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ProTechnology

ProTechnics
A CORE LABORATORIES COMPANY

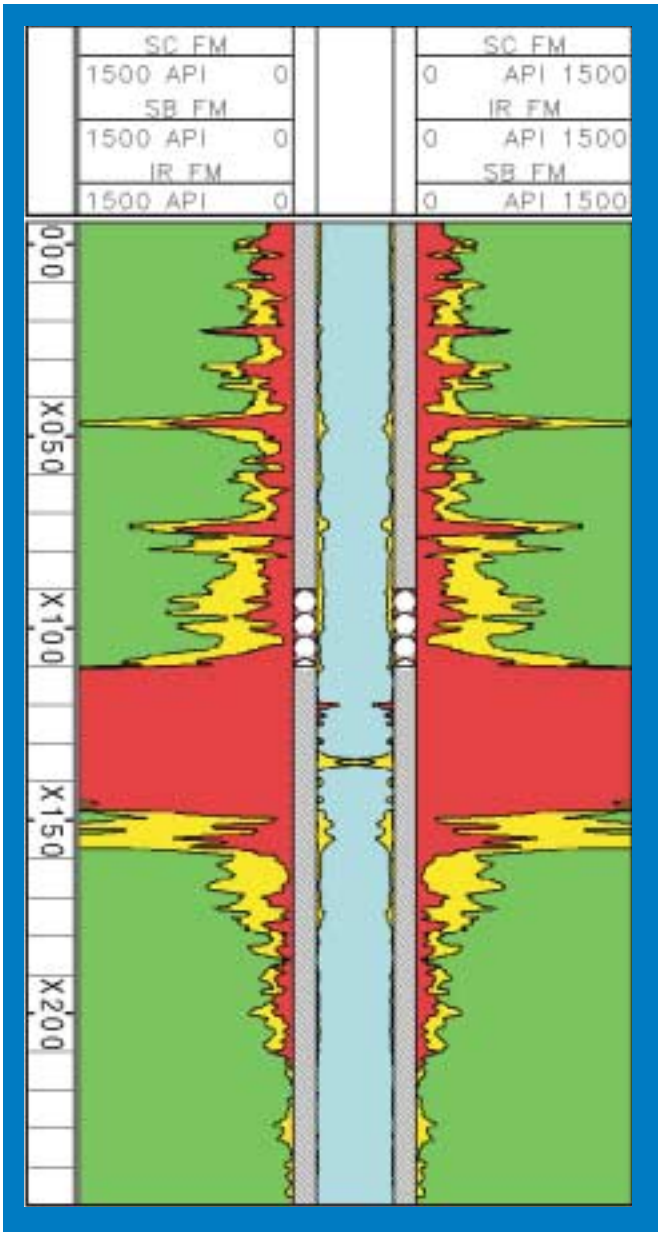
a regular technical review for clients of protechnics, a division of core laboratories

TRACER TECHNOLOGY INSTRUMENTAL IN THE EVOLUTION OF WATER FRACS

The primary driver leading to the reintroduction of water fracs (large volume slickwater and small volume proppant) in microdarcy sandstone reservoirs during the mid '90's was cost reduction. Tracer technology was instrumental in identifying a potential problem during its early redeployment, namely, channeling behind pipe resulting from pumping low-cost "gray water" cement slurries in low-cost monobore completions. Thanks to the use of Liquid Zero Wash® tracers and relative distance measurements from our SpectraScan® Imager, tracer technology quickly identified the presence of these channels. This soon led to an upgrade in cement formulations used on these completions.

Another potential problem associated with water fracs is illustrated in this figure — proppant settling. The perforated interval at X090 to X110 ft exhibits very modest counts from traced proppant (red tracer) across the perforations but very high counts of traced proppant below the perforations. Since these slickwater frac fluids possess minimal viscosities and the tight sandstone hydraulic fractures close relatively slowly, there is a tendency for the proppant to settle to the bottom of the fracture before the fracture can completely close on the proppant. Two remedies have been successfully incorporated into the water frac treatment procedures to alleviate this problem, namely, forced closure and/or positioning the perforations lower in the net pay, thus making an allowance for the proppant to settle but still not fall completely below the perforations.

As longer-term production comparisons between water fracs and conventional crosslinked gel fracs become available, tracers are instrumental in allowing problematic designs to be modified before field-wide implementation (and subsequent cost in lower NPV) occurs.



