

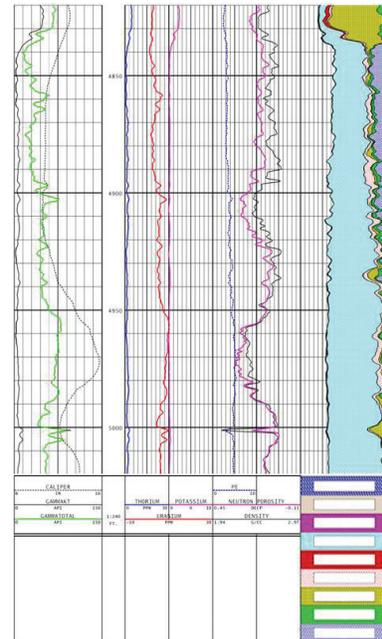
## Formation Evaluation

# Halliburton's GEM™ elemental analysis tool provides superior results to competitor's tool in shale gas market

Location: China

### Overview

An operator in China's Sichuan basin needed to evaluate reservoir quality, and identify sweet spots and a location for lateral well placement for horizontal drilling. Halliburton deployed its GEM™ elemental analysis tool, which offers rapid and precise evaluation of formations with complex mineralogies, to identify the sweet spots. Armed with its findings, Halliburton was able to provide customized selective completion strategies with the greatest potential to reduce fracturing expenses, optimize well placement, and maximize well productivity. Exceptional collaboration, intensive research, and prejob planning resulted in a successfully completed job with zero nonproductive time (NPT), health, safety and environment (HSE), or cost of poor quality (COPQ) issues. Additionally, when the GEM tool's interpretation results were compared to a competitor's results, there was really no comparison. The GEM tool produced superior dolomitization interpretation in the lower marine limestone. This well has been steadily producing 2.82 MMscfd.



CHALLENGES	SOLUTIONS	RESULTS
<p><b>Formation evaluation in shale gas plays is challenging</b> Shale gas plays in the Sichuan basin, China have become increasingly more lucrative. Operators face difficulties evaluating reservoir quality, identifying sweet spots, and planning for well placements.</p>	<p><b>Precise evaluation of complex mineralogies</b> Halliburton's sophisticated GEM elemental analysis tool can measure elemental yields that are important to mineralogical evaluations in open holes to accurately assess the reservoir and complete the well.</p>	<p><b>Job objectives met</b> Halliburton provided the client with improved porosity and total organic carbon (TOC) content, identified the sweet spot, and located the optimal zone for horizontal well placement.</p>
<p><b>New technology untested in region</b> Gaining acceptance for new technology is not always easy.</p>	<p><b>Collaboration, extensive research, and prejob planning</b> Halliburton collaborated early in the program design with the local oil/gas research center, and extensively researched local geology and mineralogy characteristics of the target reservoir. Log analyst support was provided at the wellsite to ensure nothing would affect interpretation processing parameters.</p>	<p><b>Superior results to a competitor's tool</b> The interpretation was done promptly, and the delivery of the results coincided with another service competitor's results delivery. After comparing both parties' results, the operator concluded that the interpretation from the GEM tool more closely matched their core analysis from nearby offset wells.</p>

## **Shale gas plays present challenges for formation evaluation**

In China's Sichuan basin, shale gas plays have become increasingly more important as operators tap into this prosperous market. However, these unconventional resources can present challenges, especially in formation evaluation. Operators often encounter difficulties evaluating reservoir quality, and identifying sweet spots and well placement locations for horizontal drilling.

## **Precise sweet spot identification with innovative tool**

With the introduction of Halliburton's GEM™ elemental analysis tool, we can now provide clients with sweet spot identification. The innovative system design allows the GEM tool to provide the most precise quantitative understanding of complex carbonates and shales. It improves the measurements of magnesium in carbonates and aluminum in clays and shale—until now the most difficult elements to measure, but among the most important needed to describe the reservoir. The GEM tool also measures manganese, a common constituent of carbonates and sheet silicates. Use of these three additional elements—magnesium, aluminum, and manganese—to determine mineralogy improves estimates of porosity, saturation, permeability, detection of swelling clays, and rock mechanical properties. Operators obtain more accurate estimates of their reserves, design optimal completion and stimulation programs, and maximize production.

## **Exceptional prejob planning and collaboration ensures successful results**

To ensure a successful GEM technology debut in China, Halliburton relied on collaboration and prejob planning, leaving nothing unchecked. Early in the program design, extensive research on local geology and mineralogy characteristics of the target reservoirs was undertaken in collaboration with the local oil/gas research center. Additionally, a log analyst accompanied the field crew at the wellsite and executed expert support in quality assurance and quality control, gathering critical information that might affect interpretation processing parameters.

Halliburton successfully completed this job with zero NPT, HSE, or COPQ issues. Feedback from the operator's field representative was very positive. The interpretation was completed promptly and coincided with delivery of an international service competitor's results. After a side-by-side comparison of both parties' results, the operator came to the conclusion that the GEM tool's interpretation more closely aligned with core analysis from nearby offset wells. What stood out from the two comparisons was the superior dolomitization interpretation in the lower marine limestone based on the GEM tool's magnesium measurement vs. the "pseudo-magnesium" measurement by the competitor in that dolomitized lime interval.

Halliburton provided the client with improved porosity and TOC content, identified the sweet spot, and pinpointed the optimal zone for horizontal well placement. This well has been steadily producing 2.82 MMscfd, and Halliburton's success on this project has paved the way for future work in the area.