample is to examine the contact of sandstone and mudstone with the granite clasts. The granite contains small fracture pores and dissolution pores in perthite and mica. The dissolved areas contain illite, dolomite, and bitumen cements. Dolomitic mudstone overlies and is interbedded with arkosic litharenite sandstone and granite clasts. Detrital grains in the sandstone are dominated by dolomite. No shocked quartz is observed.

--Figure Captions for photos on the facing page. Figure 1 - top left. Figure 4 - bottom right.--

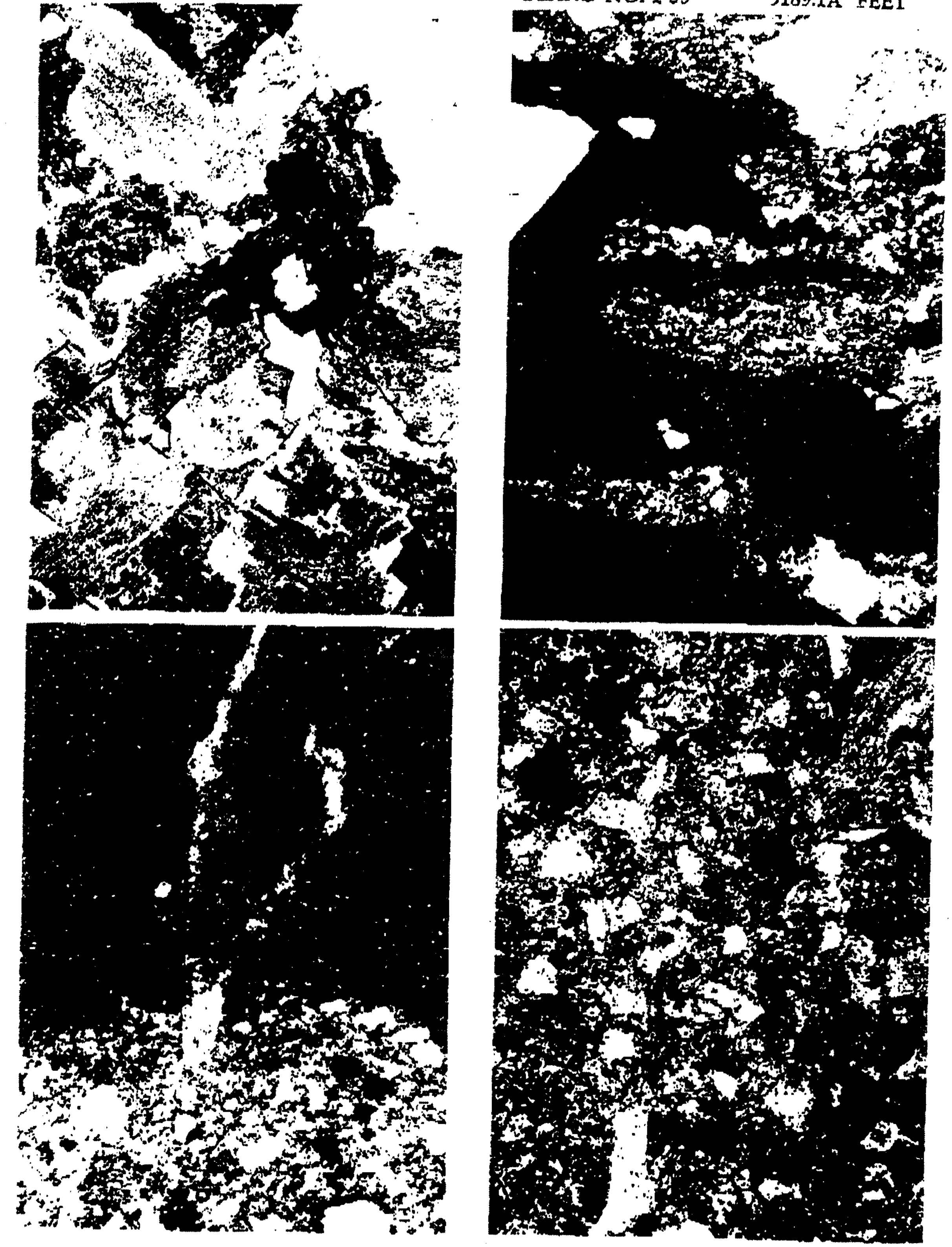
Figure 1. Black bitumen and light green, microporous illite cement small fractures and dissolution pores within a granite clast. Note murky altered feldspars and white quartz.
Thin Section, Plane Polarized Light, 20X, |.................| 1mm

