BASIC ROCK PROPERTIES REPORT

AND

Lo 16-20 Well

DETAILED PETROGRAPHICAL STUDY

FOR

PETRO-TECH PERUANA S.A.
LO16-20 WELL

+
X - RAY

CORE LABORATORIES

July, 1995

File: 9501015

CORELAB

CORE LABORATORIES

COUSA CILLONIZ OLAZABAL URQUIAGA S. A.
ASOCIADOS
COEST - CONSTRUTORA S/A

Petrofísico
95- 10.06

CC/CHII/C0203/95

Callao, 12 de Julio de 1995

Señores
Petro-Tech Peruana S.A.
Presente.-

At. : Sr. Héctor Chang

Referencia : **Análisis Mineralog.**

Estimados señores :

Estamos enviando los resultados preliminares de los análisis de Mineralog realizados en cinco (5) muestras del Pozo LO/6-20.

Cualquier inquietud al respecto, favor no duden en comunicarse con nosotros.

Atentamente,

COUSA - COEST CONSTRUTORA S/A
ASOCIADOS

ING. OSCAR ZAVALA S.
GERENTE

Incl. : Lo indicado.
EHP/ecr.

PETRO-TECH PERUANA S.A.
JUL 13 1995
FIRMA: 2241
RECEPCION

Calle Gamma N° 150 Ofs. 301 - 308, Parque Internacional de Industria y Comercio - Callao - Perú, Tefs. 464-5354 451-1760 Telefax 452-3591
Calle Moore 1756 - Iquitos - Perú Teléfono: 236332 Telefax: 094 - 242847

Maracaibo - Venezuela

MINERALOG ANALYSIS®

(Weight Percent)

Company : PETRO-TECH PERU

Well : LO16-20

File : RGS-95051V

Sample No.	Depth feet	Grain Density gr/cc	TEKTOSILICATES			CARBONATES			SULPHATES	SULPHIDES	CLAYS			
			Quartz	Plagioclase	K-Feldspar	Calcite	Dolomite	Siderite	Anhydrite	Pyrite	Kaolinite	Chlorite	Illite + Smectite	TOT CLA
-	8095.0	3.20	18	6	0	0	0	50	0	0	2	0	24	2
-	8281.0	2.66	32	12	0	0	0	2	0	0	5	0	49	5
-	8405.0	2.65	37	12	0	0	0	1	0	0	2	0	48	5
-	8612.0	2.66	31	14	0	15	0	0	0	0	7	0	33	4
-	8670.0	2.66	30	16	0	10	0	0	0	0	6	0	38	4

COUSA CILLONIZ OLAZABAL URQUIAGA S. A.
ASOCIADOS
COEST - CONSTRUTORA S/A

Petrofísico
95-10-06

CC/CHII/C191/95

Callao, 06 de julio de 1995

PETRO TECH-PERUANA S.A.
GERENCIA PLANEAMIENTO
EXPLORACION - PRODUCCION
10 JUL. 1995
RECIBIDO
FIRMA

Señores
PETROTECH
PERUANA S.A.
Av. Los Incas No. 460,
SAN ISIDRO

At.: **Ing. Héctor Chang**

Ref.: **Resultados de las Pruebas Petrofísicas Básicas - Pozo L016-20**

Estimados señores:

Adjunto a la presente estamos enviando los resultados de las pruebas petrofísicas básicas (porosidad, permeabilidad por CMS - 300 y densidad de grano) realizadas en muestras del pozo L016-20 por nuestra nuestra representada, Core Laboratories.

Agradeciendo la atención brindada a la presente, quedamos a su entera disposición para cualquier consulta. Sin otro particular, nos despedimos.

Atentamente,

COUSA COEST CONSTRUTORA S/A
ASOCIADOS

ING. OSCAR ZAVALA S.
GERENTE

CTP/rbf

PETRO-TECH PERUANA S.A.
JUL. 10 1995
FIRMA: 2180
RECEPCION

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Calle Moore 1756 - Iquitos - Perú Teléfono: 236332 Telefax: 094 - 242847

COUSA
CILLONIZ OLAZABAL URQUIAGA S. A.
ASOCIADOS
COEST - CONSTRUTORA S/A

COMPA?IA: PETRO-TECH PERU
POZO : L016-20
LOCAL :
DIST.EST:

CAMPO :
FORMACION:
FLUIDOS :
ELEVACION:

FECHA : 06-JUL-1995
API No. :
ANALISTA: US

RESULTADOS DE ANALISIS

(CONFINAMIENTO HIDROSTATICO)

NUMERO MUESTRA	PROFUNDIDAD	PRES SOBRECARGA (1000 Lpc)			HELIUM POROSITY	DENSIDAD GRANO
		K∞	Kair	POROSIDAD		
	Pies	md	md	%	%	gr/cc
1	7582.0				3.10	2.69
2	7610.0	0.010	0.017	4.7		2.69
3	7620.0				5.00	2.72
4	7650.0				2.70	2.71
5	7968.0				7.30	2.72
6	7984.0				10.20	2.77
7	8045.0				7.40	2.78
8	8176.0				11.40	2.69
9	8186.0	5.04	6.30	6.9		2.69
10	8225.0	<.001	<.001	3.2		2.70
11	8523.0	<.001	<.001	4.0		2.70
12	8536.0	0.006	0.009	5.4		2.70
13	8542.0	0.007	0.015	7.5		2.68
14	8594.0	0.003	0.006	6.0		2.70
15	8601.0	0.005	0.009	6.2		2.70
16	8640.0	<.001	<.001	2.7		2.69

Calle Gamma Nº 150 Ofs. 301 - 303 - 304 - 308, Parque Internacional de Industria y Comercio - Callao - Perú, Teléfono 645354 Telefax 523591
Calle Moore 1756 - Iquitos - Perú Teléfono: 094 - 242847 - 236332

CORE LAB

CORE LABORATORIES

Santa Fe de Bogotá, July 24, 1995

Messrs.
PETRO-TECH PERUANA S.A.
Santa Fe de Bogotá

Attention: **Mr. HECTOR CHANG R.**

Subject: Basic Rock Properties and Detailed Petrographical study, LO16-20 Well, File No. 9501015

Dear Sirs,

CORE LABORATORIES is pleased to present the final report of the core analyses performed on the **LO16-20** well.

The services performed were:

- Porosity and Permeability by CMS-300 at 1000 psi
- Helium Porosity
- Sidewall Core Storage
- Grain Density
- Mineralog Analysis
- Detailed Petrographical Study

It has been our pleasure to participate with **PETRO-TECH** in this project. We trust that the information provided in this report will aid in the evaluation of this well and in your reservoir development. If you should have any questions concerning this report or require further information about **Core Laboratories** services, please do not hesitate to contact us at 674 0400.

Sincerely yours,

CORE LABORATORIES

CORE LAB
Nit. 830.000.922-7

ALFONSO MORENO C.
Petroleum Engineer
Operations Manager

p.p. **URIEL SANCHEZ**
Petroleum Engineer
Rock and Fluids Laboratory

Enclosed: Two original copies of report

Carrera 39 No. 168-42 - Telephones (57) 1-6740400 - (57) 1-6749594 - (57) 1-6705003
Telefax: (57) 1-6730060 Santafé de Bogotá, D.C. - Colombia

TABLE OF CONTENTS

GENERAL INFORMATION

Company: Petro-Tech Peruana S.A.
Well Name: LO16-20

Twenty three (23) sidewall cores were cut and recovered from the subject well and were received at the Bogotá Core Laboratories facility. The sidewall core intervals received at the laboratory are listed in the core inventory table which follows this general information discussion.

Upon arrival of the core at the laboratory, each sidewall core was handled on a separate basis following a general analytical routine, also described in the core analysis procedures discussion. The general laboratory procedures sequence followed the work process flow diagram found within this section of the report.

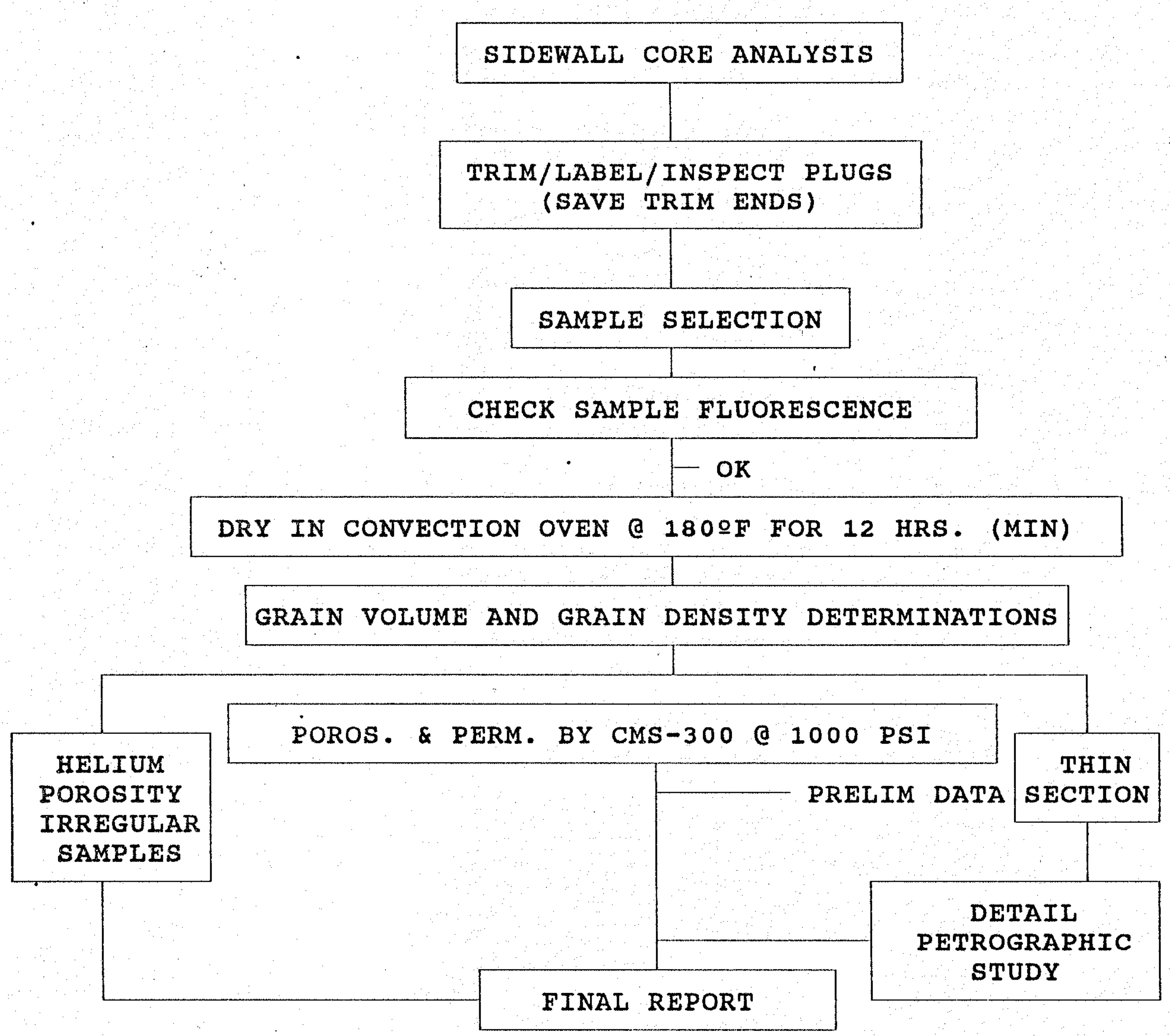
Preliminary core analysis data was reported to Petro-Tech on a regular basis in tabular and digital formats.

The core material from this well is presently in storage at our Bogotá facility.

CORE INVENTORY
COMPANY : PETROTECH PERUANA S.A
WELL NAME : LO16-20
FORMATION : BASAL SALINA
ARENA : LOBITOS

Measure Depth (Ft.)	Length (In.)	Lithology	Fluorescence
8670	1 1/4	Claystone	NF
8640	1 1/2	Claystone	NF
8612	1 1/2	Sandstone	NF
8601	1 3/4	Sandstone	NF
8594	1 3/4	Sandstone	NF
8542	2	Sandstone	Good Fluor
8536	1 1/2	Sandstone	NF
8523	1 1/2	Sandstone	NF
8405	1 1/4	Claystone	NF
8281	1	Claystone	NF
8225	1 1/2	Sandstone	NF
8186	1 1/2	Sandstone	NF
8176	1 1/4	Conglomeratic Sandstone	Fair Fluor
8157	1/2	Conglomeratic Sandstone	Good Fluor
8139.5	1	Sandstone	NF
8110	1/2	Sandstone	NF
8045	1	Claystone	NF
7984	1/2	Sandstone	Fair Fluor
7968	1	Sandstone	NF
7650	1 3/4	Conglomeratic	Good Fluor
7620	1	Sandstone	NF
7610	1 3/4	Sandstone	NF
7582	1	Conglomeratic	Fair Fluor

WORK PROCESS FLOW DIAGRAM
PETRO-TECH PERUANA S.A.
WELL NAME: LO16-20



CORE ANALYSIS PROCEDURES

Plug Sampling and Preparation

The sidewall cores selected to basic rock properties were carefully trimmed to a right cylider using water as the trim saw blade lubricant. All plugs were labelled with number, sample depth and job file number. The trim ends of the plugs were labelled and saved for future potential petrologic analysis, and are presently in storage in our facility.

The sidewall core where was not possible to take a regular cylinder were used only to measure helium porosity.

Sample Cleaning and Drying

The samples were placed in soxhlet apparatus for complete extraction of residual hydrocarbons using Toluene. Plug samples were deemed clean after passing inspection under UV Light. Samples possessing hydrocarbon fluorescence were returned to the cleaning process until observed to be fully extracted of residual hydrocarbons.

Cleaned plug samples were then placed in a convection-type drying oven to heat at 180 °F for a minimum of 12 hours.

Grain Volume and Grain Density Determinations

Dried samples were allowed to cool in a desiccator to prevent the absorption of condensed atmospheric water during cooling. The samples were then weighed to .001 gm and measured by digital caliper for average length and diameter dimensions.

Before each group of plug samples was to be measured for grain volume determination by the Heise gauge porosimeter, check samples were run and recorded to verify calibration accuracy of the equipment. Grain volumes were measured for all the samples in order to determine sample grain densities and for later porosity calculations.

Grain densities were calculated for all the samples by:

$$\frac{\text{Dry Sample Weight (gm)}}{\text{Grain Volume (cc)}} = \text{Grain Density (gm/cc)}$$

Porosity and Permeability Measurements

One automated unsteady-state CMS-300 Klinkenberg permeameter/ porosimeters were utilized in the program for measurement of all suitable plug samples. The plug samples were measured at a net confining stress of 1000 psi for this well.

Before each group of 18 1" diameter plug samples (carousel capacity of CMS-300) was run, a helium leak test was performed, and a calibrated check plug of known pore volume was tested to evaluate equipment accuracy. A sample of the results of the QC measurements are found in the appendix of this report. A routine in the CMS-300 calls for a confining pressure check every 500 samples to monitor pressure stabilization. This check is important especially for low permeability samples that undergo a longer test duration, where a decrease in confining pressure during the test could adversely effect the analytical results.

Porosity for each plug sample was calculated using Boyle's Law by the CMS-300 using grain volume and pore volume data by:

$$\text{Porosity (\%)} = \frac{V_p}{V_p + V_g} \times 100$$

Where: V_p = Pore Volume at net confining pressure (cc)
V_g = Grain Volume (cc)

The total volumen ($V_p + V_g$) for irregular samples was measured using a mercury pung. The Klinkenberg (slip corrected) permeability for each plug sample was measured as a function of pressure decay (helium blow-down). A reference cell of known volume charged the sample with helium. A downstream valve vented the sample to atmosphere, and the change in pressure with time was monitored. The multiple flow regime data allowed the determination of Klinkenberg permeability of the sample measured, along with parameters helium slip factor (b) and the Forcheimer inertial resistance factor (ß) beta.

MINERALOG ANALYTICAL PROCEDURES

The Mineralog[R] analytical technique provides rapid and quantitative mineral identification based on Fourier Transform Infrared (FTIR) Spectroscopy (Griffths, 1968). Infrared radiation is transmitted through a powdered sample in a potassium bromide matrix. The energy absorbed by the sample is recorded and is then used to characterize the molecular bonds (Harville and Freeman, 1988). The technique uses mid-range infrared radiation (between wavelengths of 2.5 and 25 microns) to initiate chemical bond vibrations within the molecules (Farmer, 1974). Each mineral has characteristic "bond signatures" which are the measurements of the frequency of vibrations in a molecule.

The sample is prepared for analysis by grinding a representative fraction into a very fine powder to ensure that the particle size is below the incidental wavelength of the infrared energy (Fridmann, 1967). The sample is then dispersed in a potassium bromide matrix and pressed into a pellet for the infrared analysis.

By measuring the amount of energy transmitted through a sample of known weight, the mineral abundance is calculated using a multivariate statistical approach (Fast Fourier Transforms). Since minerals are strong infrared absorbers, only a very small quantity of material is required for the analysis. At the present time, over 60 minerals are calibrated for Mineralog[R]. The mineral list is continuously growing as pure standards are obtained and added to baselist of calibrated minerals. The following list is an example of the more common rock-forming minerals which can currently by identified by using the Mineralog analysis.

Quartz	Apatite
Plagioclase Feldspar	Calcite
Alkali Feldspar*	Dolomite
Pyrite	Siderite
Kaolinite	Barite
Illite + Smectite**	Anhydrite
Chloride ***	Gypsum

* can include albite
** includes illite, smectite, mixed-layer clays, muscovite
*** includes biotite

Quality control verification using other mineral identification methods shows that mineral percentages using the Mineralog[R] technique are accurate to 5 weight percent (Harville and Freeman, 1988).

