Loss of Paleo-Methane in Central Africa Rift System: A Basin Modelling and Mass Balance Approach

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Abstract

The Central African Rift System (CARS) contains several basins with shared geological elements. The shared elements include tectonic regimes and histories, as well as styles of basin fill. A key question is to what extent these shared elements generated and seeped methane across the rift system. This study addressed the question by modelling petroleum system elements and processes across selected CARS basins and used a mass balance approach to quantify the lost methane from the petroleum system. The models suggest that significant methane loss took place in the Lower Cretaceous (rate >250 tonnes/year), Upper Cretaceous (rate >800 tonnes/year) and Paleocene-Eocene (rate > 1500 tonnes/year). The seepage in the Lower Cretaceous was caused by methane-generation occurring prior to the deposition of the regional sealing-formations. The mode of methane loss in the Lower Cretaceous is similar to today's seepage for the Appalachian basin where high volumes of methane seeped from the source rock without being trapped. The Upper Cretaceous losses occurred during the deposition of the regional seals, and high volumes of gas left the petroleum system. Paleogene traps could have been breached by reactivation of pre-existing faults and fractures as a result of rifting. The order of magnitude of seepage rate for ancient methane leaving the individual CARS-basins of between 101 to 103 tonnes/year is quantitatively significant, and comparable to methane seepages reported in Berbesi et al. (2014). These rates of seepages could imply that micro-seepage alone would not have been capable of releasing the methane and that at least some seepages would have been catastrophic in CARS.