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Petroleum Potential of New-Caledonia and Its Offshore Basins

Since 1994, new assessment of the petroleum potential of the New Caledonia basins has been carried out by the Institut Français du Pétrole (IFP), in collaboration with the Service des Mines de Nouvelle-Calédonie (Vially et Mascle, 1994; Vially et Benard, 2001). These studies have synthetised recent seismic data carried out within the frame of the marine ZoNéCo (resources assessment of New Caledonia's Economic Zone) and FAUST (French Australian Seismic Transect) scientific programmes (Auzende et al., 2000; Lafoy et Exon, 2002) as Taranaki basin in New-Zealand. Numerical modelling including burial reconstruction, heat-flow history allow us to define several new plays in the deep offshore New-Caledonia and Fairway basins.

1-Grande Terre western onshore basins.

Oil and gas shows are known since the beginning of the 20th century in the western part of the Grande Terre (Figure 1). The proved petroleum systems consists in Cretaceous coal and coaly shales for the source-rocks, fractured tertiary flysch for the reservoirs and shaly flysch for the seal (Figure 2).

This area is affected by an Upper Eocene compressive phase in relation with the emplacement of the ophiolitic thrust sheet eastward which is responsible of roughly NW-SE anticlines and of the maturation and expulsion of gaseous hydrocarbons. There is no evidence of thermal metamorphism at the contact of the allochthonous units in the Western coast of the Grande Terre, the maturation of the Cretaceous source-rock is only due to the tectonic burial. This hypothesis of a "cold" emplacement of the allochtonous units is confirmed by the Koumac "Mine d'Huile" (Oil mine) where oil shows have been discovered in the tectonic sole of the peridotic allochtonous units.

This play has been recently explored in the Gouaro prospect where an onshore seismic survey (the first one in New-Caledonia) was acquired (Blake, 1996). The seismic line (Figure 3) confirm that the surface anticline clearly visible in the geological map have an effective closure at the level of the inferred reservoir. The Cadart-1 well has confirmed the existence of an active petroleum system but with a poor quality of reservoirs as well as in the Cretaceous series than in the Tertiary flysch (France, 2000). A significant gas show have been encountered but no commercial accumulation.

2- New-Caledonia Basin.

Located immediately westward of the Grande-Terre, this deep offshore basin is not affected by the Eocene compressive phase. The FAUST 1 deep-seismic survey (Lafoy et al., 1998) has shown that the basin, the basement of which shows huge tilted-blocks, is filled by sedimentary deposits that can reach up to 8 km in thickness (Figure 4). According to new geodynamical interpretation based on the FAUST A seismic lines, the basement of the northern part of the New-Caledonia Basin can be interpreted as a thinned continental crust (Vially et Benard, 2001). In this hypothesis, the petroleum system described onshore can be extrapolated offshore, with Cretaceous tilted-blocks, filled with continental or deltaïc sedimentation, as structural traps. Assuming no major facies variation in the Cretaceous sedimentation, we can expect the existence of Cretaceous coal as the major source-rock. The thickness of the Cretaceous and Tertiary sedimentation is sufficient to generate a great amount of liquid and gazeous hydrocarbons in the deeper part of the northern part of the New-Caledonia basin (Figure 5). Even in the occidental