DATA RESULTS

Company: Petro-Tech Peruana S.A.
Well Name: L016-20

Tabulated core analysis results for the total interval include plug sample number, depht, permeability/porosity and sample grain density. Porosity and permeability data is presented for all measured plugs @ 1000 psi net confining stress, the helium porosity is presented at ambient conditions.

CMS-300 detailed test data are tabulated including measured sample pore volume, calculated porosity, Klinkenberg permeability, estimated air permeability, b slip factor, beta and alpha. An explanation of terms and applications of data are found in the appendix.

Mineralog Analysis are presented in tabular form. For the five samples selected for this analysis.

TABULAR DATA, TOTAL INTERVAL

CORE LABORATORIES

Company : PETRO-TECH PERU
Well : L016-20
Location :
Co,State :

Field :
Formation :
Coring Fluid :
Elevation :

File No.: 9501015
Date : 6-Jul-1995
API No. :
Analysts: US

CORE ANALYSIS RESULTS

(HYDROSTATIC CONFINEMENT)

SAMPLE NUMBER	DEPTH	NET OVERBURDEN (1000 Lpc)			HELIUM POROSITY	GRAIN DENSITY
		K∞	Kair	ϕ		
	ft	md	md	%	%	gm/cc
1	7582.0				3.10	2.69
2	7610.0	0.010	0.017	4.7		2.69
3	7620.0				5.00	2.72
4	7650.0				2.70	2.71
5	7968.0				7.30	2.72
6	7984.0				10.20	2.77
7	8045.0				7.40	2.78
8	8176.0				11.40	2.69
9	8186.0	5.04	6.30	6.9		2.69
10	8225.0	<.001	<.001	3.2		2.70
11	8523.0	<.001	<.001	4.0		2.70
12	8536.0	0.006	0.009	5.4		2.70
13	8542.0	0.007	0.015	7.5		2.68
14	8594.0	0.003	0.006	6.0		2.70
15	8601.0	0.005	0.009	6.2		2.70
16	8640.0	<.001	<.001	2.7		2.69

CMS-300 DETAIL DATA

CORE LABORATORIES

Company : PETRO-TECH PERU
Well : L016-20
Location :
Co,State :

Field :
Formation :
Coring Fluid :
Elevation :

File No.: 9501015
Date : 6-Jul-1995
API No. :
Analysts: US

C M S - 3 0 0 T E S T D A T A

SAMPLE NUMBER	DEPTH ft	NOB PRESSURE psi	PORE VOLUME cc	POROSITY %	K∞ md	Kair(est) md	b (He) psi	BETA ft(-1)	ALPHA microns
2	7610.0	1000.0	0.67	4.7	0.010	0.017	48.01	9.8646E14	3.21800E4
9	8186.0	1000.0	0.76	6.9	5.04	6.30	11.55	3.4900E10	5.65388E2
10	8225.0	1000.0	0.37	3.2	<.001	<.001	41.85	1.9244E15	2.02741E4
11	8523.0	1000.0	0.44	4.0	<.001	<.001	41.76	1.9238E16	2.04364E5
12	8536.0	1000.0	0.58	5.4	0.006	0.009	30.12	3.9614E16	8.01825E5
13	8542.0	1000.0	1.03	7.5	0.007	0.015	76.85	4.1744E15	9.92741E4
14	8594.0	1000.0	0.71	6.0	0.003	0.006	73.76	3.4338E16	3.64364E5
15	8601.0	1000.0	0.78	6.2	0.005	0.009	68.98	2.4199E16	3.69241E5
16	8640.0	1000.0	0.30	2.7	<.001	<.001	41.98	1.9199E16	2.19241E5

MINERALOG ANALYSIS DATA

CORE LABORATORIES VENEZUELA, S. A.

Maracaibo - Venezuela

MINERALOG ANALYSIS®

(Weight Percent)

Company : PETRO-TECH PERU

Well : LO16-20

File : RGS-95051V

Sample No.	Depth feet	Grain Density gr/cc	TEKTOSILICATES			CARBONATES			SULPHATES	SULPHIDES	CLAYS			
			Quartz	Plagioclase	K-Feldspar	Calcite	Dolomite	Siderite	Anhydrite	Pyrite	Kaolinite	Chlorite	Illite + Smectite	TOTAL CLAYS
-	8095.0	3.20	18	6	0	0	0	50	0	0	2	0	24	26
-	8281.0	2.66	32	12	0	0	0	2	0	0	5	0	49	54
-	8405.0	2.65	37	12	0	0	0	1	0	0	2	0	48	50
-	8612.0	2.66	31	14	0	15	0	0	0	0	7	0	33	40
-	8670.0	2.66	30	16	0	10	0	0	0	0	6	0	38	44

PETROGRAPHICAL STUDY

PETRO-TECH PERU

DETAILED PETROGRAPHICAL STUDY OF 11 SIDEWALLCORES FROM L016-20 WELL

CORE LABORATORIES

GEOLOGISTS: G. GUTIERREZ G.

JULY 1995

CONTENTS

TABLES

FIGURES

PLATES

THIN SECTION PHOTOMICROGRAPHS

SUMMARY

This report presents the results of a petrographical study undertaken on eleven sidewallcores from Well L016-20. The sandstones are predominantly Lithic Arkoses to Arkoses (8640'), with one Feldspathic Litharenite (7650'), which are compound predominantly by plagioclase feldspar, monocrystalline quartz, and rock fragments.

Average grain size ranges from coarse silt to very coarse grained, and the sandstones range from being very poorly to moderately sorted. Those samples are inmature in terms of textural maturity. Grain contacts are predominantly puntual, long, concavo-convex, and locally sutured. Most of the samples exhibit subparallel alignment of elongate grains.

The framework grains are mainly plagioclase feldspar, which shows a progressive decrease in abundance from deeper depths (8601', 8542') through shallower ones (7610', 7560'). A high percent of plagioclase is altered to calcite minerals. Monocrystalline quartz is dominant ranging between 22.52% and 7.73%, and less amounts to traces of polycrystalline quartz. Rock fragments are derived from sedimentary rocks (chert, argillaceous, and sand/siltstone clasts), and less common amounts of metamorphic rocks.

Accesory grains are common ranging from 37.6% to 4.02%, and are compound of micas biotite, glauconite pellets, and muscovite flakes, combination of organic matter, locally oxides, and opaque minerals.

Detrital clay matrix is present and it was classified as undeterminated clay (probably illite-smectite) due to the complex assemblage of minerals. Common cement minerals are kaolinite clays and calcite ranging between 5.2% and 30.87%. At 7650' the subrounded boulder clasts are cemented by calcareous mud (micrite).

Porosity comprises primary interparticle pores, supplemented by secondary inter to intraparticle microporosity generated by partial dissolution of unstable detrital grains and local microfractures, but are largely isolated, and therefore ineffective.

Reservoir quality is strongly controlled and reflects grain size, carbonate cement/matrix, ductile content and compaction. Calcite cemented horizons degrade poroperm dramatically on a local scale, but may not be significant on a reservoir scale. Reservoir quality is little high in the coarse grained sandstones.

1. INTRODUCTION

This report presents the results of a petrographical study undertaken on eleven sidewallcores. The study was requested by **PETRO-TECH PERU**

Unless stated otherwise all depths in this report refer to sample depths.

1.1 Aims of Study

The principal aims of this study are to:

1. Produce a detailed petrographical analysis for each sample.

2. Integrate all available data to allow the geological controls on reservoir quality to be assessed.

3. Make recommendations for further analyses as felt necessary to understand the reservoir sandstones.

1.2 Materials Available

1. Eleven sidewallcores from Well L016-20 were available for study, (interval 7610' - 8640').

2. Core analysis results.

3. Mineralog analysis performed on some samples

COMPANY: **PETRO-TECH PERU** TABLE 2.1

WELL: **L016-20**

Sample Depth (feet)	**7610'**	**7650'**	**8139.5'**	**8186'**	**8225'**
Quartz					
Monocrystalline	22.52	17.48	16.07	1 6.12	19.6
Polycrystalline	4.5		4.46	7.69	
Total	27.02	17.48	20.54	23.81	19.6
Feldspars					
Plagioclase	15.77	14.79	21.88	26.74	17.6
Potassium Feldspar	9.9				
Total	25.67	14.79	21.88	26.74	17.6
Rock Fragments					
Igneous					
Metamorphics		15.79	4.46		1.2
Sedimentary (Total)	16.2	14.34	10.72	9.53	17.6
Chert	5.4	4.03	1.79	3.3	1.6
Sand/siltstone		7.17			
Argillaceous	10.8	3.14	8.93	6.23	16
Total	16.2	30.13	15.18	9.53	18.8
Accesory Grains					
Muscovite	4.96	1.34	1.34	tr	
Biotite	1.35		3.13	0.73	0.8
Glauconite	4.96		3.13	tr	26
Organic Matter	0.45	1.34	7.59	1.46	5.2
Opaques	2.25	10.31	3.13	1.83	4.8
Fossil Fragments					
Undeterminated	0.45				0.8
Total	14.42	12.99	18.32	4.02	37.6
Clays (Detrital)					
Dispersed					
Laminated/Carbonaceous					
Total					
Clays (Authigenic)					
Kaolinite	3.15		9.82	8.79	2
Clhorite					
Undifferentiated					
Total	3.15		9.82	8.79	2
Non-clay Cements					
Quartz overgrowths					
Calcite	11.71	18.38	13.84	21.25	3.2
Ferroan Calcite					
Dolomite					
Pirite					
Total	11.71	18.38	13.84	21.25	3.2
Residual Hidrocarbons	NONE	NONE	NONE	NONE	NONE
Porosity					
Primary					
Interparticle		2.24			
Secondary					
Dissolution	1.35	4.48	1.34	4.4	1.2
Oversized		tr			
Fractures	0.45	2.24	0.45	1.46	
Total	1.80	8.96	1.79	5.86	1.2
Grand Total	99.97	102.73	101.37	100	100.

COMPANY: **PETRO-TECH PERU** TABLE 2.1

WELL: **L016-20**

Sample Depth (feet)	**8523'**	**8536'**	**8542'**	**8594'**	**8601'**	**8640'**
Quartz						
Monocrystalline	13.73	11.42	7.73	11.98	19.62	14.76
Polycrystalline	tr	tr			tr	7.38
Total	13.73	11.42	7.73	11.98	19.62	22.14
Feldspars						
Plagioclase	24.02	23.74	36.23	28.64	28.66	12.08
Potassium Feldspar					5.26	
Total	24.02	23.74	36.23	28.64	33.92	12.08
Rock Fragments						
Igneous						
Metamorphics	0.98	4.11	5.31	5.21	0.48	0.67
Sedimentary (Total)	14.71	10.05	6.76	5.73	13.40	2.68
Chert	1.47	1.37	1.45	1.04	3.35	
Sand/siltstone				1.04		
Argillaceous	13.24	9.13	5.31	3.65	10.05	1.34
Carbonate						1.34
Total	15.69	14.61	12.07	10.94	13.88	3.35
Accesory Grains						
Muscovite	3.92	3.2	1.9	2.08	1.44	7.38
Biotite	2.45	5.9	2.42	1.57	5.26	3.35
Glauconite	0.49	2.28	2.89	2.60	3.82	3.35
Organic Matter	1.96	10.5	6.76	10.93	7.18	6.71
Opaques	4.41	3.2	tr	5.73	2.87	8.05
Fossil Fragments		tr	tr		1.95	
Undeterminated	2.45					2.01
Total	15.68	25.08	13.97	22.91	22.52	30.85
Clays (Detrital)						
Dispersed			1.9			30.87
Laminated/Carbonaceous					0.48	
Total			1.9		0.48	30.87
Clays (Authigenic)						
Kaolinite	5.39			22.91		
Clhorite		8.67			6.75	
Undifferentiated			8.21			
Total	5.39	8.67	8.21	22.91	6.75	
Non-clay Cements						
Quartz overgrowths						
Calcite	25	16.44	11.59	2.60	1.91	
Ferroan Calcite						
Dolomite						
Siderite						
Total	25	16.44	11.59	2.60	1.91	
Residual Hidrocarbons	NONE	NONE	NONE	NONE	NONE	NONE
Primary						
Interparticle		tr				
Secondary						
Dissolution	0.49	tr	8.69		1.91	
Oversized						
Fractures						0.67
Total	0.49	tr	8.69	none	1.91	0.67
Grand Total	100	99.96	100.39	99.98	100.99	99.96

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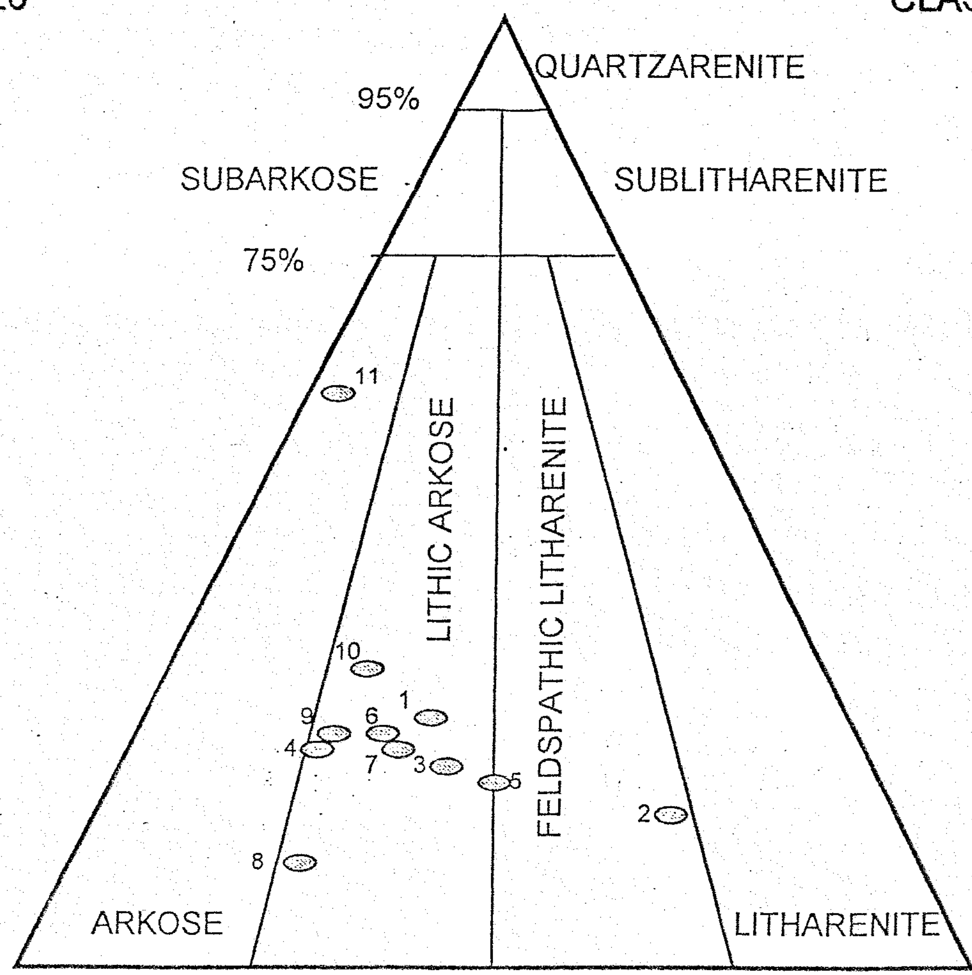
WELL L016-20

TRIANGULAR SANDSTONE CLASSIFICATIONS (FOLK 1980)

FIGURE 2.1

1. 7610'
2. 7650'
3. 8139.5'
4. 8186'
5. 8225'
6. 8523'
7. 8536'
8. 8542'
9. 8594'
10. 8601'
11. 8640'



2. DETAILED PETROGRAPHY

In this section of the report the petrography and diagenesis of the sidewall cores are studied. As part of this study petrographic analyses have been undertaken on 11 thin sections from the following depths 7610', 7650', 8139.5', 8186', 8225', 8523', 8536', 8542', 8594', 8601', and 8640'.

2.1 Sandstone Classification and Texture

The sandstones have been classified using the Triangular Sandstone Classification diagram of R. Folk et al (1980), mainly as Lithicarkoses to Arkoses, with one Feldspathic litharenites. No significant variation in minerallogy occurs between the samples analysed, which suggests a similar provenance. See table 2.1 Point Counting Data, and Figure 2.1 Triangular Sandstone Classification.

The sandstones show a range in mean grain size from 0.05 mm to 1.25 mm (Coarse silt to very coarse sand-granules), and range from being very poorly to moderately sorted; in general the coarser grained sandstones being the least well sorted. Grain shape is predominantly very angular to subangular, and grain contacts range from being point to long, concavo-convex, with less common sutured contacts, and rare floating contacts within the calcite cemented sandstones.

2.2 Detrital Mineralogy

Framework components are dominated by feldspars, and comprise both predominant plagioclase and less amounts of K-feldspar (sample 7610'). The plagioclase feldspars range from being fresh to partially, to almost completely leached (Plates 1, 3, 5 and 7), and that plagioclase abundance (12.08 to 36.23%), shows a marked and progressive decrease in abundance from depper samples to shallower ones. Monocrystalline quartz is present ranging from 22.52% to 7.73%, with minor amounts of polycrystalline quartz traces to 7.69%. Lithic fragments are common and conpound of sedimentary and metamorphic origin, but sedimentary clasts (argillaceous clast, chert, and silt-sandstone) occur in important amounts (2.68 to 17.6%).

