Experimental study of the placement of fluids in natural porous media: Application to reservoir rocks

PhD student: Victor DE OLIVEIRA FERNANDES

Supervisors: Henri BERTIN[1], Jean LACHAUD[1] and Cyril CAUBIT[2]

Introduction

The Restored State Method has been largely used in laboratory studies because of its advantages regarding the possibility to achieve representative wettability and initial water saturation (Swi), two important parameters to achieve representative conditions of a petroleum reservoir. Therefore, this project aims to study the most common techniques for setting Swi by making a clear comparison between them and conceiving an improved protocol. Parameters such as phase continuities, saturation profiles dynamic, wettability and cluster formation are visualized by NMR and Micro-Tomography scanning.

Advancements

During 2021, the choice of a dead oil able to change the wettability of the rock samples and adapted to experimental conditions has been made. For this matter, Amott tests (reference method for quantitative measures of wettability) and adhesion flask tests (fast method to identify oil adhesion in crushed rock) have been conducted.

Regarding equipment development, a multi-imagery experimental cell has been conceived to perform fluid displacements under the NMR and Micro-CT visualization. This cell has been validated and comprises a major development for the project, once it enables imaging the complete experimental cycle without unloading the sample, that is kept under pore and confining stress.

In addition, a new technique for first drainage has been developed. This technique has the advantage of obtaining a uniform saturation profile at the targeted Swi in practical experimental time. This technique was successfully tested for two types of rocks (one sandstone and one carbonate) of dimensions D = 38mm/L = 50mm.

Prospective

For the current year (2022), a patent is awaiting to be published as well as a publication in an international scientific review (SCA) regarding the development of the new drainage technique. In addition, further tests will be performed to validate its use for larger samples (D = 50mm/L = 200mm), typically used for relative permeability measurements.

Additionally, the experimental protocol for comparison of first drainage techniques will be now applied to carbonates. The idea is to perform each technique and evaluate the wettability behavior through a reference method (Amott tests), as well as to develop a new NMR based method for wettability evaluation. This approach will enable a clear comparison of the techniques regarding wettability change. Comparison of fluids distribution, pore occupancy and homogeneity of the saturation profiles will be done in experiences conducted with the new experimental cell.

[1]Université de Bordeaux/TREFLE
[2]TotalEnergies – CSTJF