GEM™ Elemental Analysis Tool

PRECISE EVALUATION OF COMPLEX MINERALOGIES

OVERVIEW

The Halliburton GEM™ elemental analysis tool offers a quick and precise evaluation of complex mineralogy, using proven interpretation processes and integrated petrophysical analysis. A neutron-induced capture gamma-ray spectroscopy logging system, the GEM tool is designed to derive elemental contributions contained within the total measured gamma-ray energy spectrum.

It can measure elemental yields that are important to mineralogical evaluations in open holes to accurately assess the reservoir composition to aid in planning a well completion.

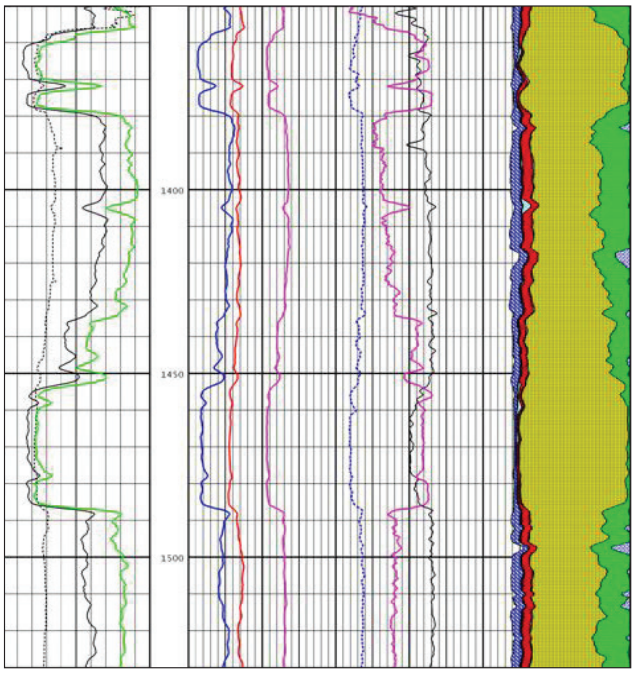
The GEM tool calculates elemental concentrations by employing an oxides closure methodology, which is used to estimate precise mineral volumes. These elemental concentrations can be applied to establish stratigraphic correlations well to well. Elemental concentrations may also be used to calculate matrix-grain density and thermal neutron-absorption (sigma) properties as well as a photoelectric absorption curve in wellbores drilled with heavy mud.

It uses a chemical source to promote wider applications due to the cost savings associated with its durability, shorter length, and simple usage requirements. The detector is enclosed in a flask with a eutectic heat sink to enable extended operation at downhole conditions. In addition, the software provides on-site or remote visualizations of the resulting data quickly and accurately, with proven, robust post-processing solutions.

BENEFITS

- Improves accuracy of integrated petrophysical analysis
- Precisely estimates mineral fractions, such as gypsum or anhydrite, carbonate, coal, pyrite, salt, siderite, quartz, feldspar, mica, and clay from complex formation analysis
- Provides matrix-density values for more accurate porosity calculation
- Estimates accurate photoelectric absorption (Pe) from GEM elemental data in wells drilled with heavy mud (barite) where conventional Pe measurement is not possible from density tools
- Improves permeability estimates based on mineralogy
- Offers a quick cool down of the eutectic heat sink for rapid job turnaround
- Allows direct comparision of XRF elemental data from Ingrain*
- Calibrates mineral model using XRD/FTIR data from Ingrain*
- Provides borehole shielding for reduced sensitivity to borehole fluids

** A Halliburton laboratory service*



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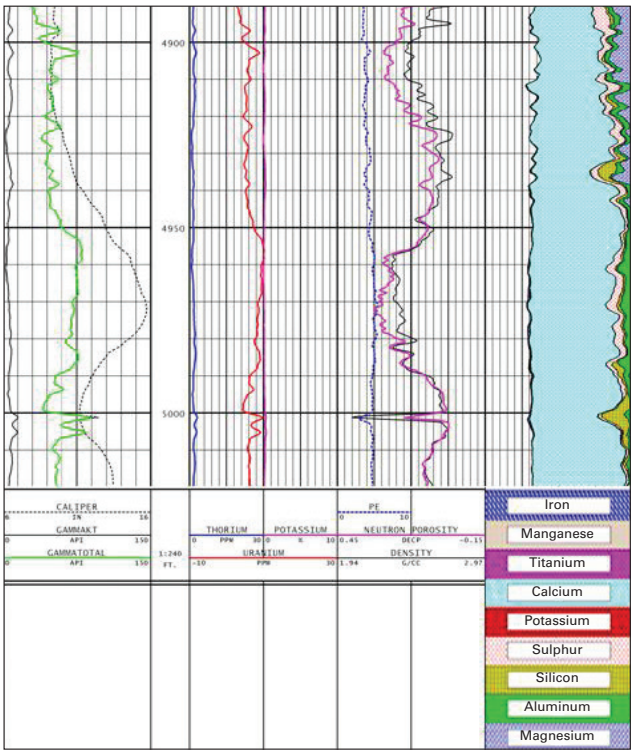

