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Creating and leveraging large, digital stratigraphic datasets by using stratigraphic section digitizers

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Summary

Stratigraphic sections (i.e., measured sections, core logs, and graphic logs) are a key tool used by sedimentologists, stratigraphers, and basin analysists communicate the nature of the sedimentary record. Stratigraphic sections are used to describe bedding thickness, grain size, occurrence of sedimentary structures, or the facies within a stratigraphic interval. They are commonly composed of an x-axis that is used to describe the grain size (i.e., sediment diameter) of the sediment and a y-axis is used to describe the thickness of the drawn interval.

Stratigraphic sections are predominantly interpreted by qualitatively comparing the grain size, thickness, or character of beds and facies. Although there are statistical measures that are used to determine sedimentary environment, interpret bed-thickness trends, or stratigraphic order of facies from stratigraphic data, many of these measures require numerical inputs that are not readily, or easily, extracted from graphical stratigraphic sections. Additionally, as stratigraphic data is used in numerous digital applications (e.g., reservoir modelling, forward modelling of sedimentary systems, and prediction of subsurface facies), an effective way to translate these data types into numerical format is required.

This talk discusses the power of stratigraphic digitizers (e.g., the open-source software stRat stat) to assemble digital bed-scale stratigraphic datasets for implementation in reservoir modelling, e-facies analysis, and machine learning. Digitizers allow for discretization of a hand-drawn or digitally-produced stratigraphic sections into a numerical format for later analysis or input in to machine learning algorithms. This process is done through: 1) the discretization of a stratigraphic section into a numerical format that preserves bed boundaries, grain size variations, sedimentary structures, and facies through a user interface; 2) the addition and summarization of additional discrete measurements (e.g., core measurements) and/or continuous measurements (e.g., petrophysical borehole measurements) that are associated with the interval; and 3) the accumulation of multiple discretized sections together to create a dataset for the analysis and comparison of a large area or interval.

Once created, digital stratigraphic datasets allow for the interrogation of stratigraphic section data to unravel the variability of geologic bodies. This can be done by computing and visualizing pertinent statistics (e.g., facies thickness, net:gross, average petrophysical response) that can later be leveraged in reservoir models or in machine-learning algorithms. The utility of this process and datasets are demonstrated through a variety of subsurface and outcrop examples where digitizers have been employed.