

Introduction

What are the key decisions in the exploration process, and how do you make them? Peter Rose (2001) suggested that “The most difficult and critical decision in petroleum exploration is not which prospect to drill, but instead, which new play to enter”. We would argue that this is even more so the case in today’s climate of decreasing reserves replacement rates, renewed focus on exploration and increased competition for quality assets. We would also propose that the next most critical decision is what acreage to pursue after the play has been identified and analysed.

The Exploration Cycle

Play and acreage analysis form a key part of the exploration cycle (see *Figure 1*), but are generally the most poorly defined from a process point of view. Decisions are often driven by subsets of the large volumes of data available to an exploration team, and by personal or historical bias, based on past experiences or exploration strategies. Quantitative analysis and the analysis of opportunities using all available information require data integration on a massive scale. It is usually seen as too time consuming to carry out on a regular basis, if it’s ever carried out at all in a structured, repeatable way.

Many companies apply different processes to their analysis, varying between countries, assets or even individuals. This makes it very difficult to objectively review opportunities on a company-wide basis, and leads to greater uncertainty in opportunity ranking and portfolio management. It is also rarely seen as an iterative process; new data is rarely fed back in on a regular basis to refine the model.

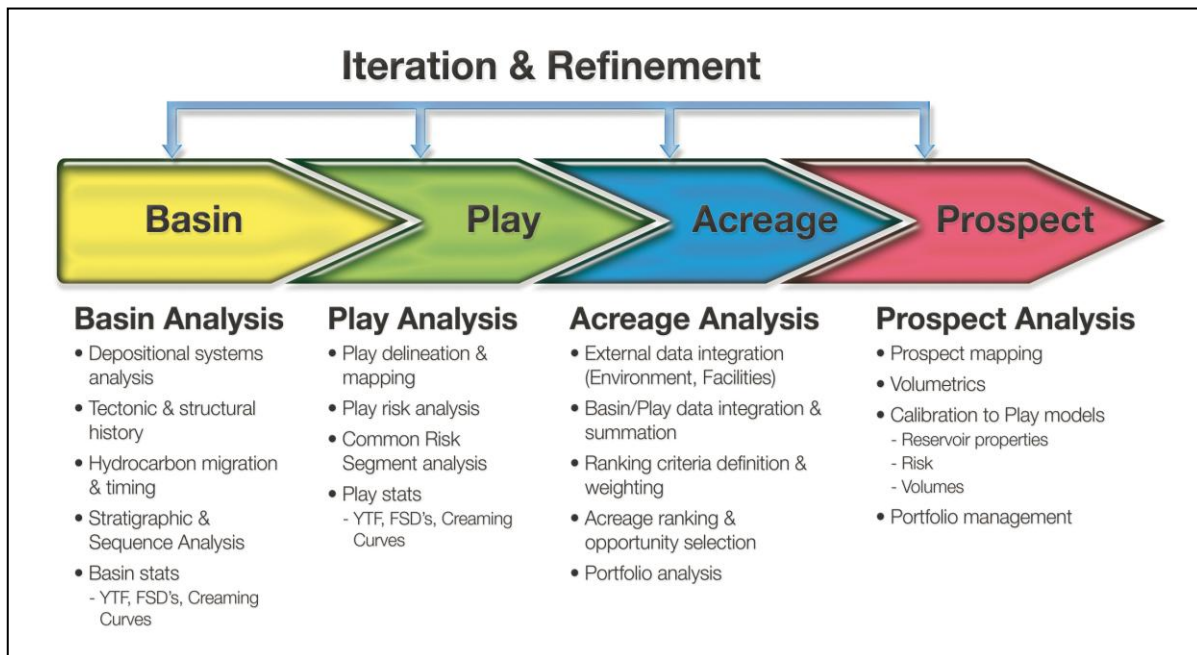


Figure 1: The Exploration process. The goal is to reduce technical uncertainty and narrow the risk estimates on the prospect portfolio through systematic basin, play and acreage analysis.