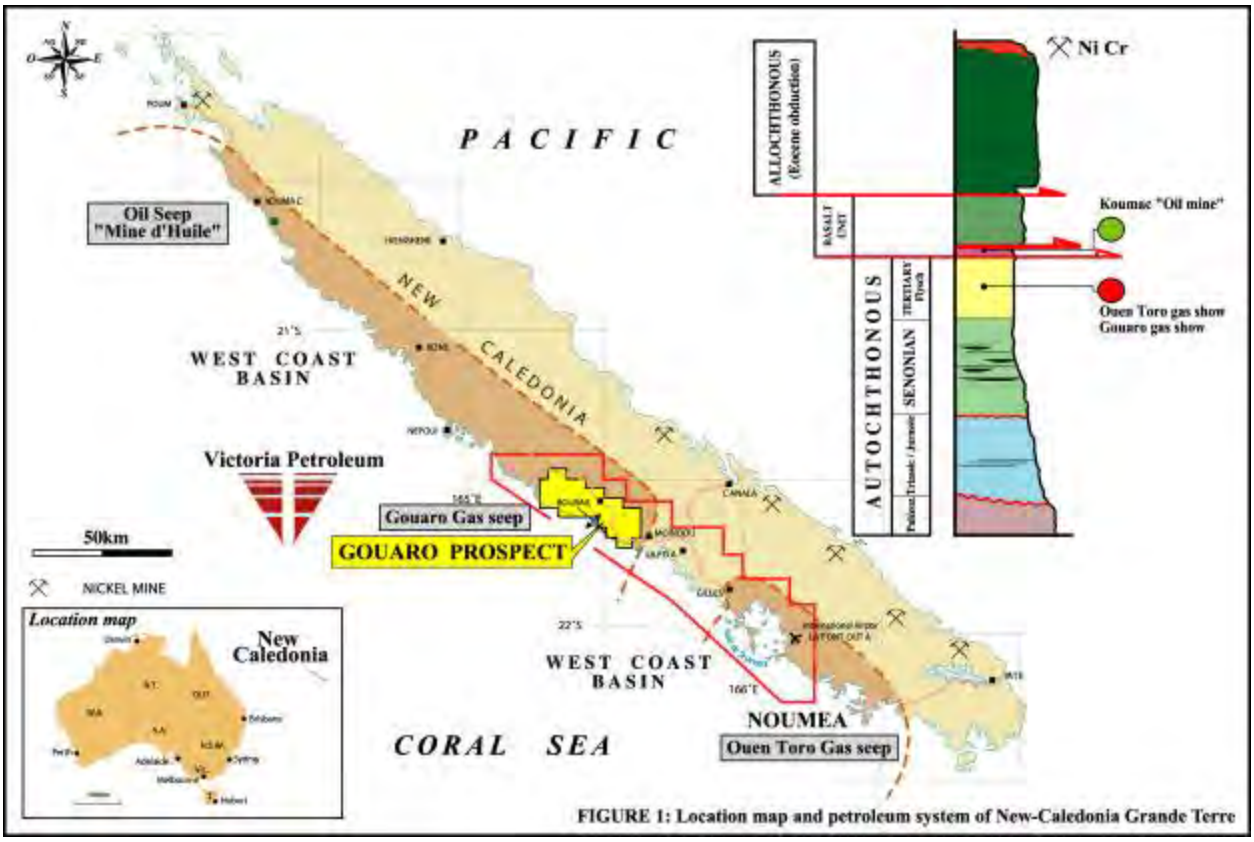

FIGURE 1: Location map and petroleum system of New-Caledonia Grande Terre

part of the basin near the Fairway ridge, the sedimentary thickness is sufficient to generate liquid hydrocarbons. In the southern part where the New-Caledonia basin have a N-S trend, the seismic facies of the crust in the deeper part of the basin have a more oceanic signature. The thickness of the sedimentary layers is decreasing as well as for the Cretaceous than for the Tertiary series. The petroleum potential of the southern part of the basin is decreasing due to a possible variation of facies in the Cretaceous (continental or deltaïc in the north, open marine to pelagic to the South) and to an insufficient burial.

3- Fairway Basin and Ridge.

The western border of the New-Caledonia basin consists in the Fairway Ridge, the origin of which still remains controversial. Westward, the NW-SE trending Fairway Basin shows a sedimentary thickness compatible with production of liquid and gaseous hydrocarbons. Good Cretaceous and Lower Tertiary reservoir can be expected in the prograding wedges fed by the erosion of the Fairway Ridge. The developpment of prograding wedges suggest that an major aerial erosional event occured during the Cretaceous especially in the northern part of the fairway Ridge. Such an erosion is in agreement with a continental origin for this part of the Fairway Ridge interpreted in that case as a regional horst with a structure and composition similar to the Haute Chaîne of the New-caledonia Grande Terre.

A "Bottom Simulating Reflector" (BSR), (Figure 6) interpreted as the base of a gas hydrate layer was evidenced during the FAUST 1 seismic campaign (Lafoy et al., 1998; Exon et al., 1998). During the ZoNéCo 5 (1999) survey, the BSR's geographic extension has been confirmed over an area of 80 000 sq. km within New Caledonia's Economic Zone (Auzende et al., 2000). Moreover, the presence of diapir-like features (both sedimentary and volcanic intrusions) associated with the BSR's extension was unveiled. More recently, the FAUST 3 cruise (2001) enabled to clarify the structural style (eastward-tilted half-grabens) and the sedimentary infilling (3 km in average) of the Fairway Basin (Lafoy et Exon, 2002).

