

# **Micro-CT Plug Analysis**

**#1 Smith Exxon  
Wayne County, West Virginia**

**December 2011**

**For**



## DISCLAIMER

The analyses, opinions or interpretations in this report are based upon observations and material supplied by the client to whom, and for whose, exclusive and confidential use this report has been made. The interpretations or opinions expressed in this report represent the best judgment of Ingrain. Ingrain and its officers and employees assume no responsibility and make no warranty or representations, expressed or implied, as to the productivity, proper operations, or profitability of any oil, gas, coal or any other mineral, property, well, or formation in connection with which such report is used or relied upon for any reason whatsoever. Ingrain reserves the right to supplement, amend, or withdraw this report in the event that it discovers additional relevant information that affects or changes its analysis.

## COPYRIGHT NOTICE

This report as a whole, and the images and videos contained in this report are the copyrighted work product of Ingrain Inc. Permission is given to reproduce this report or incorporate excerpts, images, or videos from this report in internally distributed documents and presentations providing that such excerpts, images, or videos are fairly attributed to Ingrain. This report, excerpts, images, or videos, may be distributed or presented to third parties only with the written permission of Ingrain Inc.

## TABLE OF CONTENTS

Executive Summary	4
Presentation of Data and Results	5
Individual Results	
Sample No.19 (11139.00 ft)	6
Sample No.19A (11144.00 ft)	7
Sample No.21 (11158.30 ft)	8
Sample No.24 (11190.50 ft)	9
Sample No.26 (11200.00 ft)	10

## EXECUTIVE SUMMARY

Cimarex Energy provided Ingrain with 11 samples from their #1 Smith Exxon well located in Wayne County, WV. These samples range in depth from 11139.00 to 12496.00 ft. Of these eleven samples, Cimarex decided to proceed with analysis on five.

The samples were photographed with white light, then scanned with an X-ray CT system to characterize the micro-scale heterogeneity at a resolution of approximately 28 microns per voxel. The CT produces a grayscale image based on the relative densities of the rock aggregates with high density materials represented by white and low density materials, including organics and pore, represented by darker shades of gray.

Since the samples were not marked with any point of reference, Ingrain photographed the samples and proceeded with Micro CT scanning.

To allow for visualization of the relative densities of the rock aggregates, 3D movies are provided in a digital subdirectory called “3D movies”.

Juliana DeVito, Project Geologist

## PRESENTATION OF DATA AND RESULTS

### **3D Grayscale CT Images**

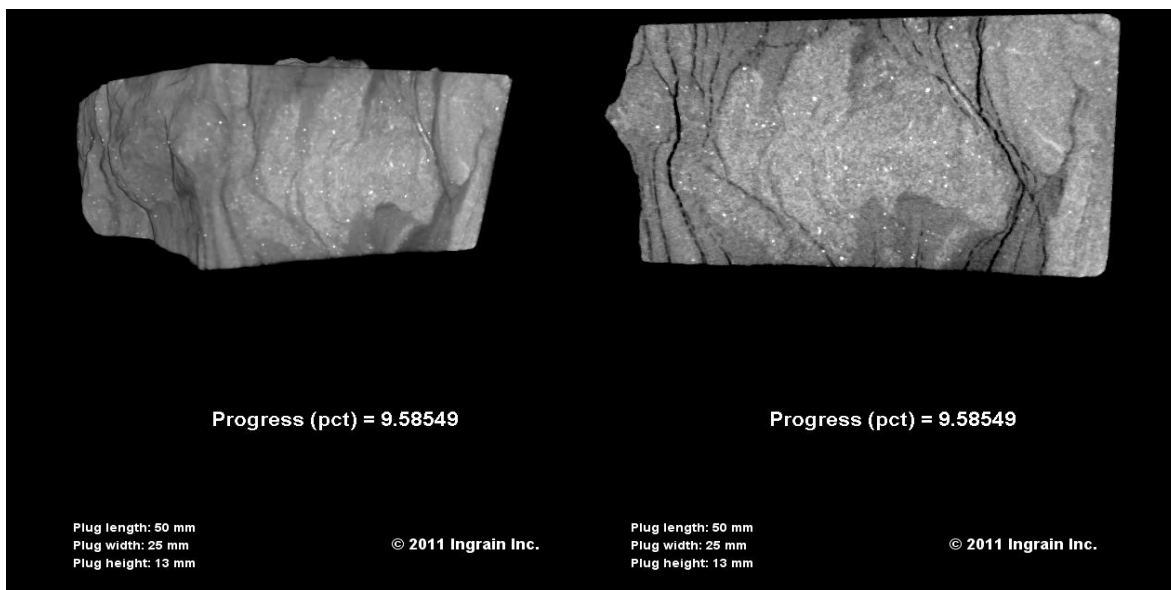
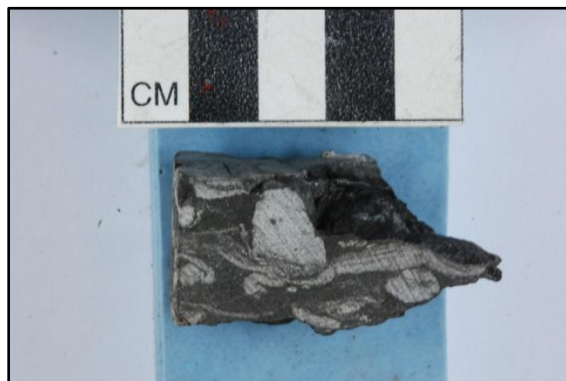
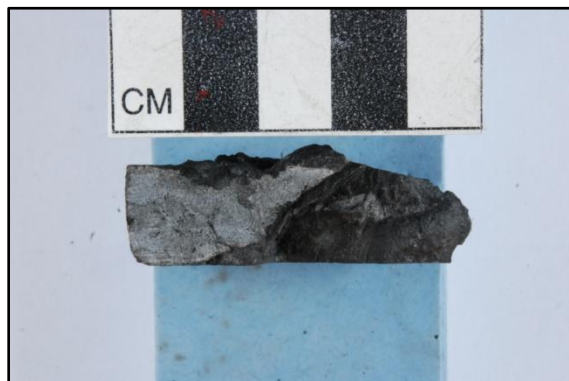
The images presented were obtained from an X-Ray CT scanner that produces a 3D volume of a vRock® Digital Reservoir Rock.