Figure 2. Bedded and interbedded arkosic litharenite sandstone and very fine-grained detrital dolomite mudstone. The black grains are pyrite.
Thin Section, Plane Polarized Light, 20X, |.................| 1mm

Figure 3. Small fractures cross the dolomitic mudstone and enter the lithic arkose sandstone at a small dolomite-lined vug.
Thin Section, Plane Polarized Light, 40X, |.................| 500μm

Figure 4. Sand-size clastic grains of quartz, feldspar, and dolomite. Opaque grains are pyrite.
Thin Section, Plane Polarized Light, 100X, |.......................| 200μm

UNIVERSAL RESOURCES CORPORATION BLAND NO. 1-33 9189.1A FEET



UNIVERSAL RESOURCES CORPORATION
BLAND NO. 1-33
9189.1B FEET

GRANITE BRECCIA
SEC. 33 T21N-R9W
MAJOR COUNTY, OK

Sandstone and Mudstone Matrix

This sample is to evaluate the dense gray material at the top of the core. The gray material is a dolomitic mudstone which is bedded to laminated. It contains quartz silt and some large granite clasts and gradationally overlies the sandstone matrix material. Sandstones are arkosic litharenite with abundant dolomite grains. The sandstone are cemented by dolomite and show isolated dissolution pores. No shocked quartz is observed.

--Figure Captions for photos on the facing page. Figure 1 - top left. Figure 4 - bottom right.--

Figure 1. Dense dolomitic mudstone with minor quartz and feldspar silt. Laminae are depositional and continue down into Figure 3.
Thin Section, Plane Polarized Light, 20X, |.................| 1mm

Figure 2. The coarser-grained matrix material is a sandstone of dolomite, quartz, feldspar and granite rock fragment grains. The grains are cemented by a very fine-grained dolomite mud.
Thin Section, Cross Polarized Light, 40X, |.................| 500μm

Figure 3. Contact of the arkosic litharenite sandstone with the overlying dolomitic mudstone. Sedimentary structures are visible at this scale.
Thin Section, Plane Polarized Light, 20X, |.................| 1mm

Figure 4. A small vug within the sandstone is partially filled by ferroan dolomite. Note the slightly curved crystal faces.
Thin Section, Plane Polarized Light, 100X, |........................| 200μm