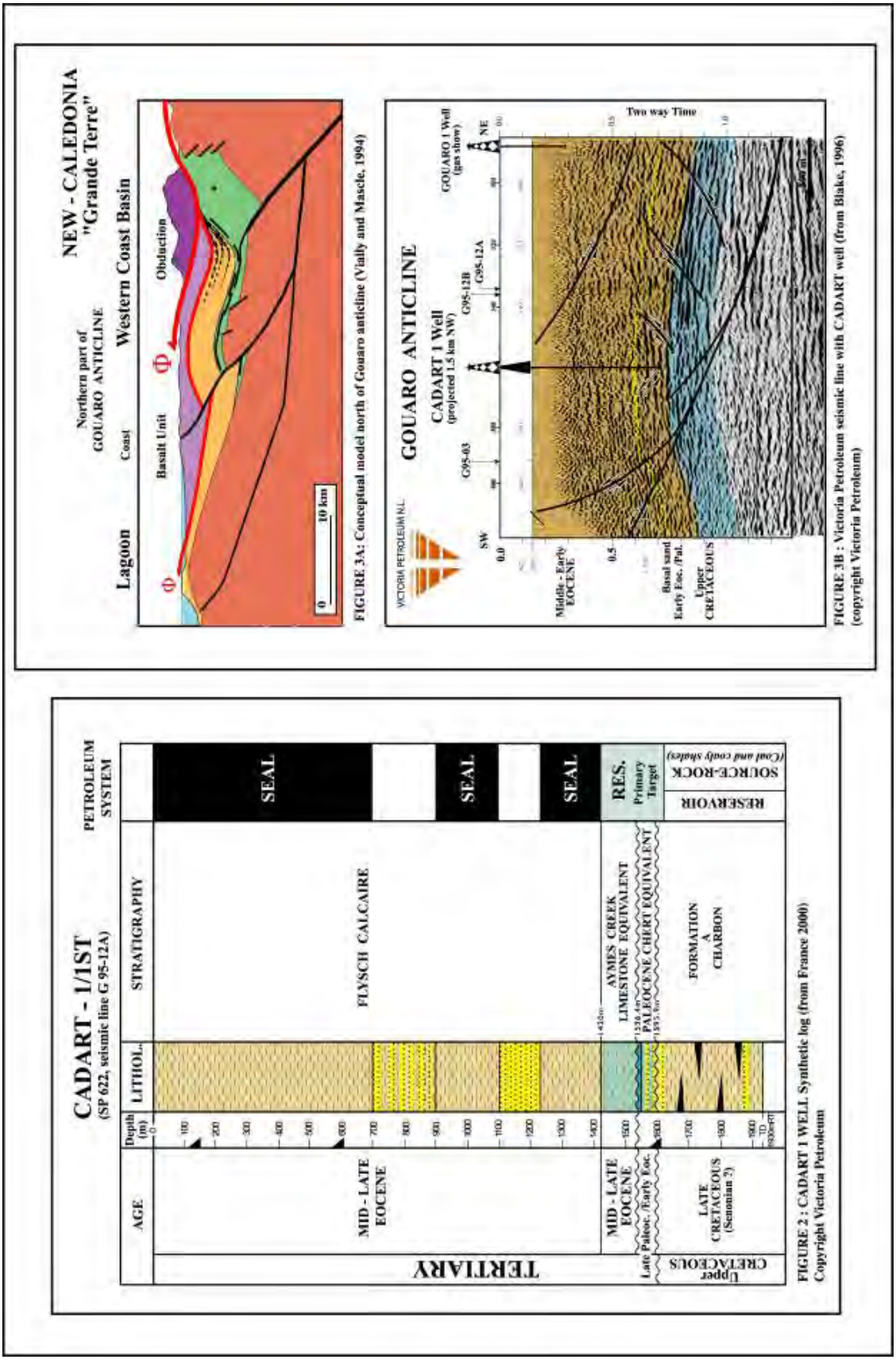

FIGURE 3A: Conceptual model north of Gouaro anticline (Vially and Mascle, 1994)

