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 kinetic analysis and burial history. This presentation applies the principle to the Kimmeridgian-Valanginian Megasequence within the Neuquén Basin, which is located in west-central Argentina.

The source rock within the Kimmeridgian-Valanginian Megasequence is known as the Vaca Muerta Formation. An integrated study of organic geochemistry and sequence stratigraphy defined the source rock to contain three organic facies within condensed sections that correspond to deposition in distal, open shelfal, and restricted shelfal settings. Kinetic analysis of different organic facies indicate nearly 20°C variation in peak generation temperatures; this invokes significant differences in the generation/expulsion parameters. In the case of the Picún Leufú sub-basin, the difference in the kinetic behavior accounts for a significant hydrocarbon charge from a source rock that previous studies demonstrated to be thermally immature. Indeed, knowledge of the vertical distribution of organic facies in the distal vs. shelfal setting (respective examples cited) provide insight to problems associated with expulsion efficiency (30% vs. 70%), expulsion orientation (downward vs. both directions with equal frequency), migration pathways (distal detached fans vs. stacked incised valleys and platform carbonates), and dominant hydrocarbon charge (gas vs. oil). Thus, this paper introduces the concept of high resolution petroleum system analysis and demonstrates its application to increase exploration success.