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Gravity current deposits: dominant reservoirs of shale oil in post-rift basins - insight from the Late Cretaceous Qingshankou and Nenjiang Formations, Songliang Basin, Northeastern China

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Songliao Basin is a large Mesozoic nonmarine petroliferous rift basin in northeastern China. The thickest deep lake source rocks were developed in Late Cretaceous post-rift strata of the Basin. Based on observation of cores and interpretations of high resolution 3D seismic data, deep water gravity current deposits (GCD) are identified within the first member (K_2qn^1) of Qingshankou Formation (Turonian) and first to second members (K_2n^{1-2}) of Nenjiang Formation (Campanian).

During $Sq_{qn}{}^1$ (K_2qn^1), northern Xiaoxinganling and western Daxinganling mountains were predominant provenances of the northern and western deltaic systems, respectively. The gravity current channels, fed by northern deltaic systems within TST_{qn1} to early HST_{qn1} and composed of trunk channels and tributary, extended a very long distance along faults from north to south. These channels terminated in bifurcations or small fans. There are slope fans composed of slump deposits, sandy debris flow, muddy debris flow and low-density flow, fed by the western deltaic systems, and controlled by flexural slope-break zone at western slope of the Qijia-Gulong depression within Sq_{qn1} (K_2qn^1) too.

During Sq_{n1-2} (K_2n^{1-2}), because of uplift of Zhuangguangcailing Mountain influenced by far-field effect caused by the oblique subduction of the Izanagi Plate under the Eurasian plate, the northern Xiaoxinganling, eastern Zhuangguangcailing mountains and southeastern uplift became dominant provenances. Channel-levee systems, fed by northern deltaic subaqueous distributary channels, extended long distance from north to south in TST_{n1-2}. Oblique progradational reflection configuration of eastern deltaic systems from east to west within HST_{n1-2} on seismic profiles indicates that lake level fell quickly with falling trajectory of the lake shoreline. Meanwhile, large scale mass transport deposits (MTD) were deposited on maximum flooding surface of the sequence.

Three factors influenced on the GCD: 1) lake level rise, 2) flexural slope break/palaeoreliefs, and 3) falling trajectory of the lake shoreline. The sand bodies of the GCD, which are encased within organic-rich source rocks, provide new targets of shale oil for hydrocarbon exploration and development.