FIGURE 3B : Victoria Petroleum seismic line with CADART well (from Blake, 1996) (copyright Victoria Petroleum)

FIGURE 2 : CADART 1 WELL Synthetic log (from France 2000) Copyright Victoria Petroleum

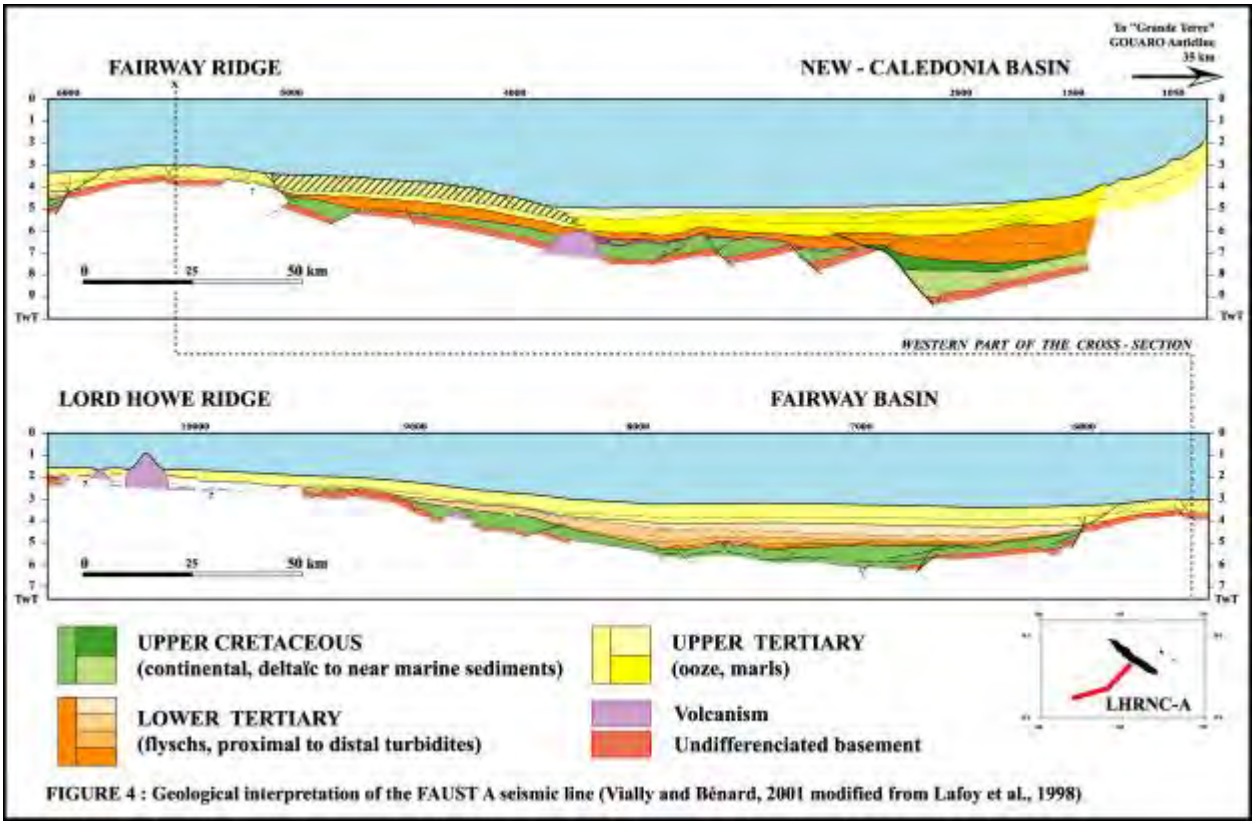

FIGURE 4 : Geological interpretation of the FAUST A seismic line (Vially and Bénard, 2001 modified from Lafoy et al., 1998)

