[PS]A Comparison of XRD Mineralogical Variability and Techniques with Proxy Approaches to Defining Mineralogy and Rock Type: Examples from the Wolfcamp-Dean-Spraberry Succession of the Northern Midland Basin*

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Abstract

Geochemical and mineralogical data from cores, rotary sidewall cores, and drill cuttings from unconventional reservoirs provide valuable quantitative constraints for reservoir characterization studies, target optimization, and completions. However, the types of geochemical and mineralogical data available to users vary widely. For this reason, the quality of mineralogical data from x-ray diffraction (XRD) and geochemical data from energy-dispersive x-ray fluorescence (ED-XRF), plus derivatives of these data types (e.g., modeled mineralogy, and chemofacies), should be evaluated in the context of the specific analytical technique(s) utilized. A key concern is that the type of sample material used, e.g. cuttings vs core, dictates part of the uncertainty in the results. Additionally, the errors associated with XRD samples prepared and analyzed as bulk powders and interpreted using a whole-pattern fitting routine (Rietveld Refinement) are inherently larger than errors associated with XRD samples analyzed using the combination of spray-dried bulk with clay separation evaluated using the Reference Intensity Ratio (RIR) method. Here we present a comparison of "wellsite-grade" and "laboratory-grade" analyses of samples from two wells from the northern Midland Basin. The wellsite-grade XRD analysis approach is rapid, cost effective, and provides the screening process necessary for making better drilling decisions, but also making better decisions for subsequent laboratory-grade analyses. Thus, while the analytical quality of the data product is highly dependent on the technique applied and the type of sample material used, both wellsite- and laboratory-grade techniques are useful and possess key limitations/benefits. In the Permian-aged strata of the Midland Basin, the largest error between wellsite- and laboratory-grade XRD analyses tends to be associated with total clay mineral abundance and speciation. A healthy appreciation for sample type and XRD technique is a prerequisite for developing and fully implementing XRF-based, stoichiometry-underpinned mineral models.

Reference Cited

Baumgardner, R.W., H.S. Hamlin, and H.D. Rowe, 2016, Lithofacies of the Wolfcamp and Lower Leonard Intervals, Southern Midland Basin, Texas: BEG Report of Investigations No. 281, Bureau of Economic Geology, The University of Texas at Austin, ISBN: 978-1-970007-06-0, 67 p.

#2207

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ABSTRACT

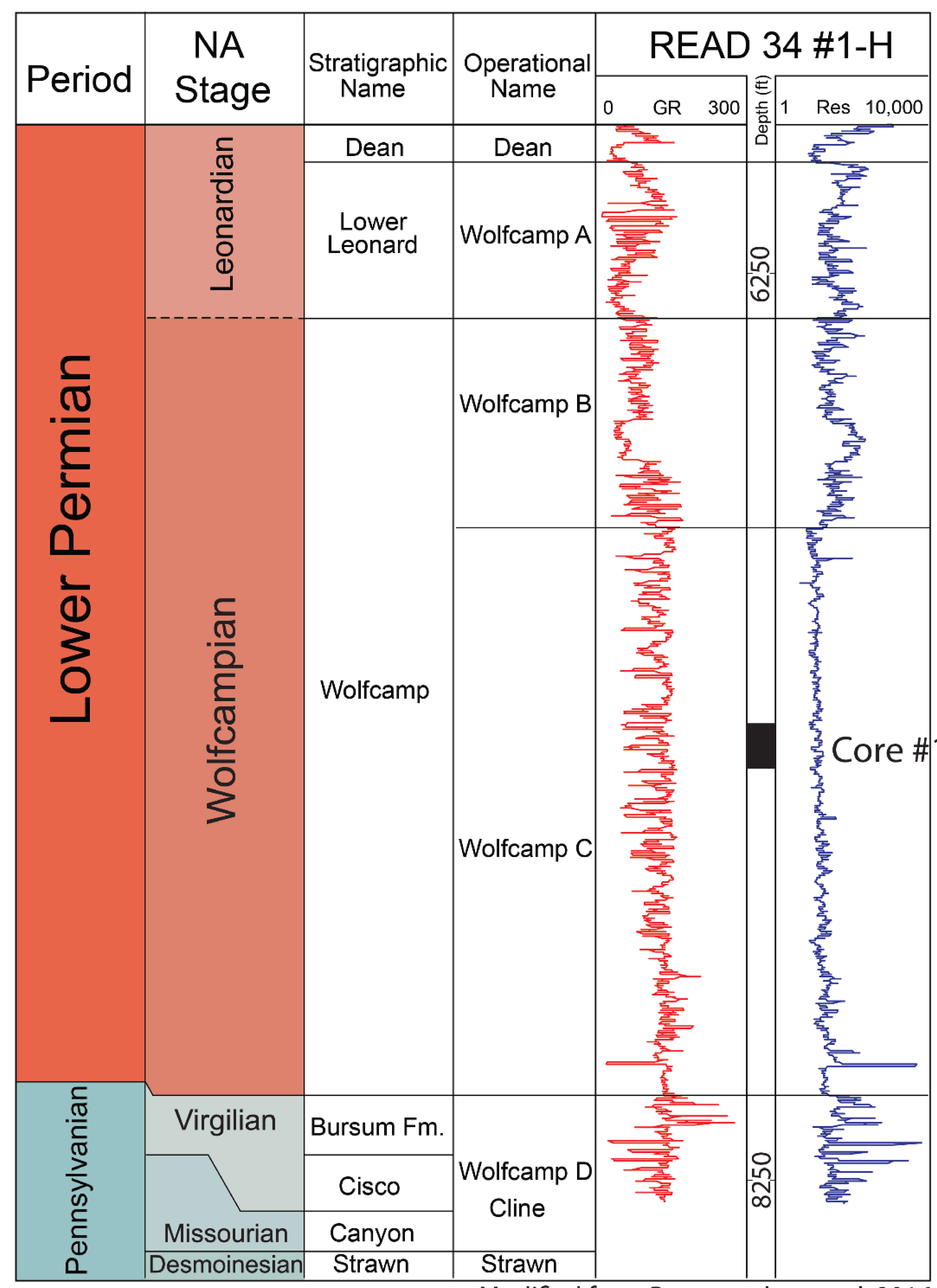
- Geochemical and mineralogical data from cores, rotary sidewall cores, and drill cuttings from unconventional reservoirs provide valuable quantitative constraints for reservoir characterization studies, target optimization, and completions. However, the types of geochemical and mineralogical data available to users vary widely. For this reason, the quality of mineralogical data from x-ray diffraction (XRD) and geochemical data from energy-dispersive x-ray fluorescence (ED-XRF), plus derivatives of these data types (e.g., modeled mineralogy) should be evaluated in the context of the specific analytical technique(s) utilized. A key concern is that the type of sample material used, e.g. cuttings vs core, dictates part of the uncertainty in the results. Additionally, the errors associated with XRD samples prepared and analyzed as bulk powders and interpreted using a whole-pattern fitting routine (Rietveld Refinement) are inherently larger than errors associated with XRD samples analyzed using the combination of spray-dried bulk with clay separation evaluated using the Reference Intensity Ratio (RIR) method. Here we present a comparison of "wellsite-grade" and "laboratory-grade" analyses of samples from one well from the northern Midland Basin. The wellsite-grade XRD analysis approach is rapid, cost effective, and provides the screening process necessary for making better drilling decisions, but also making better decisions for subsequent laboratory-grade analyses. Thus, while the analytical quality of the data product is highly dependent on the technique applied and the type of sample material used, both wellsite- and laboratory-grade techniques are useful and possess key limitations/benefits. In the Permian-aged strata of the Midland Basin, the largest error between wellsite- and laboratory-grade XRD analyses tends to be associated with total clay mineral abundance and speciation.

