



The Nature of Fractals

A Fractal Primer for
Petroleum Professionals



Energy Frontiers Partners

Objectives

- Define fractals
- Learn how to use fractal analysis
- Learn how to apply fractal statistics to the search for oil and gas



Topics

- Overview
- Definitions
- Introduction to fractal analysis
- How fractal statistics alter our view of the physical world
- Real world examples
- The power of fractals



Overview

- Fractal statistics give us an intuitive way of describing natural phenomena in a more powerful and meaningful manner.
- By describing distributions in a meaningful way, we gain better predictive abilities.



Definitions

- **B. Mandelbrot** - A rough or fragmented geometric shape that can be subdivided in parts, each of which is approximately a reduced-size copy of the whole.
- **Mathematical** - A set of points whose fractal dimension exceeds its topological dimension.



The Simple View

- The intuitive nature of fractals
- For example, in nature



[The Case of Fractals and Scale]

- We always show a scale in our geology photos.
- An example illustrates why...



Fractures at the Outcrop

Veins and dikes



Mineralized fractures can form barriers to matrix and fracture flow

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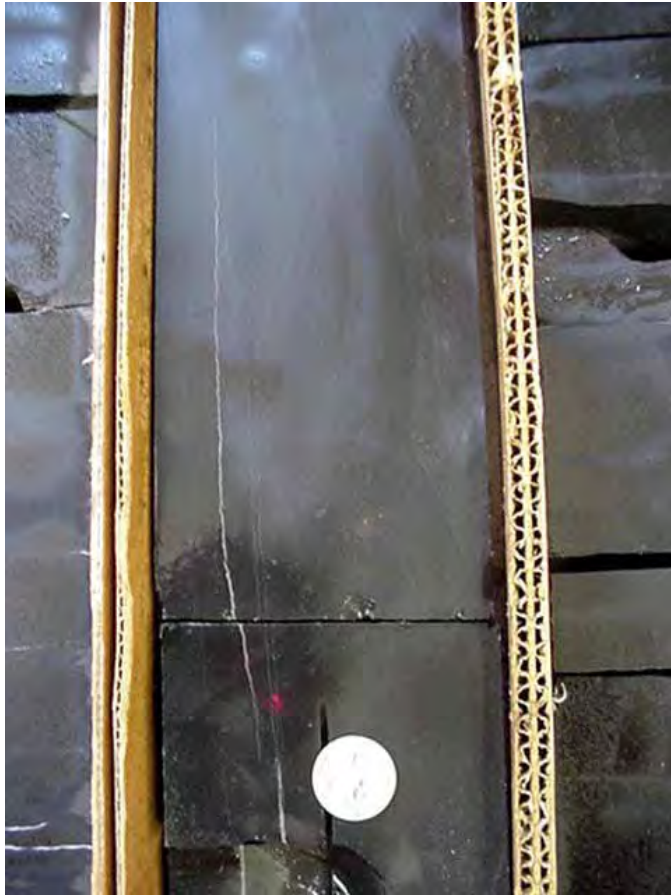
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Scale Removed