Glauconite pellets are the main mineral observed at 8225', and in minor quantities in the other samples; Undetermined bioclasts or small shell fragments in amounts of traces occur in two samples (8536',8542'). Scarce heavy minerals (tourmaline) occur in small inclusions, sample 8542'.

Ductile components are present in variable amounts between 4.03% and 37.6%, and they comprise detrital micas largely composed of green to brown biotite, well developed flakes of muscovite. Most of the biotite has been partially altered by clhoritization. Compacted mudclasts and green `glauconitic' grains are common, locally forming a pseudomatrix. `Glauconitic' clays occur as pellets, micas and detrital clay.

2.3 Authigenic Mineralogy

The sandstones analized are in general compound of unstable components, which means that they are very active diagenetic system.

Calcite. Calcite is the most abundant authigenic phase. Three morphologies are recognised within the studied samples:

1. micrite
2. fibrous spar crusts on bioclasts
3. sparry to rhombic cement

Micritic calcite is largely restricted to the 7650' sample, and rather than representing a cement as previously interpreted, may in part be a lime mud matrix, possibly precipitated during periods of siliciclastic starvation. Fibrous calcite cement occurs as reworked grains. Spar grade calcite occurs as an interparticle to intraparticle cement, nucleating within and on plagioclase minerals. Where the calcite has grown into pores it commonly has a more rhombic form (Plate 1), although it is possible that some of the rhombic carbonate may represent dolomite.

Authigenic Clay. Kaolinite is the most common authigenic clay observed, although is typically present in trace to 22.91% amounts and occurs as a pore filling cement.
In most of the samples studied a range in green `glauconitic' clays occur as pellets (traces to 26%). There is a wide range in colour suggesting that there may well be more than one phase present.

Opaque minerals Pyrite occurs as a minor cement and replacement of organic matter, occurring as fine to coarse aggregates.

3. DIAGENESIS

3.1 Compactional Diagenesis

Compaction is regarded as the major control on porosity destruction in sandstones. Closer packing and grain reorganisation also occurred as a result of compaction, being most pronounced within the finer grained, ductile-rich sandstones. (Majority of the samples). Stylolitic seams are often observed in these samples.

Microquartz cements were precipitated in the lower part of the sandbody, associated with elevated silica contents in marine waters, probably resulting from the dissolution of unstable chert and/or volcanic material. Minor amounts of ferroan dolomite were precipitated as an early cement/replacement locally engulfing the chert.

The onset of calcite cementation probably occurred relatively early within the sandstones, as it commonly preserves an open fabric indicating that it is pre-compaction. However, examination of the samples suggests that calcite cementation was probably multiphase, with early nodules in part replaced by later nodules, and may have continued during shallow burial of the sandtones. Calcite cementation may have been related to local concentrations of bioclastic debris and/or variations in porosity/permeability, as often coarse units are preferentially cemented.

Late diagenesis was characterised by the influx of pore fluids resulting in the precipitation of kaolinite by dissolution of feldspars. Most of the feldspars have been leached; they show a relative early stage partial removal of the interior zones of the ggrains by calcite (dissolution patterns ocur along prefered crystallographic directions withiin the mineral. Unstable biotite mica is another mineral that has been altered by clhoritization. Further porosity loss may have occurred as a result of grain-grain pressure solution. Minor fracturing occurred after calcite cementation, but some are filled by calcite, later generation of post calcite open fractures.

Compactional diagenesis has also resulted in some porosity generation as a result of grain brecciation, although this is not regarded to be of significance on a reservoir scale.

4. RESERVOIR CHARACTERISTICS

In this section of the report the samples studied are discussed with respect to the diagenetic controls on reservoir properties.

4.1 Facies Controls

The porosity and permeability characteristics of the sandstones are strongly related to mineralogical contain. In general the coarser grained sandstones have better poroperm characteristics than the slightly finer grained, and much better than the finer grained and more ductile-rich siltstones. Although the conglomeratic, boulder sandstone at 7650', in terms of reservoir quality is variable and largely degraded as a result of the presence of common micrite matrix/calcite cement and/or abundant ductile components.

Reservoir quality within these samples are variable and in general moderate to poor (Core Analysis Data), reflecting the constituent minerals and diagenetic overprint. This reflects a combination of poor sorting, enhanced micrite matrix/calcite cement, and higher contents of authigenic clays. The lateral extent of the cemented horizons may not be extensive.

Pore types and systems: A number of pore types are recognised within the sandstones, which can be grouped into a main pore system.

Pore systems include most of the cemented samples, they comprise poorly connected primary interparticle pores, and pore connectivity being degraded by the development of a clay/calcite cement (common `glauconitic' pellets, clays and pseudomatrix). Microporosity is present within the `glauconitic' clay and patches of authigenic clay. Secondary microporosity has been generated by the partial dissolution of unstable detrital grains, but is largely isolated, and therefore ineffective, resulting in the low permeabilities for these samples.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The principal conclusions of this study are:

1. The sidewall cored sequence in Well L016-20 comprises sandstones, boulders sandstones, conglomerates and siltstones that were largely deposited in a shallow marine environment.

2. The sandstones are classified mainly as Lithicarkoses to one Arkose, and another Feldspathic litharenites. Plagioclase feldspar is the dominant feldspar, which shows a progressive decrease in abundance from deeper depths (8601', 8542') through shallower ones (7610', 7560'). Monocrystalline quartz is dominant ranging between 22.52% and 7.73%, and less amounts to traces of polycrystalline quartz. Rock fragments are derived from sedimentary rocks (chert, argillaceous, and sand/siltstone clasts), and less common metamorphic rocks..

Average grain size ranges from coarse silt to very coarse grained, and the sandstones range from being very poorly to moderately sorted. Those samples are inmature in terms of textural maturity. Grain contacts are predominantly puntual, long, concavo-convex, and locally sutured. Most of the samples exhibit subparallel alignment of elongate grains. The principal pore filling phases are ductile components (detrital clay, glauconitic pellets and mudclasts), calcite and pyrite. Calcite occurs as a micrite matrix and as a spar grade pore filling cement. Authigenic clays are present in minor amounts typically occurring as replacements and rare pore lining/filling cements, they comprise mainly kaolinite.

Porosity comprises primary interparticle pores, supplemented by secondary inter to intraparticle microporosity generated by partial dissolution of unstable detrital grains and local microfractures, but are largely isolated, and therefore ineffective.

3. Reservoir quality is strongly mineral controlled and reflects grain size, carbonate and clay cement/matrix and ductile content. Calcite cemented horizons degrade poroperm dramatically on a local scale but may not be significant on a reservoir scale.

5.2 Recommendations

The following recommendation is made for further analysis:

The exact depositional setting of the shallow marine sandstones of these sandstones is problematic. However, the sandstones contain certain shell frgments and possible microfauna, and it is recommended that more correlational studies been undertaken on the section to try and accurately assess water depth and hence constrain the depositional model with more confidence.

6. REFERENCES

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DETAILED PETROGRAPHICAL STUDY OF 11 SIDEWALLCORES FROM L016-20 WELL

THIN SECTION DESCRIPTIONS

SAMPLES 7610', 7650', 8139.5', 8186', 8225', 8523', 8536', 8542', 8594'. 8601', AND 8640'

THIN SECTION DESCRIPTION

SAMPLE DEPTH	**7610'**
ROCK TYPE	Sandstone.
ROCK NAME	Lithic Arkose.
GRAIN SIZE	
Maximum	0.25 mm (Medium lower sand)
Minimum	0.10 mm (Very fine sand)
Average	0.15 a 0.20 mm (Fine sand)
SORTING	Moderately to well sorted
ROUNDNESS	Angular to subangular
TEXTURAL MATURITY	Inmature
GRAIN ORIENTATION	Subparallel alignment of elongate grains.
GRAIN CONTACTS	Floating, long, and concavo-convex.
COMPOSITION	This sandstone is compound mainly by monocrystalline quartz, and less amounts of feldspars like plagioclase, and potassium feldspar, with less rock fragments from sedimentary rocks.
ACCESORY MINERALS	Muscovite, glauconite, and biotite, organic matter and opaque minerals.
CEMENT	Calcite and a complex assemblage of clay minerals.
PORE TYPE	Secondary porosity is evident by partial dissolution, and occasional microfractures.
PORE SYSTEM	Heterogeneously distributed, and poorly interconnected.
PORE SIZE	The isolated dissolution pores have 0.10 mm of diameter.
COMMENTS	The sidewall sample exhibits discontinuous microfractures partially filled by calcite.

THIN SECTION DESCRIPTION

SAMPLE DEPTH	**7650'**
ROCK TYPE	Conglomeratic Sandstone
ROCK NAME	Feldspathic Litharenite
GRAIN SIZE	
Maximum	10 mm of diameter (Boulders)
Minimum	Clay size
Average	0.50 mm (Medium to coarse sand).
SORTING	Poorly sorted.
ROUNDNESS	Angular to subangular. Gravels are subrounded.
TEXTURAL MATURITY	Inmature
GRAIN ORIENTATION	None
GRAIN CONTACTS	Puntual, and predominant floating grains.
COMPOSITION	This sandstone is compound mainly by subrounded intraclast of polycrystalline quartz, chert, and sand/siltstone rock fragments, with less amounts of monocrystalline quartz and plagioclase feldspar.
ACCESORY MINERALS	Opaque minerals, organic matter and oxides.
CEMENT	A complex assemblage of intraclasts are cemented by calcareous material (micrite). Locally some fragments are rounded by oxides, and organic matter.
PORE TYPE	The primary porosity type is interparticle, and secondary porosity is evident by partial dissolution, microfractures, and very occasional oversized pores.
PORE SYSTEM	Heterogeneously distributed, and moderate to poorly interconnected.
PORE SIZE	The interparticle pores range between 0.05 mm, and 0.5 mm of diameter.
COMMENTS	The intraclast presented in this sidewall sample are subrounded by calcareous mud (micrite) to small calcite minerals.

THIN SECTION DESCRIPTION

SAMPLE DEPTH	**8139.5'**
ROCK TYPE	Sandstone.
ROCK NAME	Lithic Arkose.
GRAIN SIZE	
Maximum	0.22 mm (Medium to fine sand)
Minimum	0.07 mm (Very fine sand)
Average	0.10 a 0.15 mm (Fine lower sand).
SORTING	Moderately sorted
ROUNDNESS	Very angular to subangular.
TEXTURAL MATURITY	Inmature
GRAIN ORIENTATION	Subparallel alignment of elongate grains
GRAIN CONTACTS	Long, concavo-convex, and locally sutured.
COMPOSITION	This sandstone is compound mainly by plagiclase feldspar, and monocrystalline quartz, and less amounts of rock fragments.
ACCESORY MINERALS	Micas biotite, muscovite and glauconite, organic matter, opaque minerals
MATRIX	Undifferentiated clays.
CEMENT	Kaolinite clay, and calcite.
SEDIMENTARY STRUCTURES	Irregular laminae evidenced by alignment of elongated grains, and some blebs of organic matter.
PORE TYPE	The pore space is represented by secondary porosity with pores created by dissolution, and irregular microfractures.
PORE SYSTEM	Heterogeneously distributed, and poorly interconnected.
PORE SIZE	The dissolution pores are 0.05 mm of diameter, and the irregular fractures are open 0.02 mm.
COMMENTS	The fractures observed are disposed perpendicular to the main way of alignment of elongate grains. The combination of organic matter and opaque minerals are forming microstylolites. Soft minerals are deformed by compaction.

THIN SECTION DESCRIPTION

SAMPLE DEPTH	**8186'**
ROCK TYPE	Calcite Cemented Sandstone.
ROCK NAME	Lithic Arkose.
GRAIN SIZE	
Maximum	0.625 mm (Coarse sand)
Minimum	0.125 mm (Fine lower sand)
Average	0.375 mm (Medium sand).
SORTING	Moderately sorted
ROUNDNESS	Very angular to locally subangular
TEXTURAL MATURITY	Inmature
GRAIN ORIENTATION	Subparallel alignment of elongate grains
GRAIN CONTACTS	Puntual, floating, long, and locally sutured.
COMPOSITION	This sandstone is compound mainly by plagioclase feldspar, and monocrystalline with less amounts of rock fragments from sedimentary rocks
ACCESORY MINERALS	Micas biotite, traces of glauconite, organic matter, and opaque minerals.
CEMENT	Kaolinite clay and calcite minerals
PORE TYPE	The primary porosity types are interparticle, and secondary porosity is present with dissolution pores, and irregular microfractures.
PORE SYSTEM	Heterogeneously distributed, and moderately interconnected.
PORE SIZE	The interparticle pores are 0.125 mm of diameter, and dissolution pores ranges between 0.05mm and 0.125 mm of diameter.
COMMENTS	The irregular microfractures observed in this sample are filled by calcite minerals. Few framework grains exhibits straigh microfractures (mechanical origin?).

THIN SECTION DESCRIPTION

SAMPLE DEPTH	**8225'**
ROCK TYPE	Glauconitic sandstone.
ROCK NAME	Feldspathic Litharenite to Lithic Arkose.
GRAIN SIZE	
Maximum	0.5 mm (Medium sand, locally 0.87 mm very coarse)
Minimum	0.075 mm (Very fine sand)
Average	0.5 mm (Medium sand).
SORTING	Moderately to poorly sorted
ROUNDNESS	Very angular to subangular, and locally subrounded.
TEXTURAL MATURITY	Inmature
GRAIN ORIENTATION	Random
GRAIN CONTACTS	Puntual, floating, and long.
COMPOSITION	This sandstone is compound mainly by Glauconite minerals, and similar quantities of monocrystalline quartz, plagioclase feldspar, and rock fragments from sedimentary rocks
ACCESORY MINERALS	Micas glauconite, muscovite, and biotite, and some opaque minerals.
CEMENT	Primary calcite, and a a mixture of clay minerals.
PORE TYPE	Secondary porosity is present by partial dissolution.
PORE SYSTEM	Heterogeneously distributed, and poorly interconnected.
PORE SIZE	Average of pore diameter 0.1 mm.
COMMENTS	The predominant mineral observed in this thin section correspond to green glauconite pellets. Locally glauconite grains have been partially altered generating microporosity (see plate 5).

THIN SECTION DESCRIPTION

SAMPLE DEPTH	**8523'**
ROCK TYPE	Calcite Cemented Sandstone.
ROCK NAME	Lithic Arkose.
GRAIN SIZE	
Maximum	0.375 mm (Medium sand)
Minimum	0.075 mm (Very fine sand)
Average	0.175 mm (Fine sand).
SORTING	Moderately to poorly sorted
ROUNDNESS	Very angular to subangular.
TEXTURAL MATURITY	Inmature
GRAIN ORIENTATION	Subparallel alignment of elongate grains
GRAIN CONTACTS	Puntual, floating, long, and concavo-convex.
COMPOSITION	This sandstone is compound mainly by plagioclase feldspar, monocrystalline quartz, less amounts of polycrystalline quartz, and rock fragments from sedimentary (argillaceous) rocks.
ACCESORY MINERALS	Micas biotite, muscovite, and glauconite, and elongate opaque minerals.
CEMENT	Mainly calcite, and a mixture of clay minerals including chlorite and kaolinite..
PORE TYPE	The primary porosity types are interparticle, and locally secondary microporosity by partial dissolution
PORE SYSTEM	Poorly distributed.
PORE SIZE	Very few isolated pores were observed. (Diameter 0.074 mm)
COMMENTS	This sidewall core is partially cemented with calcite generated from unstable plagioclase grains, There are some isolated interparticle pores (Plate 6A), and microporosity by dissolution, that makes to think in a very low permeability.

THIN SECTION DESCRIPTION

SAMPLE DEPTH	**8536'**
ROCK TYPE	Micaceous Sandstone.
ROCK NAME	Lithic Arkose.
GRAIN SIZE	
Maximum	1.40 mm (Very coarse sand to locally granules)
Minimum	0.125 mm (Fine sand)
Average	0.25 a 0.375 mm (Medium sand).
SORTING	Moderately to poorly sorted
ROUNDNESS	Very angular to subangular. Occasionally subrounded
TEXTURAL MATURITY	Inmature
GRAIN ORIENTATION	Subparallel alignment of elongate grains.
GRAIN CONTACTS	Puntual, floating, and long.
COMPOSITION	This sandstone is compound mainly by plagioclase feldspar, monocrystalline quartz, less amounts of polycrystalline quartz, and rock fragments from sedimentary and metamorphic rocks.
ACCESORY MINERALS	Micas biotite, muscovite, and glauconite, and a combination of organic matter, oxides and opaque minerals.
MATRIX	Undifferentiated
CEMENT	Clay and calcite minerals.

SEDIMENTARY STRUCTURES Lamination evidenced by grain size differentiation.

PORE TYPE	The isolated primary porosity type is interparticle, and locally secondary microporosity by partial dissolution.
PORE SYSTEM	Heterogeneously distributed, and poorly interconnected.
PORE SIZE	Interparticle pores exhibits maximum 0.08 mm of diameter.
COMMENTS	This sidewall sample exhibits lamitations evidenced by coarser grains, which includes quartz, shell fragments, and elongate grains (mainly micas), showing parallel alignment, as you can see in plate 7.

THIN SECTION DESCRIPTION

SAMPLE DEPTH — **8542'**

ROCK TYPE — Conglomeratic Sandstone.
ROCK NAME — Lithic Arkose to arkose.

GRAIN SIZE
Maximum — 1.25 mm (Very coarse sand to granules)
Minimum — 0.125 mm (Very fine upper sand)
Average — 0.50 mm (Medium sand).

SORTING — Poorly sorted.
ROUNDNESS — Very angular to subangular
TEXTURAL MATURITY — Inmature

GRAIN ORIENTATION — Subparallel alignment of long axis crystal grains.
GRAIN CONTACTS — Puntual, long, and concavo-convex.

