Grid Free Object/Event based Facies Modeling of Estuarine System

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The McMurray Formation contains multi-scale complex geological features that were partially formed in an estuarine depositional environment. The inclined heterolithic stratifications deposited as part of tidal channels contain centimeter scale features. These tidal channels are common and interrelated over many square kilometers. Modeling the detailed facies in such estuarine systems requires a methodology that reflects heterogeneity over many scales. Object-based modeling is well established and preferred to the conventional variogram-based techniques when there is a good knowledge of representative geo-objects in the geological system. The geomodels generated with object-based modeling may reproduce complex geological features and may be visually attractive. In most of the object based modeling technique the geo-objects are represented as a template of cells that are coded as a particular facies inside the objects. This may lead to lack of small scale geological features reproduction.

The grid-free approach presented in this paper allows for a representation of geological objects as surfaces and parametric shapes that are not linked to any particular Cartesian grid system. Features millimeters thick or kilometers in extent are represented in the same model. Geological sequences are represented by mathematical functions.

The methodology involves development of three main components: geological object database, simulation engine, and rasterization engine. The geological database is a general library that contains the specification of geological objects and the associated architectural elements. Each geo-object is defined by a series of parameters, properties and a unique code. A simulation engine is a stochastic object-based or event-based algorithm that generates the grid free geological model by following the geological rules and using objects from the geological object database. The rasterization engine is a tool to transform the grid free geological model to the gridded model for purpose of further petrophysical properties modeling, flow simulation, or visualization. This framework will be presented with application to the estuarine facies of the McMurray Formation.