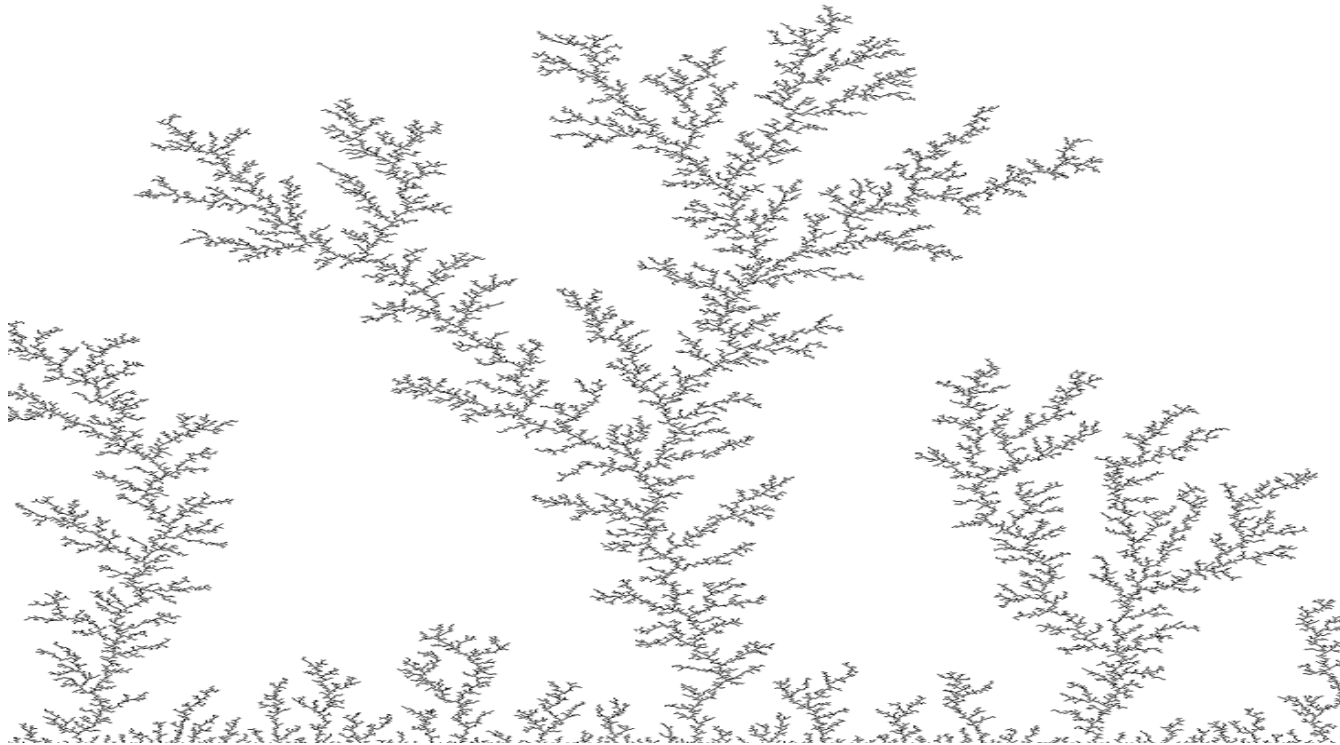


Core Photos as Examples



Fractals as Physical Models

Diffusion Limited Aggregation



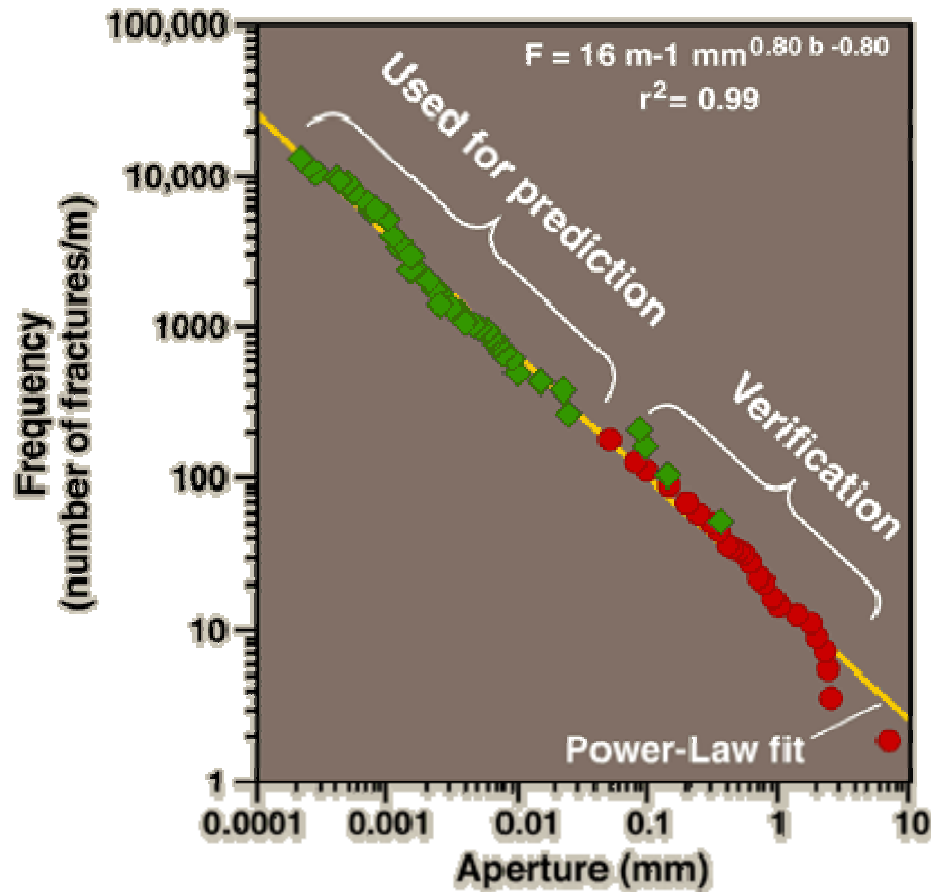
Fractal Distributions

- Question: Why fractal distributions?
- Answer: “The fractal distribution is the only statistical distribution that is scale invariant.”

