

Cased hole

# TsSP-2IMKS-73 Digital Logging Tool of Pulsed Multichannel Spectrometry



## SCOPE OF APPLICATION

- Oil and gas wells;
- Open hole/ Cased hole
- Flowing or killed well;
- Borehole filling- gas/water/oil

## FEATURES AND ADVANTAGES

- Multi-parameter studies provided in one trip:
  - Spectral pulsed neutron gamma-ray log (C/O)
  - Pulsed neutron gamma-ray log (SIGMA)
  - Spectral gamma-ray log for elemental concentrations K, U, Th.
- Accurate calculation of fractional contribution of each chemical element in the rock, obtained through the use of:
  - effective mathematical method for pulse separation when recording, reducing the number of miscalculations;
  - efficient LaBr<sub>3</sub>-based detectors with high spectral resolution and low temperature drift over a wide range of frequencies;
  - a variable-frequency neutron generator, in order to avoid overlapping of recorded spectra.
- Interpretation methods, taking into account the near zone (casing string, cement ring, paraffins, wellbore crossflows) by the ratio of short and long probes of INKG-S

## SPECIFICATIONS

|   |   |
|---|---|
| Logging speed, m/h  | 50–70   |
| Output  | Water-saturated porosity, weight concentrations of elements by spectra of inelastic gamma-ray spectrometry, neutron capture gamma-ray spectrometry, Spectral GR, oil/gas saturation of beds |
| Energy resolution of spectrometers at the peak <sup>137</sup> Cs, % | 5   |
| Relative accuracy of S <sub>o</sub> , %                             | 8   |
| Range of water-saturated porosity, %                                | 1–40  |
| Number of recording spectra / number of channels in a spectrum      | 7/1024  |
| Temperature rating, °C  | 120   |
| Pressure rating, Mpa  | 80  |
| Tool length, mm   | 3200  |
| Tool size, mm   | 75  |
| Tool weight, kg   | 40  |

## Case Study No.1

### Annular Evaluation of Low-porosity Formation Properties and Residual Saturation Using Compensated Pulsed Neutron Spectrometry

#### Challenge

As part of the workover of oil production well in the Volga-Ural region of Russia, it was necessary to evaluate the reservoir properties of low-porosity reservoirs behind a 4-inch casing. In addition, the operator needed to build an improved lithological model and determine an extended elemental composition for saturation analysis in potential reservoirs. The client made a request to VNIIGIS company to perform logging services with a new tool of compensated pulsed neutron spectrometry for locating and comprehensively evaluating the reservoirs behind the casing. Due to time limitations for workover operations, it was important to identify and calculate the full elemental composition in one trip enabling saturation analysis within reservoirs and correct the lithological model.

#### Solution

Compensated pulsed neutron spectrometry (IMKS-73) was used to display average values of the current oil saturation of formation. The logging was performed inside the 4»-casing at a given interval, while the logging sensors were operated in the surface readout mode. Then, based on the recorded data, a continuous lithological model was built and oil saturation was quantified.

#### Results

Compensated pulsed neutron spectrometry allowed to identify five reservoirs. The results helped the operator to identify and implement effective perforation intervals. The results were confirmed by subsequent production rates: the produced share of oil as a percentage of total fluid volume was 39%, compared to 44% according to IMKS-73 results. These results are within tolerance, since not all of the fluid can be recovered, as total porosity is the sum of effective porosity and water-bound clays.

#### Advantages

- Determination of current oil saturation in one trip
- Significant time reduction for operation
- Working with a 2.95» diameter tool to obtain the full range of nuclear parameters

#### Key Benefits

- Accurately, clearly and fully detects reservoirs
- Evaluates oil saturation in low-porosity formations through the casing
- Calculates spectral ratios, elemental composition of the matrix and liquid, and uranium, thorium, and potassium content

