

PS Diagenetic History and its Effect on Reservoir Quality and Reservoir Characterization of Sandstone Sequences of Matulla Formation, October Field, Gulf of Suez, Egypt*

Ahmed Kassem¹

Search and Discovery Article #20452 (2019)**

Posted February 11, 2019

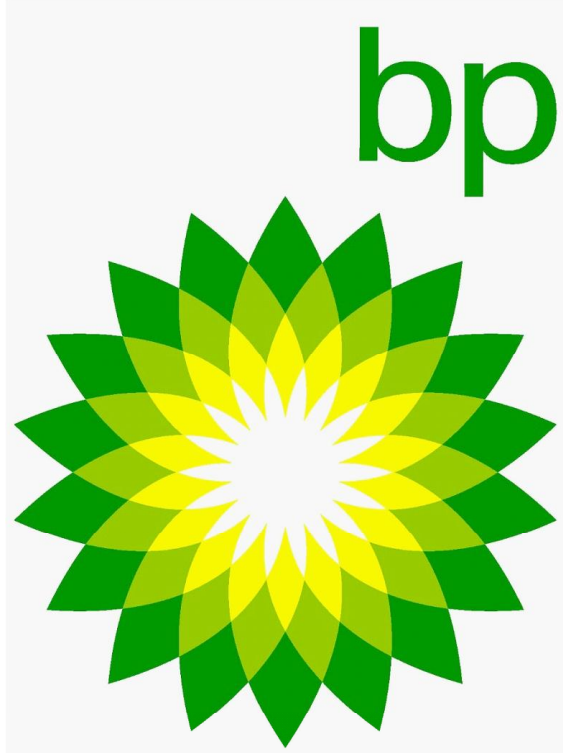
*Adapted from poster presentation given at 2018 International Conference and Exhibition, Cape Town, South Africa, November 4-7, 2018

**Datapages © 2018. Serial rights given by author. For all other rights contact author directly. DOI:10.1306/20452Kassem2019

¹GUPCO, Cairo, Egypt (kassemaa@gupco.net)

Abstract

The study of diagenesis in petroleum industry are very important and critical point for reservoir evaluation where diagenesis parameters enhance or reduce reservoir porosity and permeability which are the main factors that control the productivity of hydrocarbon from carbonate or sandstone reservoirs. In Matulla formation of October field, the sandstone represents the only reservoir where carbonates have no opportunity to produce hydrocarbon in because of charge problem and the reservoir character represent very low porosity and permeability. Porosity can be restored and enhanced at depth. The study revealed that the Matulla Formation is composed of wave and tide influenced mixed siliciclastic carbonate rocks interbedded with some oolitic ironstone beds. Primary facies and diagenetic modification both play key roles in the reservoir potential of the Matulla Formation. This study revealed that the major porosity exist in the sandstone is secondary porosity interpreted from the detailed texture petrographic study with building diagenetic historical model with depth. The distribution of this secondary porosity along the field in association with the sandstone facies maps give an overview for the accumulation of these secondary porosities which related to diagenetic events that took place with time and depth. This sandstone / diagenesis maps used as a key in the development plan of Matulla sandstone sequence in October field which provided to the reservoir engineering team to point them out for the places to get optimum recovery from the stimulation jobs. The petrology study of the rock textures also solved many problems that faced the development team during the enhanced oil recovery project where highlighted of how preventing the formation damage that may occur by using incompatible fluid/ rock solutions. The main conclusion of this study that the reservoir quality of sandstone sequence of Matulla Formation not depend on the primary intergranular porosity as was believed in the old studies but the main contributor to the hydrocarbon is the secondary porosity which show great influence on the permeability, fluid flow and rock typing distribution along the field and revealed the solution of many problems for petrophysical parameters distribution in reservoir property modeling and also led to reevaluation for the facies models that build in the days before.



Diagenetic History and its Effect on Reservoir Quality and Reservoir Characterization of Sandstone Sequences of Matulla Formation, October Field, Gulf of Suez, Egypt