Donald L. Turcotte, 1997

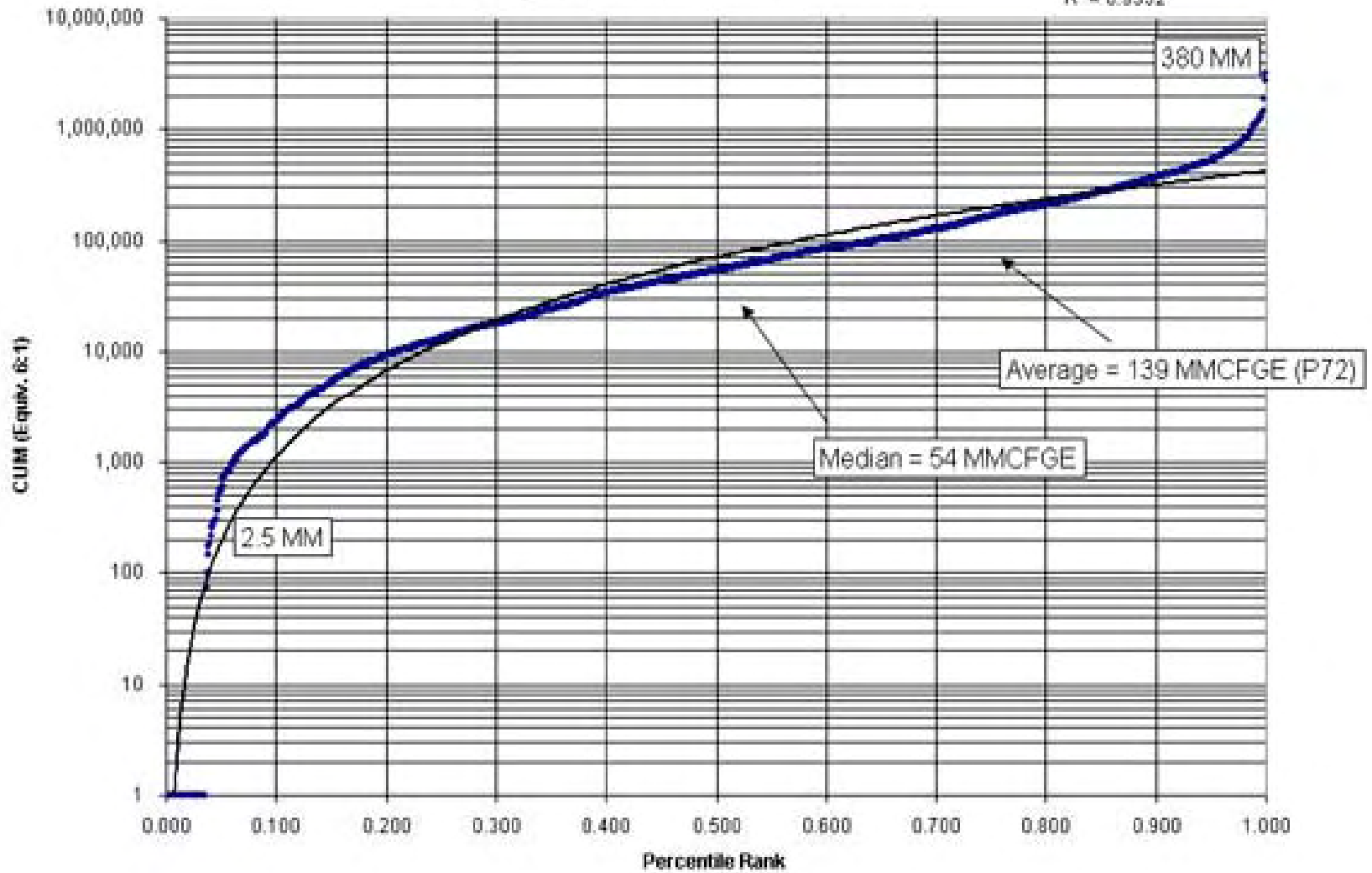


Fractal Statistics: How to Use It

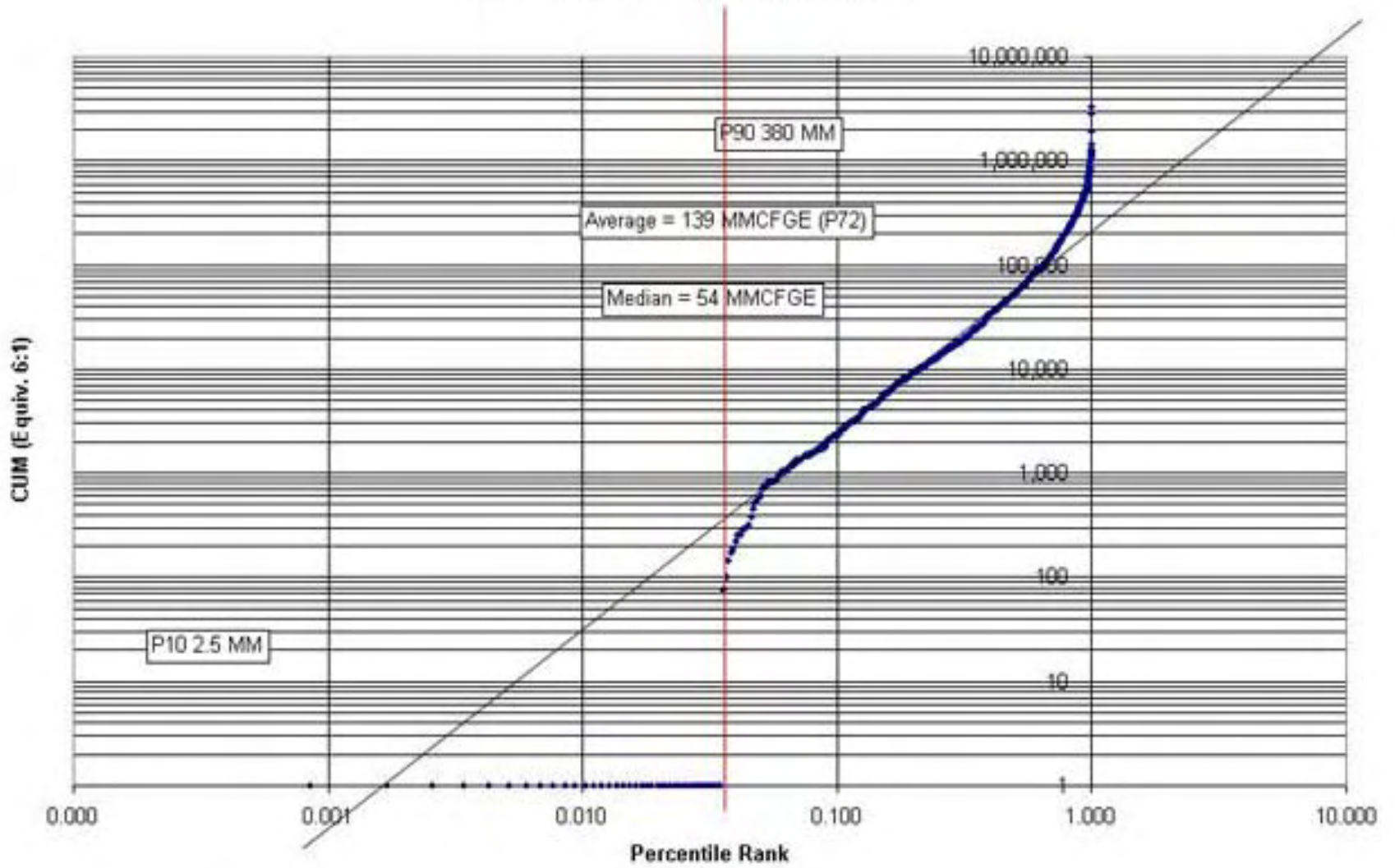


Distribution of Duffer Completions
1176 Completions Produced 164 MMCFGE

