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Advances in coalbed methane reservoirs using integrated reservoir characterization and hydraulic fracturing in Karaganda coal basin, Kazakhstan

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Coalbed methane from Karaganda coal basin is considered to be an unconventional source of energy for the Central and Eastern parts of Kazakhstan. These regions are situated far away from the main traditional sources of oil and gas related to Precaspian petroleum basin.

Coalbed methane fields in Karaganda coal basin are characterized by geological and structural complexity. Majority of production zones were characterized by high methane content and extremely low coal permeability. The coal reservoirs also contained a considerable natural system of primary, secondary, and tertiary fractures that were usually capable to accommodate passing fluid during hydraulic fracturing process. However, after closing was often observed coal formation damage including the loss of fluids, migration of fines and higher pressures required to treat formation than were expected. Unusual or less expected reservoir characteristics and values of properties of the coal reservoir might be the cause of the unusual occurred patterns in obtained fracturing, such as lithological peculiarities, rock mechanical properties and previous natural fracture systems in the coals. Based on these properties we found that during the drilling and fracturing of the coal-induced fractures have great sensitivity to complex reservoir lithology and stress profiles, as well as changes of those stresses. In order to have a successful program of hydraulic fracturing and avoid unnecessary fracturing anomalies we applied integrated reservoir characterization to monitor key parameters. In addition to logging data, core sample analysis was applied for coalbed methane reservoirs to observe dependence tiny lithological variations through the magnetic susceptibility values and their relation to permeability together with expected principal stress. The values of magnetic susceptibility were measured by the core logging sensor, which is equipped with the probe that provides volume magnetic susceptibility parameters. Permeability was measured by air permeameter. Results confirmed that there is a correspondence between the high permeability and the low magnetic susceptibility values of production zones. Importantly also were found relation of the coal envelope type between only shales coal framing or only sandstone coal framing that most likely led to different stress profiles.

In addition, we briefly describe potential of other types of unconventional resources in Kazakhstan, such as shale oil, tight gas and shale gas, where this integrated approach could be useful to apply in the future.