#### Location:

Russia, Volga-Ural region

#### Well type:

vertical, oil-producing



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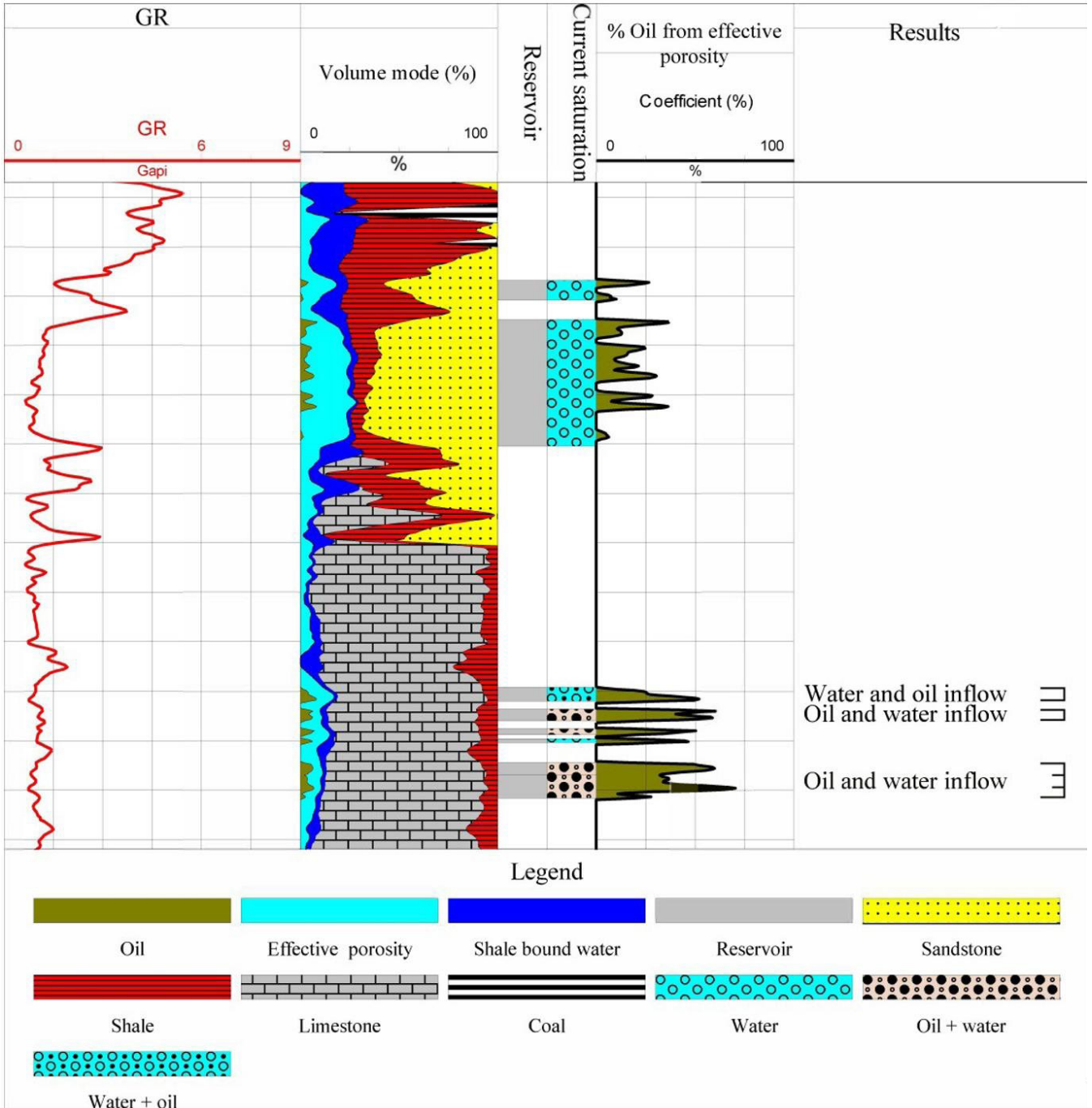
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The second track shows a lithological model based on the logging results. The elemental composition is calculated from spectral analysis of the data and used to build the lithological model.

Track 5 shows average values of current oil saturation. The nature of current saturation was determined based on the Client requirements for conditional gradations of effective porosity (ne) in pore space volume.

Track 6 is the final formation properties confirmed by perforation.



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