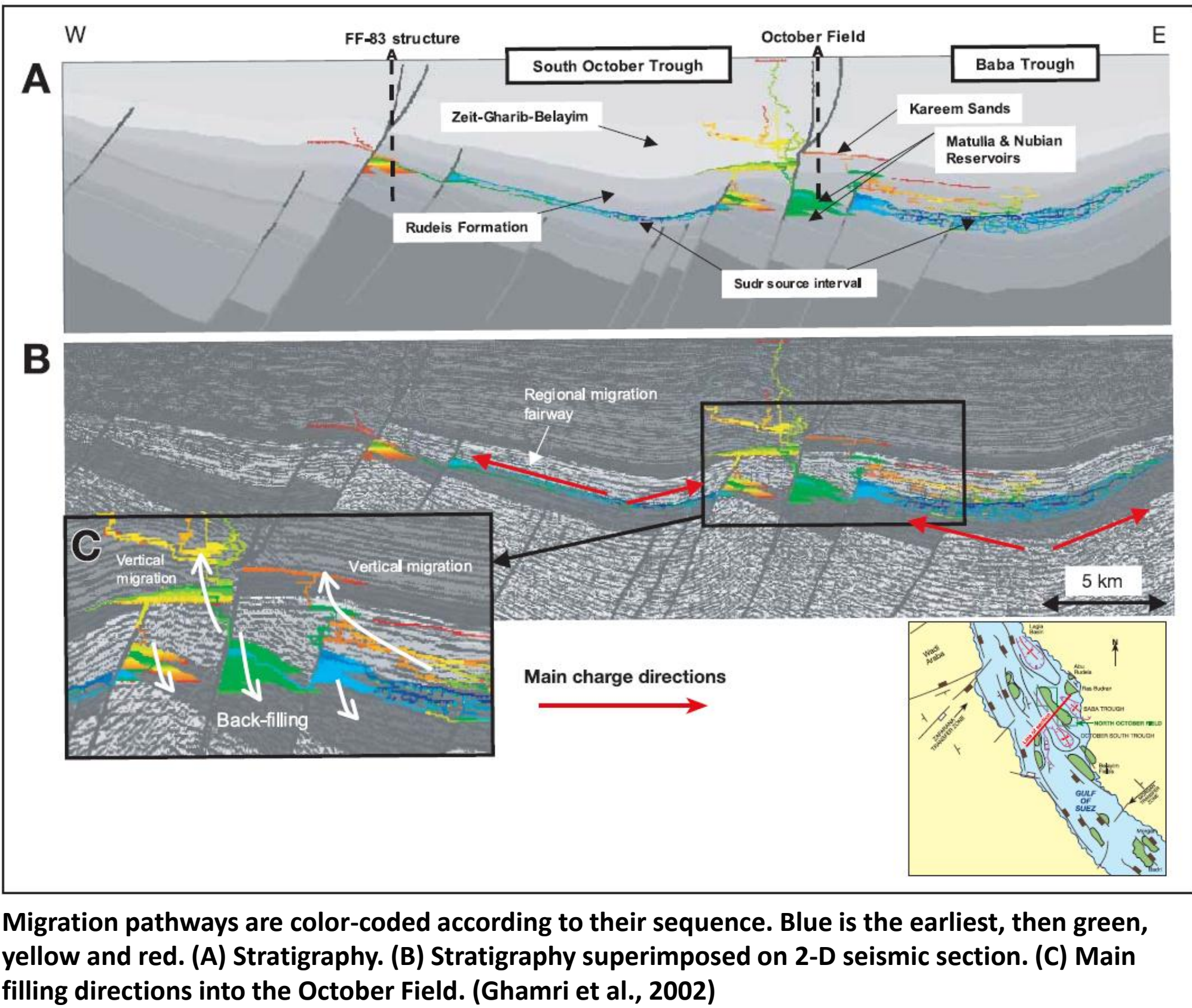
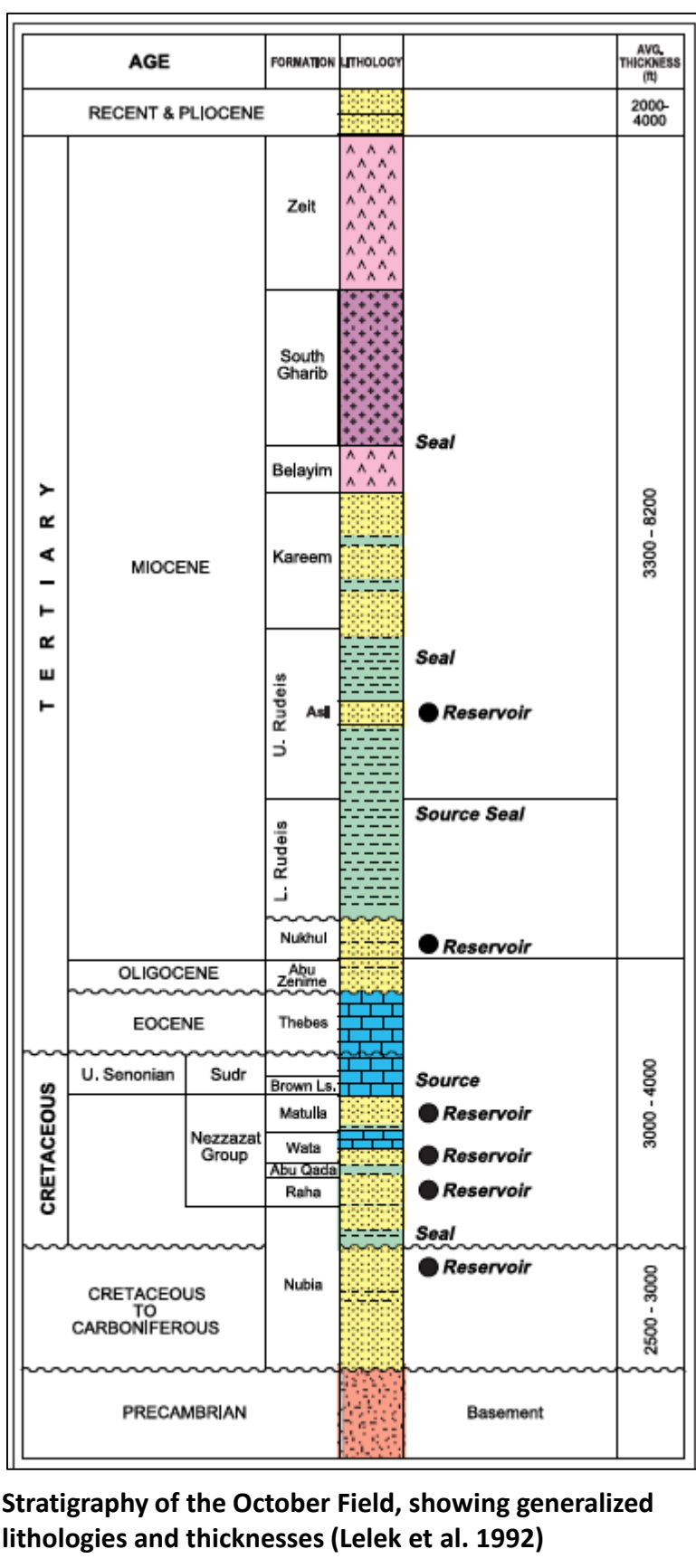