OBJECTIVES

- A comparison of "wellsite-grade" and "laboratory-grade" XRD analyses from well Read No. 34 1H located in the northern Midland Basin will be analyzed to demonstrate the limitations and benefits of different XRD analyses to make drilling decisions, and subsequent laboratory-grade analyses.

METHODS

- Well: Read No. 34 1H
- 1.) XRD "wellsite-grade" analysis on cuttings
- 2.) XRD "laboratory grade" analysis on rotary sidewall cores
- 3.) XRD "laboratory grade" analysis on core
- 4.) Mineral Models produced from XRD and XRF analyses



Modified from Baumgardner et al. 2016

<u>Read 34 #1-H:</u>

Cored Interval- Wolfcamp C (93' of 380' total)

<u>Data Collected:</u>

XRD

XRF- 2" vertical resolution

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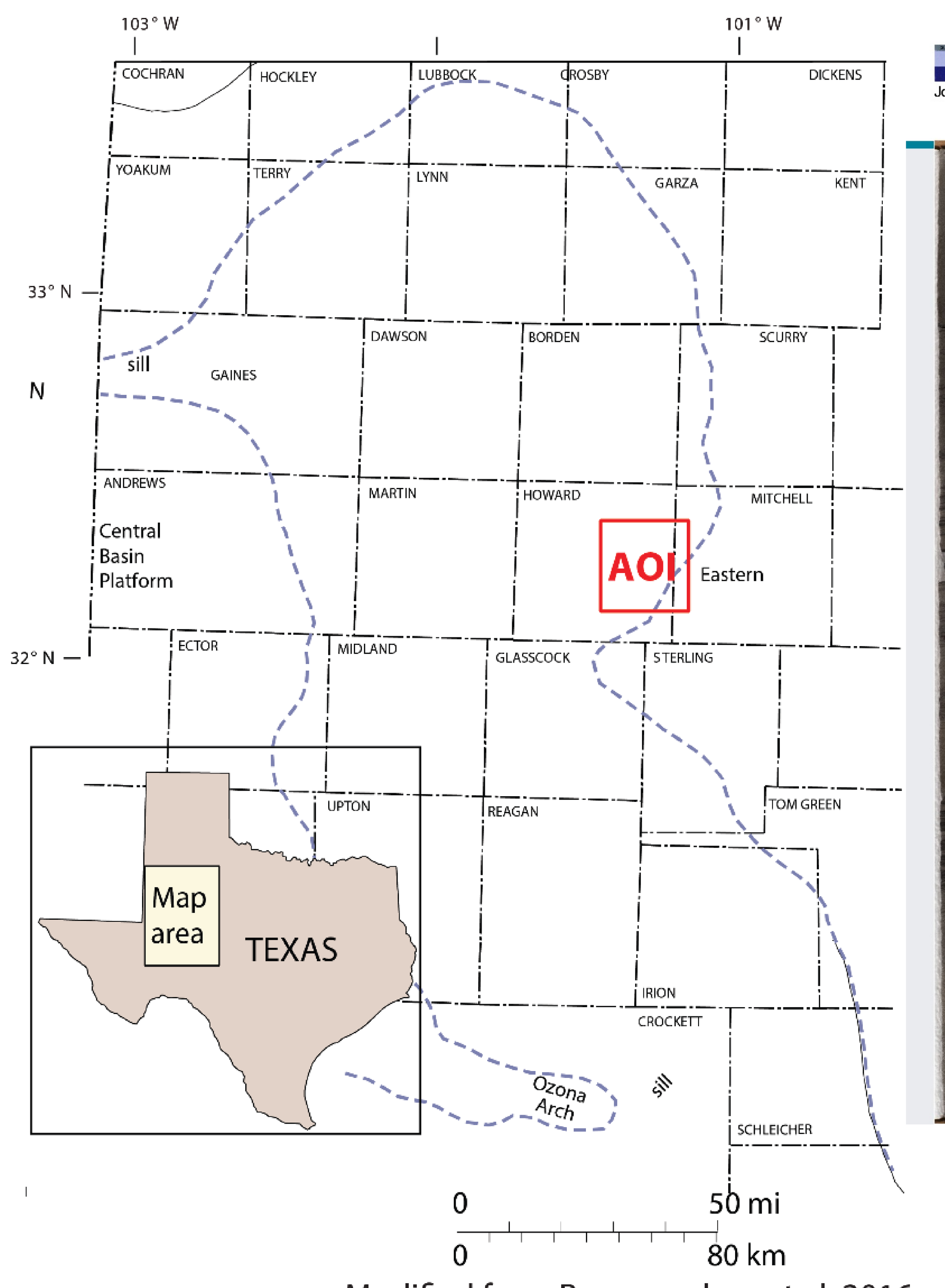
RESULTS



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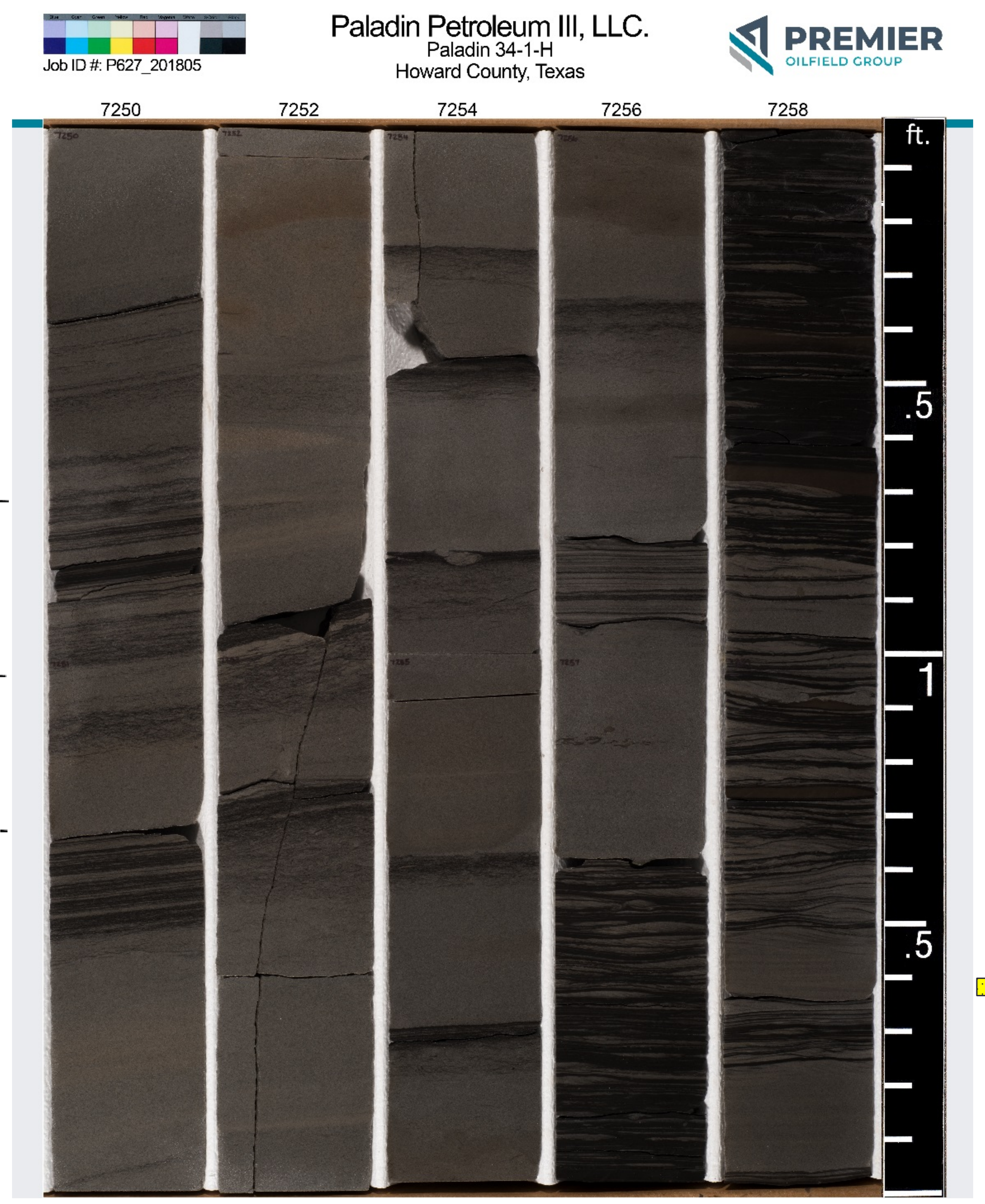

