**Oil and Gas Exploration and Geothermal Energy Applications of Temperature Log Data**

Temperature logs from oil and gas wells have long provided useful information about subsurface temperatures that has been utilized in subsurface temperature mapping. Historically, this temperature data primarily consisted of bottom-hole temperatures obtained during well logging. Over the last few decades, high-quality temperature data from cased-hole well logs have provided detailed temperatures throughout the entire logged interval, which can be used to determine how heat is transferred through subsurface lithologies. Subtle changes in the slope of the temperature curve with depth can be resolved with a 1st derivative curve which reveals differences in thermal conductivity. Subsurface thermal conductivity is primarily controlled by the porosity and fluid content of the rock. All subsurface fluids are better insulators than rock-forming minerals and hydrocarbons are better insulators than water. Therefore, porous rocks are better insulators than low porosity rocks. Hydrocarbon-saturated rocks are better insulators than water-saturated rocks because oil is about 4 times better insulator than water, and gas has a thermal conductivity near zero, i.e., it is almost a perfect insulator. For example, coal is a very strong insulator because it has high porosity that is commonly gas filled. Thermal insulators trap heat below them resulting in higher temperatures at shallower depths. This has important implications for both oil and gas exploration and geothermal energy projects.

Piceance Basin Mesaverde High-Resolution Temperature Data
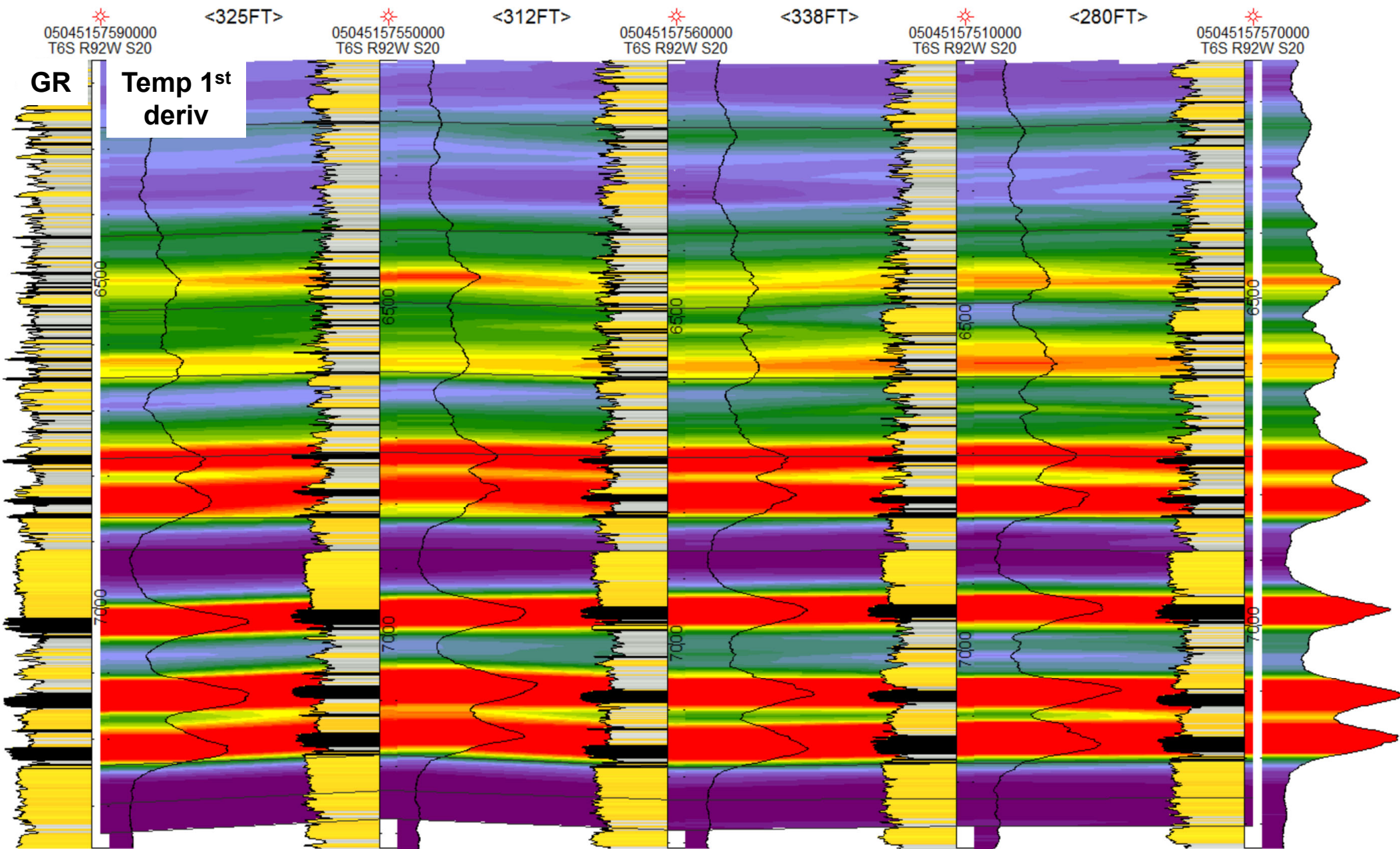
Gamma-ray and temperature 1st derivative logs from five closely spaced Mesaverde wells in the southern Piceance Basin. The color fill between wells is shows thermal insulators with warm colors and thermal conductors with cool colors. Coals, which are shown in black on the gamma-ray curve, are very good thermal insulators. Sandstones, shown in yellow on the gamma-ray curve are thermal conductors. The remarkable correlation of different lithologies using the temperature 1st derivative curve demonstrates the high quality of the temperature log data.