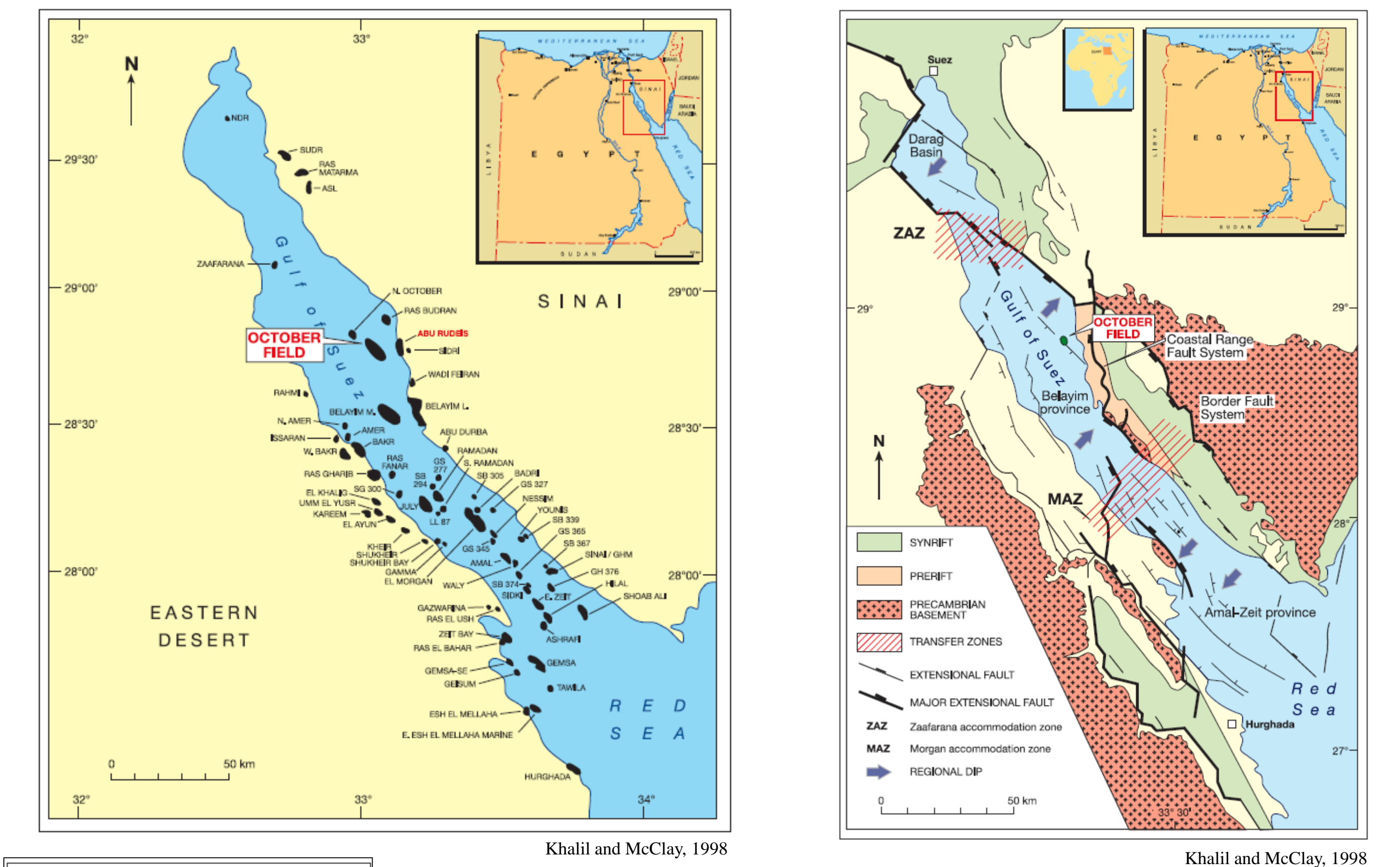
Ahmed Kassem

