How EOST sets the pace for engineering geophysics

In this occasional series featuring European geoscience education and research institutions, Prof Guy Marquis describes the geoscience education system at the Ecole et Observatoire des Sciences de la Terre, University Louis Pasteur in Strasbourg, as well as some of the relevant industry research.

Ecole et Observatoire des Sciences de la Terre (EOST) is the School of Engineering Geophysics of University Louis Pasteur in Strasbourg, one of the major French scientific universities with an enrolment of over 18,000 students.

The School of Engineering Geophysics was initiated in 1918, at the time when the Schlumberger brothers pioneered applied geophysics in Alsace. With a permanent faculty of 26 as well as numerous instructors from industry, EOST has a tradition of offering a curriculum with a strong theoretical basis, complemented by laboratory experiments and field schools, as well as a mandatory six-month internship in industry.

EOST also hosts global geophysical seismology, gravity, and magnetic observatories, as well as the French national archive of academic reflection seismic data, giving students an opportunity to work on large databases to apply the concepts learned in class.

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Prof Guy Marquis.

Research at EOST covers a wide array of geoscience disciplines: global geophysics, seismology, applied geophysics, rock physics, tectonics, geochemistry, sedimentology, and petrology.

Curriculum

Students enter EOST after two years of university education. Admission is quite selective and requires high levels in mathematics, physics, and earth sciences. The programme is over three years, so the EOST Diploma is equivalent to a M.Sc. Twenty to 30 students graduate every year.The first two years of study are focused on learning the foundations of geophysics: mathematics, signal processing, inverse theory, seismic imaging, electrical and EM methods, potential fields, rock physics, fluid mechanics, and hydrology. The focus of the school is on geophysics, but as industry needs well-rounded, multidisciplinary geoscientists, students also take classes and field schools in tectonics, sedimentology, sedimentary basin structure, and sequence stratigraphy. Classes in management, economics, finance, and QHSE give EOST students some business basics, and all EOST students must show proficiency in English (assessed by the TOEIC) in order to graduate.

Practical experience is an important aspect of the school: all students participate in a one-week geophysical field survey to address different geological problems. The school has its own field equipment and commercial and in-house interpretation tools. An example of student work applied to the localization of a recently active fault can be found in Bano et al. (2002). In addition, students take part in a marine seismic cruise in the Mediterranean on the research ship *Thetys II* and in a

Students acquiring ERT, EM and gravity data in the Vosges Mountains.

well-logging experiment at the *ALLIANCE* site near Montpellier.

A number of advanced courses at EOST are given by industry professionals: reservoir geophysics, reservoir hydraulics, 3D seismic imaging, mining geophysics, sequence stratigraphy, QHSE, and hydrogeophysics.

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Research at EOST

The Near-Surface Applied Geophysics Group focuses on methodological developments in the processing and interpretation of seismic, electrical, EM, GPR, and potential-field data. Recent developments in seismics have focused on the imaging of deep structures under a strongly tectonized subsurface (Pi Alperin et al., 2004) and on the use of multiple reflections recorded on long-offset data to determine accurately reflection coefficients and seismic source radiation patterns.

Optimal exploitation of signals is one of the strengths of our group. Loeffler and Bano (2004) have developed methods to monitor water infiltration in the vadose zone using GPR reflection coefficient data. Sailhac and Gibert (2003) have proposed a new methodology to use 2D wavelet transforms of potential-field data that enables 3D characterisation of anomaly sources.

EOST has been monitoring surface electric potential variations during reservoir stimulation experiments run at the Soultz-sous-Forêts (France) Hot Dry Rock site since 2000. These electrical data provide information on the dynamics of reservoir fluid flow that are usually not available from downhole pressure data alone, as they integrate flow at the reservoir scale (Darnet et al., 2002; Marquis et al., 2006).

The Rock Physics Group's work is based on laboratory experiments using pressure cells that allow us to study the micro-mechanical processes controlling the evolution of physical properties like rheological behaviour (Klein et al., 2001), permeability, electrical or thermal (Surma and Géraud, 2003) conductivity, elastic properties, with mechanical or thermal loading (Reuschlé et al., 2006). Applications of these studies are widespread: reservoir subsidence, borehole breakdowns/outs, formation of compaction bands or stylolites, geothermics, nuclear waste or CO_2 sequestration, fault/gouge mechanics.

The Geology Group at EOST has several research projects in close collaboration with the hydrocarbon industry. A first research priority includes the study of the tectono-sedimentary and morpho-tectonic evolution of deep magma-poor rifted margins during continental break-up. This study is mainly based on detailed analyzes of exposed examples of the ancient Alpine Tethys margins and the interpretation of geophysical and borehole data from the present-day Iberia-Newfoundland conjugate margins (Lavier and Manatschal 2006). A second research priority is related to the study of Palaeozoic glacial deposits of the North African cratonic platform. The aim of this study is to develop a sequence stratigraphic model for glacially-related siliciclastic systems (Moreau et al., 2005).

Students acquiring seismic data in the Rhine valley.

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