COMPOSITION — This sandstone is compound mainly by plagioclase feldspar, monocrystalline quartz, less amounts of polycrystalline quartz, and rock fragments from sedimentary (argillaceous) rocks.
ACCESORY MINERALS — Micas biotite, muscovite, and galuconite as well as opaque minerals.
MATRIX — Dispersed undifferentiated clays
CEMENT — A complex assemblage of undifferentiated clay minerals, and locally some calcite.

PORE TYPE — The primary porosity types are interparticle, increased by secondary porosity (dissolution of unstable grains).
PORE SYSTEM — Heterogeneously distributed, and moderately interconnected.
PORE SIZE — Pores range between 0.07 mm and 0.12 mm of diameter.

COMMENTS — This pore system makes this rock (with relative high porosity 8.6% by point counting) a poor to moderate quality reservoir.

THIN SECTION DESCRIPTION

SAMPLE DEPTH	**8594'**
ROCK TYPE	Conglomeratic Sandstone.
ROCK NAME	Lithic Arkose.
GRAIN SIZE	
Maximum	0.75 mm (Coarse sand)
Minimum	0.05 mm (Coarse silt)
Average	0.25 mm (Fine to medium sand).
SORTING	Poorly to moderately sorted
ROUNDNESS	Very angular to subangular.
TEXTURAL MATURITY	Inmature
GRAIN ORIENTATION	Subparallel alignment of elongate grains
GRAIN CONTACTS	Puntual, long, concavo-convex, and locally sutured.
COMPOSITION	This sandstone is compound mainly by plagioclase felspar, and less amounts of monocrystalline quartz, and sedimentary rock fragments.
ACCESORY MINERALS	Micas biotite, glauconite, and muscovite, and few tabular to elongate opaque minerals.
CEMENT	A complex assemblage of clay minerals including chlorite and kaolinite. localy calcite. Some irregular laminae of organic matter-oxides are also present.
PORE TYPE	There are not visible porosity in this thin section.
COMMENTS	This conglomeratic sanstone is well cemented and grains are so compacted, than there is not a single pore space. Plagioclase has been gradually replaced by calcite, and biotite mica by chlorite.

THIN SECTION DESCRIPTION

SAMPLE DEPTH	**8601'**
ROCK TYPE	Micaceous Sandstone.
ROCK NAME	Lithic Arkose.
GRAIN SIZE	
Maximum	0.375 mm (Medium sand)
Minimum	0.075 mm (Very fine sand)
Average	0.25 mm (Medium to fine sand).
SORTING	Poorly sorted. (Locally bimodal)
ROUNDNESS	Very angular to subangular.
TEXTURAL MATURITY	Inmature
GRAIN ORIENTATION	Subparallel alignment of elongate grains
GRAIN CONTACTS	Long, concavo-convex, and sutured.
COMPOSITION	This sandstone is compound mainly by partial altered plagioclase feldspar, less amounts of monocrystalline quartz, and sedimentary rock fragments.
ACCESORY MINERALS	Micas biotite, glauconite, and muscovite. Irregular and discontinuous laminae of organic matter and opaque minerals as well as heavy minerals (tourmaline).
MATRIX	Small amounts of undifferentiated clays.
CEMENT	A complex assemblage of clay and calcareous minerals.
PORE TYPE	Secondary porosity is present by partial unstable mineral dissolutions.
PORE SYSTEM	Heterogeneously distributed, and poorly interconnected.
PORE SIZE	The dissolution pores range between micropores and 0.0625 mm of diameter.
COMMENTS	Most of the unstable plagioclase grains are altered in a relative early stage removal of the interior zones of the feldspar by calcite along prefered crystallographic directions within minerals. Small shell fragments are also present.

THIN SECTION DESCRIPTION

SAMPLE DEPTH	**8640'**
ROCK TYPE	Argillaceous Laminated Siltstone
ROCK NAME	Arkose
GRAIN SIZE	
Maximum	0.1 mm (Very fine sand)
Minimum	Clay size
Average	0.05 mm (Coarse silt).
SORTING	Well sorted
ROUNDNESS	Very angular to subangular.
TEXTURAL MATURITY	Inmature
GRAIN ORIENTATION	Parallel alignment of grains.
GRAIN CONTACTS	Puntual, floating, and long.
COMPOSITION	This argillaceous laminated siltstone is compound mainly by monocrystalline quartz, less amounts of plagioclase feldspar in alteration processes, and few rock fragments.
ACCESORY MINERALS	Mainly detrital micas biotite, and muscovite, with fibres concentrations of organic matter, opaque minerals, oxides, and clays.
MATRIX	Undeterminated clays.
SEDIMENTARY STRUCTURES	Petrographic analysis reveals lamination in a low magnification view, and organic microstylolites in a moderate magnification.
PORE TYPE	There is not primary porosity, secondary porosity is evident by partial few irregular, natural microfractures.
PORE SIZE	Natural microfractures are open less than 0.01 mm.
COMMENTS	This sample shows extreme parallelism of clay minerals lamination, and a marked predominance of clay-sized material.

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**DETAILED PETROGRAPHICAL STUDY
OF 11 SIDEWALLCORES FROM L016-20 WELL**

THIN SECTION PHOTOMICROGRAPHS

PLATE 1	7610'
PLATE 2	7650'
PLATE 3	8139.5'
PLATE 4	8186'
PLATE 5	8225'
PLATE 6	8523'
PLATE 7	8536'
PLATE 8	8542'
PLATE 9	8594'
PLATE 10	8601'
PLATE 11	8640'

WELL L016 - 20

PLATE 1

SAMPLE 7610'

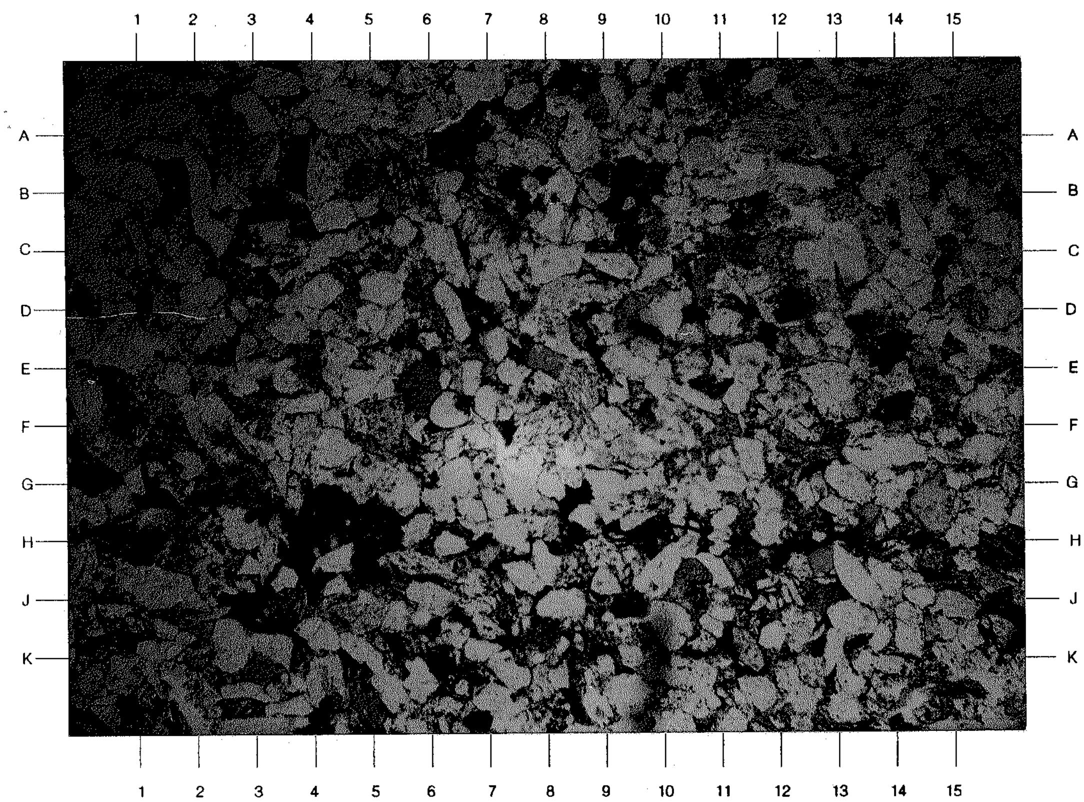
SAMPLE	7610'	GRAIN SIZE	0.20 mm (Fine sand).
ROCK NAME (FOLK 1980)	LITHIC ARKOSE	PORE SIZE	0.10 mm.
SORTING	MODERATELY TO WELL	PETROPHYSICS	
		- POROSITY	4.7 %
		- PERMEABILITY	0.01 mD
		- GRAIN DENSITY	2.69

1A PLANE POLARIZE LIGTH
MAGNIFICATION **40X**

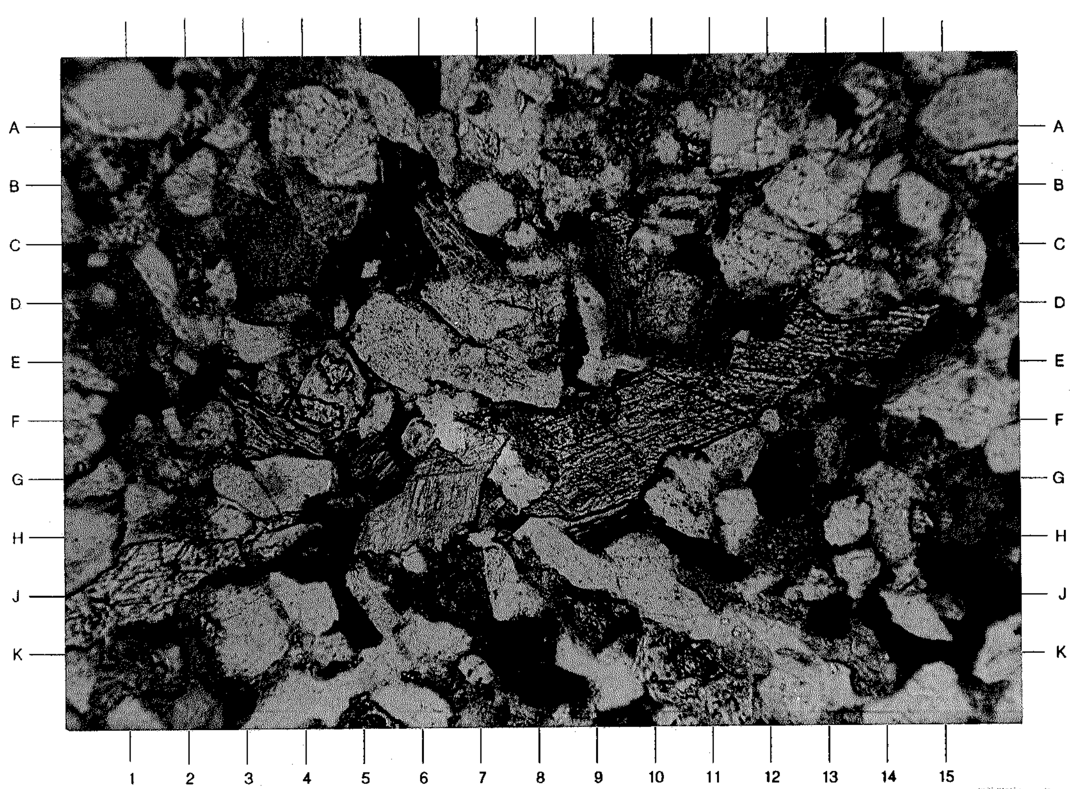
Low magnification view of a fine to medium grained lithic arkose, locally affected by microfractures (Blue colour in the lower part of the picture). This sample is compound of monocrystalline quartz, plagioclase feldspar, and less amounts of rock fragments. Accesory minerals are muscovite, glauconite, biotite, opaque minerals, and minor quantities of organic matter. Calcite occurs as a main cement (see below), and some detrital/authigenic clays occur blocking pores. The primary pore system has been destroyed and preserved locally. Some secondary porosity has been generated by feldspar dissolution (see below), and microfractures but does not enhance reservoir properties significantly. (Fractures are filled by calcite mineral).

1B PLANE POLARIZE LIGTH
MAGNIFICATION **100X**

More detailed view showing framework grains, and calcite cement. Microporosity appears attached to the feldspar grains and it was originated by partial dissolution. Note the partially replacement of plagioclase feldspars (F4, A10,), and the partially leached feldspar (F4, B9, A10); however, this secondary porosity is poorly connected and unlikely to enhance reservoir properties. Finely crystalline pore filling calcite cement shows evidence of pitting and etching (J1, H6), suggesting that precipitation pre-dated feldspar dissolution. Some accesory minerals present are muscovite mica (D9), biotite (F15), anhedral opaque minerals (J15, G12), and argillaceous fragment, C5.


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
A B C D E F G H J K

A


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
A B C D E F G H J K

B

WELL L016 - 20

PLATE 2

SAMPLE 7650'

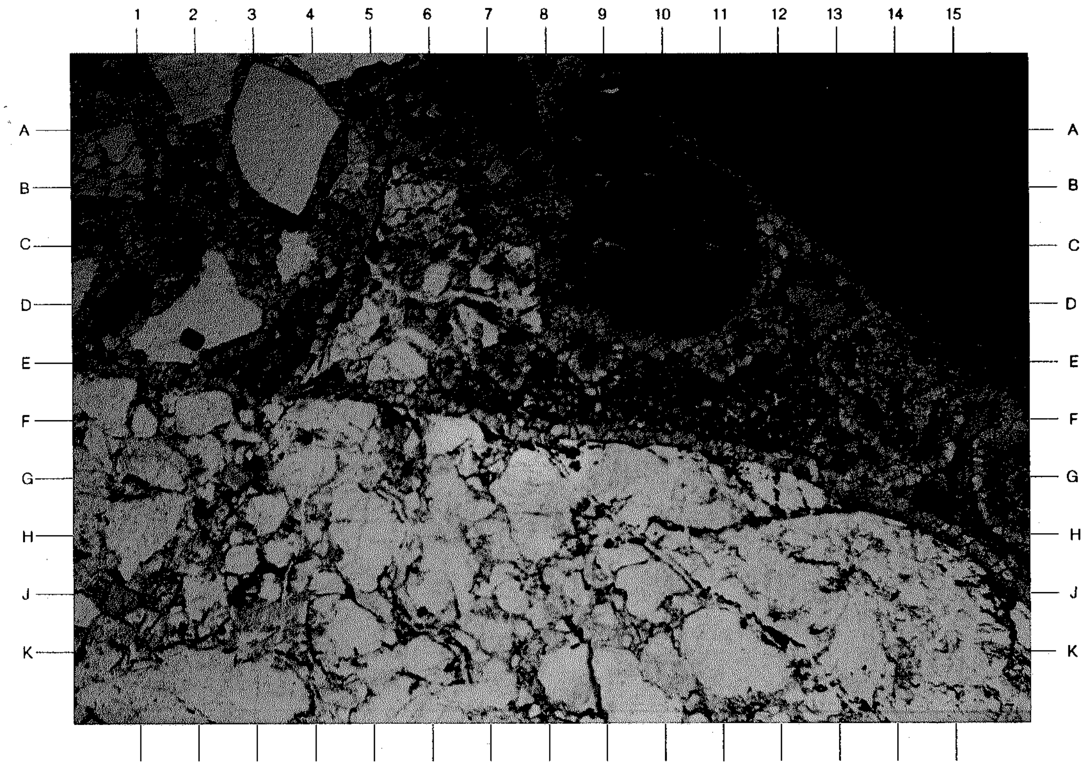
SAMPLE	7650'	GRAIN SIZE	0.5 mm (Medium to coarse).
ROCK NAME (FOLK 1980)	FELDSPATHIC LITHARENITE	PORE SIZE	
SORTING	POORLY	PETROPHYSICS	
		- POROSITY (He)	2.7 %
		- PERMEABILITY	NO DATA
		- GRAIN DENSITY	2.71

2A PLANE POLARIZE LIGTH
MAGNIFICATION **40X**

Low magnification view of a conglomeratic sandstone classified as feldspathic litharenite. This sample is compound of subrounded boulders of polycrystalline quartz from a metamorphic source, elongate argillaceous intraclast (upper rigth corner of the photo), opaque minerals (C10), chert (no present in this view), and other sedimentary clasts. Those intraclast are mainly cemented by micrite (calcareous mud), and calcite. Calcite is subrounded most of the clast borders forming small chains (G15,D13). Accesory minerals are muscovite, opaque minerals, and abundant disseminated blebs of organic matter throughout some intraclasts. The primary pore system has been destroyed, and some secondary porosity has been generated by dissolution, and microfractures, (blue color in the photograph).