Aim of the study

This study is aiming to address the main parameters controlling: the heterogeneity of siliciclastic Matulla Formation, reservoir quality, reservoir characterization, petrographic rock typing and the reservoir management studies.

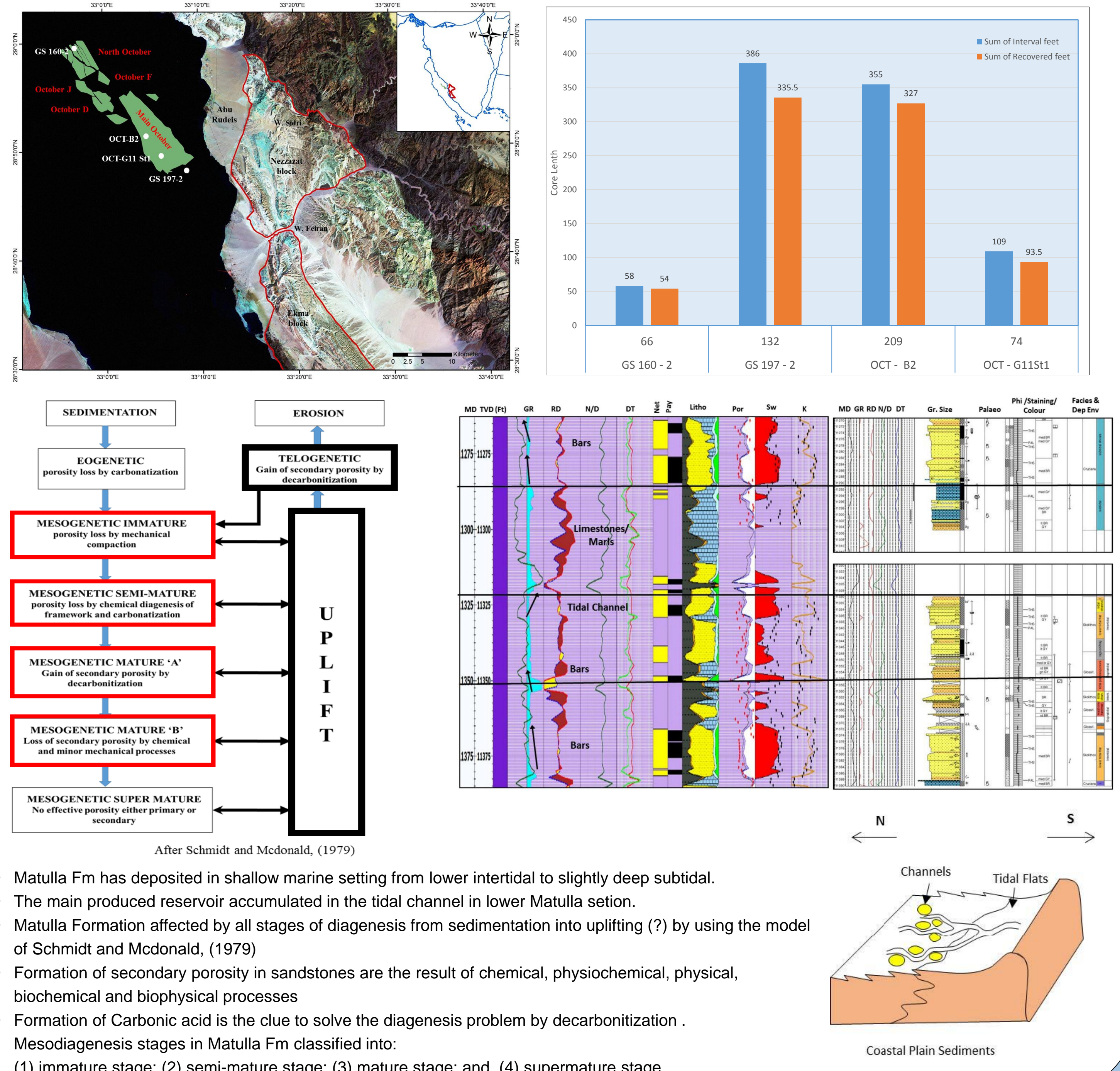
1. GOS & October field Evolution

Egypt is a mature oil and gas producer having a rich history in hydrocarbon exploration and production for a long time. Gulf of Suez basin is located in the eastern side of Egypt to separate Sinai Peninsula from Eastern Desert. October field It was discovered and began producing in 1977. It has a total STOIIP of ~2.3 BBO and ultimate recoverable reserves of 1163 MMBO, giving a recovery factor for the whole field of ~51%. Matulla early estimate put STOIIP at 250 MMBO, , with EUR of 37.5 MMBO. Cumulative production till now is 45 MMBO.

