

EAST COAST BASIN ATLAS SERIES GRAND BANKS OF NEWFOUNDLAND HYDROCARBON PROSPECTS AND FIELDS 1

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HYDROCARBON PROSPECTS ON THE GRAND BANKS As of March of 2003, 212 wells have been drilled on the Grand Banks with the first well drilled in 1965. There are 25 shallow cone holes and another 36 wells are development, delineation, etc. in the Jeanne d'Arc Basin (Fig. 1). Of the remaining 155 exploratory wells, 117 were drilled in the Jeanne d'Arc Basin, and 38 in other basins (Fig. 2). A brief description of each of the significant discoveries including their geological setting, productive reservoirs, traps, etc. is provided in the remaining figures on the index sheets Hydrocarbons (and 1), and is summarised in Table 1. Reservoir properties are listed in Table 2. The figure numbers and descriptions for the discoveries follow the order in Table 1. An outline of the salient points in the geology is given below.

STRUCTURAL AND TRAPPING STYLES A host of structural styles are represented by the discoveries of the Jeanne d'Arc Basin. With the exception of Mara (Fig. 6), all of the discoveries are structures created or modified by deformation during Aptian-Albian times, but structural styles are controlled to a great extent by their position within the basin, such as in the basin centre, along basin margins or in association with large basin bounding features. Discoveries in the basin centre include South Mara, North Ben Nevis, Ben Nevis, West Ben Nevis and Hibernia. These structures are defined by the NW-SE trending Trans Basin Fault Trend (Grant, et al., 1986 and Erachescu, 1987) of Aptian-Albian age. These faults bound generally long, narrow blocks with closure as typified by North Ben Nevis. Intersection of faults and contemporaneous arching of faulted blocks provides additional components of closure, as seen at Hibernia and West Ben Nevis respectively.

Discoveries located along the basin margins include Hibernia, Nautilus, WhiteRose, Fortune and Terra Nova; these tend to display composite styles of trapping. For example, the Hibernia structure (Fig. 4) is defined by the intersection of the Trans Basin Fault Trend with the basin margin such that it forms a southerly tilted faulted block bound to the northeast by the major Nautilus Fault. The structure is further complicated by rollover associated with bed slippage into the basin centre. The Nautilus structure (Fig. 11) is similarly transected by NW-SE trending faults and shows eastward bed truncation.

At the hydrocarbon-bearing horizon, the Terra Nova structure (Fig. 5) is a keyhole graben at the crest of a north plunging anticline. Oil is trapped within the graben and on the east flank. Isopatch mapping indicates that the anticline was formed in Aptian-Albian times when a large block with a fault into the lowermost Rankin carbonates, was tilted to the south. A transpressional structure, located to the south of Terra Nova, indicates synchronous dip-slip movement along faulting to the east caused by increased northward, giving the final northerly plunge to the structure.

The WhiteRose structure (Fig. 7), on the eastern margin of the Jeanne d'Arc Basin, comprises a broad faulted dome formed by basin subsidence and rollover associated with both salt movement and rollover into the fault-bound Outer Ridge during the Aptian-Albian.

REFERENCES Canadian-Newfoundland Offshore Petroleum Board 2003: Website: http://www.cnopb.nfnnet.com/ Erachescu, M.E. 1987: The tectonic and structural framework of the northwest Newfoundland continental margin; in: Sedimentary Basins and Basin-forming mechanisms, edited by C. Beaumont and A.J. Tankard, Canadian Society of Petroleum Geologists, Memoir 12, p. 117-145.

