Comparison of Conventional Density and NMR Porosity with Core Porosity from Montney and Doig Phosphate in the Monias Area, Northeast British Columbia, Canada*

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Abstract

The Montney Formation and Doig Phosphate Member are being exploited as unconventional tight gas plays in northeast British Columbia. Both units are characterized by low porosity, varying from 2% to 6%. A large amount of the recovered gas is thought to be from this pore space, not from adsorbed gas. To determine where the best recoveries occur from these units, it is necessary to identify zones with effective porosity. Core analysis provides the best clues, but it is expensive to acquire and usually yields coarse sampling. Standard density porosity measurements are commonly used, but correlation with core is often erroneous. This discrepancy can be explained after establishing the lithology of the Montney and Doig Phosphate. Both units, especially the Doig Phosphate, contain exotic components that significantly impact porosity calculations derived from conventional density logs.

Method

By assuming a consistent matrix density, porosity can be estimated using standard methods. For most conventional reservoirs, a consistent matrix density is a good approximation; however, for the Montney and Doig Phosphate this is not the case. Both units contain varying amounts of kerogen, pyrite, and phosphatic material. Kerogen-rich layers yield lower matrix densities, which give false high porosity readings on conventional density logs. Higher concentrations of pyrite or phosphatic material give higher matrix densities, which give false low porosity readings. In addition, carbonate type and content also varies; higher concentrations of dolomite compared to calcite create an apparent drop in porosity.

Without a good estimate of matrix density, it is difficult to calculate accurate measurements of porosity using standard methods. Lithological estimates for corrections are useful, but a technique independent of matrix density should be used. The Nuclear Magnetic Resonance (NMR)

tool gives an estimate of porosity based on relaxation time of hydrogen protons. It is also possible to estimate relative permeability and fluid typing using NMR tools.