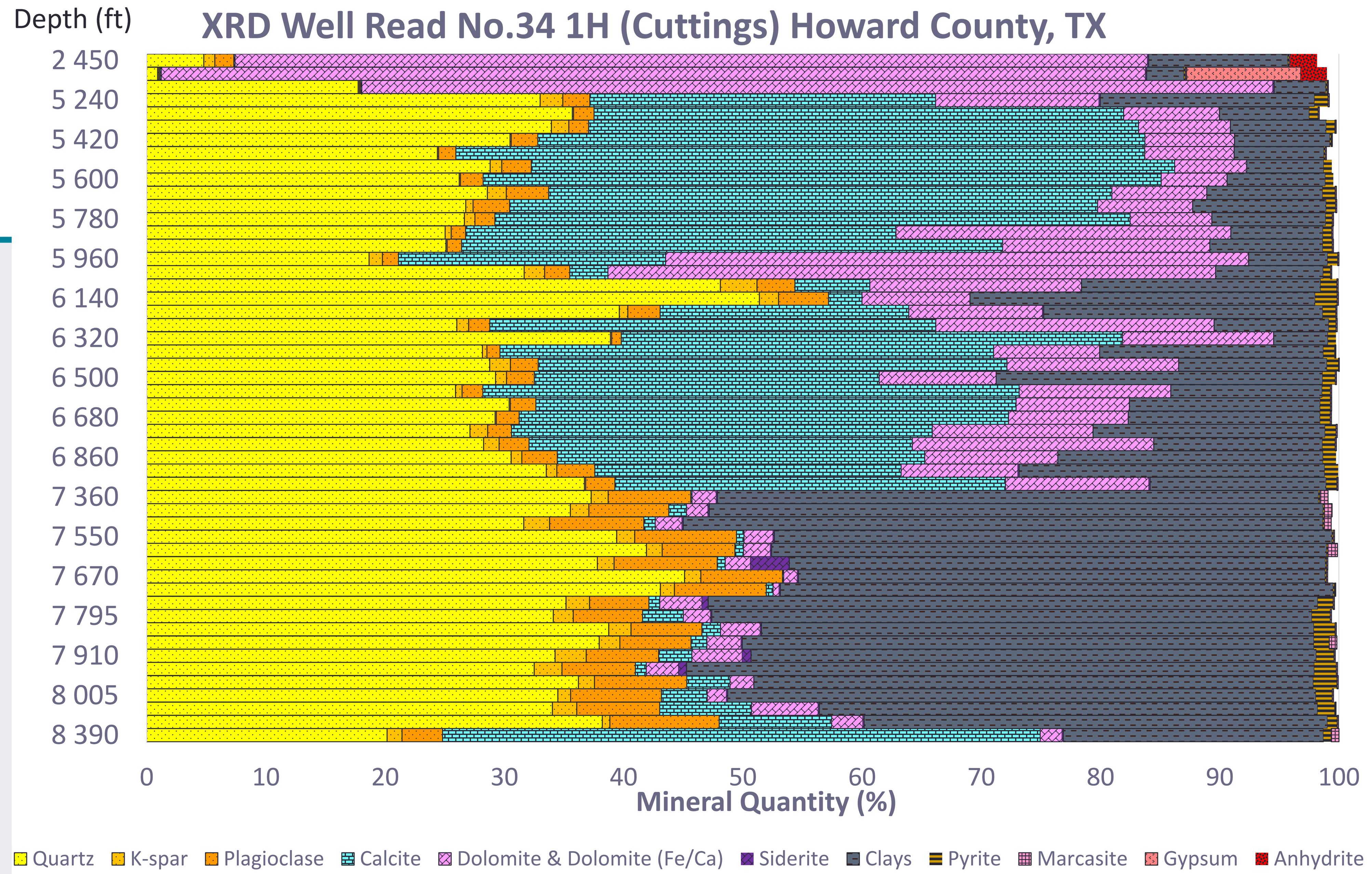

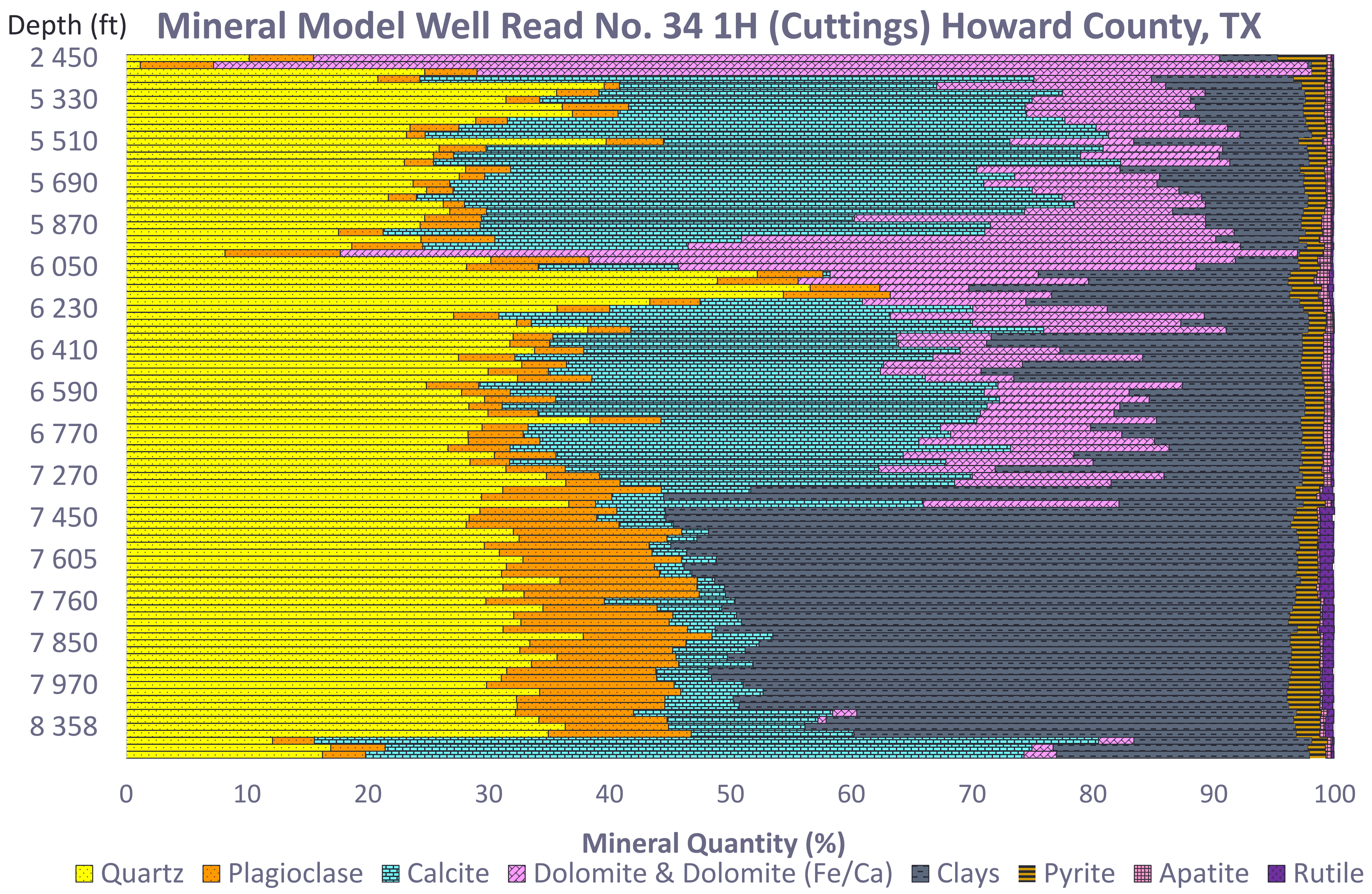

