

CHEMICAL RESEARCH AND DEVELOPMENT DEPARTMENT

HALLIBURTON SERVICES
DUNCAN, OKLAHOMALABORATORY REPORTNo. T11-A118-87To Mr. John Riley
Halliburton Services
Oklahoma City, OKDate December 17, 1987

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submitted formation core samples.

We give below results of our examination of _____

Submitted by Plains Resources, Inc.

Marked Well: No. 1 Grisson
Location: Sec. 3; T24S; R40W; Hamilton Co., KS
Formation: Winfield
Depth: 2,444 to 2,483 feet
Date Received: December 1, 1987

Purpose

These formation cores were submitted for the following tests and examinations: x-ray diffraction, acid solubility, immersion, scanning electron microscope (SEM), petrographic, and regained gas permeability.

Conclusions

Results of the tests and examinations completed are presented in the Data Section of this report.

The qualitative x-ray diffraction, iron content, and HCl solubility analyses are presented in the Data Section. Since the samples are different, the minerals varied from sample to sample. The HCl acid solubility ranged from 1.5% to 88.9%.

The iron content, which is HCl acid soluble iron, ranged from 0.39% for the limestone (Sample No. 1) to 4.1% for one of the sandstones (Sample No. 4). This iron content is high and if HCl acid is used on this formation then iron control additives plus an oxygen scavenger should be used in all acid solution to help prevent the reprecipitation of iron in the formation. Also, the formation wafer should be analyzed for water soluble iron, and if found then iron control practices should be followed in all fluids used in any stimulation treatment on this formation.

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Conclusions Cont'd

The regained permeability tests performed indicated no fluid/formation problems. All the test fluids recovered 100% in less than 2 hours. The 0.25 NH_4Cl brine and the Standard API Brine both recovered 100% in less than one hour. Fresh water also recovered 100% in one hour.

The immersion tests indicated that Sample No. 4 at 2,464 feet is very sensitive to all the fluids tested. The other four samples were not effected. The better fluids seem to be 0.25% NH_4Cl brine and Standard API Brine.

Based on the data obtained on the submitted formation samples, the use of gelled water with CO_2 should have a minimal damage effect on this formation.

DataSample Description

<u>Sample No.</u>	<u>Depth (feet)</u>	<u>Description</u>
1	2,444	Limestone tan-light grey micrite some crystalline calcite in old fractures.
2	2,455	Sandstone lower very fine - medium very fine grain, subangular light brown, moderately cemented dark brown, absorbant semi-soft, siltstone in lighter colored zones.
3	2,457	Similar to Sample No. 2.
4	2,464	Shale reddish brown sandy with a few light grey shale streaks.
5	2,483	Shale brown - reddish brown sandy with few thin zones of spotty calcite nodules and other thin zones of light color which are slightly more sandy.

Table 1 contains the lithology data supplied by the customer.

Data Cont'dQualitative X-ray Diffraction, Iron Content,
and Acid Solubility Analyses

Purpose: To identify the types and relative quantities of minerals in the formation sample.

Procedure: A pulverized one gram sample is placed in an x-ray beam and rotated through an arc. The x-ray beam is diffracted by the sample and the diffraction patterns are recorded.

Results: The diffraction patterns are used to identify the types of minerals present and their relative quantities. The relative quantities for the submitted samples are as follows:

Sample No.	1	2	3	4	5
Depth (feet)	<u>2,444</u>	<u>2,445</u>	<u>2,457</u>	<u>2,464</u>	<u>2,483</u>
HCl Solubility*	88.9%	17.5%	5.9%	1.5%	13.7%
Iron Content**	0.39%	1.06%	1.51%	4.10%	1.27%
Quartz	5-10%	25-30%	40-50%	30-40%	30-40%
Feldspar	2-5%	20-25%	10-15%	5-10%	25-30%
Calcite	0	0	0	0	0
Dolomite	80-95%	15-20%	5-10%	0.5-2%	10-15%
Kaolinite	0	0	0	0	0
Illite/Mica	0	5-10%	15-20%	15-20%	10-15%
Smectite	0	0	0	0	0
Mixed Layer	2-5%	5-10%	5-10%	25-30%	2-5%
Chlorite	0	2-5%	2-5%	2-5%	2-5%
Anhydrite	5-10%	2-5%	0.5-2%	0	0.5-2%
Sodium Chloride	0.5-2%	0.5-2%	0	0	2-5%
Hematite	0	0	0	0.5-2%	0

*One gram of sample is added to 0.5N HCl. After reaction, the excess acid is titrated with 0.2N NaOH. The results are calculated and reported as calcium carbonate. (Note: a pure dolomite will be reported as 108%).