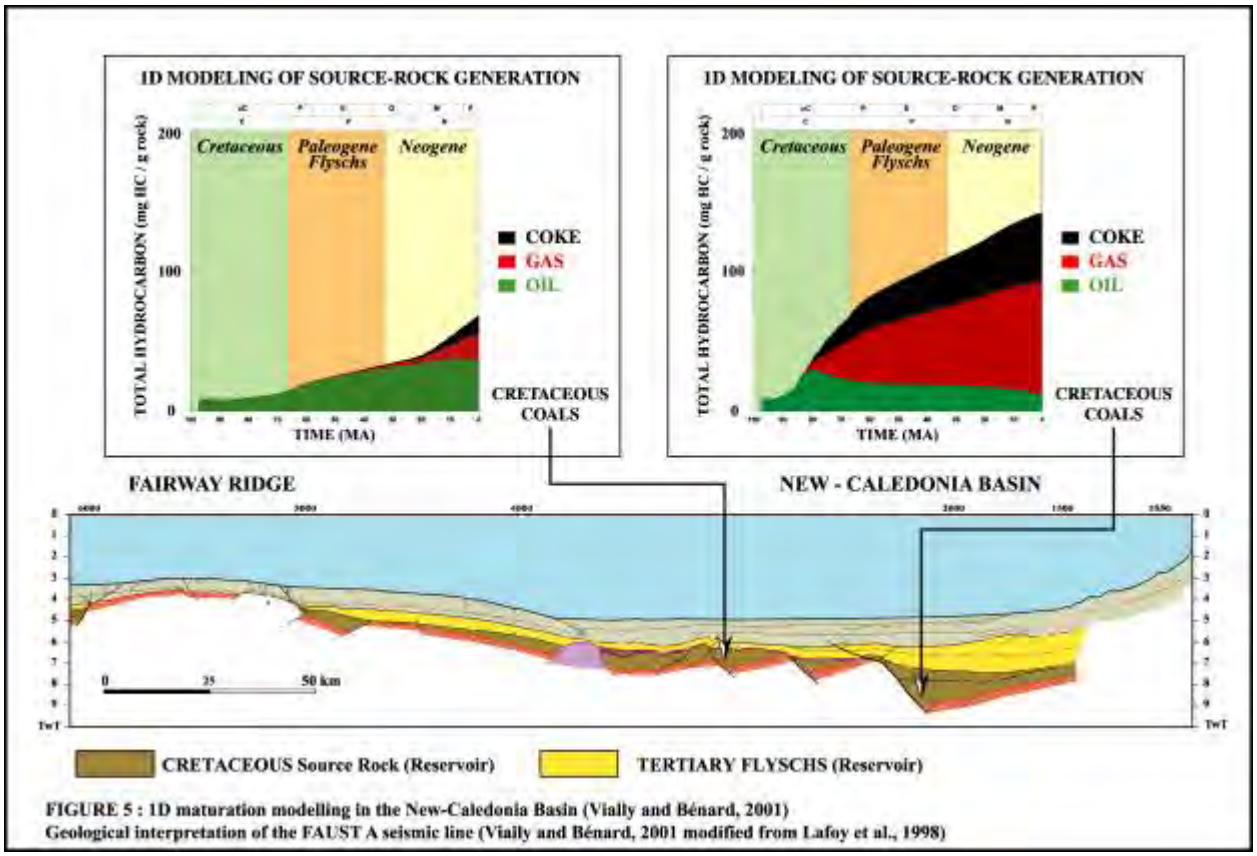

FIGURE 5 : 1D maturation modelling in the New-Caledonia Basin (Vially and Bénard, 2001)
Geological interpretation of the FAUST A seismic line (Vially and Bénard, 2001 modified from Lafoy et al., 1998)