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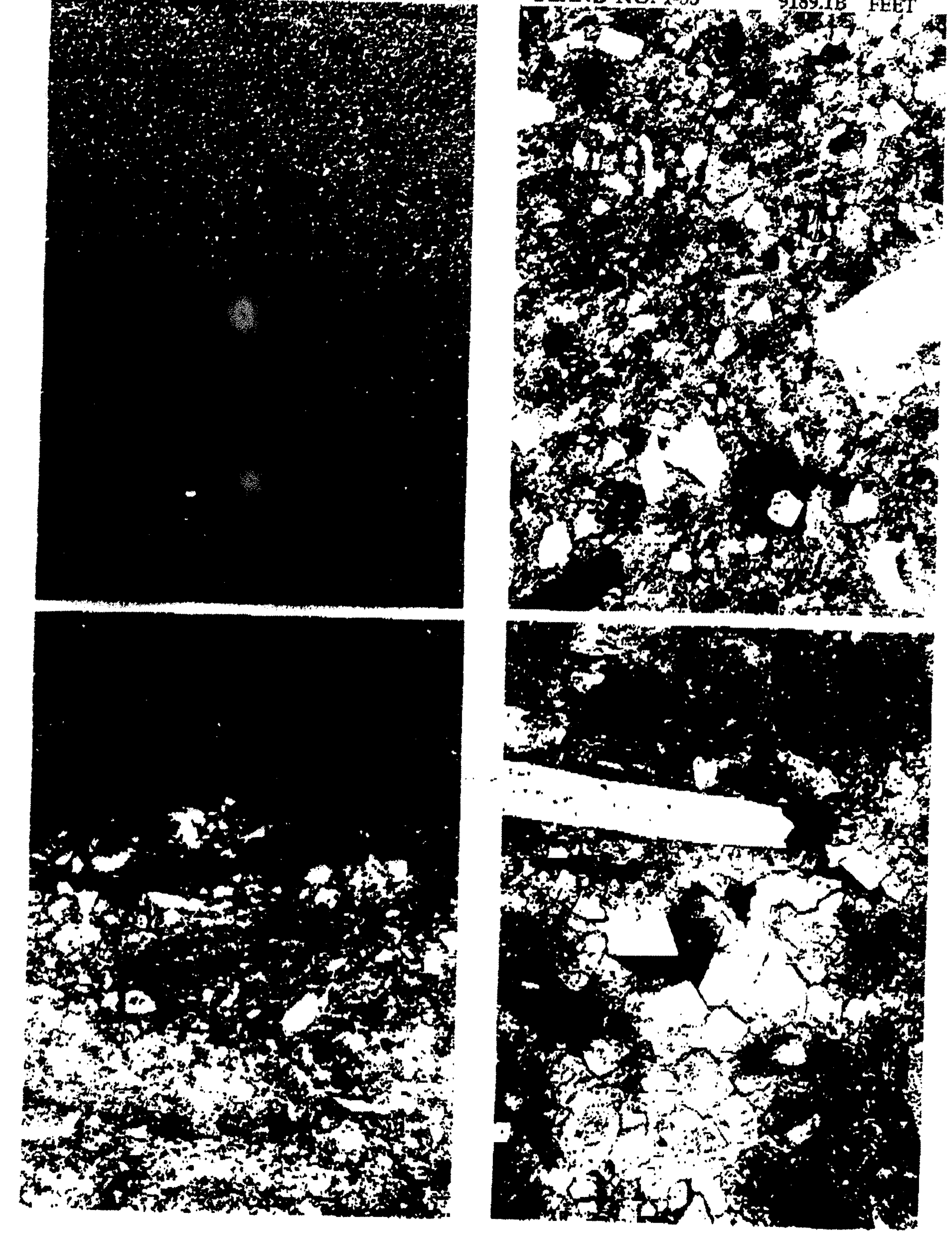


UNIVERSAL RESOURCES CORPORATION
BLAND NO. 1-33
9191.0 FEET

GRANITE BRECCIA
SEC. 33 T21N-R9W
MAJOR COUNTY, OK.

Granite Clast Overlain by Sandstone and Mudstone Matrix

This sample illustrates the common stratigraphy of a granite clast overlain by an arkosic litharenite of dolomite, quartz, and feldspar. The sandstone is gradationally overlain by a laminated silty dolomitic mudstone. There is little intergranular porosity, but isolated grains are dissolved yielding dissolution pores. Bitumen is present in some dissolution pores and fractures. No shocked quartz is observed.

–Figure Captions for photos on the facing page. Figure 1 - top left. Figure 4 - bottom right.–

Figure 1. Dolomitic mudstone overlies and is interbedded with a sandstone that overlies a large granite clast shown in Figure 3. Opaque grains are pyrite.
Thin Section, Plane Polarized Light, 20X, |.................| 1mm

Figure 2. Dissolution pores and fractures within the large granite clast contain illite and bitumen. Dissolution pores are after mica and feldspar.
Thin Section, Plane Polarized Light, 20X, |.................| 1mm

Figure 3. A large granite clast is overlain by angular and subangular quartz and feldspar grains which are cemented by medium crystalline dolomite. Intergranular pores are bounded by quartz, feldspar, or dolomite. The sandstone grades up into a mudstone as in Figure 1.
Thin Section, Plane Polarized Light, 20X, |.................| 1mm

Figure 4. The origin of the large dissolution pores in the sandstone matrix is not known. They are presently bridged by microporous illite. The pores are surrounded by the dolomitic matrix sandstone.
Thin Section, Plane Polarized Light, 100X, |........................| 200μm

UNIVERSAL RESOURCES CORPORATION BLAND NO. 1-33 9191 FEET

UNIVERSAL RESOURCES CORPORATION
BLAND NO. 1-33
9191.4A FEET

GRANITE BRECCIA
SEC. 33 T21N-R9W
MAJOR COUNTY, OK

Matrix Sandstone and Mudstone

This sample shows some large vugs in the matrix material vugs that are lined by detrital grain surfaces and diagenetic dolomite. Sandstones are overlain by dolomitic mudstones. Shelter pores are present below larger detrital grains and may be the reason for larger vugs too. Small fractures are present in the mudstones which are generally cemented by dolomite. No deformation lamellae in quartz grains were observed.