Interpretation of SEM image:

- White: High density material (e.g: iron rich)
- Shades of Gray: Minerals with densities of 2-3 g/cc
- Black: Pore space

## Micro-CT Images

### Original Sample White Light Photos



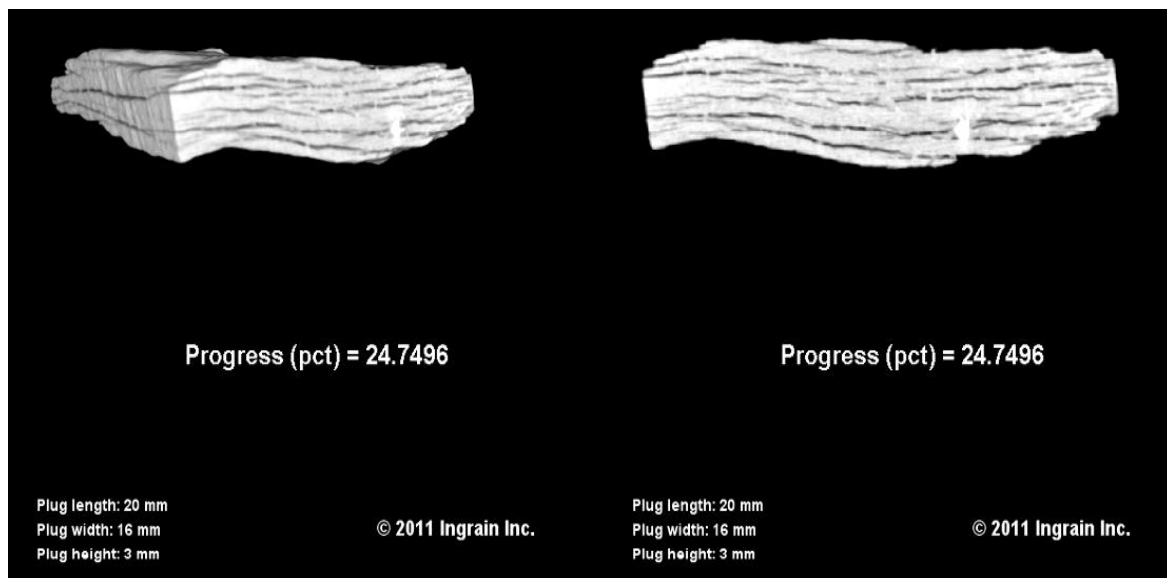
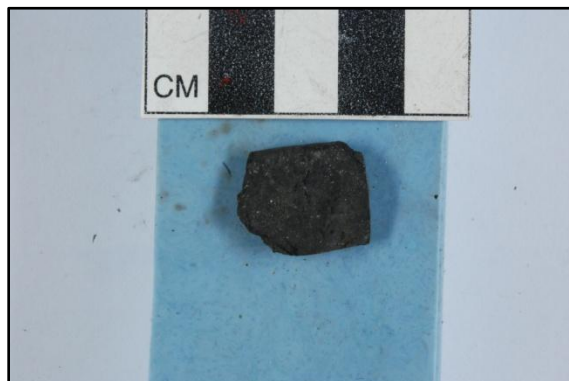
CT scan @ 29  $\mu\text{m}$  per voxel

