N491: Play and Prospect Assessment

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Format and Duration
Classroom - 5 Days

Summary

Play fairway analysis (PFA) and common risking segment (CRS) mapping is commonly used in evaluation of basins. Plays are the basic unit of exploration and the mapping of play elements (presence and effectiveness of reservoir, source and seal) and their integration into common risk segment maps provides the basis of interpretation and development of models. Within a play there may be families of prospects which have shared play risk and interdependencies. Prospect delivery is focused specifically on issues of prospect definition, estimating trap volume, risk assessment and hydrocarbon type. This course involves the description of prospects in the context of the play and reviews the methods of calculating prospect resources.

Learning Outcomes

Participants will learn to:

1. Map the play elements (presence and effectiveness of reservoir, source and seal) and consider interpretation confidence and alternative models.
2. Integrate risks on all play elements to compile common risk segment maps and calibrate with drilling statistics and well failure/success analyses.
3. Determine play resource and yet to find estimates using various techniques including creaming curves and gap analysis, geochemical volumetrics, and prospect density.
4. Calculate geological risk and uncertainty in exploration prospects.
5. Review methods of calculating prospect resources.

Training Method

This is a five-day classroom 'hands-on' course with a number of informative exercises designed to get across the principles, punctuated by a series of short talks. The course will have a workshop format with the majority of time spent using and interpreting the data under the guidance of an industry expert.

Who Should Attend

The course is aimed at explorers with experience of seismic interpretation, having a sound understanding of other geoscience disciplines and how they impact petroleum systems and plays. The courses is aimed at the fundamental level for geoscientists with 1-5 years of experience, though it will also serve as an excellent refresher for more experienced explorers.

Course Content

Day 1

Play recognition and mapping: play classification and subdivision, and play maps that high-grade the most favorable areas with minimal geologic risks

- Play definition: play fairway, and petroleum system. Play fairway map, events chart and play cartoon. Importance of the regional foundation (structure, stratigraphic and petroleum systems).
- Work flow overview (play definition, play elements and interpretation confidence map, common risk segment mapping, resource estimates at play level).

- Play elements: construction of Gross Deposition Environment GDE maps from seismic, seismic attributes, isochores and key wells (reservoir, top seal and source presence).

Day 2
Play recognition and mapping: play classification and subdivision, and play maps that high-grade the most favorable areas with minimal geologic risks continued

- Play elements: reservoir deliverability, seal capacity and charge access. Importance of first carrier, lateral versus vertical drained systems, maturity vs. organo-facies, effects of early oil and pore pressure on porosity, and charge focus.
- Risking plays using Common Risk Segment mapping - calibration using fields and well failures. Risk vs. uncertainty, phase risk and composition.

Day 3
Review of common assessment methods: selection of the most practical approach

- Play resource (yet to find) estimates - creaming curves, field size distributions, areal yield, prospect density, leads and prospect inventories.

Geological controls of oil and gas occurrence: their impact on exploration risk and success

- Geochemical characterisation of the oil and gas to determine their origins.
- Use the integrated petroleum system approach to understand the geologic controls of hydrocarbons.

Review hydrocarbon charge assessment procedures for estimating possible amounts of oil and gas generated, migrated, and trapped in prospects

- Source rock effectiveness risk addresses whether the identified source rock is mature enough for the expulsion of hydrocarbons within the fetch of the identified prospect.
- The charge access risk considers whether the expelled charge can migrate effectively from the source rock into the prospect.

Application of volumetric prospect assessments: techniques, comparative data, and graphs to estimate input factors, such as trap volume, porosity, net/gross saturation, hydrocarbon fill fraction, formation volume factors, and recovery efficiencies

- Understand the principles of resource estimation.
- Calculate the volume estimate after determining the risk.
- Resource estimation is a collaborative exercise that should involve the prospect geoscientists, play or regional geoscientists, and reservoir engineers.
- Before estimating resources, a clear description of the geological model for calculating volumes.
- A separate resource estimation is required for each alternative geological model
- Bulk rock volume (BRV) is the parameter with the greatest potential to get wrong
  --A degree of fill is controlled by available charge budget, seal capacity constrained, or spill point.

- Carefully decide for each input parameter what is the most appropriate type of probability distribution and what values define it, especially the minimum.
- How to determine phase and FVF vs. gas expansion factors (departures from normality etc)?
- What are the ranges of recovery efficiencies in the various production scenarios, water injection (strong and weak aquifers), gas injection, drawdown in gas reservoirs, condensate recoveries? Simple, dual phase and super critical fluids etc.

Day 4
Risk analysis: principles and practice

- Risk analysis in exploration.
- Estimation of geological probability of success (PoS).
- Common industry way to estimate the geological PoS: what is wrong with it?
- A better way: Lookup tables for estimation of the geological PoS.
- Consistency is the key to portfolio management.

Probability methods: to get a number and a range of possible outcomes, the expression of uncertainty for input factors and results including Monte Carlo techniques

- Input a range of values for each assessment parameter
  -- Usually minimum, most-likely, maximum.
- Justify the reservoir and fluid input parameters using data from nearby petroleum pools, global analogues and models.
- Keep the range of input parameters sufficiently wide.
- Use correlations between input parameters.
- Reduce biases affecting uncertainty assessments.
- Different types of bias (e.g., point data vs. field average; application of cut-offs; a degree of fill; effective porosity and N:G; ridiculous upsides).

Limitations, pitfalls, uses, and discovery concepts: the philosophy of judging and using assessment results and the importance of basic geologic concepts

- Explorers tend to ignore the base rate information (e.g., success rates and field sizes in plays/basins), therefore, consistently underestimated the geological PoS and overestimated the success case volumes.
  --Study not only our own prospects, but also surrounding discoveries, dry holes and prospect.
  --Deliberately seek and integrate relevant base rate information into prospect assessments.
  --Post-well analysis and performance tracking to learn and share from the experience, and lead to improve future forecasts.
- Pitfalls related to seismic interpretation such as false DHI's e.g., opal quartz CT transitions.
- Charge modelling software
  --The input into those models are poorly qc'ed and poorly understand
  --As an industry we are poor at predicting source presence and properties particularly in frontier basins
  --The quality of hydrocarbon migration is always limited by how well the model has calibrated with

pools and show database.

Day 5
Prospect assessment workshop: projects will be worked by teams and reported to the entire group.

An extra day working a dataset and well results, participants could work on many topics such as:

- The key plays in a basin.
- Play test versus mature fairway well.
- Prospect definition
  --Describe accurately the observations based on the data available.
  --Interpret and integrate these observations into a reasonable geological model that applies not only to the prospect, but also fits with the regional play fairway analysis already undertaken.
  --Recognise alternative models that explain the same observations.
  --Assign risks to these models, and also assign reasonable ranges to the properties which define the prospect in order to assess its volumetric potential.
- Pre-drill predictions with post-drill actual results.
- How good were the predictions?
- How do the well results affect prospectivity?
- In the success case, is the discovered resource within the predicted range?
- In the failure case, was the key pre-drill risk the actual reason for failure?
- Examine shot-point risk associated with the possibility of missing the target.
- Do the GDE and CRS maps need to be updated to reflect the well results.
- Assess inert gases (CO2, H2S and N2) contamination risk.
- Are there new plays?