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Dimensions and Ratings

	Standard	DeepSuite™		Standard	DeepSuite™
Max Temp	350°F (177°C)		**Max Pressure**	20,000 psi (137 895 KPa)	30,000 psi (206 843 KPa)
Maximum OD	5 in. (12.70 cm)	5.15 in. (13.08 cm)	**Min Hole**	6 in. (15.24 cm)	
Length	9.64 ft (2.94 m)		**Max Hole**	24 in. (60.96 cm)	
			Weight	368 lb (166.9 kg)	413 lb (187.3 kg)

Borehole Conditions

Borehole Fluids	Salt ■	Fresh ■	Oil ■	Air □
Recommended Logging Speed	15 ft/min (4.6 m/min)			
Tool Positioning	30 ft/min (9.1 m/min)			
Tool Positioning	Centralized □		Eccentralized ■	

Hardware Characteristics

Source Type	15-Ci Americium-Beryllium
Sensor Type	One BGO Scintillation Counter
Sensor Spacings	Proprietary
Sampling Rate	4 samples/ft (10 samples/m)
Combinability	LOGIQ® standard

Measurement

Principle	Elemental yield based on neutron-induced capture gamma ray spectroscopy
Range of Measurement	600 keV to 9.5 MeV
Vertical Resolution (90%)	18 in. (45.72 cm)
Depth of Investigation (50%)	6 in. (15.24 cm)
Output Curves	Mg, Al, Si, S, K, Ca, Ti, Mn, Fe, and Gd elemental weight fractions from oxides closure
Primary Curves	Mg, Al, Si, S, K, Ca, Ti, Mn, Fe, and Gd elemental yields
Secondary Curves	Mg, Al, Si, S, K, Ca, Ti, Mn, Fe, and Gd elemental weight fractions from oxides closure

Statistical Precision*

	Mg (wt. %)	Al (wt. %)	Si (wt. %)	S (wt. %)	K (wt. %)	Ca (wt. %)	Ti (wt. %)	Mn (wt. %)	Fe (wt. %)	Gd (ppm)
Austin Chalk**	0.04±0.2	0.06±0.1	0.02±0.05	0.02±0.06	0.01±0.03	39.89±0.27	0.01±0.01	0±0	0±0	2.19±0.3
Indiana Limestone**	0.09±0.27	0.24±0.2|	0.21±0.26	0.1±0.1	0.05±0.08	39.42±0.48	0.01±0.01	0.01±0.01	0.02±0.03	1.08±0.34
Kasota Dolomite†	11.06±1.48	1.07±1.02	6.53±0.89	0.61±0.29	1.99±0.44	16.59±1.55	0.12±0.04	0.14±0.03	0.81±0.16	0±0
Berea Sandstone†	0.35±0.7	1.62±1.43	37.55±2.05	1.14±0.43	2.36±0.45	3.75±0.76	0.09±0.06	0.16±0.05	1.19±0.22	0±0
Massillon Sandstone†	0.44±0.89	1.19±1.47	38.58±2.29	0.99±0.41	2.39±0.42	3.32±0.92	0.16±0.07	0.13±0.05	1.02±0.2	0±0

* From stationary logs recorded at 15 ft/min simulated logging speed in the Halliburton Sonde Acceptance Wells
** Freshwater-filled 8-in. borehole † 166 Kppm saltwater-filled 8-in. borehole

Calibration

Primary	None
Wellsite Verifier	Stainless/polyethylene with 0.5 Ci Americium-Beryllium source

Physical Strengths*

Hardware	Tension	Compression	Torque
Tool Joints	130,000 lb	130,000 lb	600 ft-lb
	(59 000 kg)	(59 000 kg)	(814 N-m)

* Strengths apply to new tools at 70°F (21°C) and 0 psi.

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For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com