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DREAM™—Drilling and Real Time Migration: A New Method for the Geophysical Monitoring of Wells

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Interpreted seismic sections and derived maps in time and/or depth are normally used to locate wells. The same data are subsequently modified and reinterpreted on the basis of final well results. In the drilling phase, there is a sort of blackout in the use of geophysical information. The "migration while drilling continuously" (MWDC©) method is a new approach to the while-drilling geophysical monitoring of a well. The approach makes it possible to answer two basic questions: Where is the bit in relation to the seismic section? Is the geological prognosis coherent with the while-drilling information?

Starting from a depth reference section obtained with an initial velocity field, the method allows the operator to continuously update the velocity field while drilling, and thus to refine the depth model and iterate the depth migration. The seismic velocities obtained by recording systems (i.e., Seisbit, or Tomex), which exploit the noise generated by the bit as a source of acoustic energy, are the most suitable to integrate well and migration velocities. Other velocities may also be derived from logging-while-drilling (LWD) measurements. One of the main advantages of seismic-while-drilling (SWD) tools compared to the other possible sources of data is the capability of prediction "ahead of the bit." As the original depth seismic image is continually updated, integrating the new well velocity information on the initial model, the seismic image becomes more and more reliable. With this more reliable image, important decisions can be made, such as redefining the well program, picking casing points, predicting over-pressured zones, etc.

Agip and Western Atlas are developing a new product that combines MWDC© principles and software from Western Atlas. The software package (DREAM™) is structured into four main modules: a project database, a while-drilling info package (Well Data Analysis), a modeling module, and the depth-processing package. The prototype actually handles 2-D seismic data, but extensions to 3-D data sets are presently being developed. The core of the DREAM™ package is the integration between surface velocity data (geophysical time domain) and well velocity data (geological depth domain) that have a different physical meaning and, therefore, may vary a great deal. Those velocity functions are processed by an interactive module (Well Data Analysis) that calculates, using linear and non-linear regression techniques, the new velocity profile. This new velocity information is added to the flow of operations so that the initial velocity model can be changed laterally and vertically using also the section's structural information. The resulting model makes it possible to obtain a new depth (and time) seismic image using migration or conversion algorithms. Both MWDC© principle and DREAM™ prototypes have been practically applied on synthetic data sets and real cases. Examples will be shown concerning an exploration well located in the Po River plain. ■

Luca Aleotti graduated in Geological Sciences from the University of Milan in 1983, and joined Agip in 1984 in the Seismic Data Processing Department. Since 1986, he has gained considerable experience in the field of well seismic acquisition, processing, and interpretation. He became technical leader for well seismic operations in the Seismic Stratigraphic Methodologies Department in 1993, and was in charge of the R&D activities for Seisbit and Cross-hole Seismic projects. Presently, as technical leader, he is in charge of an exploration project for the New Ventures Department.

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Luca Savini graduated in Geological Sciences from the University of Ferrara in 1986. He joined Agip in 1987, gaining professional experience in the Geophysical Research Department. Since 1989, he was in charge of the field planning group for 2-D and 3-D seismic. In 1995, he was assigned as technical leader for well seismic operations in the Seismic Stratigraphic Methodologies Department. Presently he is in charge of the Seisbit/Dream project.

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MWDC©—Agip patent

DREAM™—Western Atlas patent