2B PLANE POLARIZE LIGTH
MAGNIFICATION **40X**

This is another low magnification view of the same conglomeratic sandstone. In this picture you can see the secondary porosity by dissolution in some organic matter rich intraclasts. The white grains are polycrystalline quartz and they are surrounded by micrite mud. Intense yellowish color corresponds to Fe-Ti oxides. This sample is representing a high energy deposit, an storm ??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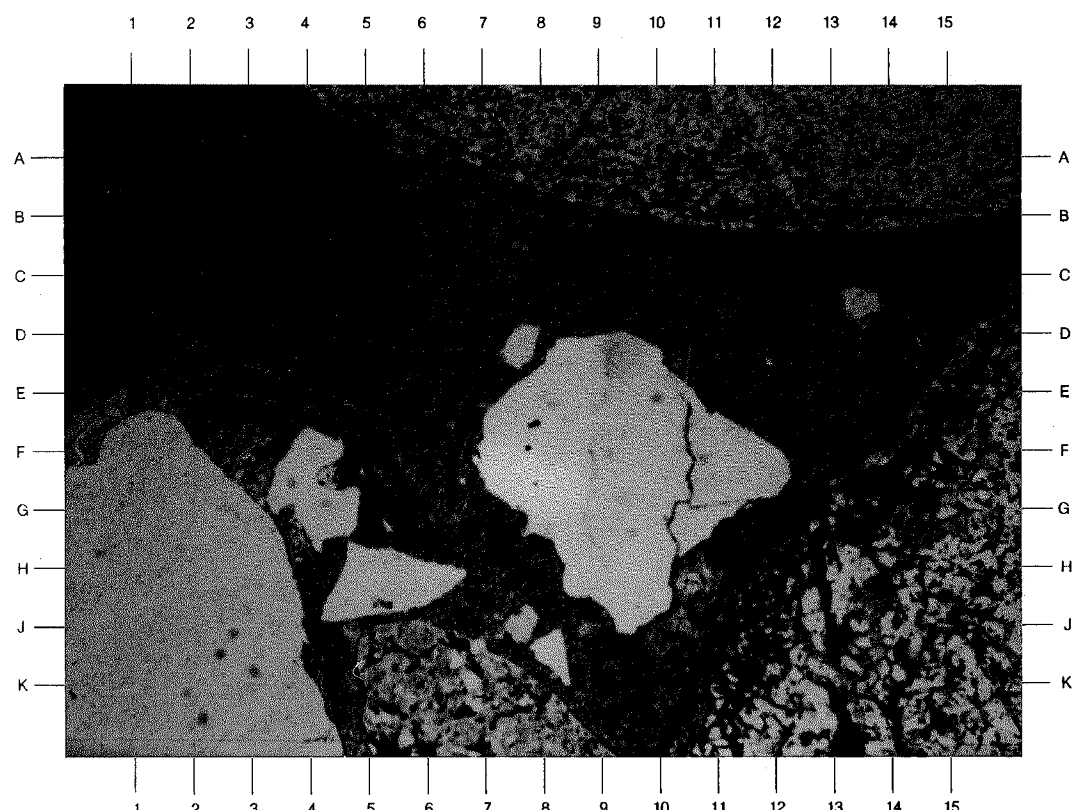
A B C D E F G H J K

A


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
A B C D E F G H J K

B

WELL L016 - 20

PLATE 3

SAMPLE 8139.5'

SAMPLE	8139.5'	GRAIN SIZE O.15 mm (Fine lower sand).	
ROCK NAME (FOLK 1980)	LITHIC ARKOSE	PORE SIZE 0.05 mm.	
SORTING	MODERATELY	PETROPHYSICS	
		- POROSITY	NO DATA
		- PERMEABILITY	NO DATA
		- GRAIN DENSITY	NO DATA

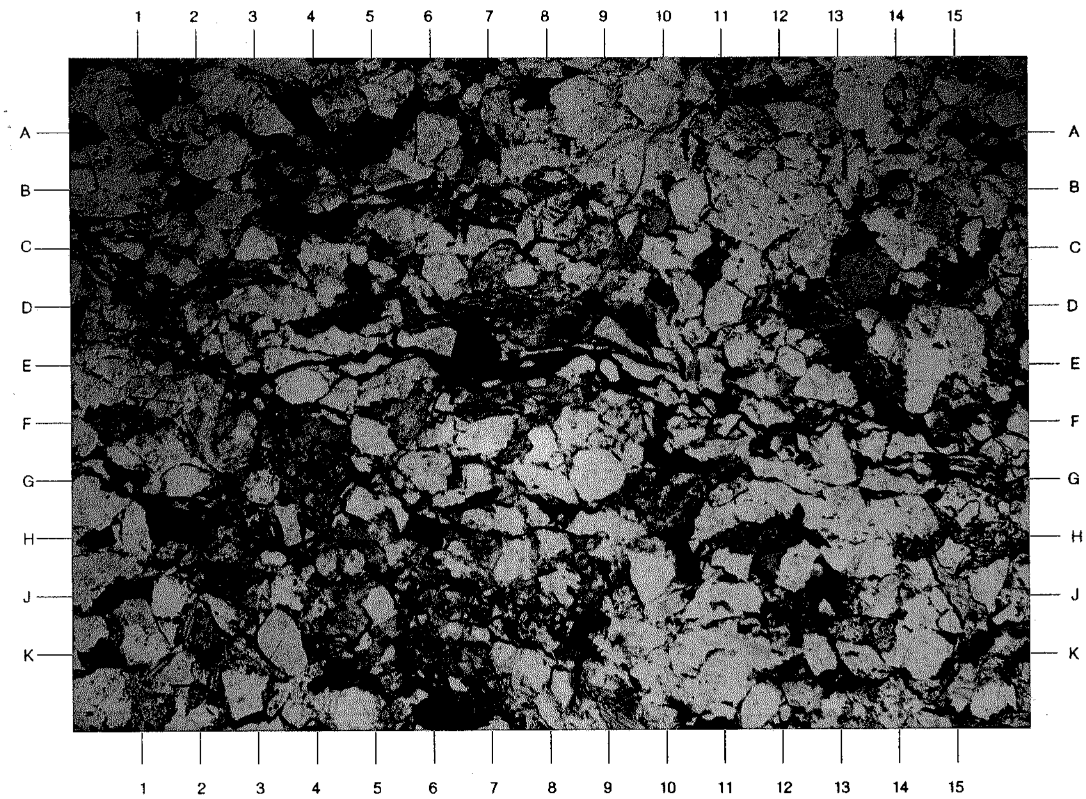
3A PLANE POLARIZE LIGTH
MAGNIFICATION **40X**

General view of a very fine to medium grained lithic arkose. The framework grains are compound of monocrystalline quartz, plagioclase feldspars, and lithic fragments. Accesory minerals are mica biotite (K4-5, J1), glauconite (B-C10), and muscovite (G15), irregular laminae of organic matter (E7, F14), and opaque minerals (A4).

The elongate grains have subparallel alignment (left to right in the photograph), and the microfractures are disposed perpendicular to the irregular lamination (blue colours). Note, irregularities and discontinuities of microfractures, as well as microstylolites formed by organic matter (center of the photo). Poorly interconnected secondary dissolution pores are preserved locally (left side of the view).

3B PLANE POLARIZE LIGTH
MAGNIFICATION **100X**

High magnification view of a (avg.) fine lower grained lithic arkose, which is compound of monocrystalline quartz (D3, F11), plagioclase feldspars (A2, G2, K10, H14), and lithic fragments (D7). The main accesory minerals are mica biotite locally altered (middle of the photo), glauconite (H11), and muscovite. Laminae of organic matter are common in this sample. Most of the plagioclase feldspars exhibit partial dissolution by calcite (yellowish grains A2, A13, E1, and G2), as well as the glauconite grains (green colour grains F15).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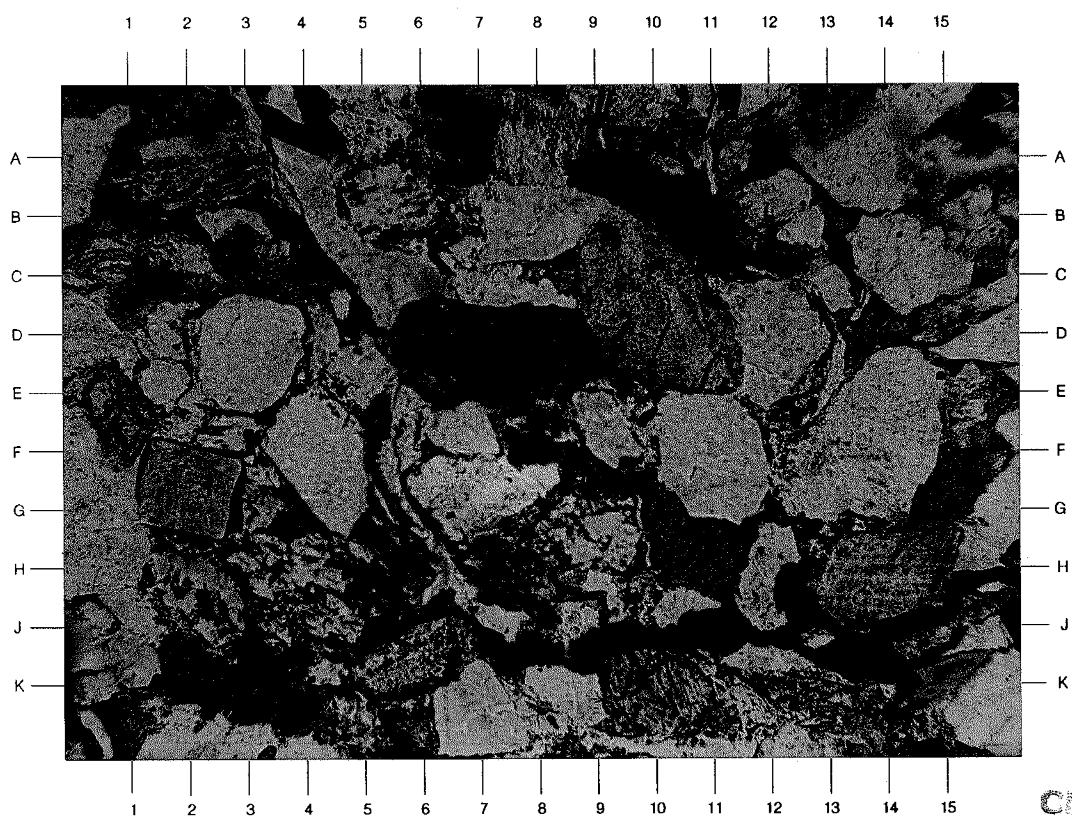
A B C D E F G H J K

A


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
A B C D E F G H J K

B

WELL L016 - 20

PLATE 4

SAMPLE 8186'

SAMPLE	8186'	GRAIN SIZE	0.375 mm (Medium sand).
ROCK NAME (FOLK 1980)	LITHIC ARKOSE	PORE SIZE	0.125 mm.
SORTING	MODERATELY	PETROPHYSICS	
		- POROSITY	6.9 %
		- PERMEABILITY	5.04 mD
		- GRAIN DENSITY	2.69

4A PLANE POLARIZE LIGTH
MAGNIFICATION **40X**

General view of a medium grained lithic arkose. The framework grains are compound of monocrystalline quartz (F3, J11, B14), altered plagioclase feldspars (F10, E14), and lithic fragments (G7). Accesory minerals are mica biotite, glauconite (D9), and rare muscovite, irregular patches of oxides-organic matter (J-H0, A14-15), and opaque minerals (D15, B6-7). Cement is much less abundant within this sample resulting in a moderately well connected pore system. Porosity is dominated by primary interparticle pores (Intense blue colour), supplemented by secondary pores generated by dissolution of unstable detrital grains (E1, J10, B11-12). Calcite occurs as a minor cement (H14) and detrital/authigenic clays locally occur blocking pores.

4B PLANE POLARIZE LIGTH
MAGNIFICATION **100X**

More detailed view showing pores, and leached minerals. Feldspars commonly undergo leaching; on A14 there is a feldspar grain showing a relatively early stage partial removal of the interior zones of the grain. Note the strong control of dissolution patterns along prefered crystallographic directions within the mineral, and in the upper part of the photomicrograph. A mixture of authigenic clay-organic matter stages of cement material are visible with thin, authigenic coatings formed around most of the detrital grains. Few fibres or elongate minerals are present as single grains or inclusions (B6).

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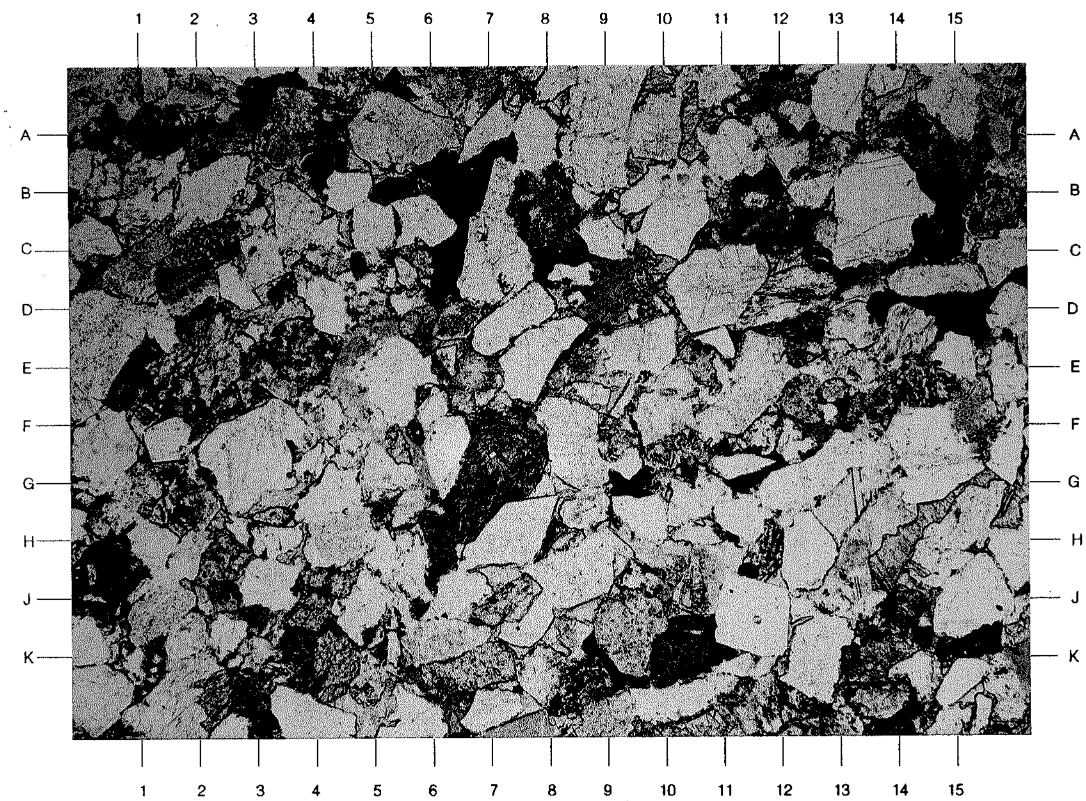
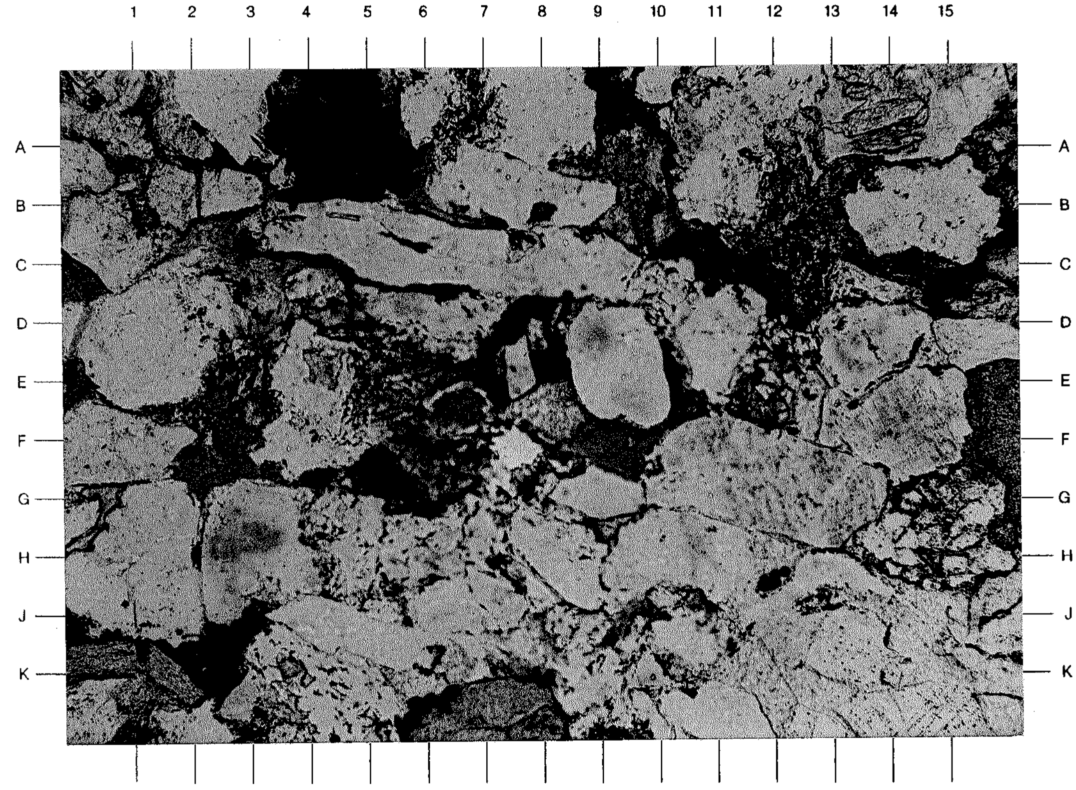


A



B

WELL L016 - 20

PLATE 5

SAMPLE 8225'

SAMPLE	8225'	GRAIN SIZE 0.5 mm (Medium sand).	
ROCK NAME (FOLK 1980)	FELDSPATHIC LITHICARENITE TO LITHIC ARKOSE	PORE SIZE 0.1 mm.	
SORTING	MODERATE-POORLY	PETROPHYSICS	
		- POROSITY	3.2 %
		- PERMEABILITY	< 0.001 mD
		- GRAIN DENSITY	2.70

5A PLANE POLARIZE LIGTH
MAGNIFICATION **40X**

Low magnification view of a glauconitic sandstone classified as feldspathic lith arenite to lithic arkose. This sample is compound mainly of subrounded glauconite (26% of the total rock, green mineral colour at the photo), monocrystalline quartz (white grains), feldspars (yellowish gray colour), argillaceous intraclasts (A3, B15), and chert. Accesory minerals are muscovite, opaque minerals (B6, F15), and abundant disseminated blebs of organic matter throughout some intraclasts. The primary pore system has been destroyed, and some secondary porosity has been generated by dissolution, and microfractures, (blue color in the photograph). Rare, small and poorly connected primary interparticle pores (BD-79) are preserved locally

5B PLANE POLARIZE LIGTH
MAGNIFICATION **100X**

Close up of above photomicrograph showing the partial dissolution of a plagioclase grain (F7-8, D10), as well as the glauconite in partial dissolution generating small intraparticle spaces (A13, G2, K6 green-blue colour).