The Role of Technology

Technology vendors have traditionally focused on the prospect analysis part of the exploration process, then down in to the Earth model and the ‘Digital Field’. There are also several innovative technologies associated with basin analysis, often driven by academic research. However, there is very little technology support for the play and acreage analysis components. Geographic Information Systems (GIS) technology has been used increasingly in this area in recent years, with some success.

How GIS Helps

Many companies only use GIS as a simple data integration and visualisation tool, and don't exploit its full spatial analysis capabilities. Once data has been collected in a GIS, it is often exported for further analysis in Excel, where the rich spatial trends and relationships inherent in the data are lost. However the spatial analysis functionality that lies at the core of GIS can be used to support the interpretation of large volumes of data and develop quantitative play analysis models. It enables you to develop play risk models review and rank acreage based on large volumes of GIS-based data in an objective, consistent, iterative way. The following workflow (Figure 2) illustrates how GIS can be used to support play analysis:

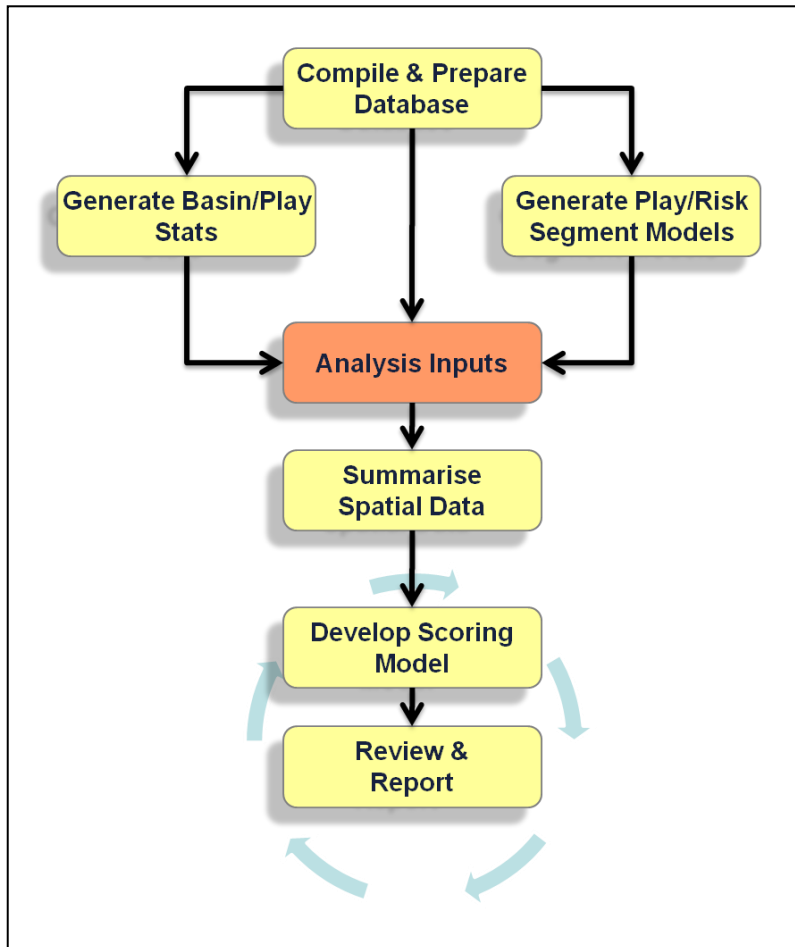


Figure 2: Play analysis workflow using GIS

We will look at two examples of where GIS can add value to the workflow: Common Risk Segment mapping and opportunity ranking.

Common Risk Segment Mapping

Palaeogeography and/or gross depositional environment mapping can be created or imported in to our GIS and converted to a numeric risk or probability. Spatial analysis functionality can be used to map data density and quality, and these can be used as modifiers to the geoscience risk or probability estimates. These maps can then be combined automatically using overlay capability to define Common Risk Segments using the approach described by Hood et al, 2000, see Figure 3. In this case, GIS is essentially replacing time consuming manual overlay processing of data on the light table. Because the process is much faster in GIS, it encourages update and iteration of risk models based on additional scenarios or new data.