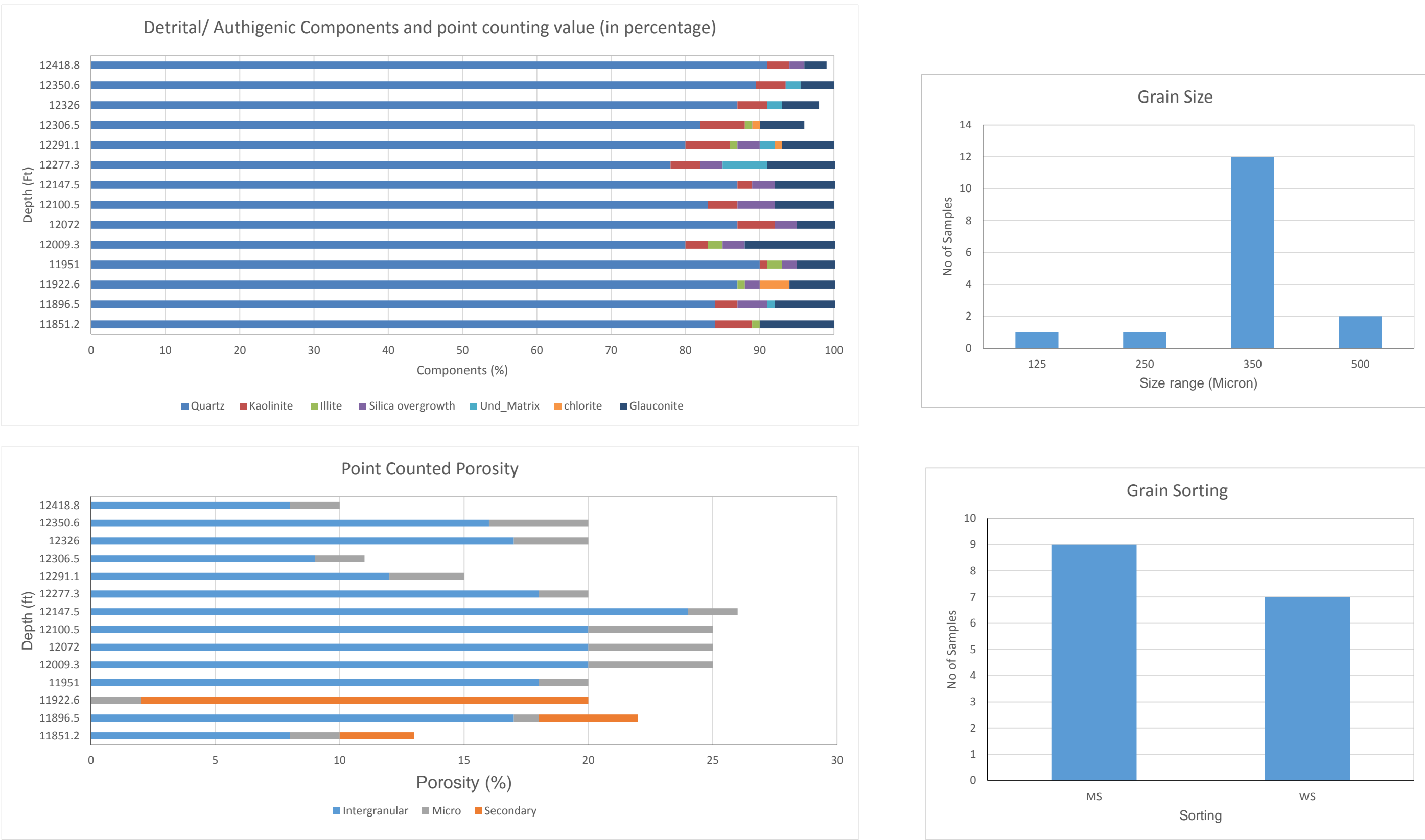


2. Work Flow

Four cored wells studied in details to define the petrological parameters controlling the reservoir quality and address the diagenesis as well as diagenetic history. point counting for about 100 thin sections with selected samples for XRD and SEM