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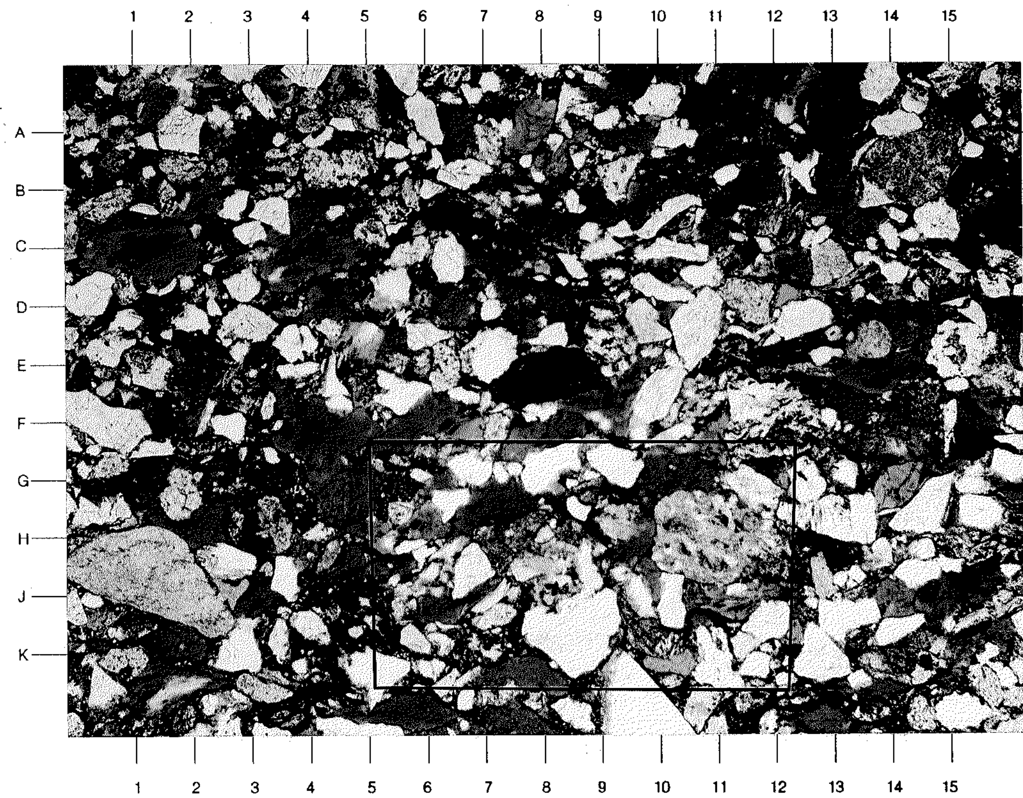

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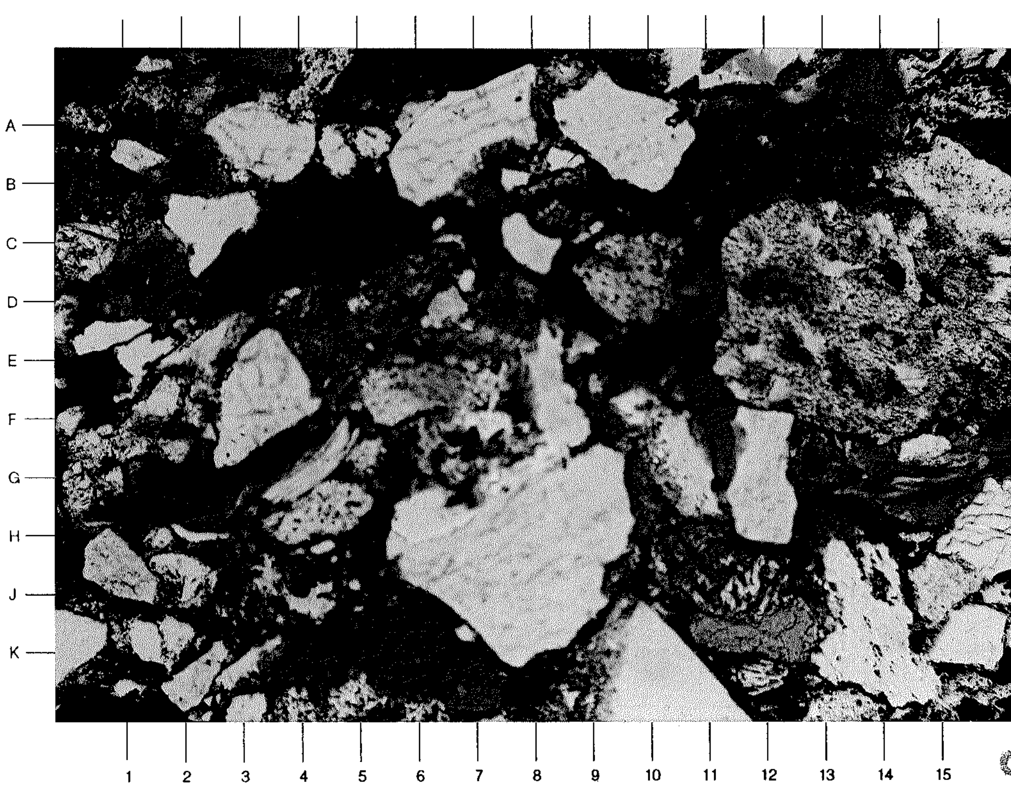

B

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PLATE 6

SAMPLE 8523'

SAMPLE	8523'	GRAIN SIZE	0.175 mm (Fine sand).
ROCK NAME (FOLK 1980)	LITHIC ARKOSE	PORE SIZE	0.074 mm.
SORTING	MODERATE TO POORLY	PETROPHYSICS	
		- POROSITY	4.0 %
		- PERMEABILITY	< 0.001 mD
		- GRAIN DENSITY	2.70

6A PLANE POLARIZE LIGTH
MAGNIFICATION **40X**

General view of a fine grained lithic arkose. The framework grains are moderately to poorly sorted (lower part of the photomicrograph); grain roundness is very angular (B11, G-H4) to subangular (J15); and the elongate grains show different ways of alignment probably by flow disruption. The primary pore system has been destroyed by the abundant clay, and calcite cement; rare, small and poorly connected primary interparticle pores are preserved locally (middle of the view).

6B PLANE POLARIZE LIGTH
MAGNIFICATION **40X**

General view of a calcite cemented sandstone , showing a very tigh rock with isolated pore spaces. The primary interparticle pore system has been largely occluded by detrital clay and by calcite cement

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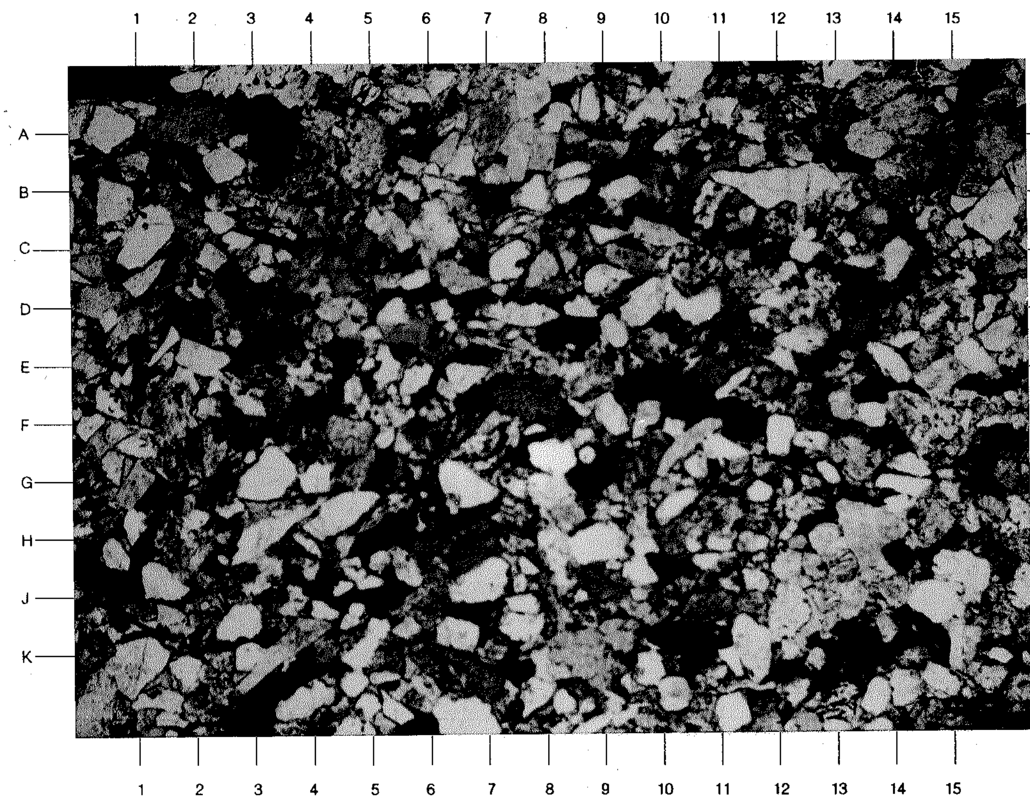

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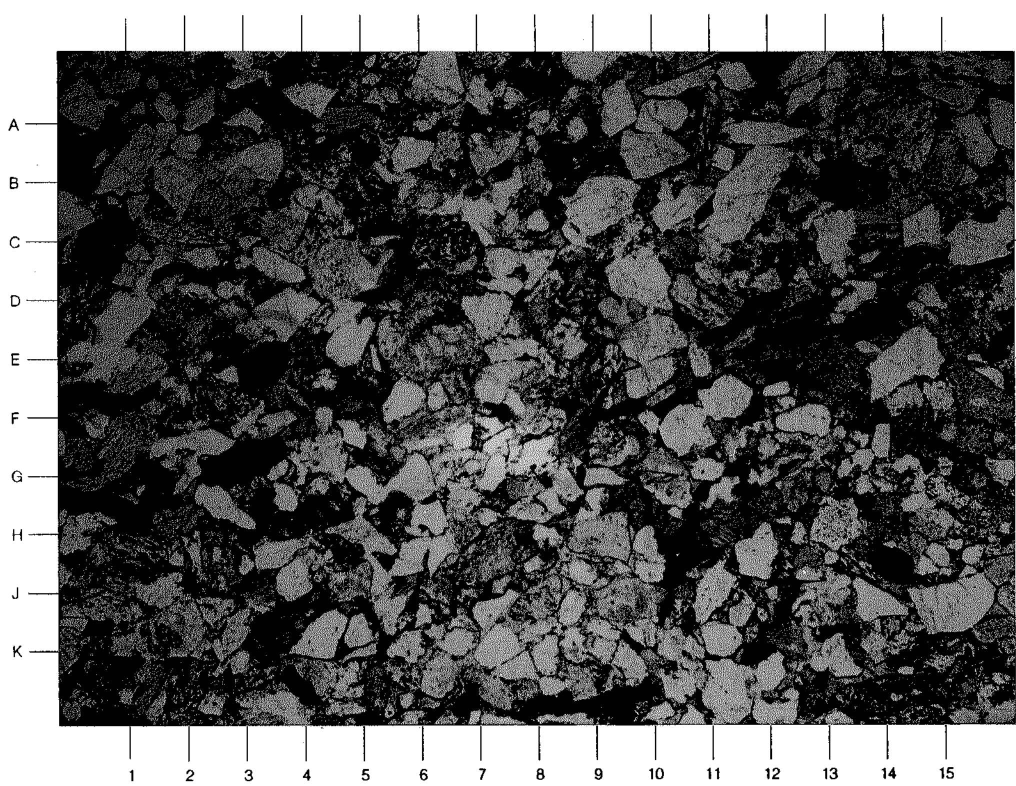


B

WELL L016 - 20

PLATE 7

SAMPLE 8536'

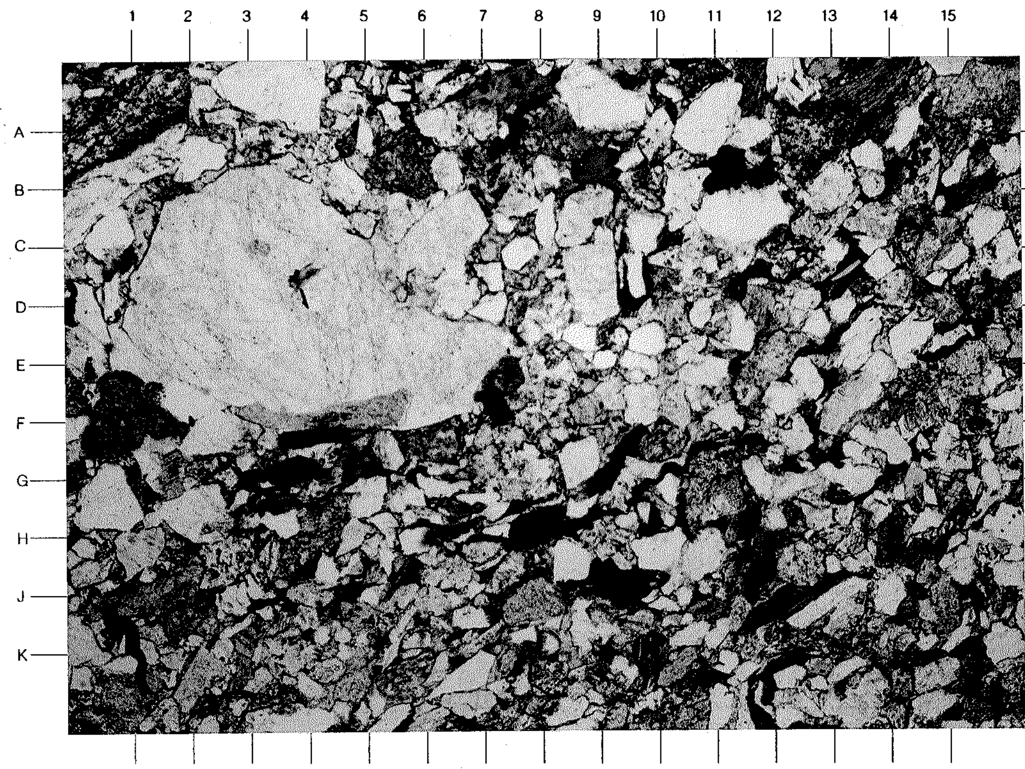
SAMPLE	8536'	GRAIN SIZE	0.25 mm (Medium sand).
ROCK NAME (FOLK 1980)	LITHIC ARKOSE	PORE SIZE	0.08 mm.
SORTING	POORLY	PETROPHYSICS	
		- POROSITY	5.4 %
		- PERMEABILITY	O.006 mD
		- GRAIN DENSITY	2.70

7A PLANE POLARIZE LIGTH
MAGNIFICATION **40X**

A medium grained, poorly to moderately sorted lithic arkose is shown here. Framework grains are composed mainly of plagioclase feldspars (pinkish gray), monocrystalline quartz (white), and lithic fragments in minor quantities: chert (H4, J8), argillaceous (A1, A13, F1), and few polycrystalline quartz from metamorphic rocks. The elongate grains show subparallel aligneament (B1, E14, J12) as well as coaser grains, which are disposed in laminae. Accesory minerals are common, biotite (J12, B14, AB9), small glauconite (GH-67, K11) and muscovite (CD13). There are concentrations of relative insoluble organic matter, opaque minerals, clays and other minerals yielding the dark appearance (G3-4, H8, K15).