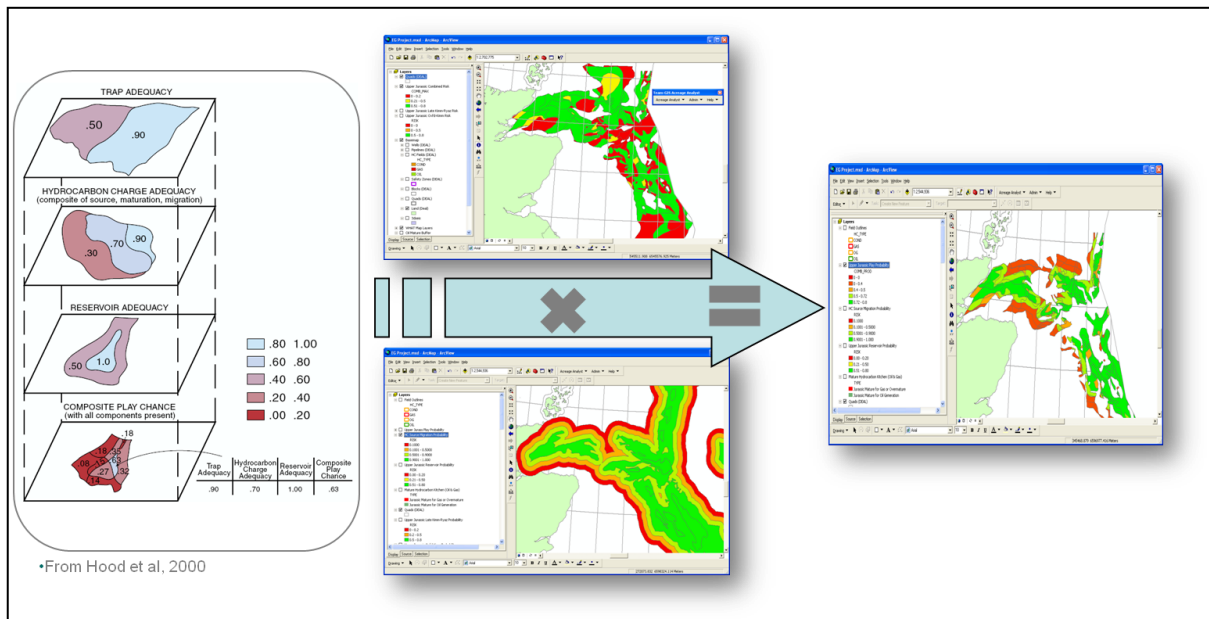


Figure 3: Common Risk Segment map creation. Risk maps are generated and combined using GIS overlay functionality.

Opportunity Ranking Approach

Data that is important to decision making and opportunity ranking, including Common Risk Segment models and other geoscience, engineering and environmental data, is analysed and summarised on a block-by-block basis (Figure 4). Examples of inputs might include:

- Depth to reservoir(s)
- Number of play present
- Distance to facilities
- Distance to hydrocarbon kitchen
- Percentage coverage of seismic data
- Drilling activity and success rates
- Field and prospect reserves
- Yet to find reserves estimates

A scoring model can then be developed to quantify the relative value of different blocks e.g. blocks closer to the hydrocarbon kitchen score more than those that are further away. Different data types can also be weighted to reflect their importance in the analysis e.g. distance to facilities may be more important than depth to reservoir.

The resulting blocks can then be ranked based on the scoring model and models calibrated to basin statistics, known discoveries and the prospect portfolio, ensuring consistency and reduced uncertainty. This screening process allows more time for detailed analysis and prospect generation work on the best opportunities, and provides a quantitative model to test assumptions based on knowledge and previous experience in a basin.

