Microfacies, diagenesis and reservoir characterization of Sakesar Limestone Salt Range, Pakistan

Sajjad Ahmed[1]; Asad Zia[2]; Muhammad Hanif[2] and Asad Kamran[2]
[1]*Department of Geology, University of Peshawar*
[2]*National Centre of Excellence in Geology, University of Peshawar*
asadkamran7704@gmail.com

Abstract

The early to middle Eocene Sakesar Limestone of the Western Salt Range has been studied in detail for carbonate microfacies, depositional modeling, diagenetic fabric and reservoir properties. These studies are important in order to determine the nature and timing of depositional and digenetic processes which control the distribution of porosity and permeability and to measure lateral and vertical heterogeneity in facies types and reservoir rock potential. Ninety two rock samples were collected at three studied sections (i.e Dhak Pass, Zaluch Nala and Chhidru Nala). A total of 3 microfacies (SLF-1 to SLF-3) have been recognized on the basis of lithology and primary sedimentary depositional features.

The identified microfacies are, larger benthic foraminifera wack-packstone microfaceis (SLF 1), Foraminiferal-algal wack-packstone microfacies (SLF 2) and Brachiopod rich bioclastic wack-packstone microfacies (SLF 3). Based on paleoecology, sedimentary structures and microfacies type the Sakesar Limestone is suggested to be deposited in inner to middle ramp and middle ramp lagoonal environment.The absence of turbidite deposits, reefal facies, gradual facies changes and widespread tidal flat deposits indicate that the Sakesar Limestone was deposited in a carbonate ramp environment. Due to the great diversity and abundance of larger benthic foraminifera, this carbonate ramp is referred to as a "foraminifera-dominated carbonate ramp system". This suggests that during the Early Cenozoic, following the demise of the end Cretaceous rudist-coral assemblage, nummulitid (Nummulites, Assilinaand Operculina), orthophragminid (Discoyclina) and alveolinid (Alveolina) larger benthic foraminifera (LBF) thrived on shallow, oligotrophic enviornment of the Tethyan carbonate platforms.

Diagenesis is mainly constrained by microfacies. Features such ass-tylolites, calcitization, neomorphism, nodularity, various cement types (Blocky, Fibrous, Granular mosaic, Bladed, Drusy mosaic and Equant isopachous), stylolization and fracturing were found in majority of the samples from study area. Interpretation of these features indicating marine to meteoric to burial environment for studied samples from the Western Salt Range.

Porosity and permeability studies were carried out in order to account for hydrocarbon potential. Our results show the range of porosity interparticle to fractures with overall porosity greater than (20%). In the middle and lower part of the Sakesar limestone, high permeability (up to 0.17 MD) and low porosity-permeability (poro-perm) is present in some parts of the Sakesar limestone. The best reservoir quality is present in the middle and lower part of the Sakesar limestone. The Sakesar limestone beds in the study area are thick enough with suitable porosity and permeability values, which could be good targets for hydrocarbon exploration in future.