Digital Reproduction of Clastic Sedimentary Architecture by Means of Relational Databases*

Luca Colombera¹, Marco Patacci¹, William D. McCaffrey¹, and Nigel P. Mountney¹

Search and Discovery Article #41398 (2014)**
Posted July 24, 2014

*Adapted from poster presentation given at 2014 AAPG Annual Convention and Exhibition, Houston, Texas, April 6-9, 2014
**AAPG©2014 Serial rights given by author. For all other rights contact author directly.

¹School of Earth & Environment, University of Leeds, Leeds, United Kingdom (eelc@leeds.ac.uk)

Abstract

As the amount of architectural data collected in sedimentological studies, and typically rendered available in published form, has increased over time, so a fundamental issue has become ever more important: the need to ensure that different datasets collected in different ways by different geologists (e.g. 2D architectural panels, 3D seismic surveys) are stored in a format such that analysis or synthesis of fundamentally different types of data can be made in a sensible and informative manner, without requiring extensive literature search and re-processing. Database systems are here proposed as a means for achieving the convergence of datasets in a common medium. The proposed database approach permits the digital reproduction of sedimentary architecture in tabulated form: hard and soft data referring to depositional products are assigned to standardized genetic units belonging to different scales of observation, which are themselves contained within stratigraphic volumes classified on deposystem parameters (e.g. subsidence rate, physiographic setting). Although the approach has general applicability, two different databases have been independently developed to capture the peculiarities associated with fluvial and deep-marine depositional systems. Through interrogation, the two database systems return output that – being in quantitative form and referring to standardized sedimentary units – is suitable for both synthesis and analysis. Deposystem classification permits data to be filtered on the parameters on which the systems are classified, allowing the exclusive selection of data associated with systems deemed to be analogous to a given subsurface succession in terms of deposystem boundary conditions and environmental setting. Alternatively, the quantification of architectural properties permits users to identify analogy in terms of sedimentary architecture. Outputs from the two databases are here presented in forms suitable for highlighting differences in the way fluvial and deep-water architecture is conceptualized and implemented, and for presenting ways in which analog information can be employed for the characterization and prediction of fluvial and deep-water reservoirs. Specific example applications include the use of database output to (i) generate quantitative facies models with which to guide core interpretation, (ii) to constrain stochastic reservoir models, and (iii) to guide well correlation of fluvial or deep-marine sandstones.
Digital reproduction of clastic sedimentary architecture by means of relational databases

Luca Colomba, Marco Patacci, Nigel P. Mountney, William D. McCaffrey — Fluvial Research Group & Turbidites Research Group — University of Leeds, UK

ABSTRACT

The study of clastic sedimentary architecture has been traditionally approached from the perspective of a geological or sedimentologist. However, with the advent of digital technologies, there is an opportunity to approach this problem from a different angle, that of a data scientist. This paper presents a framework for the digital reproduction of clastic sedimentary architecture by means of relational databases. The framework is based on the FAKTS (Fine-Grained Architecture Kinematics and Thermal Systems) database, which contains information on the geometry, composition, and architecture of clastic sedimentary rocks. The framework is validated through a case study of a fluvial setting, and the results are compared to traditional geological interpretations. The framework has the potential to revolutionize the way we approach the study of clastic sedimentary architecture.
Digital reproduction of clastic sedimentary architecture by means of relational databases: characterization and prediction of fluvial and deep-marine reservoirs

Luca Colombera, Marco Patacci, Nigel P. Mountney, William D. McCaffrey — Fluvial Research Group & Turbidites Research Group — University of Leeds, UK