**One gram of sample is added to concentrated HCl. After reaction, the dissolved iron is titrated with Potassium Dichromate and reported as percent by weight.

Data Cont'dImmersion Test

Purpose: To observe the effect of various base fluids on core chips from selected representative cores.

Procedure: Freshly broken chips from cores are immersed in test fluids; one chip per fluid in a 30 ml beaker. The samples are then placed in a vacuum for one hour. After that time an observation is made to evaluate the effect of the fluid on the core chip.

Results: Released fines from a core chip may indicate formation sensitivity to the test fluid.

Effects of immersion under vacuum at 80°F (test temp.) for one hour in the following fluids:

Sample No.	1	2	3	4	5
Depth (feet)	<u>2,444</u>	<u>2,445</u>	<u>2,457</u>	<u>2,464</u>	<u>2,483</u>
Fresh Water	V	S	S	P	S
2% KCl Water	S	V	S	P	S
0.25% NH ₄ Cl Water	V	V	S	P	V
API Standard Brine	N	V	S	P	V

N - No fines released.

V - Very small amount of fines.

S - Small amount of fines.

M - Moderate amount of fines.

L - Large amount of fines.

P - Partially disintegrated.

CD - Completely disintegrated.

GR - Gelatinous residue formed.

PD - Partially dissolved.

C - Completely dissolved.

*0.5 gallon CLA-STA II compound per 1,000 gallons.

Data Cont'dRegained Permeability Tests (N₂ Gas)

<u>Sample No.</u>	<u>Depth (feet)</u>	<u>Test Pressure (psig)</u>
2-A, 2-B2	2,455	200
3-A, 3-B	2,457	1,000

Purpose: To measure the effect of fluids on the permeability of samples.

Procedure: The core test plugs (1 inch in diameter by 1 inch in length) are oven dried and the sides are sealed with epoxy to insure linear flow through the test plugs. Initial nitrogen permeability measurements are then obtained in one direction. The core plugs are then saturated and a measured volume of fluid is flowed through the core plug in the opposite direction. Fluid flow temperature was 90°F. Regained permeability measurements are obtained in the original direction. Gas flow measurements are at 90°F.

Results: The data are reported as a percent of the initial permeability recovered.

<u>Sample No.</u>	<u>Initial Perm. Gas (N₂) (md)</u>	<u>Saturation Fluid</u>	<u>Saturation</u>	
			<u>Fluid Perm. (md)</u>	<u>Test Fluid*</u>
2-A	2.31	API Standard Brine	0.23	Fresh Water
2-B	2.52	API Standard Brine	0.45	1% KCl Brine
3-A	0.09	API Standard Brine	0.02	0.25% NH ₄ Cl Brine
3-B	0.09	API Standard Brine	0.01	None

*Fluid descriptions are under the Fluid Loss Tests section.

<u>Sample No.</u>	<u>Percent Regained</u>						
	<u>Time (hours)</u>						
	<u>0.5</u>	<u>1.0</u>	<u>2.0</u>	<u>3.0</u>	<u>4.0</u>	<u>6.0</u>	<u>24.0</u>
2-A	72.4	100+					
2-B	63.5	94.4	100+				
3-A	81.1	100+					
3-B	86.3	100+					

Data Cont'dScanning Electron Microscope (SEM) Examination
and Petrographic ExaminationFor SEM:

Purpose: To provide a greatly magnified view of a core sample. Minerals present in the sample can be identified and their location observed.

Procedure: A core chip with a freshly broken surface is required for this examination. The sample is coated with a gold palladium alloy and placed in the vacuum chamber of the SEM. The core chip is viewed at a high magnification and a photomicrograph is taken. An associated energy dispersive x-ray (EDX) is used to help identify the mineral content of the sample.

Results: The framework grains can be identified and their size approximated. The location of the clay minerals within the sample can be observed. The SEM can produce, in effect, a pseudo three-dimensional view of formation pore spaces. The area of the sample viewed is very small and may not clearly characterize the entire formation.