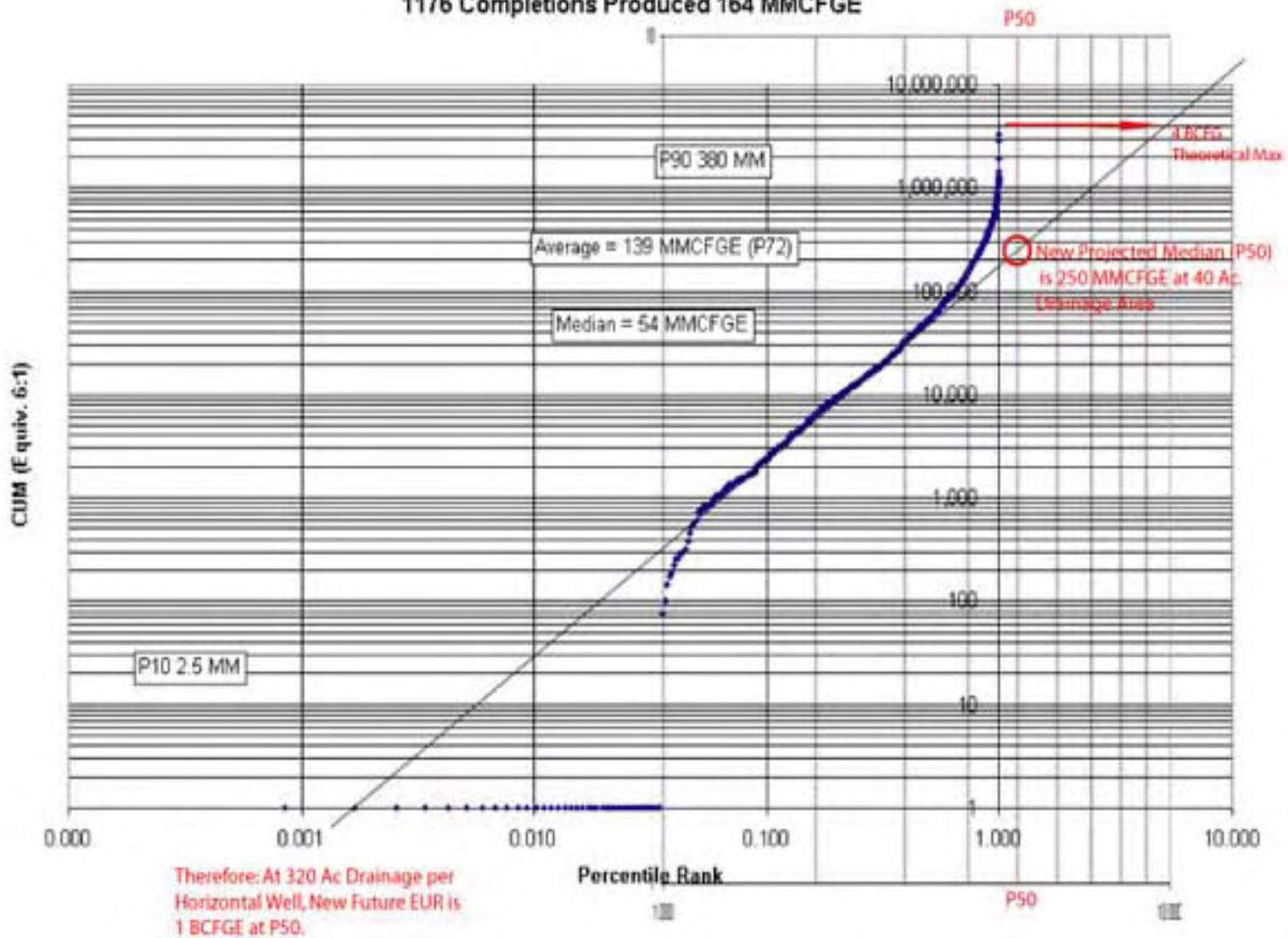
$y = 419915x^{2.0669}$
 $R^2 = 0.9332$



Distribution of Duffer Completions 1176 Completions Produced 164 MMCFGE



Distribution of Duffer Completions 1176 Completions Produced 164 MMCFGE



Conclusion

- Fractals are intuitive.
- Fractals are powerful models of the physical world.
- Fractal statistics are powerful descriptors and even predictors of future performance.



The Future is Fractal...

