

# Facies Modelling With GeoSyntax

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CSIRO has been developing a new method for generating facies models which can reproduce the complex shapes and spatial relationships found in channel-related depositional environments.

## Facies models of petroleum reservoirs

Petroleum reservoir engineers use a variety of computer-generated statistical modelling techniques to generate the large number of facies models (realisations) required to assess the uncertainty in their understanding of reservoir heterogeneity. However, the resulting models are often not geologically realistic.

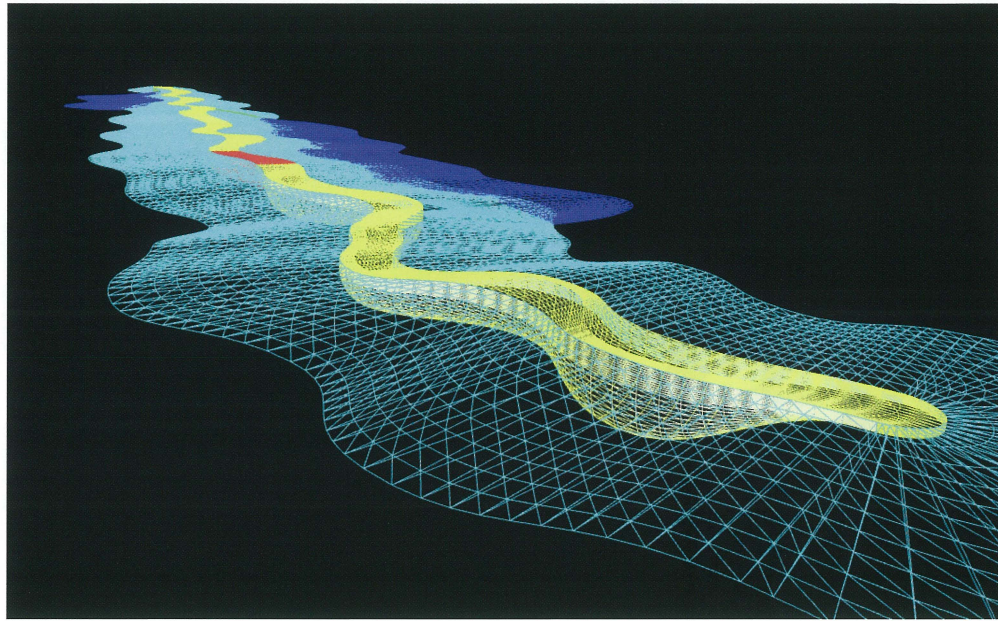
More recently, methods such as marked point processes and models based on training images have been developed to incorporate geological patterns into facies models. However, these methods are not always good at reproducing the complex shapes of channel fill bodies and the correct spatial relationships between the various sedimentological entities. Furthermore, they tend to be computationally intensive as they are grid-based.

## The GeoSyntax method

Realistic facies models need to be based on analogue models that have been developed from studies of modern depositional systems or sedimentary outcrops.

CSIRO has been developing a new method for documenting analogue models in a format that is both computer readable and intuitive to a geologist. The method is based on formal language theory. Using this method each analogue model is encoded as a grammar, which allows a precise description in a compact format.

In a grammar, a complex object is described in terms of its components and a set of rules that describe how the components are assembled to form a complex object. For example, the rules may state that a channel-fill deposit must be flanked by levee deposits, or that a crevasse splay deposit lies adjacent to the outside bend of a channel segment.



3D channel (yellow) with overbank and splay deposits (cyan and blue).

The GeoSyntax grammars are probabilistic, i.e. a probability is assigned to every rule. Additionally, the size or shape attributes of a symbol may be described by a probability distribution, so that the natural variation inherent in a sedimentary system can be included in the model description.

## Generating facies models with GeoSyntax

CSIRO has released a computer program called a parser to generate multiple realisations of facies models using descriptions provided by the GeoSyntax grammars. There are two versions of the parser available.

An older version of the parser can generate 2D facies models as vertical sections. The vertical sections are generated as a series of layers—each layer contains a set of related depositional bodies deposited over a specific time interval, e.g. a single channel fill with associated levee deposits.

The pattern of symbols in each layer that is generated can be influenced by the pattern of symbols in the previous layer. In this way vertical patterns, such as those resulting from nested or migrating channels, can be imitated.

A newer version of the parser is capable of generating facies models as 3D layers. The layers can be stacked to create a 3D volume, although the parser cannot at this time generate vertical patterns such as nested channels.

## References

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