Giant Palaeo Oilfields in the Silurian Sandstone, Tarim Basin, China: Evidence from Bitumen, Quantitative Fluorescence and Fluid inclusions

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Abstract

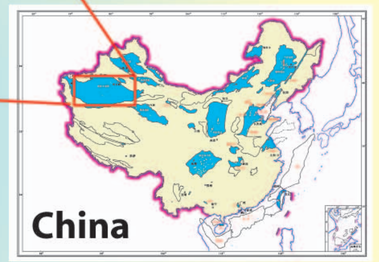
Over 25,000 square kilometres of bitumen-bearing reservoir sandstones have been mapped out in the Silurian stratigraphic succession in the Tarim Basin, western China. An integrated investigation of the bitumen-bearing sandstones from 22 exploration and production wells using fluid inclusion analysis, Quantitative Grain Fluorescence (QGF) and QGF on extracts (QGF-E) and Total Scanning Fluorescence (TSF) techniques have delineated the spatial distribution of the one-time giant palaeo oilfields. The palaeo oilfields consist of two basin-wide major reservoir units of several metres to tens of metres on average separated by an intraformational capillary barrier, sandy shale and in places the palaeo oil columns may attain up to 70 m high. The fluid inclusion results and the quantitative fluorescence fingerprints of the inclusion oils also indicate the presence of oils from multiple sources in the study area and possible from multiple charge events.

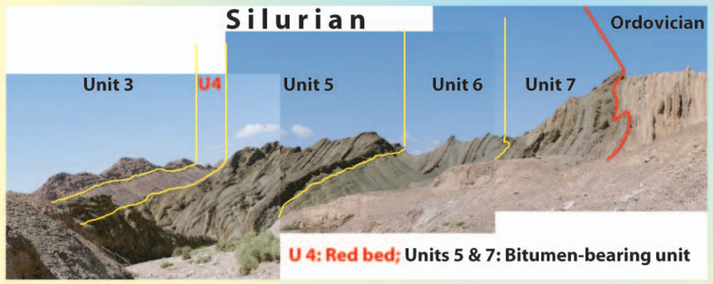
An initial estimate for the area investigated suggests that the one-time palaeo reserve amounts to over 13 billion tons of liquid hydrocarbons equivalent. The destruction of the giant palaeo oilfields is thought to be primarily due to tectonic movement after the emplacement of the hydrocarbons. Biodegradation of the oil in relatively shallow depths has been suggested to be the major mechanism for the development of the wide-spread bitumen.

Location

Tectonic and structural setting of Tarim Basin, west China showing major oil and gas discoveries

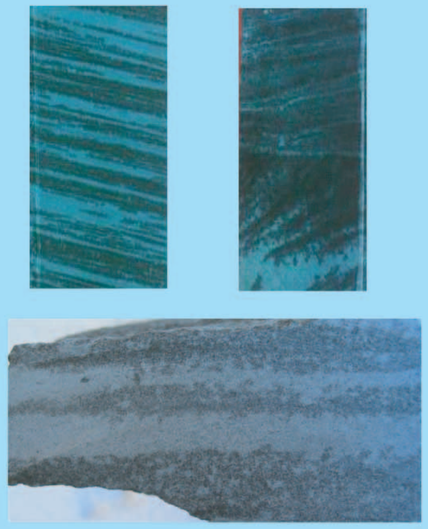
Major petroleum producing basins (blue shaded) in China





Outcrop of Silurian bitumen-bearing sandstones

Bitumen-bearing Sandstones



Methodology [1-3]

Fluid inclusion petrography (GOI) is a petrographic method of counting the abundance of grains containing oil inclusions [3]. An empirical threshold is usually used to delineate the presence of palaeo oil.

Quantitative Grain Fluorescence (QGF) is a spectroscopic method of measuring the fluorescence emission spectrum (300-600 nm) from clean and dry sand grains [1] after excited using a short (254 nm) *UV* light.

QGF-E (QGF on Extract) measures adsorbed hydrocarbons (in solvent) on reservoir grains after a pre-cleaning (QGF) procedure involving solvent, hydrogen peroxide and acid [1].

Total Scanning Fluorescence (TSF) on petroleum inclusions is a method for fingerprinting oil inclusion extract that generates a 3D excitation-emission fluorogram. QGF cleaned samples undergo further vigorous cleaning to remove surface adsorbed hydrocarbons and any contaminants prior to crushing in solvent. The TSF spectrograms are obtained by using varying excitation wavelengths (220-340 nm) and recording the corresponding (250-540 nm) emission spectra synchronously [2].

Tarim Basin Silurian Stratigraphy

Strat. Unit	Lithology	Logs
Unit 2 Upper Shale	Brown-grey shale, siltstone, sandy shale interbedded with fine sandstone	
Unit 3 Interbedded sand and shale	Grey to brown siltstone with interbedded brown sandy shale and shale	
Unit 4 Red shale bed	Massive brown-reddish shale	
Unit 5 Bitumen sand	Grey bitumen-bearing fine sandstone and shale	
Unit 6, Shale	Grey-greenish shaley sandstone	
Unit 7 Bitumen sand	Grey fine sandstone interbedded with silty shale	