Paris Basin Offers Opportunities for Unconventional Hydrocarbon Resources

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Applying basic concepts and methods used on unconventional plays elsewhere, such as the Bakken Shale and Barnett Shale of the USA, three possible unconventional hydrocarbon plays in the Paris Basin of France namely,

- The Lias Shale oil play
- The Permo-Carboniferous Shale gas play
- The Upper Carboniferous coalbed methane play

Have been identified based on analysis of IHS proprietary data using IHS PETRA geology and engineering analysis software.
The Paris Basin, with an area of ~170,000 sq km, encompasses most of the northern half of France and extends into Luxembourg, Belgium and Germany. The basin is roughly circular in shape, centred on the city of Paris.
Three known conventional petroleum systems are recognised in the Paris Basin.

- **Upper Lias–Dogger petroleum system** with source rocks in the Lower Jurassic marine shales of the Schistes Carton Formation, which is considered to be the main source rock in the basin.

- **Triassic–Middle Lias petroleum system** with two Middle Jurassic source rock horizons namely, Sinemurian shales of the Argiles à Promicroceras Planicosta Formation and the overlying Pliensbachian shales of the Argiles à Amalthees Formation.

- **Upper Carboniferous–Triassic petroleum system** with source rocks as the coals in the Upper Carboniferous Series and Permian bituminous shales of the Autunian Unit.
Unconventional Hydrocarbon Plays

Unconventional hydrocarbons discussed here are hydrocarbons trapped in low porosity and low permeability rocks, which are generally the source rocks and the stratigraphically and areally adjacent rocks.

These continuous-type accumulations, as defined by Schmoker (1996), include coalbed methane, fractured shale oil and gas, basin-centred gas, fractured chalk gas, and tight-reservoir gas.

Applying concepts and methods used on well known producing plays, such as the Bakken Shale and Barnett Shale (Pollastro et al., 2007), three possible unconventional hydrocarbon opportunities are identified in the Paris Basin based on analysis of IHS proprietary data using HIS PETRA geology and engineering analysis software. The three plays are briefly discussed here.
**Lias Shale oil play**

The three source rocks in the Lower Jurassic Lias Series, along with all the mudrocks lying between the impermeable lowermost unit of the Middle Jurassic Dogger Series carbonates and the lowermost Lower Jurassic Hugleville Limestones are grouped as a single unit, the **Lias Shale**, for this unconventional play.

A preliminary isopach map of vertical thickness of the Lias Shale has been prepared using formation tops from IHS well data and PETRA geology and engineering analysis software. Lias Shale is within the oil window. Thus, a large part of these shales is mature for oil as indicated by the two contours for equal maximum temperature of 435°C. The violet contour is for the Sinemurian Argiles à Promicroceras Planicosta and the green contour is for the Toarcian Schistes Carton Formation. These contours show two prospective areas based on maturity: the first is the combined extent of the areas enclosed by the two contours and the second area is the more prospective area where the two contours overlap.
**Permo-Carboniferous Shale gas play**

The Upper Carboniferous bituminous shales interbedded with the Stephanian and Westphalian coals, the underlying Namurian Unit, and the overlying Permian bituminous shales of the Autunian Unit are grouped into a single unit, the Permo-Carboniferous Shale, for this play. Only about 50 wells have penetrated this shale package (IHS data as of mid-2008).

A preliminary isopach map of penetrated vertical thickness of the Permo-Carboniferous Shale shows that a considerable thickness is present mostly in the southern and eastern parts of the basin. The Permian shales are within the condensate–wet gas window (1.3–2% Ro). The Carboniferous shales are in the dry gas window, above 2% Ro. No data on maximum temperature and vitrinite reflectance are available for these shales. However, the majority of the shales are considered well mature for gas and the total prospective area could be defined by an arbitrary cutoff at the 50 m isopach.
**Upper Carboniferous coalbed methane play**

The Upper Carboniferous coals in the Westphalian and Stephanian successions are included in this play. Coals are more abundant in the Westphalian succession. The Ro of Westphalian coals reaches up to 5.5% in the Gironville 101 well (Delmas et al., 2002). There are very limited well data to prepare preliminary subcrop/isopach maps for these coals. However, the Lorraine Sub-basin is considered to be the main coal-bearing basin in France, and it extends north-east into the Saar-Nahe Trough of the Vosges Gréseuses Plateau, Germany, where coals outcrop. Coal was mined in the Lorraine Sub-basin by Houillères du Bassin de Lorraine for 60 years until the end of 2007, when the company was dissolved. In the adjacent Northern Coal Basin, two fields, namely Désirée and Poissonnière have been producing coalbed methane since 1992 from the Upper Carboniferous coals of the Nord Pas-de-Calais mines. Mapping of the coals in other parts of the basin is hindered by the very limited numbers of deep wells.
Conclusion

• The current work is a synthesis of the existing, mainly IHS, well data and public literature using IHS PETRA geology and engineering analysis software.

• This provides a first step in a screening approach for further exploration of these possible unconventional hydrocarbon resources.

• The next phase would include identification, mapping and ranking of various potential productive horizons within each resource play, with the help of intensive studies of cores and cuttings; fracture system identification; analysis of the coal and shale characteristics from logs; and analogue studies with known producing plays elsewhere. Volumetric studies to determine the volumes of hydrocarbon generated, expelled and retained are also needed to give an estimate of the resources.
References