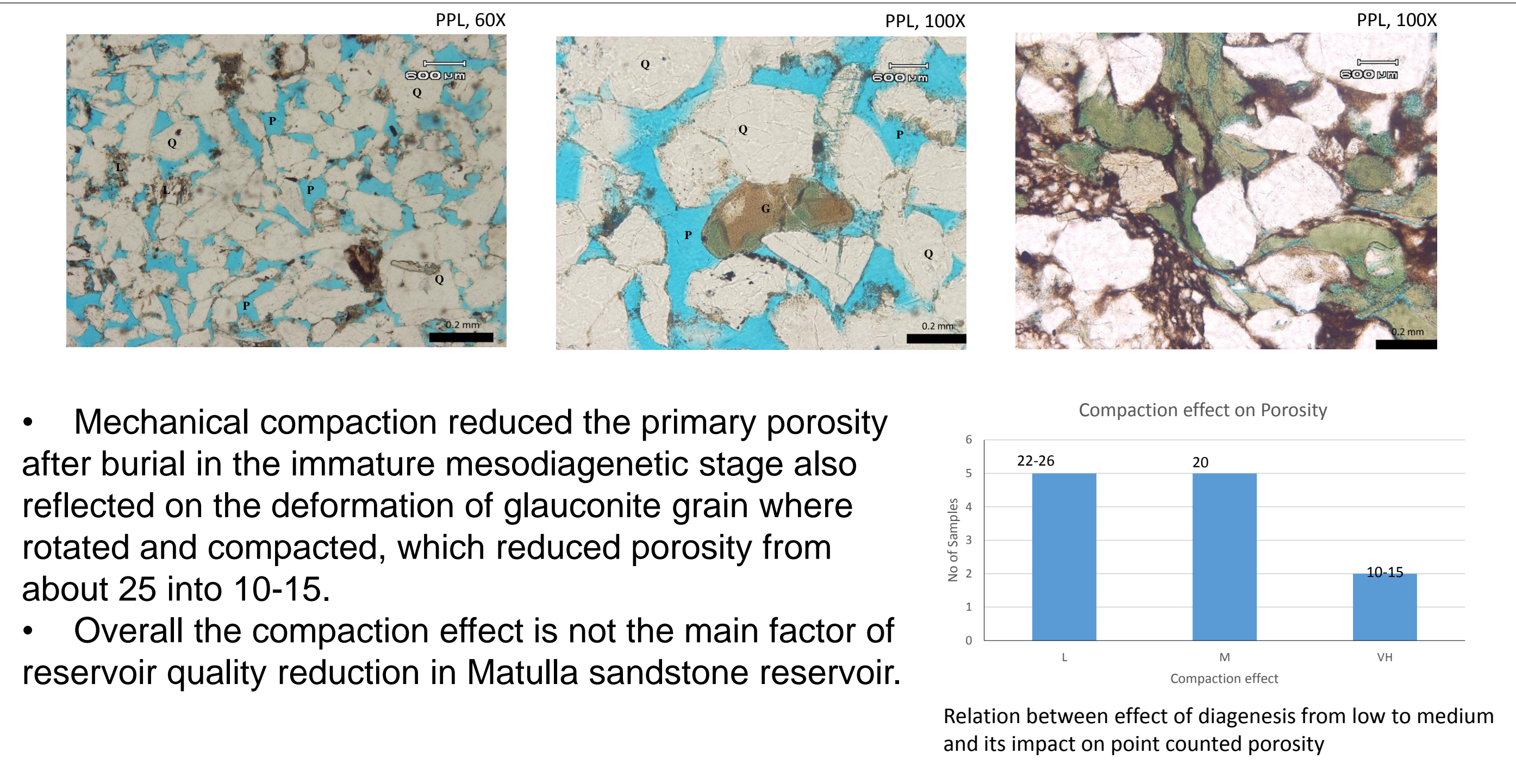


3. Petrology analysis and RQ control

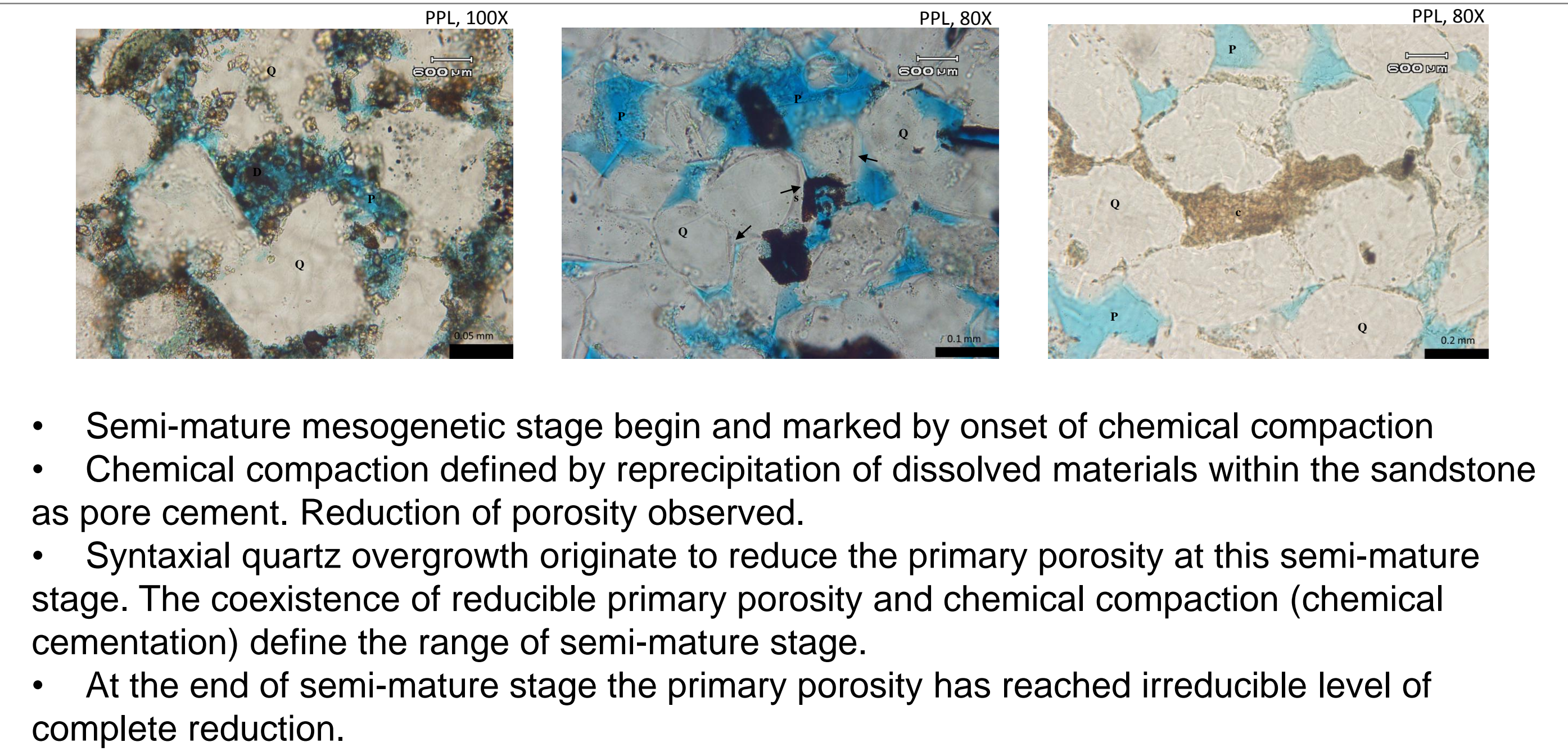


- Thin section petrography point counting and XRD interpretation.
- Uni-modal medium grained size of moderately to well sorted quartz arenite

