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New Integrated Solutions For Geological Process Modelling To Assess Reservoir Play-Fairways, Stratigraphic Traps And Seals

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ABSTRACT

Integration of multi-disciplinary “concept-thinking” and a variety of numerical tools is essential to produce reasonable multi-scenario simulations and probabilistic information. This helps in making better decisions for further de-risking and efficiently improving hydrocarbon exploration and production. Alternatively, such tools and approaches can be used to apprehend the subtlety of sedimentary basins and reservoirs for developing hydrothermal energy resources and/or carbon and energy storage.

Today, the global energy market does not allow taking high risks for conventional hydrocarbon exploration and production. Therefore, cutting-edge technologies for better assessment of reservoir play fairways and (stratigraphic) traps have become crucial. Since such elements of any conventional petroleum system are dynamic and might drastically evolve through time (e.g., diagenesis for carbonates and siliciclastics for seal integrity), post-depositional processes (up to production time) have to be integrated in future wokflows. A unique working environment for the whole integrated basin/reservoir analysis has to be available and efficient, including the following basic building blocks: i) characterization of all available geological, geophysical and geo-mechanical data (leading to conceptual models); ii) sedimentary facies modeling (with forward stratigraphic numerical engines); iii) structural characterization and modeling (deformation, inversion and faults); iv) burial/thermal and petroleum systems modeling; and v) uncertainty analysis and modeling (to quantify uncertainty and produce probability maps).

In order to achieve such challenges, collaborative geoscience must be achieved bridging the gap between sedimentologists, structural geologists, geophysicists, petroleum geologists, and geo-modelers. This approach should also be equipped with an efficient platform capable of managing and exchanging a great deal of data through transverse solutions.

Several case studies from different parts of the world (e.g., Arabian Gulf, Mediterranean region, Caspian Sea), on carbonate as well as siliciclastic systems, have been used to improve our workflows and to provide new integrated numerical solutions for geological modeling. This contribution will make use of such cases to illustrate the proposed integrated approach and to highlight venues for better assessment and prediction of stratigraphic reservoir fairways and traps. The ultimate goal is to provide models as tools for further improving petroleum systems and uncertainty analyses, and eventually for decision-making. Finally, new challenges for the future research and development and innovation will be proposed.