

Abstract for EAGE
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New Applications in Petroleum Geochemistry

This lecture aims to give an overview of recent developments in petroleum geochemistry. After a short review of established methods, the presentation focuses on the latest geochemical applications in the exploration and production of 'conventional' hydrocarbons. Recent technology to support the development of 'unconventional' resources such as shale gas, acid gas and heavy oil will also be discussed. Although the presentation is targeting a wide audience, students with a basic understanding of (petroleum) geology and chemistry will benefit most from this lecture.

Introduction

Petroleum Geochemistry has seen a rapid development in recent years. Increased interest in unconventional resources has created a new demand in the petroleum industry and rejuvenated research efforts in both the oil companies and the service industry. Also the search for the last conventional barrels has stimulated the demand for new technology including geochemistry.

Originally, Petroleum Geochemistry was applied for exploration risk assessment only. Source rock presence and maturity was the domain of the geochemists, many of whom evolved from a background in coal petrography. As a result, the oil generation process is still expressed in terms of vitrinite reflectance – a unit which is adequate for measuring coalification, but is less suitable for describing the chemical conversion of a petroleum source rock into liquid hydrocarbons.

Today, hydrocarbon exploration is no longer the mainstay of the petroleum geochemist and Geochemistry is applied in all phases of the E&P lifecycle. Applications now deal with field appraisal and development, with production surveillance, field abandonment and CO₂ sequestration. With the accelerating global demand for energy and the increased proportion of unconvensionals in the energy mix, the interest in geochemistry is likely to continue to grow.

Exploration Geochemistry

Most of the world's sedimentary basins have seen several rounds of exploration by now. As a consequence, new prospectivity reviews and acreage evaluations now start with a re-

evaluation of existing data and samples from previous exploration campaigns. Geochemistry plays an important role in such reviews: in basins without any discovered hydrocarbons, screening of cuttings with new geochemical techniques can help identify previously overlooked (micro) shows in dry wells. Increased analytical capability has made it possible to type hydrocarbons in fluid inclusions and correlate them to their source rock. In mature, producing oil provinces, analysis of produced fluids can help identify additional or overlooked petroleum systems: is the produced oil indeed from a single source rock or is there evidence for a contribution from a second, deeper petroleum system? Modern exploration geochemistry focuses on identification of missed opportunities and on testing the boundaries of the known hydrocarbon plays.

Production Geochemistry

Reservoir and Production Geochemistry is much younger than Exploration Geochemistry and the deployment of this technology is still in an early phase. Originally, Reservoir Geochemistry was used to identify flow barriers in producing reservoirs (compartmentalization studies). In recent years, molecular differences in oil composition are more often used to set up production monitoring programs. Adequate surveillance programs are essential for production reconciliation and geochemical analyses can provide both the accuracy and long term reliability that is required and even fiscal metering between different off-shore fields has been carried out with geochemical analysis now.

Also the monitoring of waterfloods and other enhanced recovery techniques depend on accurate metering techniques. But metering is notoriously inaccurate in production streams with high water cuts and increasingly, 'physical' metering is being replaced by 'chemical' metering. Chemical metering consists of the molecular analysis of a production stream with the objective to resolve the contribution of several sub-streams. A good example would be the analysis of the oil from the export line of a gathering station to determine the contribution of the individual fields that produce into the station. Such analytical programs can become very complicated, depending on the number of end-member fields and the configuration of the surface facilities.

Unconventionals

The economic development of unconventional resources such as shale gas and heavy oil depends to a large degree on the ability to find 'sweet spots' in a resource base with otherwise very unattractive reservoir and fluid properties. Identification of such sweet spots requires a much more detailed understanding of reservoir and fluid properties than was ever required for the development of conventional hydrocarbon reserves. The ability to recognize, understand and forward model variations in reservoir architecture and fluid properties could mean the difference between an economic development or an abandoned field trial. In the coming years, new developments in petroleum geochemistry will contribute more and more towards the identification of sweet spots in unconventional plays. Particularly the production of shale gas and heavy oil stand to benefit from new methods in Petroleum Geochemistry.