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Deep-Water Folds Offshore Morocco – An Exception to the General Perception of the Non-Prospectivity of Oceanic Crust

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ABSTRACT

One of the last frontiers for hydrocarbon exploration today are ultra-deep water margins of the oceanic domain. The potential for discoveries in sediments overlaying hyper-extended continental to oceanic crust is perceived to be very limited. This is due to high uncertainty regarding reservoir and source rock deposition, and in particular to low heat flows which are insufficient for oil generation. In addition, safe drilling in ultra-deep water conditions is very expensive, therefore large traps are required for discoveries to be economic. However, large structural traps are not common in those oceanic domains, which generally are tectonically quiet. A series of prominent deep-water folds with very large apparent structural closures are observed in the ultra-deep water Atlantic margin of Morocco, which is assumed to be floored by oceanic crust. These features result from a post-oceanization tectonic overprint during Late Cretaceous to Early Cenozoic times, with the starting continental collision and the beginning influence of the Canary Islands hotspot. Regular widespread turbidite sequences within the Lower Cretaceous, interbedded with marine shales, are proven by a nearby well and outcrops. The charge of those traps remains the most uncertain part of the exploration puzzle. In the presented work, a case has been made for the deposition of possible source rocks during Toarcian times, by transgression on to shallow half grabens floored by oceanic crust. Basin and petroleum systems modeling indicates sufficiently high present day temperature for moderate oil generation. Basement faults, which have been reactivated during the folding, link the possible kitchen to the newly created traps. Those faults might have allowed for focused oil migration into the traps. In addition to that base case, several critical thermal scenarios related to the distance to the ridge and the Canary Islands hotspot have been investigated. In particular the hotspot heating might have tremendously enhanced the oil generation, with possible cracking into gas. A widespread but slow-moving hydrocarbon migration has been modeled. This additional non-focused charge style might have the potential for super-charging of the deep-water folds. The key risk for the trap fill is then assumed to be a function of seal capacity of the top seals and the faults.