For Petrographic:

Purpose: To describe the framework grains, the matrix or the cementing material, and the pore spaces.

Procedure: Core chips are glued to glass slides and then ground to a thin section through which light can be transmitted. The slide is placed under a microscope and viewed using polarized light at high magnification.

Results: The result of this examination is a descriptive and systematic classification of the rock and materials present in the sample. This analysis is a visual observation, thus is somewhat subjective.

Data Cont'dScanning Electron Microscope Examination Cont'd

Sample No: 1
Depth: 2,444 feet

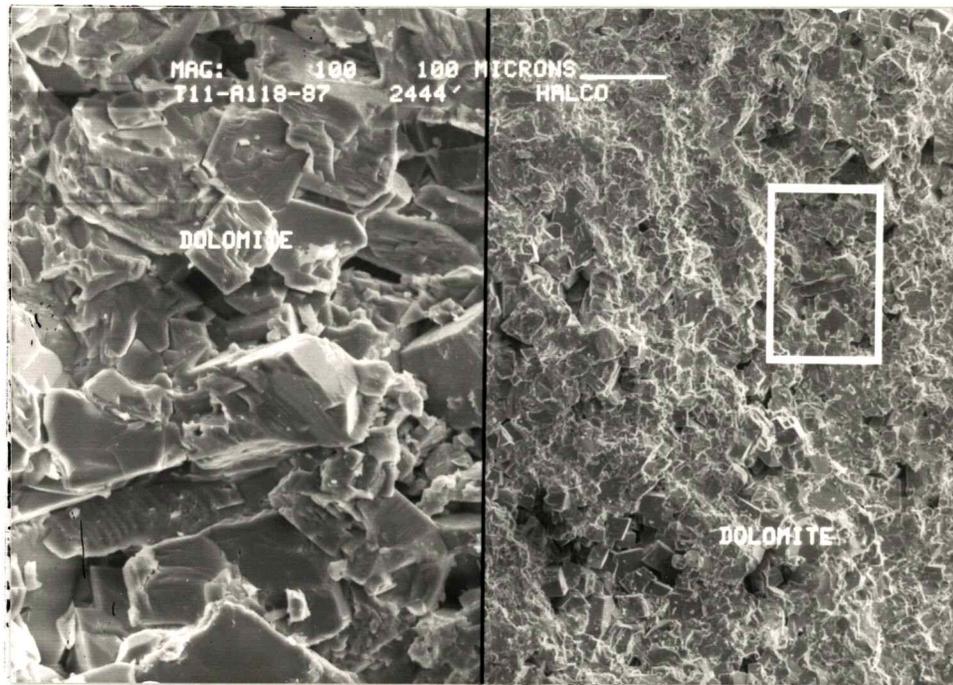


Figure No. 1; Negative No. 1455; Magnification 100X, 500X

The photomicrograph illustrates the dolomite framework.

Petrographic Examination Cont'd

SANDY ANHYDRITIC DOLOMITE - Framework of interlocking sparry dolomite crystals with very fine sand sized quartz and feldspar grains and anhydrite vug and pore fill throughout the sample, trace mixed layer clay, very poor vuggy porosity.