–Figure Captions for photos on the facing page. Figure 1 - top left. Figure 4 - bottom right.–

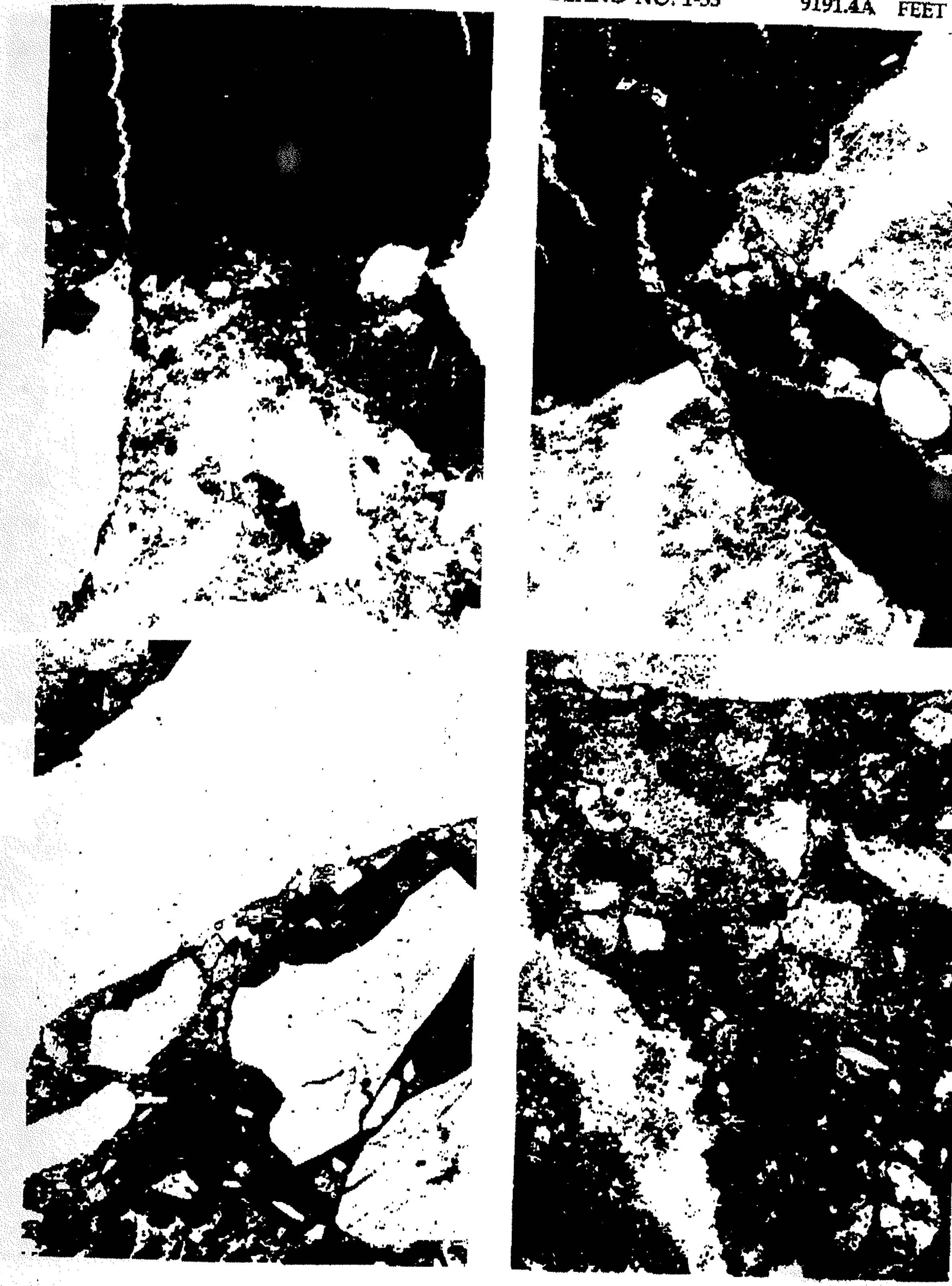
Figure 1. Characteristic sandstone overlain by dolomitic mudstone. Also note the large dissolution pore with illite cements that is connected to a subvertical fracture in the dolomitic mudstone. Opaque material is pyrite.
Thin Section, Plane Polarized Light, 20X, |................| 1mm