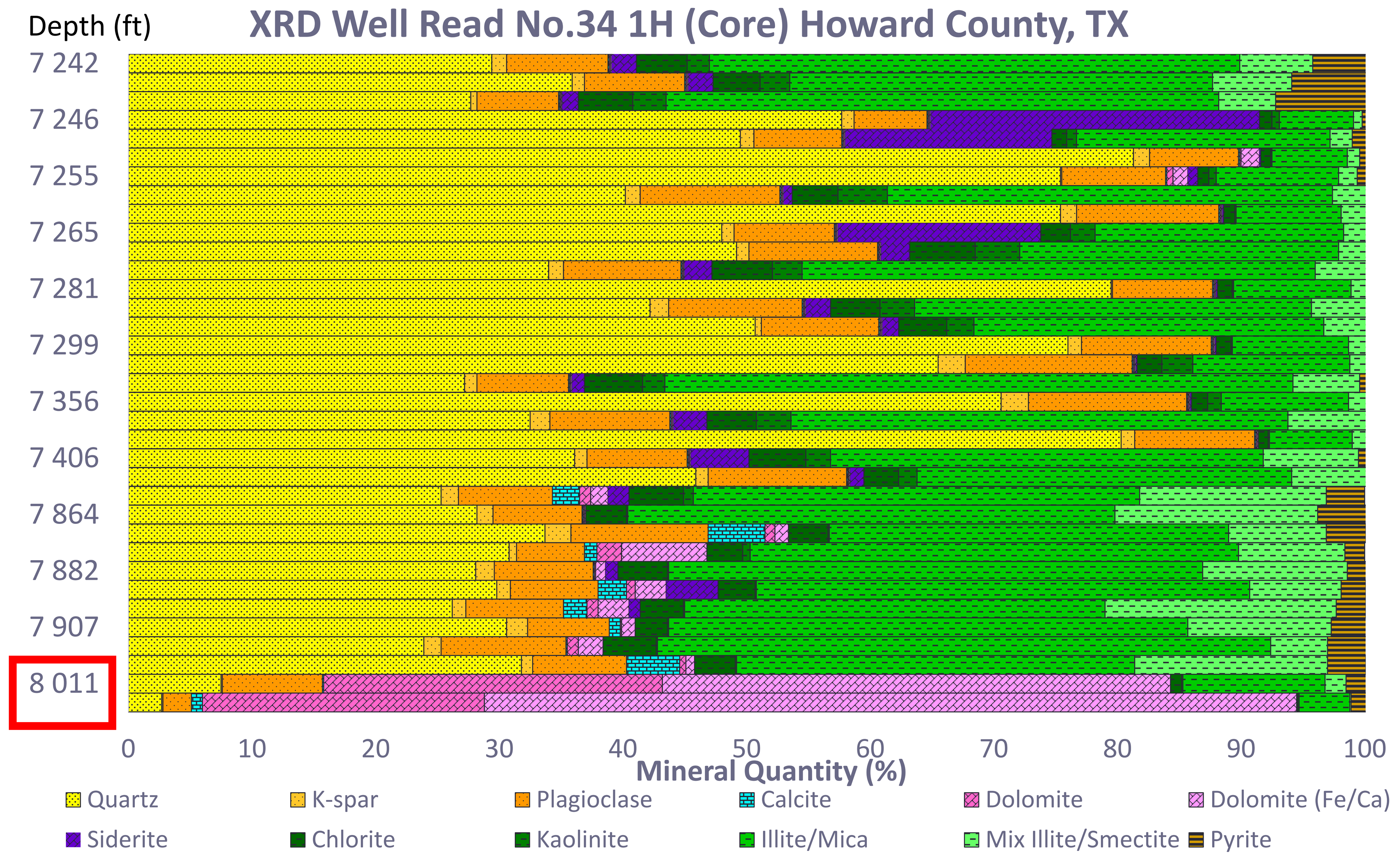

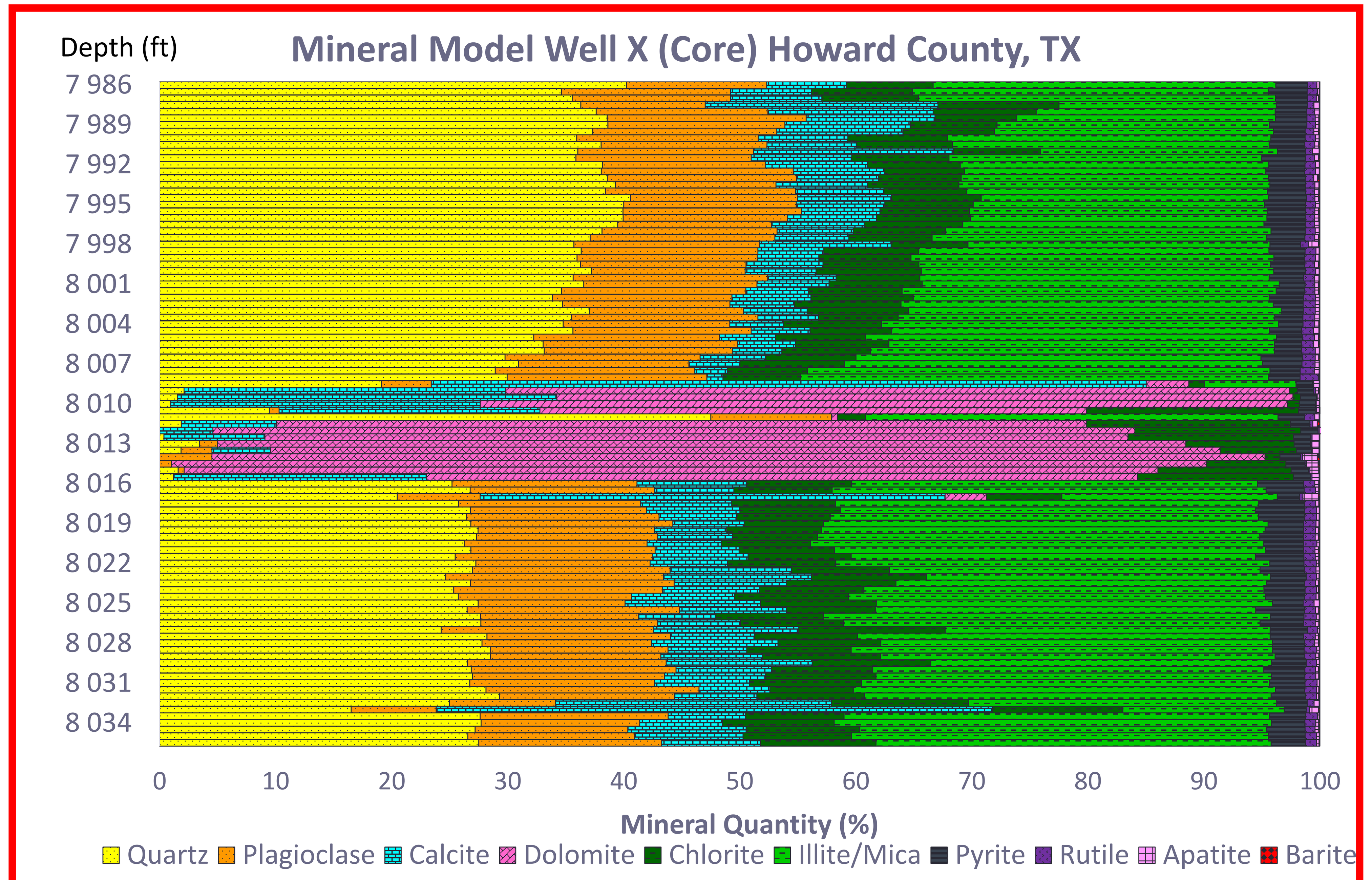

Number of Cuttings Analyses

-XRD: 52 (“Wellsite-grade”)

-XRF: 104

Number of Core Analyses

-XRD: 35 (“Laboratory-grade”)

