STUDY ON OIL & GAS DISTRIBUTION IN THE BADIN BLOCK

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The thermal breakdown of oil at elevated temperature was studied in order to better understand flushing volumetrics and the exploration consequences thereof. Knowing that deeply buried oilfields crack to form gas, the cracking reaction was modeled for simple hydrocarbon (HC) compounds. The volumetric expansion factor from oil to gas transformation was calculated for some 80 simple HC compounds at the reservoir conditions of the oil floor (300°F, 6270 psia) in the Badin Block in Sindh Province, Pakistan. The expansion factor for an alkane/ napthene / NSO mixture of 35° API was found to be 2.72, which is believed suitable for Typical Badin Crudes.

The expansion factor of 2.72 shows that in a deeply buried oil reservoir only 37% of the oil volume would break down to produce sufficient methane to replace completely that volume. If an oil reservoir is full to spill, 37% of the oil breaks down and fills the trap with gas whilst 63% of the oil is flushed out of the trap through displacement andre-migrates further updip. The generated gas can not flush itself and remains 'deep' below the liquid window unless the trap leaks or is breached. Conversely, shallow gas, which lies above the oil floor, is probably derived directly from maturation of gas prone source rock.

This unpublished in-house paper was originally written in February 1989 when there was limited published literature on the subject of expansion of volume due to the cracking of oil. In April, 1991 a paper was published in AAPG by P. L. Forbes and others on Compositional Modeling of Petroleum Generation and Expulsion to present an application of a compositional kinetic model of petroleum generation degradation into gas and residue. In February 1989 there were no deep thermal gas fields in Badin Block. However, based on a study of source maturity and migration it was determined, that only Liari Field (Upper Sand) was an example of the flushed oil case. At that time it was anticipated that there would be the possibility of a gas discovery in the Basal Sand where cracking of oil could have taken place. But now there are several fields in the north of Badin Block e.g., Sakhi, Meyun Ismail, Tangri and Jagir etc., which contain oil in the Lower Goru Upper Sand. This oil could have been flushed from the deeper Lower Goru Basal Sand (now filled with gas reserves). The deep thermal gas (generated by cracking of oil) found in the Basal Sand contains 6% to 18% carbon dioxide which differs in chemical composition from the shallow gas of the Upper Sand which has an insignificant carbon dioxide content (generated from gas prone source).

The migration of the flushed oil could be through carrier beds or through faults. Meyun Ismail is a classic example to support the migration through a fault. At Meyun Ismail the average porosity in the Upper Sand is 11% at a depth of 7,000 Ft. while the porosity in the Basal Sand is as high as 16% at a depth of 10,000 Ft. The higher porosity in the Basal Sand at a greater depth suggests that the oil primarily migrated to the Basal Sand through carrier beds from the Sembar source rock and preserved the porosity present at the time of migration. Due to the absence of hydrocarbons in the Upper Sand, compaction effects reduced the porosity. After the cracking process, oil flushed (secondary migration) from the Basal Sand could have migrated to the Upper Sand through a fault. The major fault in this area cuts the Deccan Volcanic and dies out in Tertiary, suggesting that the primary migration took place from the Sembar source to the Basal Sand by carrier beds during early Tertiary or late Cretaceous. After the cracking process, the displacement of oil (secondary migration) from the Basal Sands to the Upper Sands could have taken place at any time during late Tertiary time through a fault.