High Resolution Petroleum System Analysis: Application to Los Molles-Lajas Megasequence of Neuquén Basin, Argentina

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High resolution petroleum system analysis is an analytical method whereby a conventional petroleum system is subdivided according to different organic source rock facies. In essence, each organic facies will have a unique oil window as defined by kerogen kinetics analysis and burial history. This study applies the principle to the Neuquén Basin, which is located in west-central Argentina. The Middle Jurassic Los Molles-Lajas (Cuyo) Megasequence is a frontier exploration target that has been proposed in the literature to be a speculative petroleum system.

This research documents that the Cuyo Megasequence actually contains two petroleum systems: one source rock facies is dominated by marine organic matter (associated with turbidite sequences) and the other by nonmarine organic matter (marsh environments). The Huincul Dorsal defines the hinge line that separate the two petroleum systems. Kinetic analyses of the different source rock facies indicate as much as 20°C variation in peak generation temperatures; this invokes significant differences in the generation/expulsion parameters. The reservoir/migration conduits are also different: the marine system is composed of prodelta/turbidite sequences, in contrast to fluvial systems that dominate the nonmarine sequences. Traps in both systems are combined stratigraphic and structural, with the latter enhanced by the Oxfordian-Kimmeridgian transpressional deformation. Despite quite different geologic histories and kerogen kinetic values, the critical moment for each petroleum system coincides with the Late Cretaceous. Thus, this paper introduces the concept of high resolution petroleum system analysis and demonstrates the application to the Los Molles (marine)-Lajas (!) and Los Molles (nonmarine)-Lajas (.) Petroleum Systems.