Results

The core used in this display was acquired by Terra Energy Corporation from 13-08-82-22W6 in the Monias area of northeast British Columbia. The 18 m core, which straddles the contact between the Doig Phosphate and Montney, is characterized by strata that contain high concentrations of kerogen, pyrite and phosphatic material. Porosity derived from core plugs has a better correlation with porosity calculated from NRM logs compared to conventional density logs (Figure 1). Another Terra core from 14-16-83-20W6, which spans 36 m and straddles the contact between the Middle and Lower Montney, shows a dramatic increase in dolomite. Again NMR porosity has a much better correlation with core porosity (Figure 2). A better understanding of porosity in the Montney and Doig Phosphate will help identify drilling opportunities and aid our understanding of play economics.
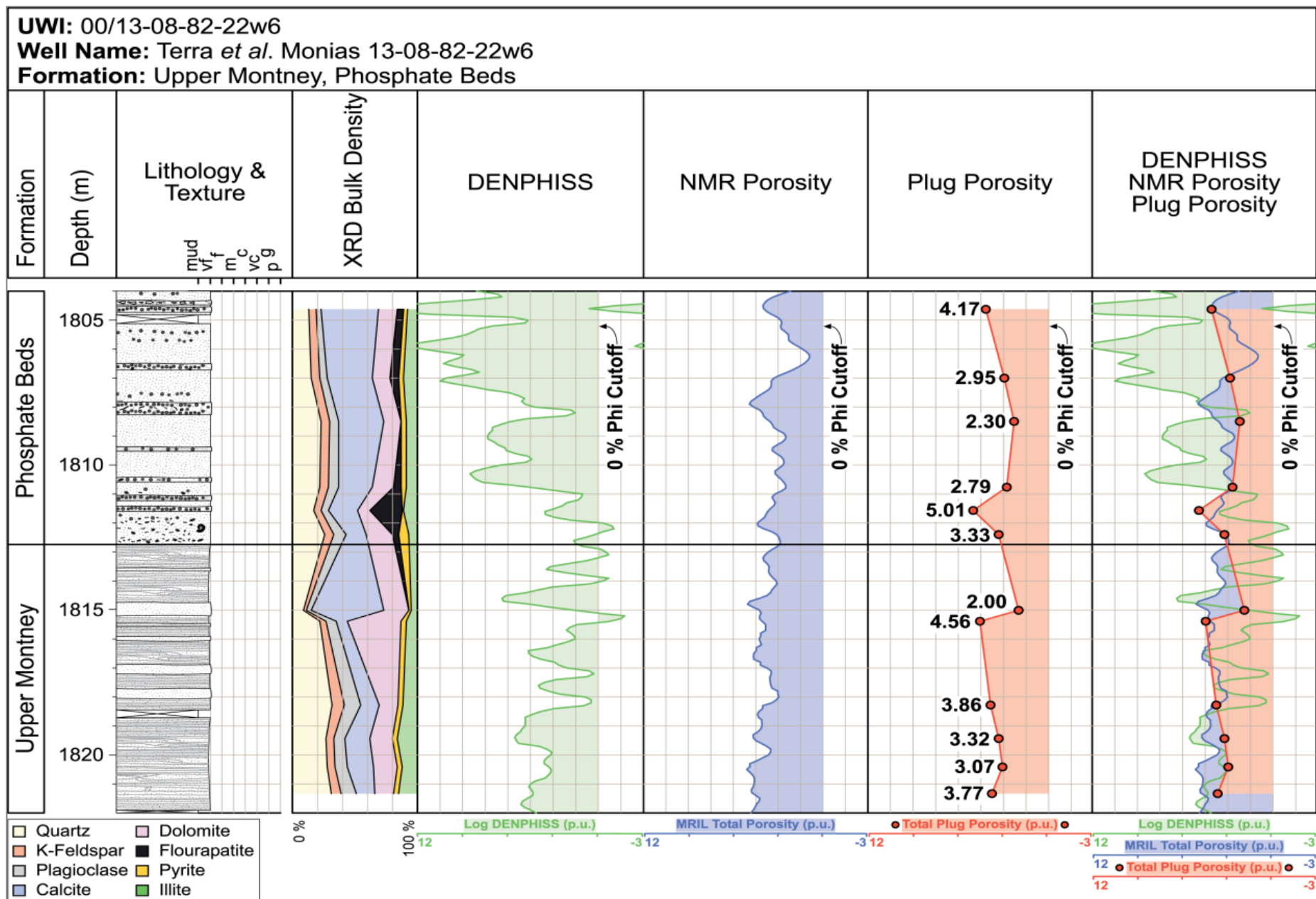
Figure 1. Lithology, XRD bulk density, and comparison of core, density, and NMR porosity from Terra et al. Monias 13-08-82-22W6.
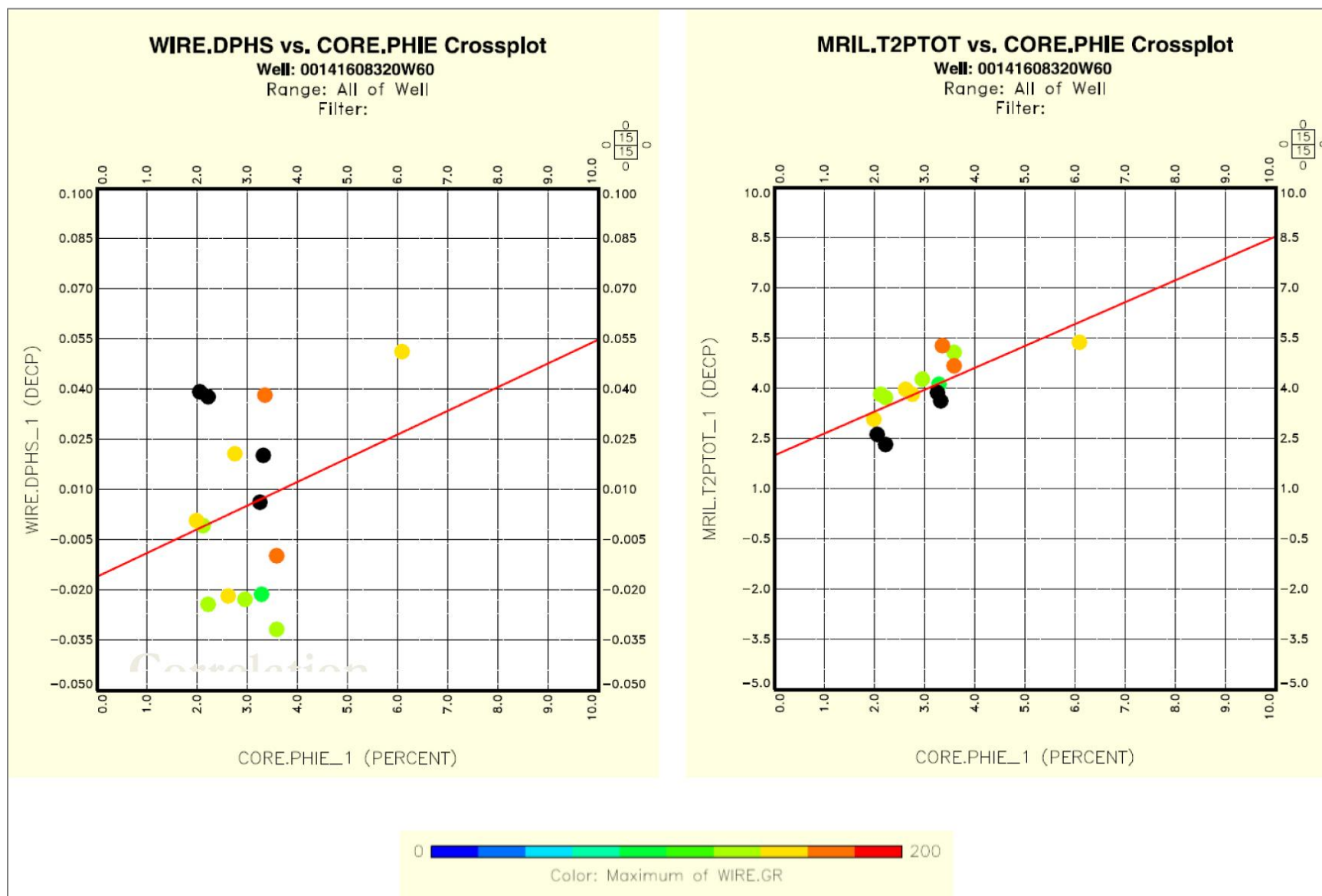
Figure 2. Correlation between core, density, and NMR porosity from Terra et al. Monias 14-16-83-20W6.