From Segmented Normal Faults to Strike-Slip Fault — How Reactivation Produces a Dual Transpressive-Transtensive System

Ramadan Ghalayini
Agenor Energy

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Reactivation of normal faults, or inversion, is a common process in sedimentary basins, occurring as a result of a change in the regional stress fields. Fault reactivation includes, theoretically, either a renewed activity of the fault under the same faulting regime or a transition into a new one, i.e. a fault can be normal and then is reactivated under a reverse or a strike-slip regime. Fault inversion, or the reactivation under a reverse regime, has been extensively studied with little attention given to strike-slip reactivation of normal faults, although both can have a great impact on the creation, preservation or destruction of hydrocarbon traps, in addition to fluid flow from source to reservoir. A complex dextral strike-slip system has been identified in the Levant Basin offshore Lebanon. The faults, transpressive in nature, exhibit large pop-up structures clearly visible at the base Messinian horizon and narrowing down in the deeper units. The faults appear positive flower structures in their upper part rooting into a single deeper fault that is suspected to extend to the basement. Structural restoration was performed and confirms that the strike-slip faults initially consisted of normal faults and were active during the Permo-Jurassic rifting event that impacted the Levant margin. The current fault zone, initially extensional, exhibits a series of relay zones between right-stepping segments, with the steps between the individual faults showing pull-apart geometries due to dextral strike-slip movement. Transfer faults and lateral ramps are observed at the edge of the old extensional relay zone indicating that the latter has been reactivated and widened. New pull-apart basins were also identified between two master parallel dextral strike-slip faults. Although the two master faults are

transpressional, the pull-apart basin in the middle shows extensional geometries, typical of transtensional systems, as the bounding faults are moving in opposite directions. This feature is rarely documented in transpressional systems and is observed in this area because the current fault zone was reactivated and the old geometries were preserved. This shows, that the strike-slip reactivation of normal faults could produce geometries that are unique and not usually observed in non-reactivated strike-slip systems, leading to the presence of a dual transpressive-transtensive system, which is rarely observed elsewhere. Given the potential of transpressive systems to form areas of local uplift, they may form potential traps for hydrocarbon accumulation. The adjacent relay ramps and pull-apart basins may form loci for fluid flow, creating more fractures that will facilitate up-fault hydrocarbon migration into the adjacent transpressive anticlines.

AAPG Datapages/Search and Discovery Article # 91200 © 2020 AAPG Annual Convention & Exhibition Online, Sept. 29- Oct. 1.