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Significance of the Paleozoic for the Hydrocarbon Potential of the High Plateaux, Eastern Meseta, Morocco.

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ABSTRACT

The Tendrara and Anoual exploration permits covering 23,500 sqkm are located in the Hauts Plateaux of Eastern Morocco, a Mesozoic basin underlain by a thick Paleozoic succession beneath the regionally extensive Hercynian Unconformity. Structurally the Hauts Plateaux represent a relatively moderately deformed terrane of the Saharan Hercynian platform, and an extension of the Saharan Triassic province between the High Atlas Mountains to the south and Middle Atlas Mountains and the Hercynian chain to the north and west. This terrane offers the potential for these prolific Mesozoic and Paleozoic petroleum systems to have survived the effects of the Alpine Orogeny which has impacted onshore regions of Morocco elsewhere. The petroleum system of the Hauts Plateaux is supported by three fundamentally favourable elements: the presence of mature Paleozioc source rocks, a regionally extensive (at least 500m thick) Triassic halite providing an extremely effective seal and the underlying gas charged Mesozoic clastic reservoirs of the transgressive ephemeral fluvial and alluvial deposits the Trias Argilo-Greseux Inferieur Formation (TAGI). The permits host two gas discoveries reservoired in the TAGI at Sidi Ahmed Balkacem (SBK-1) and Tendrara (TE-5). Paleozoic source rocks are known to be present in the Silurian and Devonian successions of Morocco and regionally across the Saharan Hercynian platform. Organic rich shales of Silurian (Rhuddanian) age are present in the Tadla Basin (BJ-105, KAT-1 and KAT-2) and exposed at the surface across the Anti Atlas at Wadi Taimrerh Out. Devonian (Frasnian and Fammenian) aged organic rich shales are regionally significant sources and are also exposed in the Anti Atlas of Morocco at Erfoud and Alnif along with Lower Carboniferous (Touraisien) shales. The presence of these Paleozoic source rocks in the Hauts Plateaux is speculated, however Upper Carboniferous (Westphalian and Namurian) aged organic rich shales and coals have been penetrated by OSD-1 and TE-8 on the Hauts Plateux and are exposed northwards towards Jerada. Basin modelling across the Hauts Plateaux suggests all the source rocks entered the oil window before the Hercynian Orogeny (except the Upper Carboniferous). The Devonian progressively entered the gas window during the Cenozoic. The Lower Carboniferous remained in the oil window during the whole Mesozoic with the Upper Carboniferous just entering the oil window at present. Even assuming the hydrocarbons generated by these Paleozoic source rocks before and during the Hercynian Orogeny are entirely lost, the modelling suggests that the total hydrocarbon mass generated at basin scale results in significant hydrocarbon exploration potential. Reservoirs of the TAGI Formation and the deeper Paleozic sequences are the primary target for future exploration with the proximity of the Gas Maghreb-Europe (GME) pipeline offering a viable commercialization opportunity.