Modelling Of an Outcropping Heavy Oil Carbonate Field, Using Dense Well Calibration, Field Work and Lab Measurements: The Oligo-Miocene Reservoir of the Maiella Mountain - Central Apennines, Italy

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Abstract

Heavy oil and bitumen in-situ resources, which provide today a large potential supply of the world's oil resource, have been extracted along the Italian peninsula since historical time, in particular in the Abruzzo Region.

We carried out a Quantitative Reservoir Modelling on a partially outcropping and "frozen" Carbonate Oil Field, represented by the heavy oil bearing reservoir of the Majella Anticline NW flank (Central Apennines): the reservoir is made of medium-high matrix porosity ramp calcarenites of the Bolognano Formation (Oligo-Miocene in age), slightly affected by a superimposed fracture system and displaced over the area by few major NNW/SSE normal faults.

A wide range of data at different scale were used to obtain a dense 3D model of the distribution of hydrocarbons:

- Historical data associated to the bitumen extraction/production of the first half of the 20th Century (Eni Archive): an extensive geological/drilling campaign was organized and carried out in 1942, resulting in the drilling of about 200 shallow wells (depths 80-200m), regularly spaced 100x100m.
- Well data from deep exploration drilling (from the 60s/70s).
- Reservoir Quantitative petrophysical characterization, through original field geological work, thin section analysis and laboratory measurements: about 20 sample were selected in the field to cover the observed facies vertical and lateral variability and calibration plugs were prepared on which density, porosity, permeability, and P/S wave velocities at increasing confining pressure were measured.

All data were then combined in a modelling exercise (using Petreltm), in which the full integrated 3D picture of the oil field were reconstructed in the subsurface and along the topographic surface, including a simplified fault model.

Results will be discussed on the peculiar distribution of hydrocarbons within the reservoir that we observed, both laterally and vertically, not in simple direct correlation with e.g. porosity trend: this appear to record a multiphased hydrocarbon migration/emplacement and trapping mechanism. The results obtained allowed moreover to better understand the main factors controlling hydrocarbon distribution vs reservoir quality, trap geometry, burial/exhumation history, migration mechanism, and the fault/fracture system. Finally, this unique high density set of

data can provide an analogue for other similar heavy oil carbonate fields and a calibration for other discoveries in the region, both on/off shore, and also in the Adriatic area.