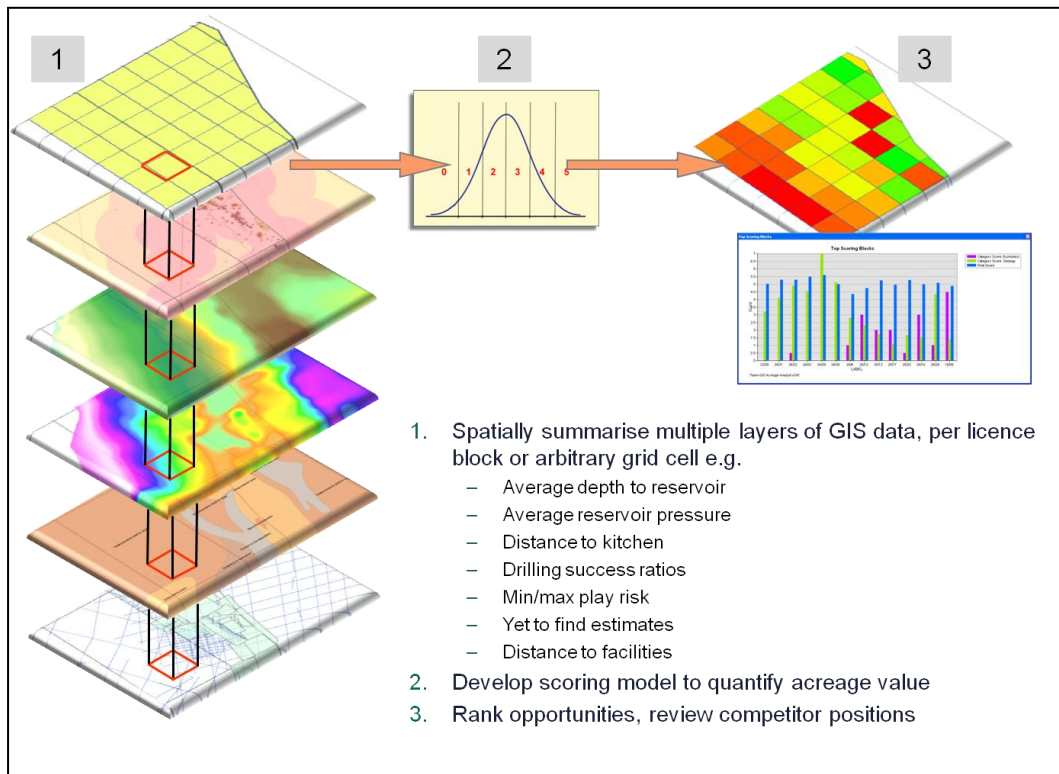


Figure 4: Acreage analysis workflow. GIS is used to automatically summarise input data, and a normalised scoring model is then created.

Conclusions

GIS is emerging as a key component for supporting and improving the exploration process, including risk assessment and opportunity screening and ranking. The key benefits of this approach are:

- GIS provides the ideal platform for data integration in the exploration analysis process. Using all the data available, in a consistent fashion, improves our confidence levels in assessing risk and uncertainty.
- GIS can significantly reduce the cycle times for an exploration project, especially for manually intensive processes such as data integration, analysis and risk map generation. This time can be used to iterate and refine the models used for ranking opportunities, or to reduce overall project times.
- GIS provides a framework for developing consistent exploration processes across all assets within a company. This leads to a more consistent, auditable corporate prospect portfolio, and better portfolio management decisions.

The overall result of reducing technical uncertainty, standardising process and understanding risk is improved decision making and better exploration efficiency. Better prospects will be drilled earlier in a programme, and an improved framework for integrating the results of new wells back in to the regional play risk models will be established.

References

Rose, P.R. [2001] *Risk Analysis and Management of Petroleum Exploration Ventures*. AAPG Methods in Exploration Series, No. 12.

Hood, K.C., South, B.C., Walton, F.D., Baldwin, O.D. and Burroughs, W.A. [2000] Use of geographic information systems in hydrocarbon resource assessment and opportunity analysis. In: Coburn, T.C. and Yarus, J.M. (Eds.) *Geographic Information Systems in petroleum exploration and development*. AAPG Computer Applications in Geology, No. 4, 173-186.