A novel upscaling workflow of multi-phase flow properties for water-, and mixed-wet reservoirs – applications for conventional hydrocarbon field developments and low-carbon business

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Within OMV's digital transformation program, we are combining the latest software developments in digital rock simulation (DRS) and special core analysis (SCAL) simulation, with SCAL data mining and log-based upscaling to provide reservoir engineers swiftly with multi-phase flow characteristics to predict reservoir performances. Unlike classical investments in time-consuming and cost-intensive laboratory workflows, flow properties are estimated by a petrophysical data-model sourced from a rock-fluid database, supported with digital rock simulation, and where required, SCAL measurements. DRS- and database derived relative permeabilities, including associated uncertainties, are key input parameters to impact decision quality in field developments and can substantially accelerate reservoir simulation workflows. Current estimates expect that relative permeabilities can be obtained significantly faster from the new, combined workflow of DRS, SCAL database and log-based data predictions, compared to running individual special core analysis programs in labs for a field. The agile managed project has entered the execute phase in April 2021. It is planned for 3–5 years, delivering minimal viable products (MVPs) in yearly super-sprints, with increasing scope of complexity. The project scope covers clastic and carbonate reservoirs with varying multi-phase flow properties. Gas and oil-bearing reservoirs are included, with rock wettability ranging from water-wet to oil-wet. Moreover, for the mid-term scope, multi-phase flow properties for renewables / carbon capture storage are also considered. In 2021, we worked with our project partners on key wells from Norwegian and Austrian fields, and results from the MVP 2021 (water-wet reservoirs). Due to the positive outcome of the proof of concept, multiple pilot projects are currently scheduled with the business units to apply the developed upscaling concept. Results of the Pilot projects have been already reviewed, incorporated in the dynamic modelling, together with the field reservoir engineers, and will be shared herein. Further technical development in all the work streams is ongoing. In DRS, the latest developments on dynamic pore morphological simulations will be evaluated for mixed-wet reservoirs. In parallel, advances in digital geochemistry modelling and applications for low carbon business will be evaluated. In the SCAL stream, the rock-fluid database is continuously growing, and new experimental data is constantly being uploaded into the database. Therefore, the modelling of fluid flow properties and their uncertainties will be continuously improved. Besides ongoing updates in the DRS and SCAL streams, the inhouse development on the probabilistic log interpretation application will be also continued. By end of 2022, developed MVPs allow to track, monitor (over time), and predict (probabilistic, data-based) multi-phase flow, to enable better decisions for field developments and optionality for more favorable business cases in conventional hydrocarbon field developments, low-carbon business, or enhanced hydrocarbon recovery.