Data Cont'dScanning Electron Microscope Examination Cont'd

Sample No: 2

Depth: 2,445 feet

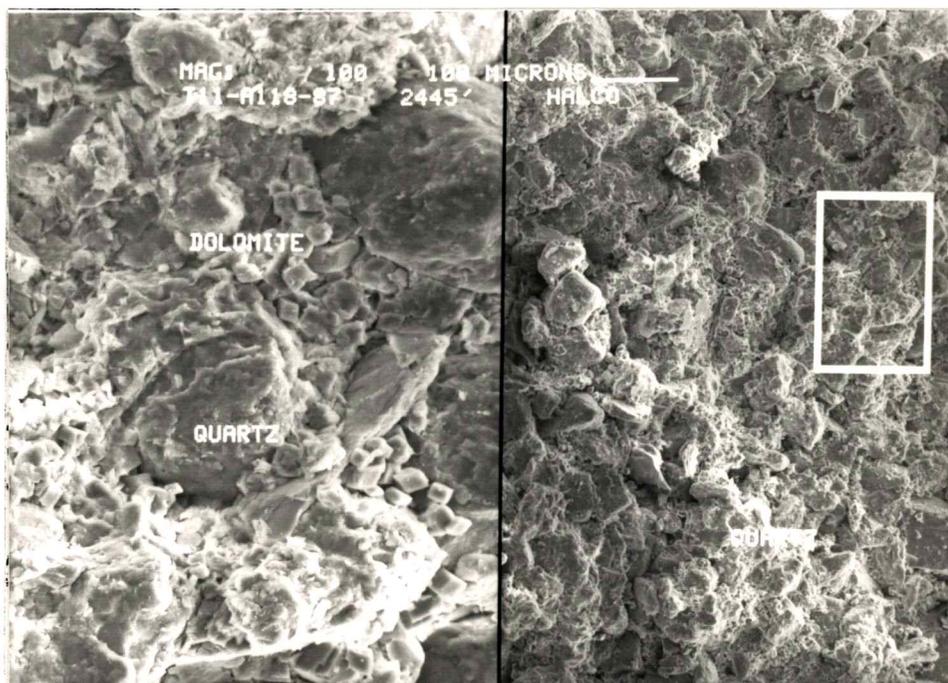


Figure No. 2; Negative No. 1456; Magnification 100X, 500X

The photomicrograph illustrates the dolomite pore fill.

Petrographic Examination Cont'd

DOLOMITE CEMENTED ARKOSIC FERROGINOUS SILTSTONE - Framework of moderately well sorted, subangular, silt to very fine sand sized grains of quartz, feldspars, and mica, cemented by finely crystalline dolomite, chlorite and mixed layer clays line and infill many intergranular pore spaces, trace of anhydrite and sodium chloride, very poor to no visible porosity.

Data Cont'dScanning Electron Microscope Examination Cont'd

Sample No: 3
Depth: 2,457 feet

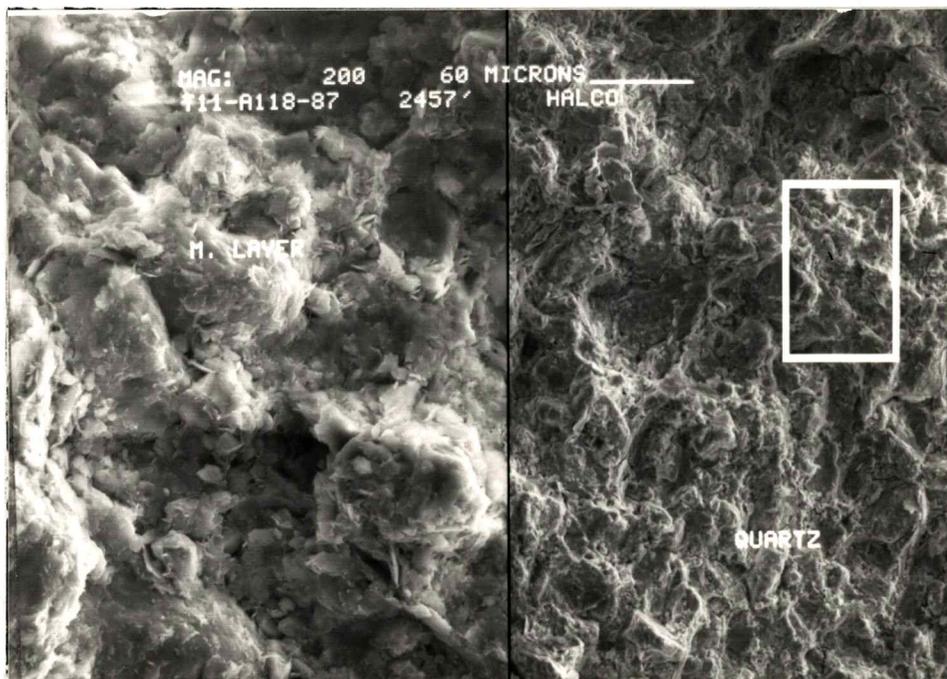


Figure No. 3; Negative No. 1457; Magnification 200X, 1000X

The photomicrograph illustrates the mixed layer and dolomite pore fill.