-XRF: 770

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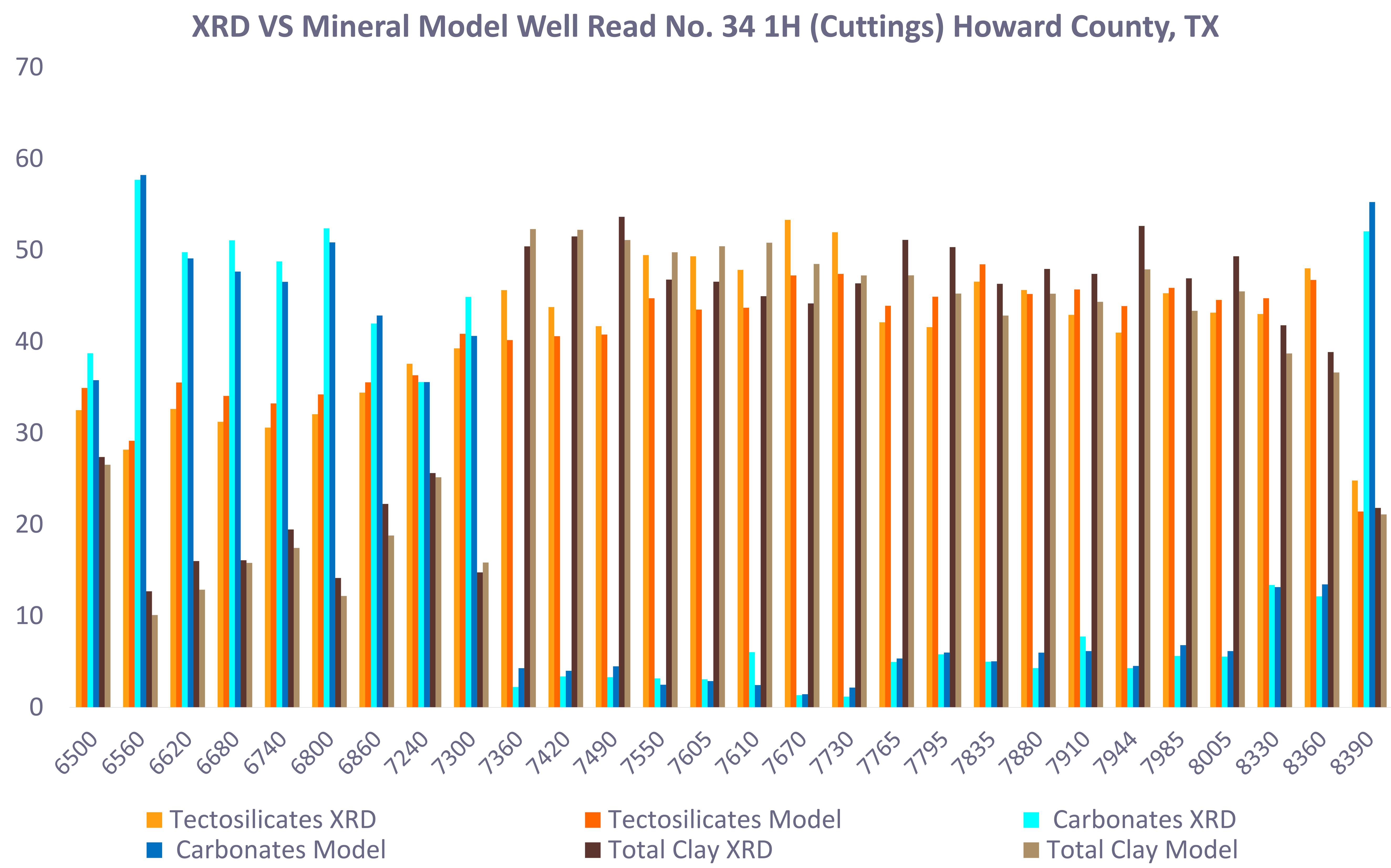
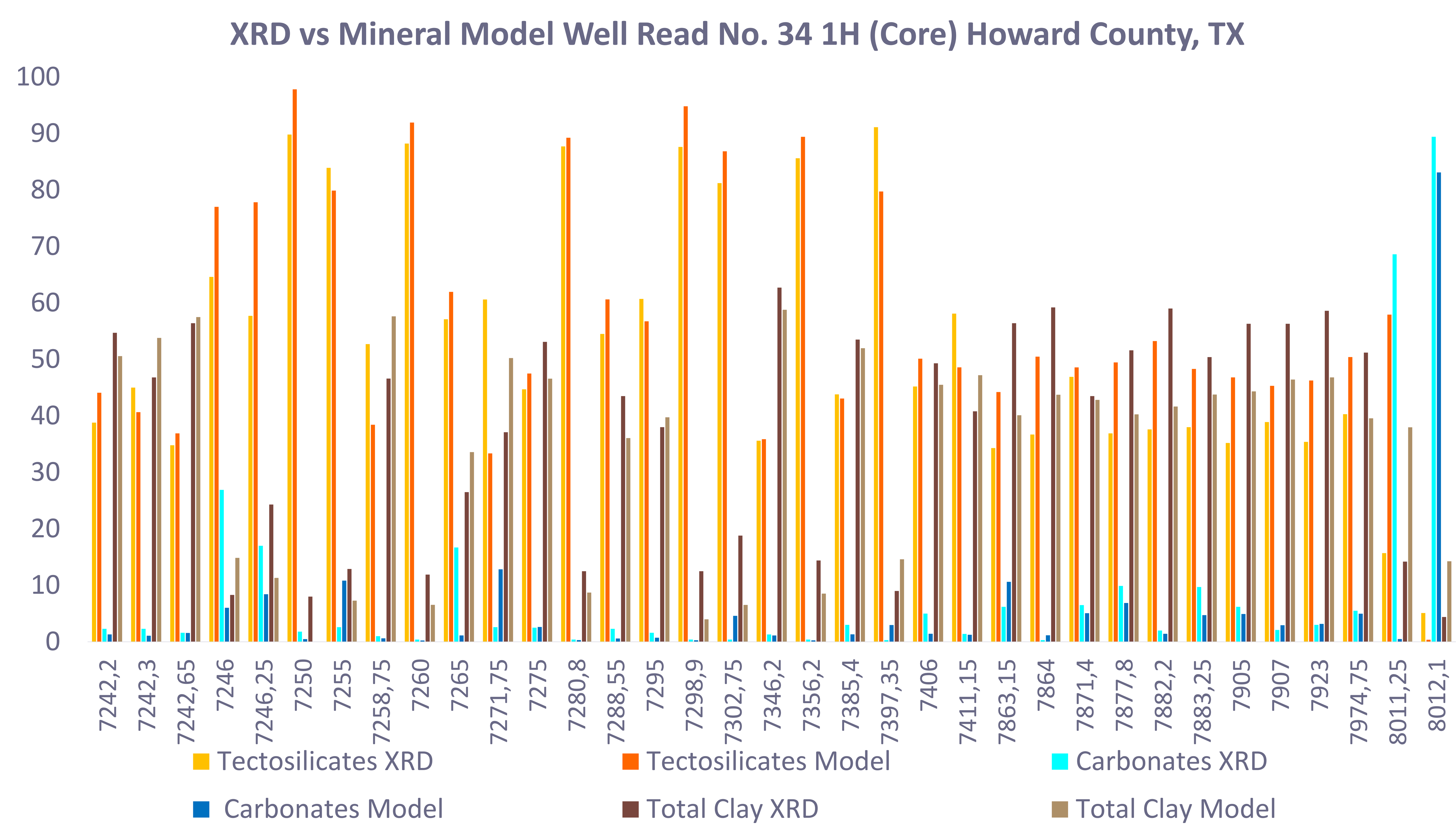
RESULTS CONT'D





SUMMARY

- Geochemical and mineralogical data from drill cuttings, cores, rotary sidewall cores can be utilized to provide valuable quantitative constraints for reservoir characterizations, target optimization, and completions.
- Legacy drill cuttings XRD and XRF analyses can provide useful information when compared to rotary sidewall cores, and cores providing a screening process necessary for making better drilling decisions.
- The XRD mineralogical results can vary depending on the type of analyses "wellsite-grade" vs "laboratory-grade", the type of sample material used, and the method of interpretation Rietveld Refinement (WPF) vs Rate Intensity Ratio producing quantitative errors of about 5% and in certain occasions up to 10% specially in the clay minerals.
- Mineral Models produced from XRD and XRF analyses are an excellent tool to produce more mineralogical data in a cost effective manner.

ACKNOWLEDGEMENTS

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