Mark Grutters (Shell)

Geochemist in petroleum exploration and production

Coming from university it is hard to imagine what it is like to work for a large international company, like Royal Dutch Shell. Most of the Earth Science students will start their career in an exploration environment, but inevitably will soon get exposed to a world outside their core competence. Once petroleum is found, and a conceptual plan for development has been established, it takes approximately 5 to 10 years before a field is in production. During that period, many different disciplines, from fundamental science to applied engineering, will have to work together to make the project a success. Earth Science students can play an important role in many of these project stages, and some of these might not be immediately obvious. In addition, most academics struggle in the beginning to combine a scientific background with the pragmatism that is required in a commercial environment. Sometimes scientific depth is required, in other cases important decisions has to be made on the spot.

In my career as (geo-)chemist I contributed to most of the project stages. Moreover, I have worked on projects that involved fundamental research and projects to solve day-to-day operational problems. Therefore I would like to give a brief impression about the various jobs a geochemist can play in petroleum exploration and production, and how her/his skills can be used in a multidisciplinary environment.

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Läslo Evers (KNMI)

Seismology of the atmosphere

Infrasound are low frequency air pressure fluctuations with frequencies below the human hearing threshold of 20 Hz. The lower frequency cut-off of infrasound is limited by the thickness of the atmosphere. KNMI has developed a microbarometer capable of measuring infrasound in the frequency range of 0.002 (500 sec) to 20 Hz. Monitoring of infrasound is done to provide public information on sources in the solid earth -earthquakes- and atmospheric sources both causing vibrations. A wide variety of sources generate infrasound, like: explosions, meteors, nuclear test, lightning, avalanches, sea waves, volcanoes, airplanes, aurora, severe weather, ... Occasionally, coherent infrasound is detected of unknown origin.

Infrasound is measured with arrays of microbarometers to increase the signal-tonoise ratio and to localize the sources. The array apertures range from tens of meters up to several kilometers, depending on the frequencies of interest, the number of sensor vary from six to sixteen. Noise due to wind often leads to signalto- noise ratios of less than one, therefore sensitive digital signal detectors are applied. One of the applied detectors is based on the Fisher statistics and is used both in the frequency and time domain. With the continuous measurements of infrasound a picture is obtained of both the sources and the atmosphere as medium of propagation. Because of its low frequency contents, infrasound can travel over large distances up to heights of 150 km. For example, infrasound from the eruptions of Mt. Etna in Italy can be detected in the Netherlands. While infrasound from the major nuclear tests in the sixties could travel around the globe several times. In that perspective, infrasound measurements are one of the verification techniques for the Comprehensive Nuclear-Test-Ban Treaty (CTBT). In this presentation the technique of measuring infrasound will be described, array processing and beamforming will be illustrated with examples. Challenges are not only source detection and identification but also the application of infrasound to image the atmosphere.