7B PLANE POLARIZE LIGTH
MAGNIFICATION **100X**

Detailed photomicrograph showing the early stage dissolution type. Primary pores are rare, isolated (F6-7), small and poorly connected and are often partially occluded by calcite or detrital/authigenic clay. Feldspars in the middle of the photograph is leached; It shows a relatively early stage partial removal of the interior zones of the grain by calcite. Note the strong control of dissolution patterns along prefered crystallographic directions within the mineral.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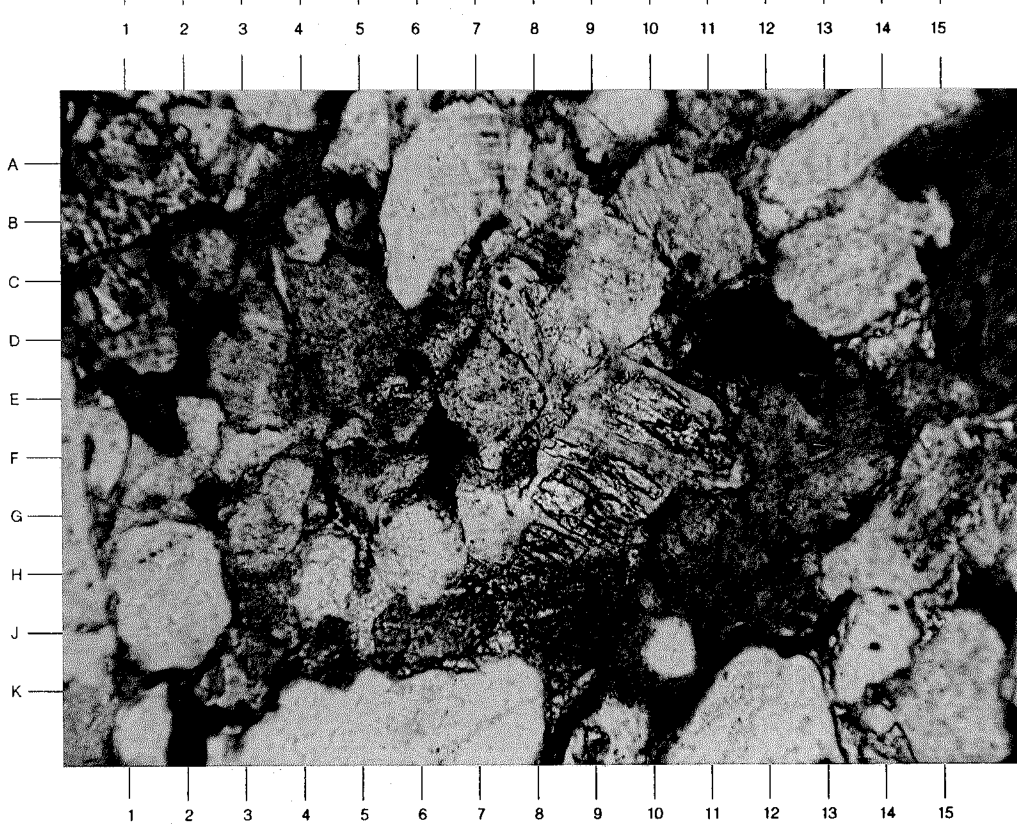
A B C D E F G H J K

A


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
A B C D E F G H J K

B

WELL L016 - 20

PLATE 8

SAMPLE 8542'

SAMPLE	8542'	GRAIN SIZE O.5 mm (Medium sand).	
ROCK NAME (FOLK 1980)	LITHIC ARKOSE	PORE SIZE 0.1 mm.	
SORTING	POORLY	PETROPHYSICS	
		- POROSITY	7.5 %
		- PERMEABILITY	0.007 mD
		- GRAIN DENSITY	2.68

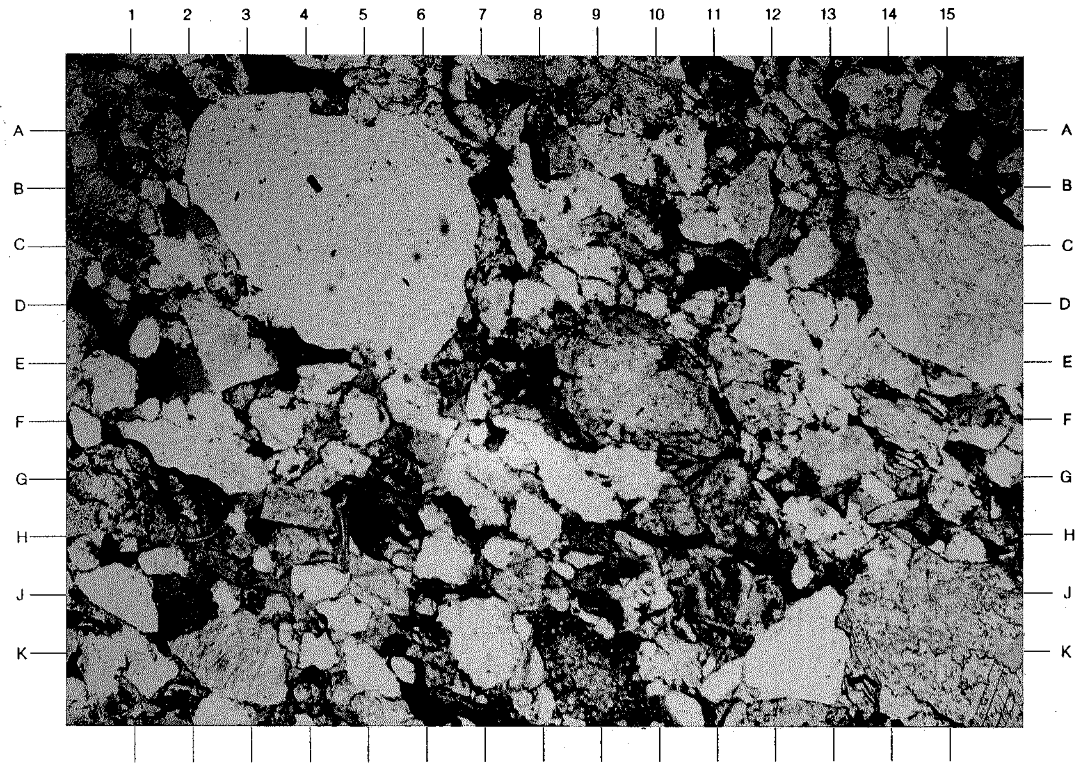
8A PLANE POLARIZE LIGTH
MAGNIFICATION **40X**

General view of a conglomeratic sandstone, classified like lithic Arkose to Arkose. Grain size range between very coarse sand to granules (C5, D15), and very fine upper sand (H7, H15), average medium sand grained. This sample is poorly sorted, and the grain roundness is very angular to subangular (K1, K12), considered as inmature. There is a subparallel alignment of elongate grains (diagonal in the photograph). Grain contacts are puntual (K5), long (D12, E14), and concavo-convex (B14).

The primary porosity types are interparticle (E7), and secondary porosity was created by dissolution, the pore system is heterogeneously distributed, and moderately interconnected. Pore sizes range between 0.07 mm and 0.1 mm of diameter.

8B CROSSED POLARIZERS
MAGNIFICATION **40X**

This is the same field, and the same magnification, of the above photomicrograph under cross polarize ligth. Framework grains are composed mainly of altered plagioclase (H4, J14, K10, A13), monocrystalline quartz {(granule sizes C5 within tourmaline inclusion, D15, K12 with local inclusions), and smaller grains H8, G3, D12}, and lithic fragments in minor quantities (3, J2): chert (E9, K9), argillaceous fragments (C1, A15), and few metamorphic rock fragments. The elongate grains show subparallel aligneament (biotite H10, H5, and muscovite G15-16). There are concentrations of calcite minerals in K15.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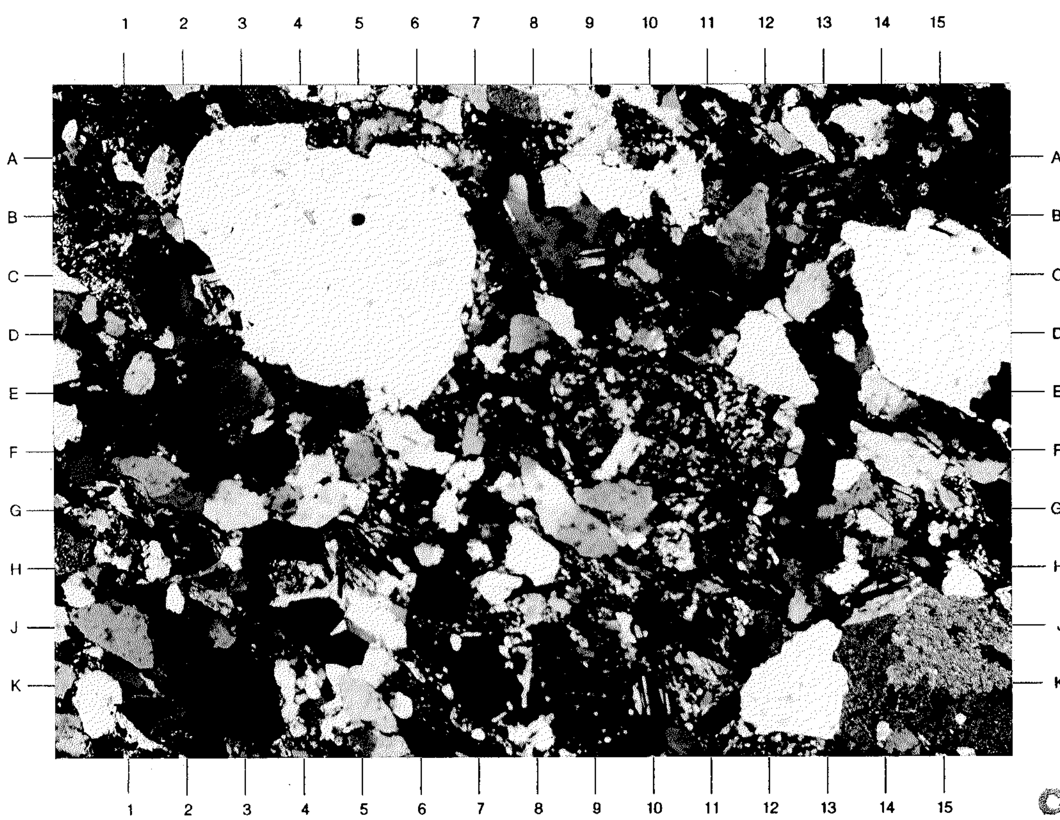
A B C D E F G H J K

A


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
A B C D E F G H J K

B

WELL L016 - 20

PLATE 9

SAMPLE 8594'

SAMPLE	8594'	GRAIN SIZE	0.5 mm (Medium sand).
ROCK NAME (FOLK 1980)	ARKOSE-LITHICARKOSE	PORE SIZE	NONE
SORTING	POORLY	PETROPHYSICS	
		- POROSITY	6.0 %
		- PERMEABILITY	0.003 mD
		- GRAIN DENSITY	2.70

9A PLANE POLARIZE LIGTH
MAGNIFICATION **40X**

General view of a conglomeratic sandstone, classified like lithic arkose. Grain size ranges between coarse sand (J6, E7, K13), and coarse silt (A3 to A14), average medium sand grained. This sample is poorly sorted, and the grain roundness is very angular to subangular (G5, A9), considered as inmature. There is a subparallel alignment of most elongate grains (diagonal trends in the photograph). Grain contacts are puntual (A1-2), long (J6-7, C15), concavo-convex (G13), and locally sutured (G15-16).

9B PLANE POLARIZE LIGTH
MAGNIFICATION **40X**

Low magnification view of a fine to medium grained lithic arkose. Framework grains are composed mainly of plagioclase (F13, H14), monocrystalline quartz (H2, A7, C2) and lithic fragments in minor quantities: chert (E9, D13), argillaceous fragments (C-D15, and D7 in the above photo), and few metamorphic fragments (A3). The elongate grains show subparallel aligneament (large biotite G5, D9, and muscovite (D4). Another mica is glauconite (J13). There are some well developed calcite minerals cemented this rock (A13). Unstable biotite mica (H6, H9) has been suffering chloritization.

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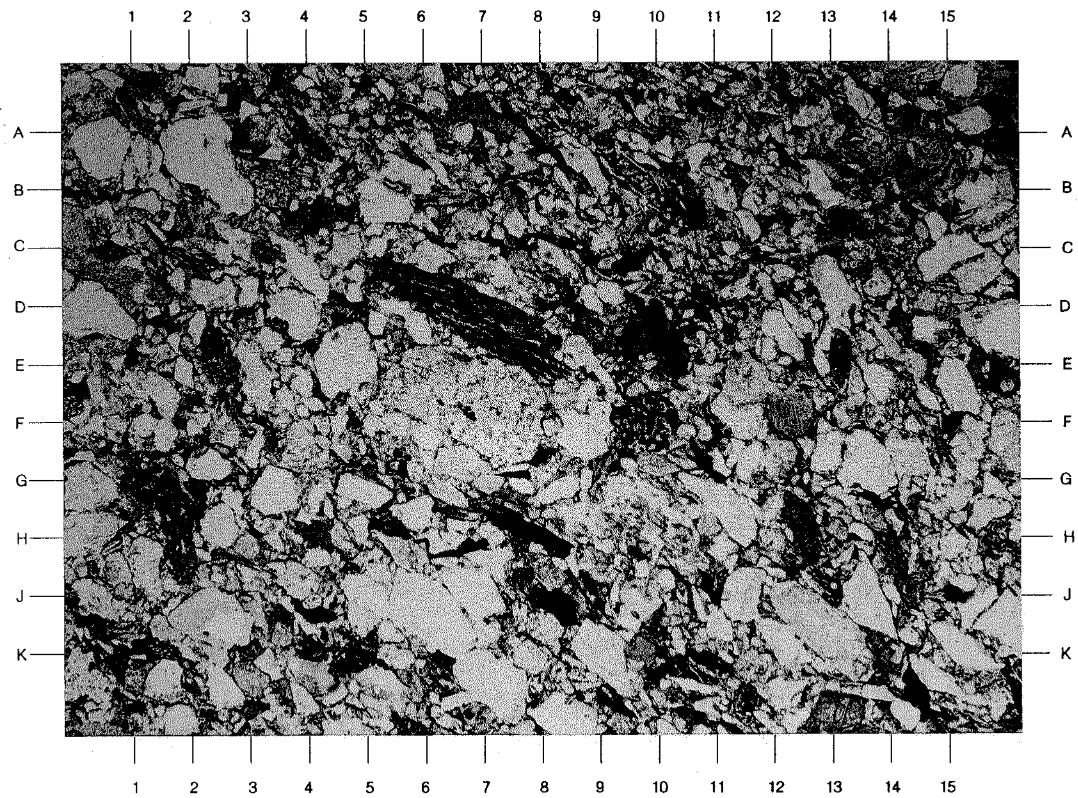

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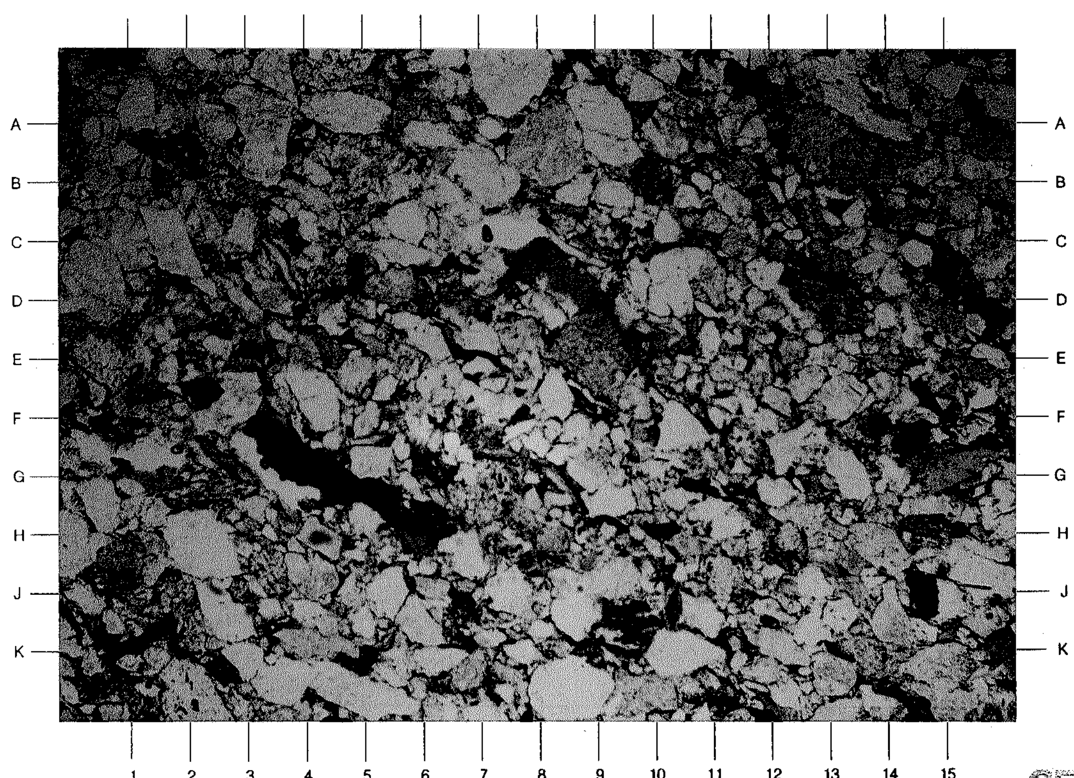

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WELL L016 - 20

PLATE 10

SAMPLE 8601'

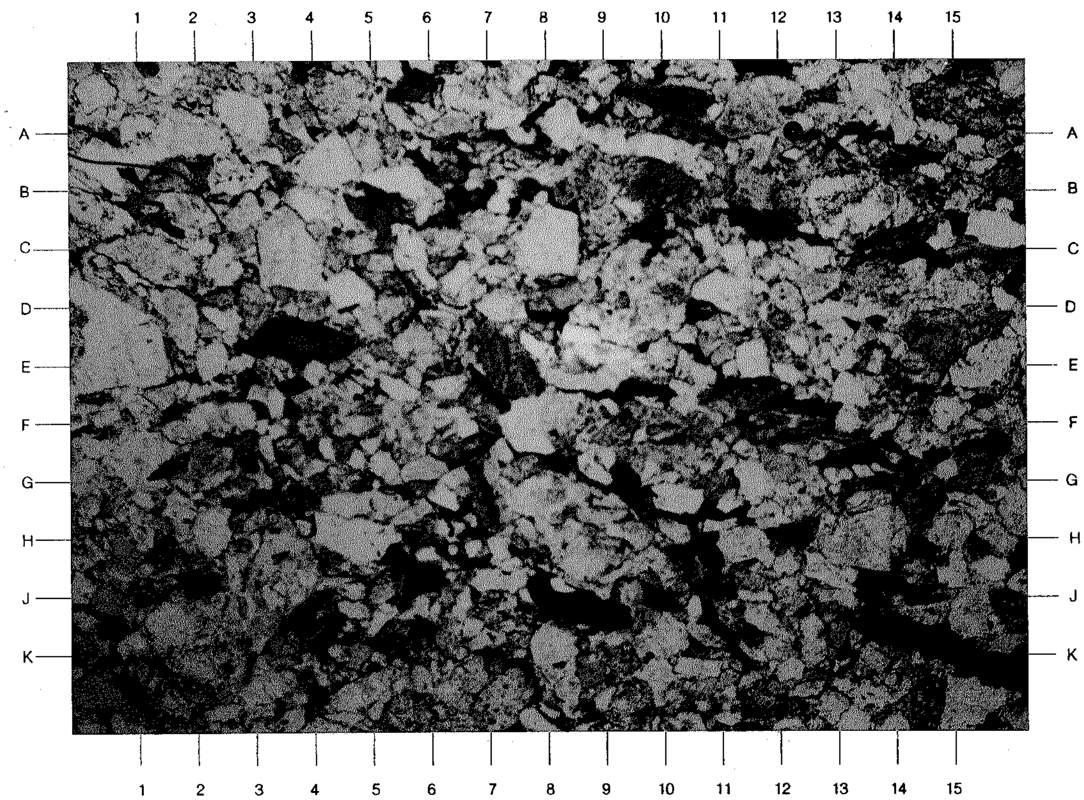
SAMPLE	8601'	GRAIN SIZE 0.25 mm (Medium to fine).	
ROCK NAME (FOLK 1980)	LITHIC ARKOSE	PORE SIZE 0.0625 mm.	
SORTING	POORLY	PETROPHYSICS	
		- POROSITY	6.2 %
		- PERMEABILITY	0.005 mD
		- GRAIN DENSITY	2.70