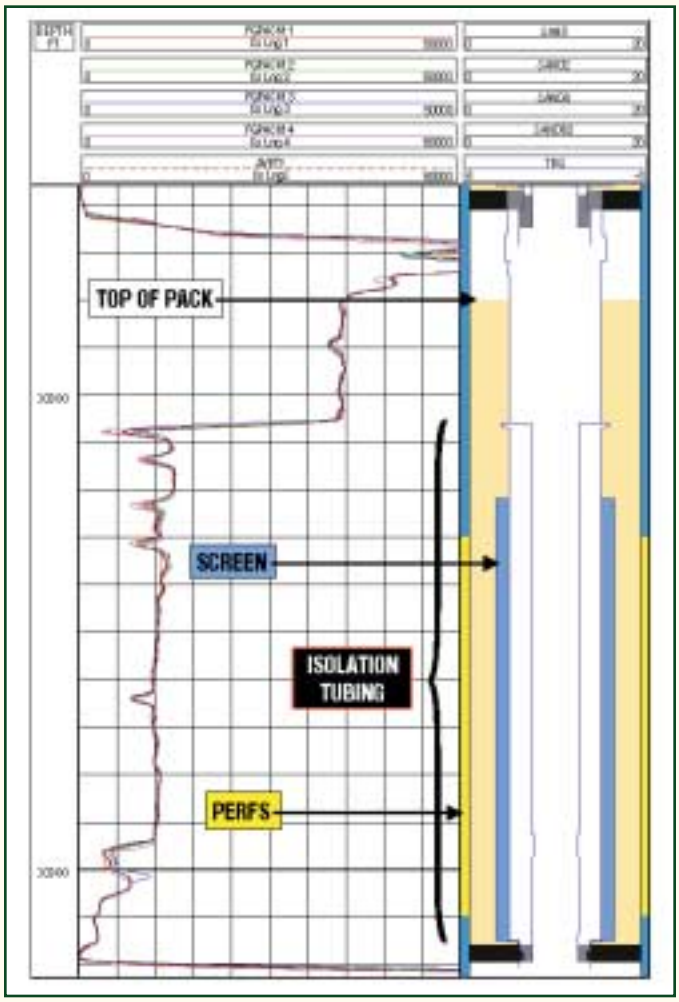
THE PACK IS BACK

Today's most prolific discoveries are typically unconsolidated sandstone reservoirs situated in deepwater where the cost of sand control failure is extreme. Frac packs, high rate water packs, open hole and horizontal gravel packs as well as conventional gravel packs are the completions of choice in many new oil and gas finds.

ProTechnics is re-engineering the way operators think about evaluating the quality of their sand control procedures with the new PackScan™ Gravel Pack Density Imager. PackScan is a memory gamma-gamma density logging tool which measures changes in the bulk density of a gravel pack completion. A gamma ray source is used to emit gamma rays radially into the formation and some of these gamma rays which have undergone Compton-scattering are detected. The number of gamma rays detected is proportional to the bulk density of the material between the source and detector.

By designing this new tool as a memory-logging instrument, it is now possible to deploy the service with a variety of hoisting mechanisms. The tool can be run on slickline, coiled tubing (in the case of highly deviated wells) and washpipe. The ability to deploy on washpipe allows the tool to be placed at or below the completion interval in the washpipe or workstring prior to the actual gravel pack pumping procedure. After completing the gravel packing operation, the tool records the density data as the washpipe is retrieved from the wellbore. This leads to substantial savings in rig time and associated costs and ensures that the data is available soon after a completion allowing remediation procedures to be employed before pumping equipment leaves the jobsite.

The PackScan Image at left is a frac pack completion from the Gulf of Mexico. This is the lower zone from a two-stage completion and the density tool was run on slickline. This lower zone is producing through a perforated isolation tubing (X807 – X915). The isolation tubing represents the same effect on the density log as one would see with the tool inside washpipe. As can be seen from the four logging passes and calculated average count rate, the gamma ray counts are very stable and low (good pack) throughout the screen interval (X822 – X915). Fluid Density and Dielectric data indicated a gas/water contact at X835 — this tool with it's optimized source-detector spacing minimizes the effect of changes in the borehole environment, including changes in fluid density. Density increases are seen as excursions to the left (lower gamma ray count rates) of the pack baseline and density decreases are to



the right (higher counts) of the pack baseline. Several collars and tool joints are seen throughout the interval (X864, X832, X823, X807, and X790). Because of the large change in wellbore internal diameter at the top of the isolation tubing, an increase in counts above X807 is seen. The top of the gravel pack in this stage is easily detected from the increase in gamma count rates at X778. The extreme density of the sump packer (X917 – 920) and the upper gravel pack packer (X758 – 761) are evidenced by the low count rate readings in those areas. The increase in density over the bottom 20 feet of the pack is due to formation fines or solids which have migrated into the isolation tubing/screen annulus from perforations at the top and subsequently settled to the bottom of that annulus.

PackScan
Gravel Pack Density Imager

For more detailed technical information on PackScan, review or call us for a copy of SPE 58779 “Gravel-Pack Evaluation Using a Memory Gamma-Gamma Density Tool” presented at the International Symposium on Formation Damage held in Lafayette, LA in Feb. 2000. When planning for well longevity over the life of your reservoir, wouldn’t you like to know early on if you have achieved a good, continuous gravel pack?

DID YOU KNOW?

SpectraMark™

ProTechnics provides many types of depth control markers. Radioactive collar marks are used for flush joint and non-magnetic casings where conventional CCL’s have difficulty locating casing collars. Also, R/A marks are used on a variety of downhole tools such as whipstocks, packers, centralizers, liner hangars, TCP hardware, etc. to ensure positive depth control. In many areas, subsidence monitoring is necessary and ProTechnics provides R/A marks for casing and also for core barrels and bullet perforators that are placed in the formation. When it absolutely, positively has to be exactly on depth, turn to ProTechnics for your depth control marking needs.

Core Makes Another Acquisition

Core Laboratories (NYSE: CLB) has completed its acquisition of Production Enhancement Corporation (PENCOR), a privately held company based in Broussard, Louisiana. PENCOR provides fluid phase behavior services used to characterize crude oils, natural gases and other reservoir fluids for the purpose of enhancing daily production and ultimate field recovery rates. PENCOR specializes in providing high pressure reservoir fluid services needed for deepwater developments. In addition, PENCOR also provides its technologies at the wellsite in remote areas such as Sakhalin Island and West Africa.

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Due to expansion of our laboratory services, ProTechnics is relocating our Houston facility into Core Laboratories new location. **Effective July 17, 2000** we will be located at:

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