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Geological and numerical modeling of the Santa Maria Mare hydrocarbon field in central Adriatic Sea (Italy)

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The study describes the results of a geological and numerical modelling of Santa Maria Mare (SMM) hydrocarbon field discovered in 1974 in central Adriatic offshore (Italy). The geological domain of the SMM reservoir refers to the Umbro-Marchigiana Series and hydrocarbon mineralization is inside the Scaglia Formation that is characterized by oil units (called R1, R2, R3, R4) consisting of permeable and porous calcarenites, alternated with non-oil units (called IR1, IR2, IR3, IR4) consisting of impermeable micrites.
The meticulous analysis of all the available data led to realize a detailed 3D static geological and fluid-dynamic models of the reservoir in order to study the over thirty years old of the field exploitation. The hydrocarbon production began in 1975 and until 2015 about 3045 km3 of oil and 218 kSm3 of gas were extracted. The numerical modeling has also considered the injection of formation waters produced during the SMM field exploitation and the ones coming from other close hydrocarbon reservoirs; a total amount of 4390 km3 of formation waters were re-injected between 1975-2015 and 3090 km3 belong to SMM reservoir.
The results obtained by the fluid-dynamic modelling were more than satisfactory with a very low differences between the simulated values of pressure and the ones measured during the exploitation of the field.
A particular analysis has been made for 1987 to investigate if there is a relationship between the water injection peak (March 1987) and the following earthquakes (September 1987) with maximum local magnitude of 5.0, hypocentral depths greater than 14 km and epicentral area located about 5-6 km from SMM field. The analysis have shown that the alterations of the stress field linked to the re-injection process were generally modest and the overpressures are limited to the volume close to the four injection wells and significantly decrease in few hundreds of meters. In fact, for the main injection well SEM 1D, in the area around the structure, an overpressure of about 14 bar was detected but rapidly decreases till less than 1.5 bar in less than 300 meters. At the edges of the computational domain, which is distant from 1 to 5 km respect to the re-injection wells, there are no alterations of natural pressure field. As a consequence it is highly unlikely that the re-injection of formation waters could have influenced the seismicity.