10A PLANE POLARIZE LIGTH
MAGNIFICATION **40X**

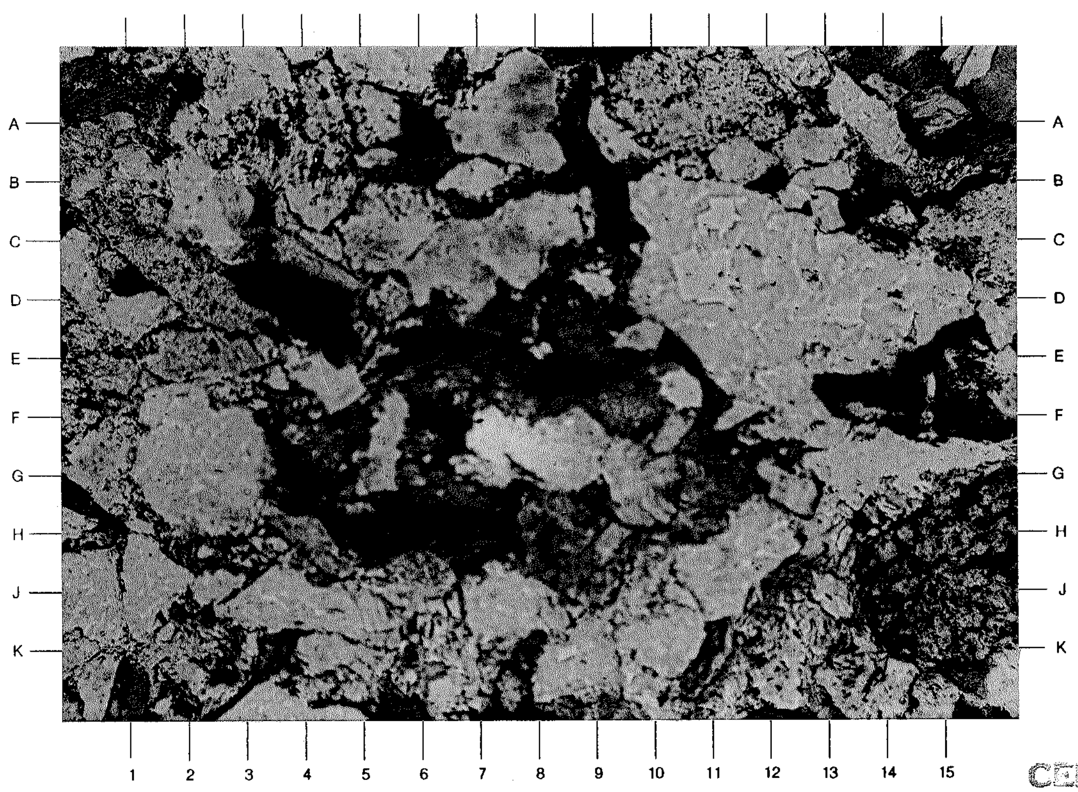
A medium to very fine grained, poorly to locally bimodal sorted sandstone is shown here. Framework grains are composed mainly of plagioclase feldspars (pinkish gray coloured minerals), monocrystalline quartz (white) and lithic fragments (dark minerals) in minor quantities: chert (J16 y E4), argillaceous, and few metamorphic fragments. Accesory minerals are common, biotite (G9, B10), altered glauconite (D8, F2-3) and muscovite. Dissolution has its effect in rock fragments, accesory minerals and mainly feldspar grains, generating microporosity. There are concentrations of relative insoluble organic matter, opaque minerals, clays and other minerals yielding the dark appearance.

10B PLANE POLARIZE LIGTH
MAGNIFICATION **100X**

Detailed view showing the inestability of the main framework grains. In the middle of the photomicrograph there are two types of biotite (E9 broun colour, H6 green to dark colour) in alteration processes and generating authigenic clays. Through the photo´s borders plagioclase feldspars are in incipient stages of dissolution been removal of the interior zones of feldspar by calcite (A4, K3). Some argillaceous intraclast are also present (J15), as well as organic matter fibres (C9-10, F14). The primary pore system has been degraded. Secondary porosity has been generated by dissolution of unstable detrital grains (B-A6, G4, K3-4).


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
A B C D E F G H J K

A


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
A B C D E F G H J K

B

WELL L016 - 20

PLATE 11

SAMPLE 8640'

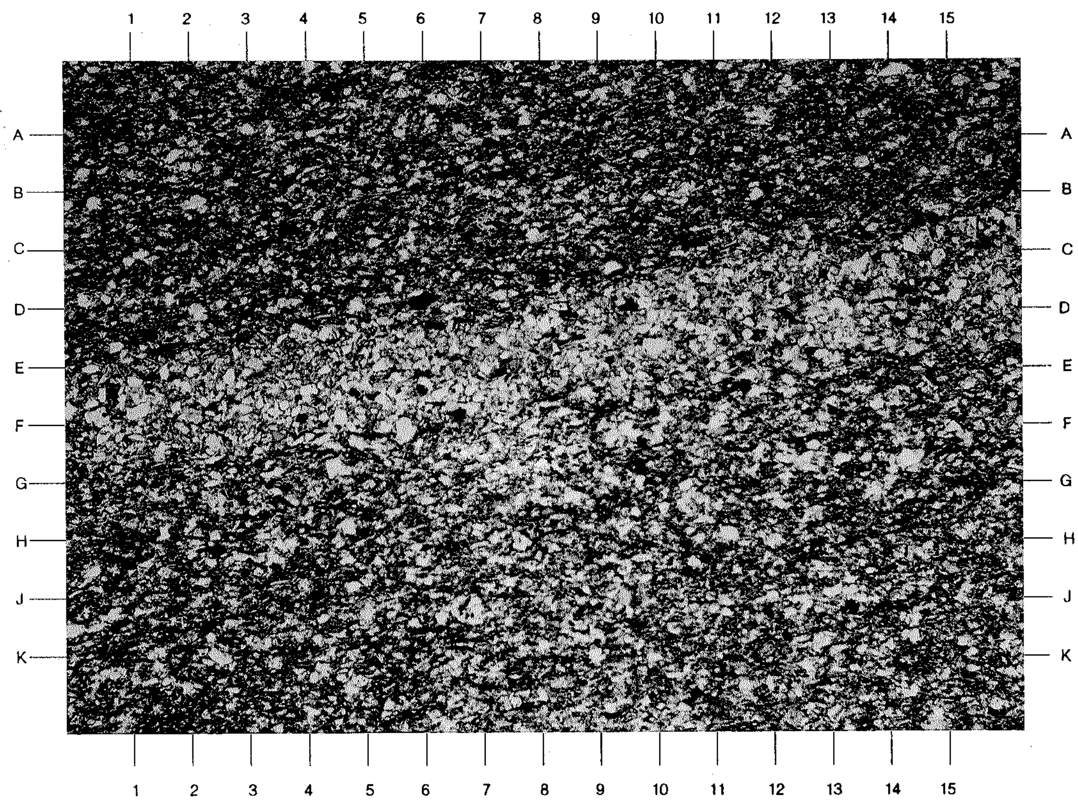
SAMPLE	8640'	GRAIN SIZE	0.05 mm (Coarse silt).
ROCK NAME (FOLK 1980)	ARKOSE	PORE SIZE	0.01 mm (Fractures)
SORTING	WELL	PETROPHYSICS	
		- POROSITY	2.7 %
		- PERMEABILITY	< 0.001 mD
		- GRAIN DENSITY	2.69

11A PLANE POLARIZE LIGTH
MAGNIFICATION **40X**

General view of a very fine lower sand to coarse silt grained Arkose. In this sample clay minerals are preferentially oriented and extreme colour changes are noted in the photograph (darker and lighter colored areas), where clay minerals are showing lamination. The photo exhibits excellent alignment of elongate minerals, and the predominance of silt size over clay sized material. Darker laminae contain abundant disseminated blebs of organic matter associated with oxides, and opaque minerals.

11B PLANE POLARIZE LIGTH
MAGNIFICATION **100X**

Detailed view of a coarse silt grained argillaceous laminated siltstone, classified as Arkose. In the photomicrograph there are two types of laminae the darker one with high contain in organic matter and the lighter colored mineralize area in the uppert part of the view. The primary pore system has been degraded, and secondary porosity by microfracture is present (blue colour in the lower part of the view). Framework grains are composed mainly of monocrystalline quartz (some of white small minerals), plagioclase feldspars, and less amounts of lithic fragments. Accesory minerals are common: mica biotite, muscovite, and glauconite. All of then are difficult to recognize due to the size.



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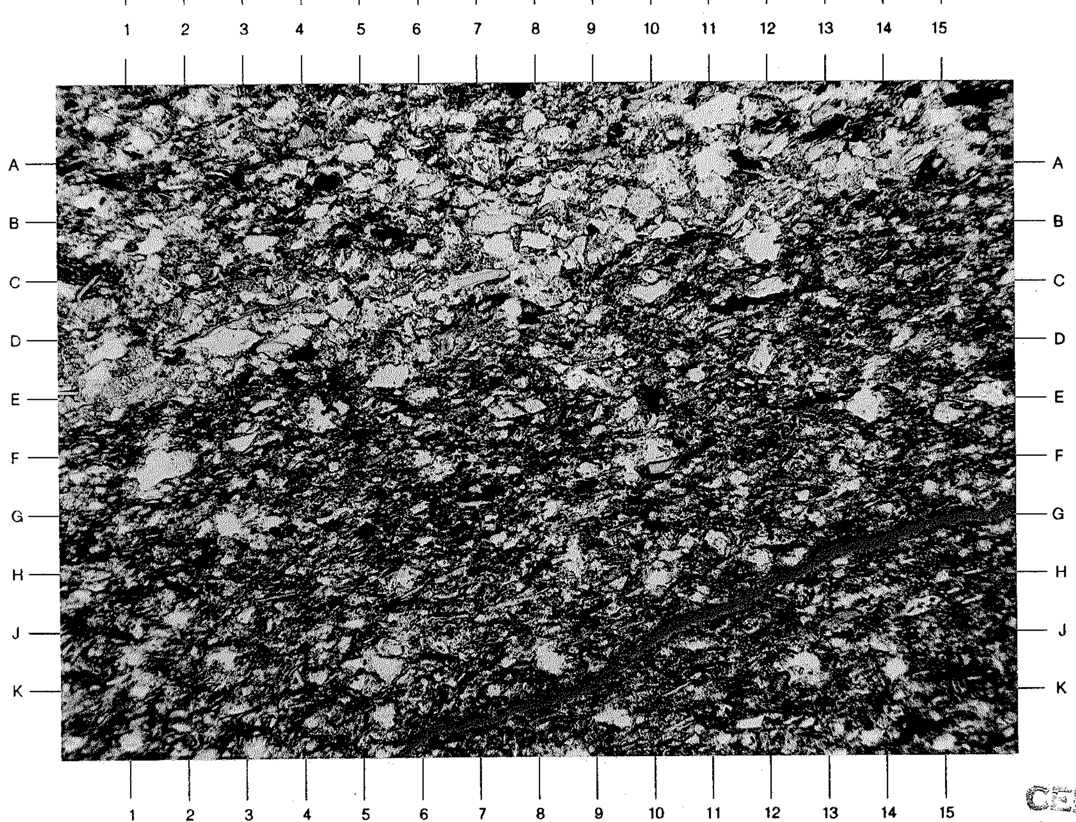

B

APPENDIX

APPLICATION OF PARAMETERS DETERMINED BY THE CMS-300

Porosity determined at several net stresses enhances reservoir description and permits:

- More accurate calculation of hydrocarbon volume in place.
- Evaluation of variation in reservoir pore volume with decline in reservoir fluid pressure from depletion of the reservoir.
- Calibration of log derived porosities.
- Extrapolation of historical porosity data obtained at ambient conditions to insitu stress conditions (practical link to historical data).
- For friable samples, porosity can be extrapolated accurately to higher reservoir stresses that could crush a small core plug (utilizing algorithm).

Klinkenberg Permeability determined at various stress conditions:

- Provides more representative data for comparison with pressure build-up data and better reservoir description data for application in simulators.
- Permits determination of permeability variation with depth in order to establish vertical zonation of the reservoir into hydraulic units.
- Reveals permeability decreases with stress as reservoir pore pressure declines. The magnitude of the permeability decrease can be indicative of the damage potential induced by drawdown.
- In combination with relative permeability data, reservoir depletion strategies can be optimized.
- For friable samples, permeability can be extrapolated accurately to higher reservoir stresses that could crush a small core plug (utilizing algorith).
- Extrapolation of historical permeability data attained at minimum stress conditions to insitu stress conditions (practical link to historical data).

Additionally, porosity and permeability reductions with varying net overburden pressures can be used to establish the productive capacity of formations targeted for deeper exploration. Porosity and Klinkenberg corrected permeability data as functions of stress also permit computation of the Reservoir Quality Index, RQI.

$$RQI\ (microns) = 0.0314 * (K\infty/\phi)^{0.5}$$

RQI is useful for zoning a reservoir into units of similar hydraulic characteristics.

Klinkenberg Permeability

Klinkenberg Permeability is the gas permeability at infinite mean pore pressure equivalent to permeability of a non-reactive liquid. Klinkenberg permeability is the same for a sample regardless of the gas that has been used in the test, and is independent of the mean pore pressure (Pmean). This is important when comparing permeability data from different laboratories which may make measurements using different Pmean or with different gases (air, nitrogen, etc.) to determine a gas permeability. Other applications include:

- Flow Capacity, distribution and profile.
- Transmissibility and stress sensitivity.
- Zonation of reservoir units.
- Computation of RQI

Klinkenberg Slippage Factor (b) for helium gas. A plot of K vs. 1/Pmean yield a straight line with a slope of K∞ * b and an intercept equal to K∞. The slope varies as a function of gas type. b is referred to as the Klinkenberg slippage factor.

$$K = K\infty\ (1 + b/Pmean)$$

In general, an inverse relation between permeability and b exists, some applications include:

- Calculation of equivalent air permeability (Kair) to serve as a common tie point to historic core data.

- Reciprocal slip factor 1/b, is approximately proportional to the characteristic length, $(k/\phi)^{0.5}$

Forcheimer Inertial Resistance Factor (Beta, ß). This term can be used to describe pressure losses during non-darcy flow into a wellbore (typical in gas wells). Other applications include:

- When properly averaged and combined with flowing well analysis, can help predict the economic effects of perforating conditions, as well as the number and size of perforations for maximum production (primarily in gas wells).

- The measurement of Beta provides a very sensitive indication of permeability heterogeneity on a core-plug level.

- Plotting Beta vs. K_∞ aids in delineation of hydraulic units.

Alpha is a factor equal to the product of K_∞ and Beta. This product times a unit conversion factor yields alpha in microns.

- Alpha and Beta are incorporated in the pore level heterogeneity index (Hi):

$$Hi = \log_{10} (\alpha\phi/RQI)$$

Where:

$$\alpha = 3.238\text{E-}9\ \beta K_\infty \text{ (microns)}$$
$$RQI = 0.0314\ (K/\phi)^{0.5} \text{ (microns)}$$
$$\phi \text{ (fraction)}$$
$$K_\infty \text{ (md)}$$
$$\beta \text{ (ft}^{-1}\text{)}$$

- A plot of Hi vs. RQI can be used to assist in delineation of hydraulic units.

Additionally, porosity and permeability reductions with varying net overburden pressures can be used to establish the productive capacity of formations targeted for deeper exploration. Porosity and Klinkenberg corrected permeability data as functions of stress also permit computation of the Reservoir Quality Index, RQI.

$$RQI\ (microns) = 0.0314 * (K\infty/\phi)^{0.5}$$

RQI is useful for zoning a reservoir into units of similar hydraulic characteristics.

Klinkenberg Permeability

Klinkenberg Permeability is the gas permeability at infinite mean pore pressure equivalent to permeability of a non-reactive liquid. Klinkenberg permeability is the same for a sample regardless of the gas that has been used in the test, and is independent of the mean pore pressure (Pmean). This is important when comparing permeability data from different laboratories which may make measurements using different Pmean or with different gases (air, nitrogen, etc.) to determine a gas permeability. Other applications include:

- Flow Capacity, distribution and profile.
- Transmissibility and stress sensitivity.
- Zonation of reservoir units.
- Computation of RQI

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