Relationships Between Depositional Processes, Geochemical Signature and Seismic Geometries in the Vaca Muerta Formation, Neuquén Basin, Argentina

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Abstract

The Upper Jurassic-Lower Cretaceous Vaca Muerta Formation (VMF) in the Neuquén Basin (Argentina) has recently emerged as the main shale oil/gas producer outside USA. The VMF is an extensive world-class hydrocarbon source rock with a prospective area in the order of 30.000 km^2. The unit is part of a mixed clastic-carbonate succession deposited in a distally-steepened ramp, characterized by the development of northwest prograding clinoforms. In order to investigate possible relationships between depositional processes, geochemical signature, and geometries, which ultimately impact reservoir production, an integrated study involving inorganic geochemistry, core characterization, and seismic interpretation was conducted along a dip-oriented transect (ca. 25 km) in the center of the Neuquén Basin. The basinal facies are primarily composed of laminated mudstones with the highest content of redox-sensitive elements (V, Mo, Cr, Co, Ni, Zn) depicting sub-horizontal parallel reflections. Toe-of-slope facies comprises mainly laminated and bioturbated mudstones showing a decrease in the amount of redox-sensitive elements coupled with an increment in elements indicative of siliciclastic sedimentation (Si, Al,K, Zr, Ti) and availability of nutrients (Ba, P). Finally, upper slope and roll-over facies involve bioturbated mudstones and mudstones with benthonic foraminifera and are characterized by a relative decrease in elements indicative of siliciclastic sedimentation along with an increase in elements with carbonate affinity (Ca, Sc, P). These results suggest a genetic relationship between inorganic geochemical signature and depositional processes along the clinoform, thus providing and additional proxy to evaluate shale reservoirs particularly in the absence of core and/or 3D seismic data.

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