Petrographic Examination Cont'd

DOLOMITE CEMENTED ARKOSIC FERROGINOUS SILTSTONE - Framework of moderately well sorted, subangular, silt to very fine sand sized grains of quartz, feldspars, and mica, cemented by finely crystalline dolomite, chlorite and mixed layer clays line and infill many intergranular pore spaces, trace of anhydrite and sodium chloride, very poor to no visible porosity. (Less feldspar and more mica than in Sample No. 2.)

Data Cont'dScanning Electron Microscope Examination Cont'd

Sample No: 4

Depth: 2,464 feet

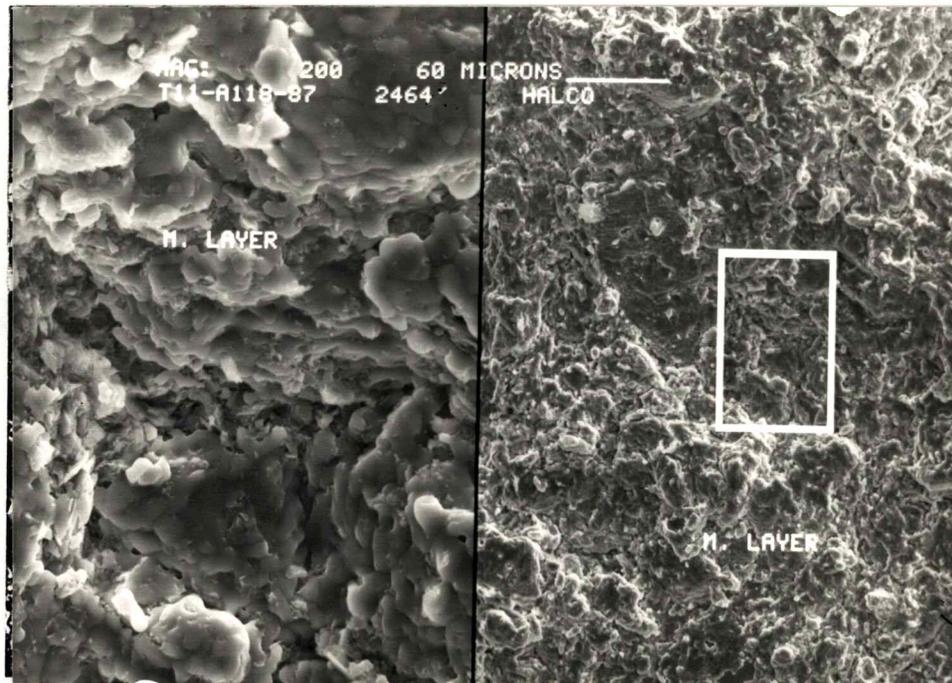


Figure No. 4; Negative No. 1458; Magnification 200X, 1000X

The photomicrograph illustrates the mixed layer covering typical of this sample.

Petrographic Examination Cont'd

FERRUGINOUS SILTY SHALE - Framework of iron stained mixed layer clay with silt sized grains of quartz, feldspar, and mica throughout, no visible porosity.