Figure 2. Shelter porosity is apparent in this sample beneath some granite clasts. Carbonate mud is present on the low side of the interclast area and the shelter vug is lined by larger diagenetic dolomite crystals. Also note cemented tension fractures.
Thin Section, Plane Polarized Light, 20X, |................| 1mm

Figure 3. Another example of probable shelter porosity beneath a larger grain. Note the mud is only on the low side. The pore is lined by diagenetic dolomite.
Thin Section, Plane Polarized Light, 20X, |................| 1mm

Figure 4. Small dissolution pores lined by pore bridging illite are common in the matrix sandstone. The pores represent the removal of some detrital grain. Quartz, feldspar and dolomite grains are visible.
Thin Section, 100X, |......................| 200μm

UNIVERSAL RESOURCES CORPORATION BLAND NO. 1-33 9191.4A FEET



UNIVERSAL RESOURCES CORPORATION
BLAND NO. 1-33
9191.4B FEET

GRANITE BRECCIA
SEC. 33 T21N-R9W
MAJOR COUNTY, OK

Matrix Sandstone

This sample was taken to evaluate a large dark clast that is apparently partially dissolved. The identity of the dissolved grain is unknown, but the space is filled by chlorite, illite, and pyrite and the grain is rimmed by chalcedony cement (chert) and dolomite cements. Small amounts of intergranular porosity is present, but most porosity in the slide is from dissolution of dolomite or the unknown grains. No quartz grains with deformation lamellae were observed.

—Figure Captions for photos on the facing page. Figure 1 - top left. Figure 4 - bottom right.—

Figure 1. The matrix material shows the typical fining upwards grading. Also note the dissolved grains and abundant opaque pyrite.
Thin Section, Plane Polarized Light, 20X, |................| 1mm

Figure 2. A large, altered, dissolved grain is shown here in thin section. The interior is a mixture of microporous illite, pyrite, and dolomite. The bottom edge is white, inclusion-rich chert, and the sides are rimmed by dark very fine-grained pyrite.
Thin Section, Plane Polarized Light, 20X, |................| 1mm

Figure 3. Detail of the lower rim of chert in Figure 2. Also note the diagenetic dolomite between the chert and a granite clast.
Thin Section, Cross Polarized Light, 100X, |......................| 200μm

Figure 4. Detail of the matrix showing dolomite and quartz grains and a dissolved grain. The dissolution pore contains pyrite and illite. Only microporosity is visible between the detrital grains.
Thin Section, Plane Polarized Light, 100X, |......................| 200μm

UNIVERSAL RESOURCES CORPORATION
BLAND NO. 1-33
9193.7 FEET

GRANITE BRECCIA
SEC. 33 T21N-R9W
MAJOR COUNTY, OK

Matrix Sandstone

Matrix material consisting of granite rock fragments 3 to 100 mm in size and sand-sized quartz, feldspar, and dolomite grains. The rock is cemented by dolomitic mud and diagenetic dolomite and contains diagenetic pyrite. Pores after unknown dissolved detrital grains are filled by microporous illite and chlorite and may contain bitumen. Intergranular porosity is preserved in this sample. No quartz grains with deformation lamellae were observed.

–Figure Captions for photos on the facing page. Figure 1 - top left. Figure 4 - bottom right.–

Figure 1. Typical composition of a granite clast. The granite is dominated by quartz, perthite, and plagioclase with minor amounts of mica.
Thin Section, Plane Polarized Light, 20X, |................| 1mm

Figure 2. The matrix material is again graded from coarse sandstone to bedded dolomitic mudstone. Small cemented fractures are common in the mudstone.
Thin Section, Plane Polarized Light, 20X, |................| 1mm

Figure 3. Locally, intergranular porosity is important within the matrix material. More than half of the detrital grains are dolomite. Also note altered mica and opaque pyrite near the center of the photo.
Thin Section, Cross Polarized Light, 40X, |................| 500μm

Figure 4. Typical dissolution porosity within perthite in granite clasts. Also note diagenetic dolomite which cements the intergranular area.
Thin Section, Plane Polarized Light, 100X, |......................| 200μm

UNIVERSAL RESOURCES CORPORATION

BLAND NO. 1-33 9193.7 FEET