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Cekungan Jawa Timur Utara merupakan salah satu cekungan di Indonesia yang telah menghasilkan cadangan minyak dan gas bumi yang besar. Salah satu bagian cekungan tersebut adalah *North Madura Offshore* (NMO) yang memiliki banyak pengalaman kegagalan pemboran. Tujuan pelaksanaan penelitian ini adalah menentukan fasies dan lingkungan pengendapan reservoir batuan karbonat pada daerah telitian, mengetahui proses diagenesis karbonat pada daerah penelitian dan hubungannya dengan perubahan nilai porositas reservoir, menentukan properti reservoir batuan karbonat berdasarkan petrofisik. Lokasi penelitian berada sekitar 30 km arah utara Pulau Madura, daerah lepas pantai memanjang dari barat laut ke tenggara bagian utara Pulau Madura. Data yang digunakan dalam penelitian ini terdiri dari 4 sumur eksplorasi (log elektrik, *cuttings*), 120 data petrografi, beberapa data SEM dan data pendukung lainnya. Berdasarkan penelitian diketahui bahwa fasies karbonat Formasi Kujung terdiri dari enam kelompok yaitu *Larger Foram- Planktic foram Bioclastic Wackestone* (FL1), *Red Alga- Algae bioclastic mudstone/ wackestone/ packstone* (FL2), *Larger foraminifera bioclastic wackestone-packstone* (FL3), *Coral - Coralline Algae bioclastic mudstone/ wackestone/ packstone* (FL4), *Planktic foraminifera bioclastic mudstone wackestone* (FL5), *Bioclastic Wackestone Packstone with small bentic foram bioclastic* (FL6), diendapkan pada lingkungan *Back Reef-Shoal, Shelf lagoon / Shoal, Reef/ Initial Bank, Reef Front*, dan *Edge platform*. Proses diagenesis yang terjadi pada Formasi Kujung lapangan MSM antara lain sementasi, mikritisasi, neomorfisme, disolusi, dolomitisasi dan *fracturing*, serta terjadi pada zona *Freshwater phreatic*, zona *Marine phreatic*, dan zona *Mixing*. Hasil perhitungan petrofisika di daerah penelitian memiliki nilai properti reservoir batuan karbonat antara lain nilai volume *shale* rata-rata 8,2%, 5-32%, porositas total rata-rata 26,8%-31,4%, porositas efektif rata-rata 5,2%-11,9%, faktor tortuosity (eksponen a) 0,971, faktor sementasi (eksponen m) dibagi pada kelompok tipe porositas *vug* antara 1,46-3,8, kelompok tipe porositas *vug-fract* antara 1,12-3,65, saturasi air metode Archie sebesar 92%-94%, metode Indonesia sebesar 84%-87%, metode Simandoux sebesar 80%-85%. Perhitungan saturasi yang terbaik adalah menggunakan metode Simandoux dilihat dari kondisi batuan dan fluidanya dengan salinitas tinggi. Penentuan metode perhitungan saturasi air yang terbaik membutuhkan validasi dari analisa saturasi laboratorium. Proses diagenesa terjadi setelah sekuen pengendapan batuan karbonat dan memiliki hubungan dengan perkembangan nilai porositas yaitu sedikit menambah dan banyak mengurangi nilai porositas dalam satu tubuh reservoir.

Kata Kunci: Cekungan Jawa Timur Utara, Formasi Kujung, reservoir batuan karbonat, petrografi, mikrofases, diagenesis, porositas, petrofisik.

ABSTRACT

The North East Java Basin is one of the basins in Indonesia that has produced large oil and gas reserves. One part of the basin is North Madura Offshore (NMO) which has many experience of drilling failure. The objective of this research is to determine the facies and the deposition environment of carbonate reservoir, to know the process of carbonate diagenesis in the research area and its relation with the change of the reservoir porosity value, and determining the reservoir property of the carbonate rock based on petrophysics. The research location is about 30 km north of Madura Island, offshore area from the northwest to the southeast. The research data consist of 4 exploration wells (electric logs, cuttings), 120 petrographic data, some SEM data and other supporting data. Based on this research it is known that Kujung Formation carbonate facies consist of six groups, that are Larger Foram- Planktic foram Bioclastic Wackestone (FL1), Red Alga- Algae bioclastic mudstone/ wackestone/ packstone (FL2), Larger foraminifera bioclastic wackestone-packstone (FL3), Coral - Coralline Algae bioclastic mudstone/ wackestone/ packstone (FL4), Planktic foraminifera bioclastic mudstone wackestone (FL5), Bioclastic Wackestone Packstone with small bentic foram bioclastic (FL6), deposition environment are Back Reef- Shoal, Shelf lagoon / Shoal, Reef/ Initial Bank, Reef Front, dan Edge platform. Diagenesis process that have happened in MSM Field Kujung Formation are cementation, micritization, neomorphism, dissolution, dolomitization and fracturing, and those process occurs in Freshwater phreatic zone, Marine phreatic zone, and Mixing zone. The results of the petrophysical calculations in the study area has value of carbonate reservoir properties including average shale volumes 8.2%-32%, average total porosity of 26.8% - 31.4%, average effective porosity of 5.2% -11.9%, the tortousity factor (exponent a) is 0.971, the cementation factor (exponent m) is divided in the vug porosity type group between 1.46-3.8, the vug-fract porosity type group between 1.12-3.65, Archie's water saturation of 92% -94%, the Indonesian method of 84% -87%, Simandoux method of 80% -85%. The best saturation calculation is to use the Simandoux method in terms of rock and fluid condition with high salinity. Determination of the best water saturation calculation method requires validation of laboratory saturation analysis. Diagenesis process occurs after the depositional sequence of carbonate rock and has a relationship to the development of porosity value, which is a little increase and more reduce the porosity value in one body reservoir.

Keyword: North East Java Basin, Kujung Formation, Carbonate Reservoir, Petrography, Microfacies, Diagenesis, Porosity, Petrophysic.