

Multi-means synthetically analyzing hydrocarbon accumulation process of the Kela-2 and Dabei giant gas fields, Kuqa Foreland Basin, China

LU XUESONG^{12*}, LIU KEYU¹²³, ZHUO QINGGONG¹²,
MENG QINGYANG¹² AND JIANG LIN¹²

¹Research Institute of Petroleum Exploration & Development, PetroChina, Beijing, 100083, China
luxs@petrochina.com.cn(*)

²Key Laboratory of Basin Structure & Hydrocarbon Accumulation, CNPC, Beijing, 10083, China

³CSIRO Earth Science and Resource Engineering, P.O.Box 1130, Bentley, WA 6102, Australia

The Kela-2 and Dabei gas fields located in the Kuqa foreland basin, western China represent one of the most significant discoveries in subsalt structures in China. It is a typical dry gas with 95~98% of methane and a relatively heavy CH₄ carbon isotope and is classified as an over-matured coal-type gas. Only minor amount of associated condensate oil was produced during the gas production. In this study we employed an integrated approach to investigate the charge history using fluid inclusion petrography, fluorescence spectroscopy, Quantitative Grain Fluorescence (QGF), field emission scanning electron microscopy (FE-SEM), and X-ray micro-CT tomography and to further unravel the multiple hydrocarbon accumulation processes.

On the basis of Quantitative Grain Fluorescence (QGF) and QGF on extract (QGF-E) and petroleum inclusion analyses, a huge palaeo oil column of over 350 m was detected in the Kela-2 gas field within the current gas and water zones. Microscopic and FE-SEM analyses and together with micro-CT scanning have revealed that the original oil was charged during the time of dolomitisation. The oil charge may be of multiple phases as two petroleum fluid inclusion assemblages consisting of yellow-white and blue-white colors are present. Fluid inclusion petrography and FE-SEM analysis indicate the presence of three phase petroleum inclusions with solid bitumen, liquid hydrocarbons and gas and movable oil in nanopores, suggesting that the originally charged liquid oil was flushed by a late charged gas, forming the present giant gas discoveries. The co-occurrence of bitumen with calcite veins suggested that the oil charge was episodic and may sometimes be triggered by regional tectonism and associated with fluid flow events.