See associated movie file:

CMX-1-Smith-19-11139p00\_volume.mpg

## Micro-CT Images

### Original Sample White Light Photos



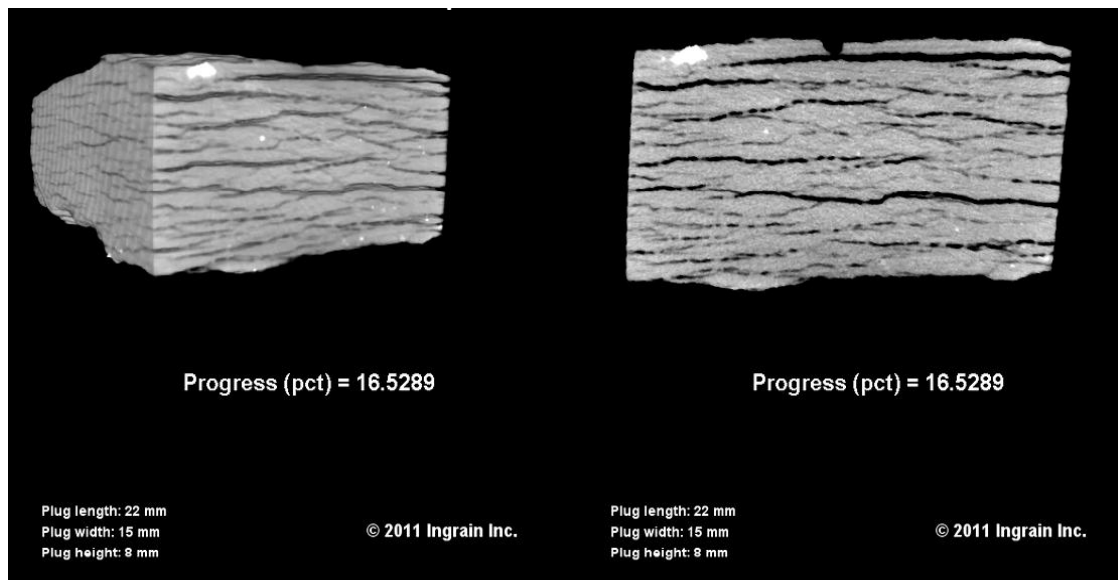
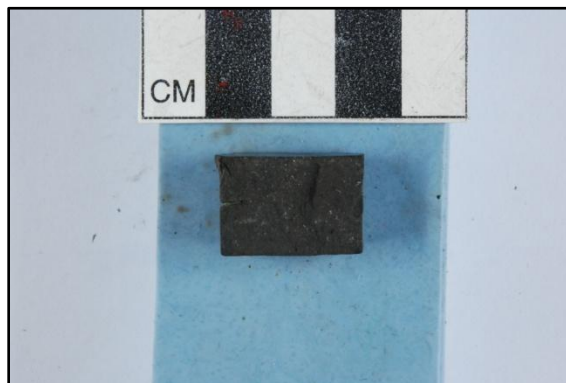
CT scan @ 28  $\mu\text{m}$  per voxel

See associated movie file:

CMX-1-Smith-19A-11144p00\_volume.mpg

## Micro-CT Images

### Original Sample White Light Photos



CT scan @ 28  $\mu\text{m}$  per voxel

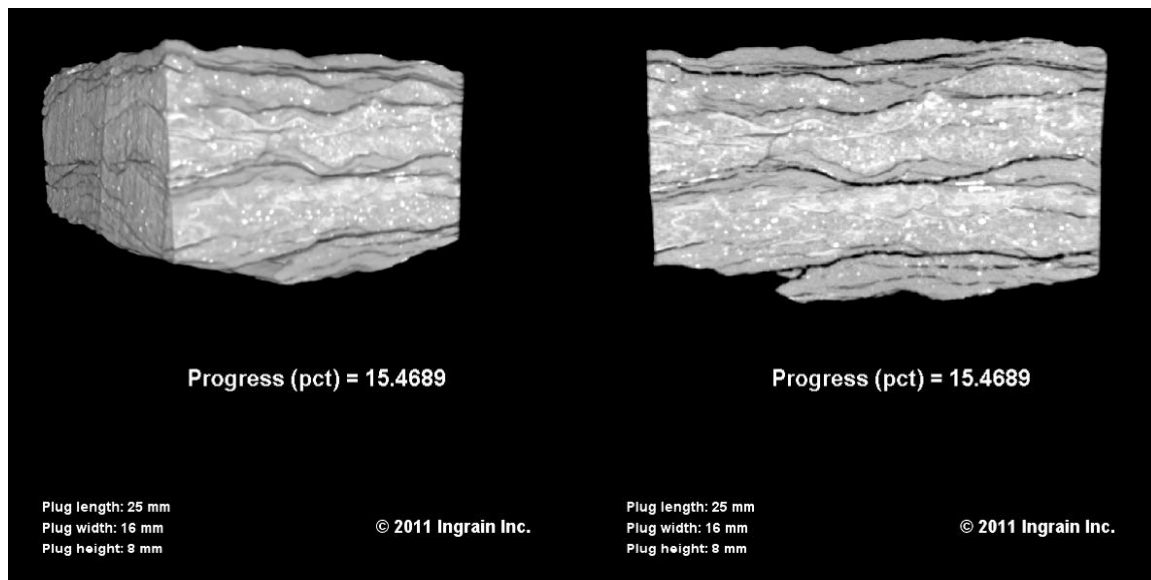
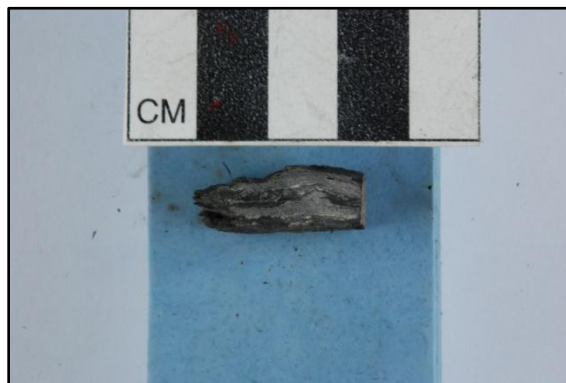
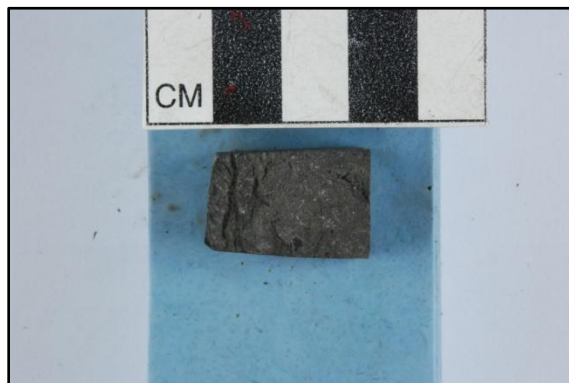
See associated movie file:

CMX-1-Smith-21-11158p30\_volume.mpg



## Micro-CT Images

### Original Sample White Light Photos



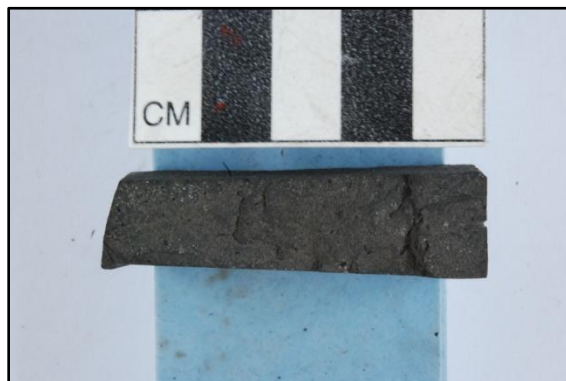
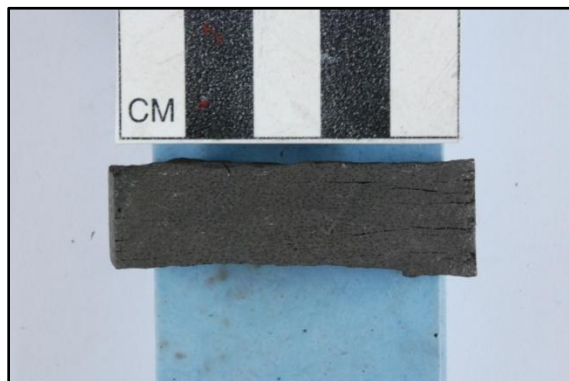
CT scan @ 28  $\mu\text{m}$  per voxel

See associated movie file:

CMX-1-Smith-24-11190p50\_volume.mpg

## Micro-CT Images

### Original Sample White Light Photos



CT scan @ 28  $\mu\text{m}$  per voxel

See associated movie file:

CMX-1-Smith-26-11200p00\_volume.mpg