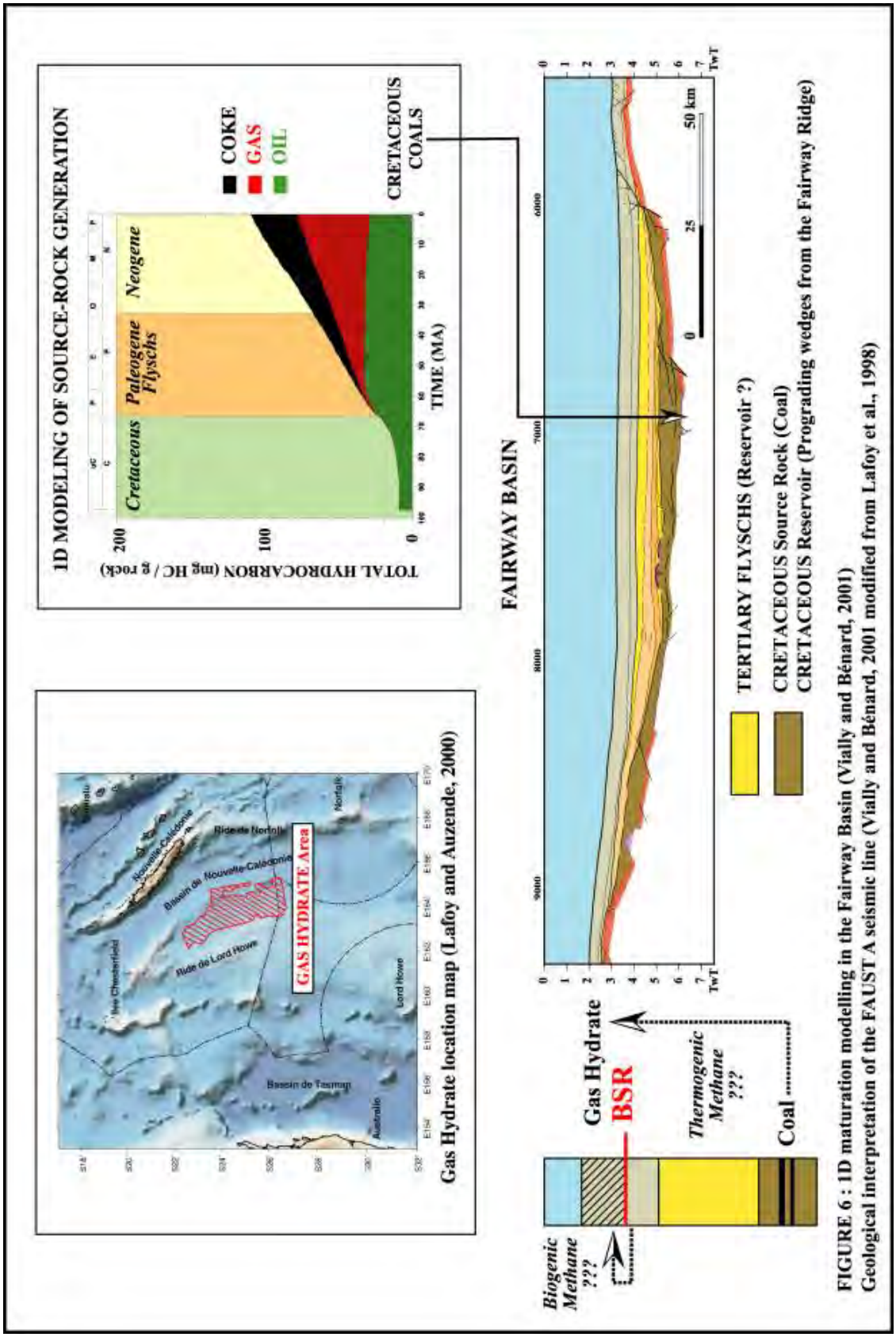

FIGURE 6 : 1D maturation modelling in the Fairway Basin (Vially and Bénard, 2001)
Geological interpretation of the FAUST A seismic line (Vially and Bénard, 2001 modified from Lafoy et al., 1998)

Within the Fairway Basin and at the eastern border of the Fairway Ridge, both the depth and thermal conditions are adequate for gas hydrate to be stable within the upper part (more than 500 m) of the sedimentary cover. Although the origin of the methane trapped in the gas hydrates still remains unknown (biogenic or thermogenic), the Fairway Basin can be considered as a long-term petroleum prospect as well as for conventionnal hydrocarbon than for gas hydrate recovery.

The totally unexplored New-Caledonia deep offshore basins appear to have a likely petroleum potential, and consequently, can be considered as frontier basins for the 21st century's hydrocarbon exploration. The northern part (Grande Terre latitude) seems the major target for conventionnal exploration with thick sedimentary layers and tilted-blocks untrappment. In the Fairway basin, conventionnal oil and gas can be discovered in the siliciclastic prograding wedges near the Fairway Ridge as well as gas hydrate which have been sismically imaged in a great part of this basin.

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