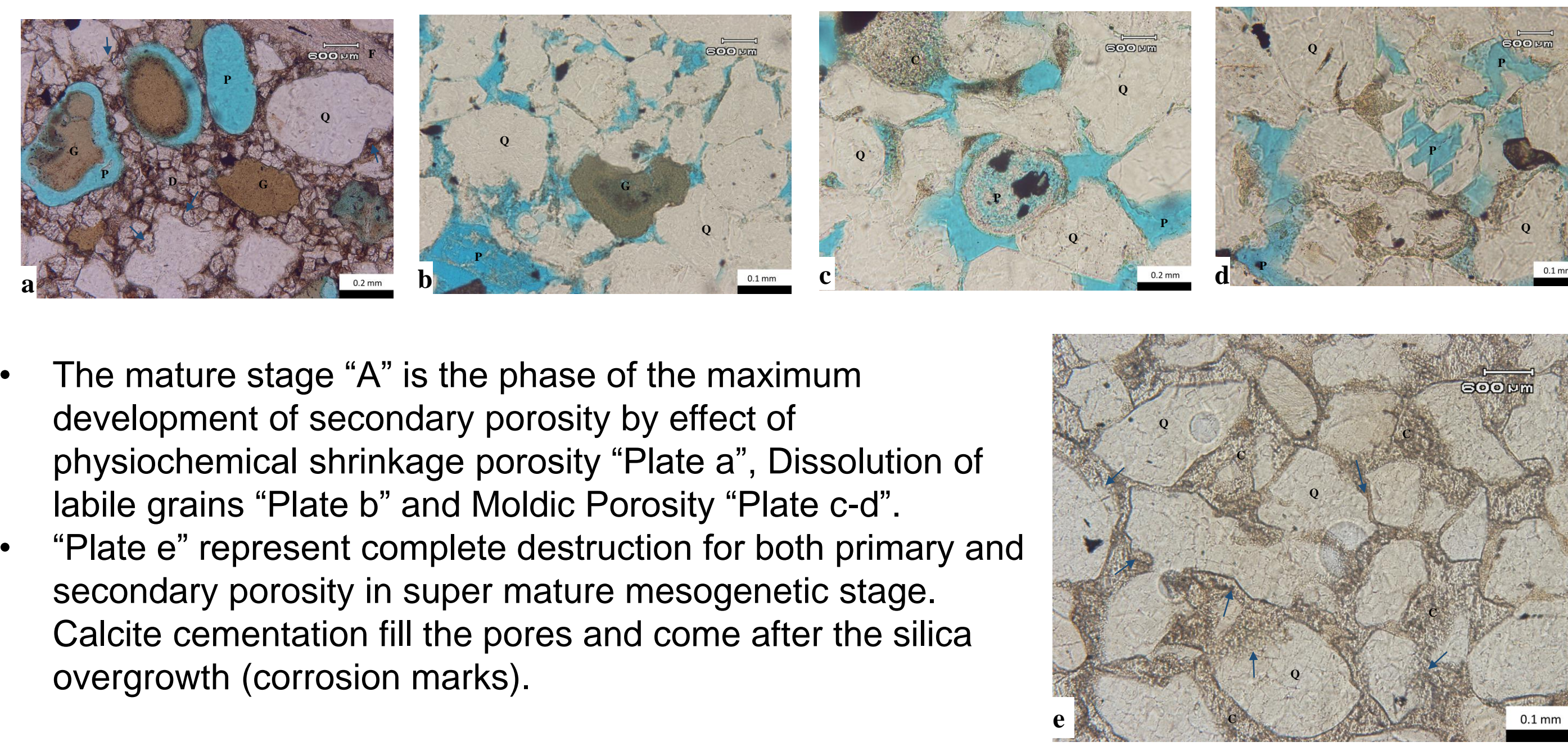
4. Diagenesis and RQ Control



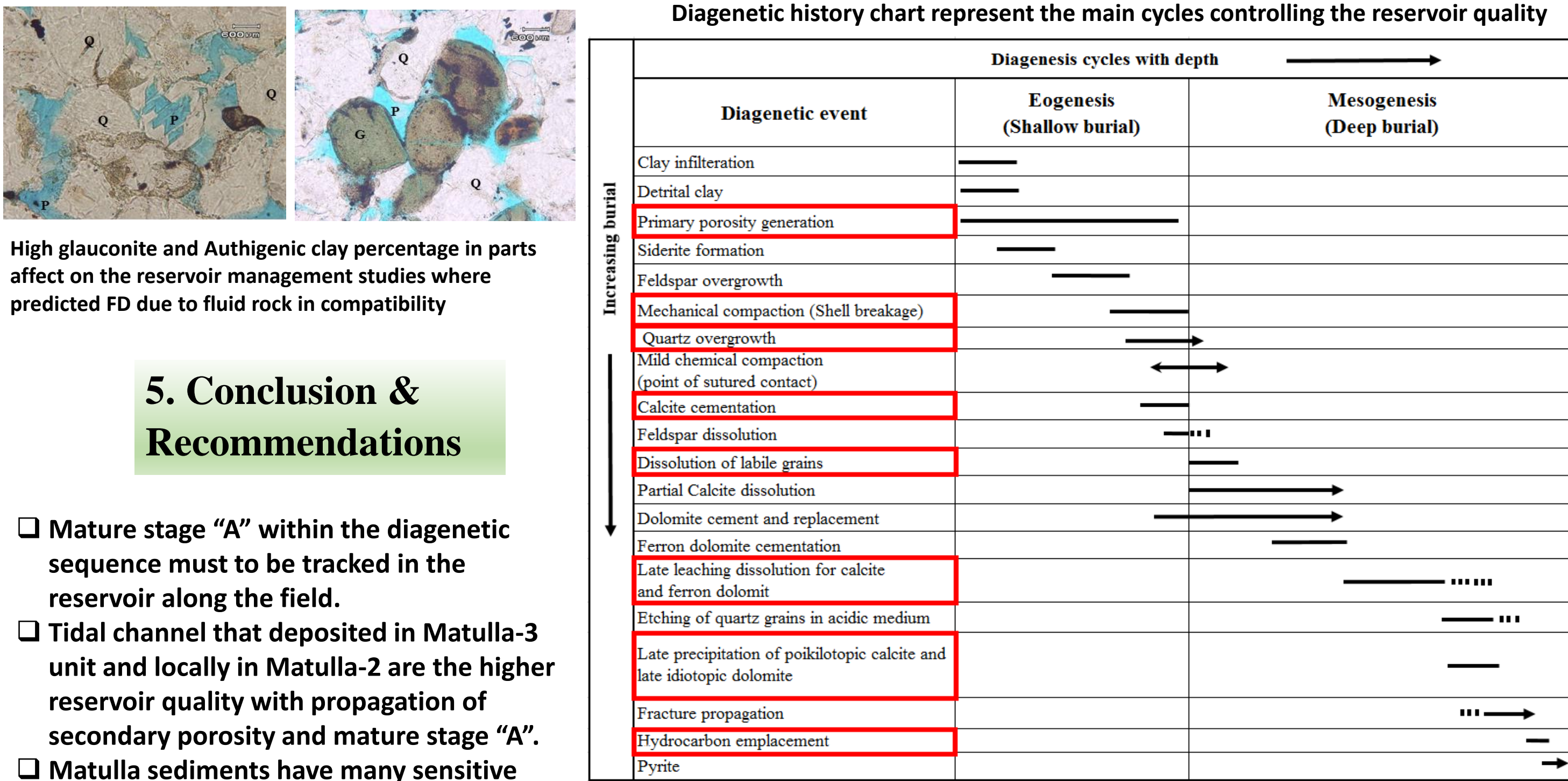
- Mechanical compaction reduced the primary porosity after burial in the immature mesodiagenetic stage also reflected on the deformation of glauconite grain where rotated and compacted, which reduced porosity from about 25 into 10-15.
- Overall the compaction effect is not the main factor of reservoir quality reduction in Matulla sandstone reservoir.



- Semi-mature mesogenetic stage begin and marked by onset of chemical compaction
- Chemical compaction defined by reprecipitation of dissolved materials within the sandstone as pore cement. Reduction of porosity observed.
- Syntaxial quartz overgrowth originate to reduce the primary porosity at this semi-mature stage. The coexistence of reducible primary porosity and chemical compaction (chemical cementation) define the range of semi-mature stage.
- At the end of semi-mature stage the primary porosity has reached irreducible level of complete reduction.



- The mature stage “A” is the phase of the maximum development of secondary porosity by effect of physiochemical shrinkage porosity “Plate a”, Dissolution of labile grains “Plate b” and Moldic Porosity “Plate c-d”.
- “Plate e” represent complete destruction for both primary and secondary porosity in super mature mesogenetic stage. Calcite cementation fill the pores and come after the silica overgrowth (corrosion marks).



5. Conclusion & Recommendations

- Mature stage “A” within the diagenetic sequence must to be tracked in the reservoir along the field.
- Tidal channel that deposited in Matulla-3 unit and locally in Matulla-2 are the higher reservoir quality with propagation of secondary porosity and mature stage “A”.
- Matulla sediments have many sensitive criteria related to rock properties such as:
 - Iron bearing mineral of glauconite and chlorite which make FD with acid stimulation jobs.
 - Authigenic clay minerals and its impact on formation evaluation and reservoir characterization.
 - Clay mineralogy and types which make FD by reduce the permeability and porosity due to fluid injected incompatibility.
 - Petrology and diagenesis study is critical for evaluation the heterogeneous reservoir which have deposited within intertidal to slightly deep subtidal setting.