Data Cont'dScanning Electron Microscope Examination Cont'd

Sample No: 5

Depth: 2,483 feet

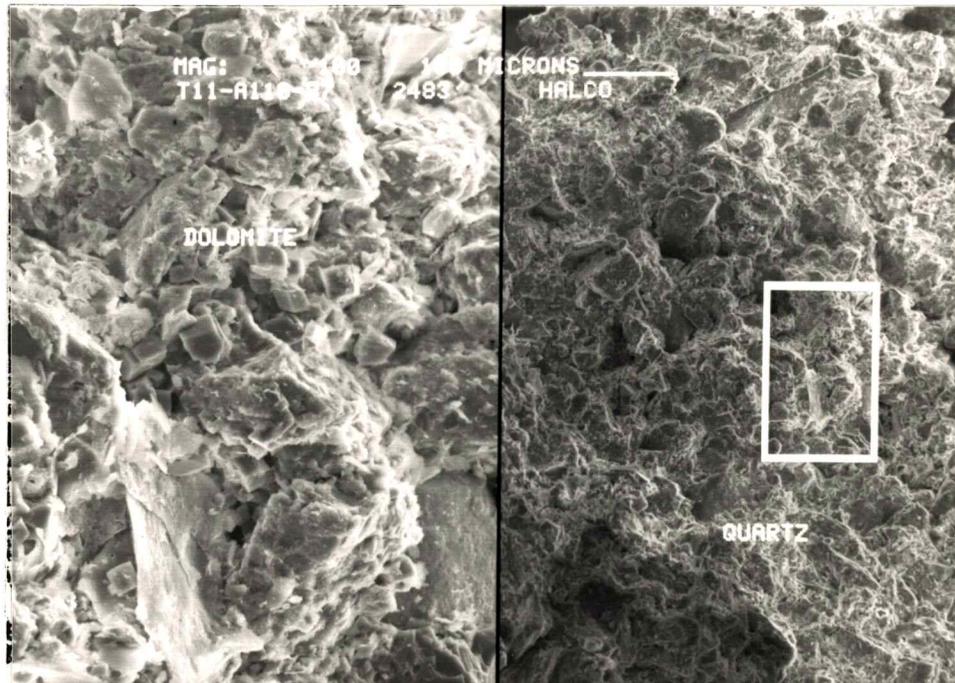


Figure No. 5; Negative No. 1459; Magnification 100X, 500X

The photomicrograph illustrates the dolomite pore fill cement.

Petrographic Examination Cont'd

FERRUGINOUS SILTY SHALE - Framework of iron stained mixed layer clay with silt sized grains of quartz, feldspar, and mica throughout, very poor to no visible porosity.

Table 1

COMPUTER PETROLEUM
#1 Grissan, Sec. 3-24S-40W
Winfield Core
Hamilton County, Kansas

Log Depths

2435-39 Shaley
Top Winfield
2439-46 Limestone
2446-49 Shaley
2449-60 Sandstone [Perfs]
2460-67 Shaley
2467-70 Limestone
2470-72 Shale
2472-94 Shaley

Sample
no Core Depths

2435-38 Shale maroon, gray, green dense (Limey?)
2438-39 Soil zone? congl. of Limestone & shale, Limestone rounded weathered w/ppt \emptyset shale laminae gray-green, Limestone white - lt. tan. No perm contact with Limestone below gradational begin at 2440 complete at 2441.
1 - 2440-47.5 Limestone tan-lt gray micrite some xyline calcite in old fractures. No perm mottled gray irregular zones at base..
2447.5
-48.5 Shale med. gray
2448.5
-49 Sandy lt. green shale
2449-50 Lt. gray siltstone
320 / 2450-58 Sandstone lower very fine - medium very fine grain, Subangular lt. Brown, Moderately cemented Drk Brown, absorbant semi soft, siltstone in lighter colored zones.
2458-59 Shale Med gray
4 - 2459-70 Shale Reddish brown sandy with a few lt. gray shale streaks.
2470-71 Shale lt. gray
5 - 2471-94 Shale brown - Reddish Brown sandy with few thin zones of spotty caliche nodules and other thin zones of lighter color which are slightly more sandy (Best sandstone development at 2489).

Core Sample Disposition

The core samples will be held in storage for 60 days following mailing of the report. At the end of this time, we will select representative core pieces for storage in the Core Library and discard the remainder unless we are requested to ship the cores to another location.

The selected core pieces will be in the Core Library for two years and will be considered the property of the customer. These core pieces will not be released without the permission of the customer, the originating Halliburton Engineer, or a Stimulation Engineering and Design Section Supervisor. After two years, the selected core pieces will be kept for another eight years, during this time the pieces may be used for a variety of projects.

Keywords

Wichita Division Hamilton Co. Kansas
Plains Resources Inc. Winfield Formation Sec. 3; T24S; R40W
No. 1 Grisson Cores

Abstract

Tests and examinations: x-ray, solubility, iron content, regained permeability, immersion, SEM, petrographic. X-ray(%): Q=5-50 F=2-30 C=0 D=0.5-95 K=0 I/M=0-20 CH=0-5 S=0-30 ML=2-30 Anhydrite=0-10 Sod.Chl.=0-5 Hematite=0-2. HCl sol.=1.5-88.9%. Iron Con.=0.39-4.10%.

Data Book Reference

The data presented in this report are recorded in Stimulation Engineering and Design Book No. 6285, page 37; Stimulation Engineering and Design Book No. 6252, page 41; Analytical Book No. 6282, page 35; Analytical Book No. 6272, pages 39 and 40; and Analytical Book No. 6283, page 16.

cc: Mr. D. E. Fontenot
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Respectfully submitted,

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12-21-87

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