Grant, A.C., McAlpine, K.D. and Wade, J.A. 1986: The continental margin of eastern Canada: geological framework and petroleum potential. In: M.T. Halbouty (ed.), Future Petroleum Provinces of the World. American Association of Petroleum Geologists, Memoir 40, p. 177-205

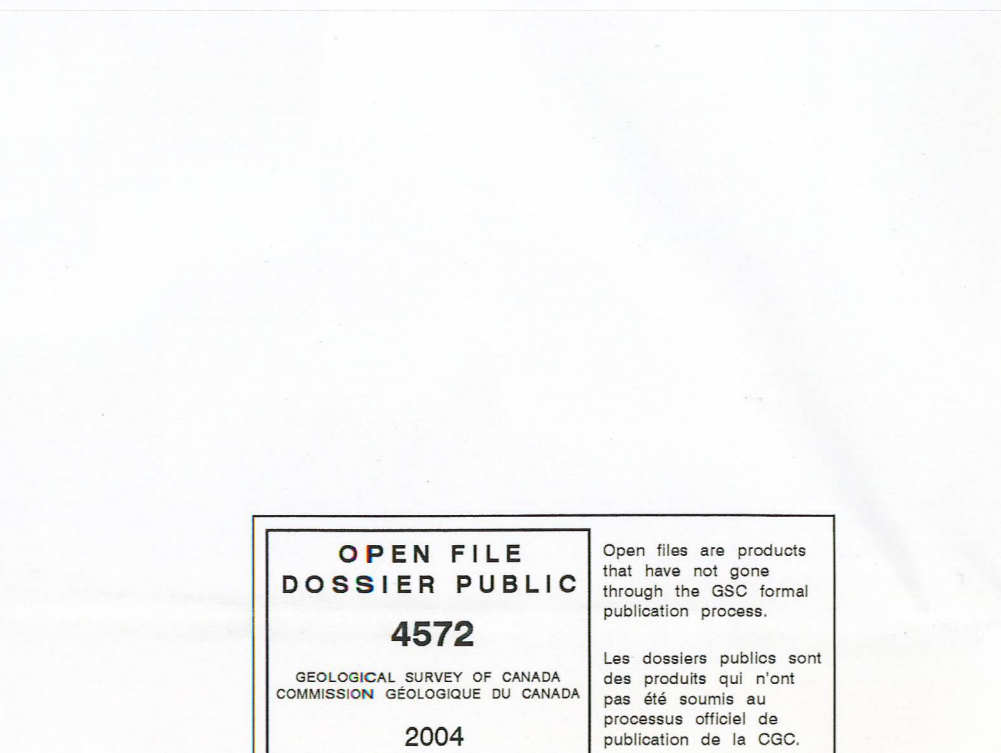
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Sheet 1 of 2 Edwards, A., Sinclair, I.K., Wilems, J.B.W., and Jauer, C.D. 2004: Hydrocarbon prospects and fields, Grand Banks of Newfoundland (East Coast Basin Atlas Series). Geological Survey of Canada, Open File 4572.

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Table 1 Discovered reserves and resources - Offshore Newfoundland and Labrador

Table with 7 columns: Field, Oil (10^9 m^3, 10^10 Bbls), Gas (10^12 m^3, 10^11 Bbls), NGL, and Shows. Lists fields like Hibernia, Terra Nova, WhiteRose, Ben Nevis, Nautilus, Springdale, South Tempert, Kings Cove, East Rankin, Fortune, South Mara, West Sona Bay, North Dana, and Trave.

Note: Source: Canadian-Newfoundland Offshore Petroleum Board. The data are until March 2003.

Table 2 Properties of Oil-bearing Reservoirs - Offshore Newfoundland and Labrador

Table with 14 columns: Field, Wells in field, Water depth, Reservoir formation, Average depth, Net oil pay, Average porosity, Average permeability, Oil API density, GOR, Test rate, Pressure, and Temperature. Lists fields like Hibernia, Terra Nova, Hebron, WhiteRose, West Ben Nevis, Mara, North Ben Nevis, Springdale, Nautilus, South, Tempert, Fortune, and South Mara.

Properties of Gas-bearing Reservoirs

Table with 14 columns: Field, Wells in field, Water depth, Reservoir formation, Average depth, Net gas pay, Average porosity, Test rate, Liquid content, Gas gravity, Oil API density, Pressure, and Temperature. Lists fields like WhiteRose, Hibernia, Springdale, South Mara, and Trave.

Note: Source: Canadian-Newfoundland Offshore Petroleum Board. The data are until March 2003; del= delineation; dev= development; inj= injection.

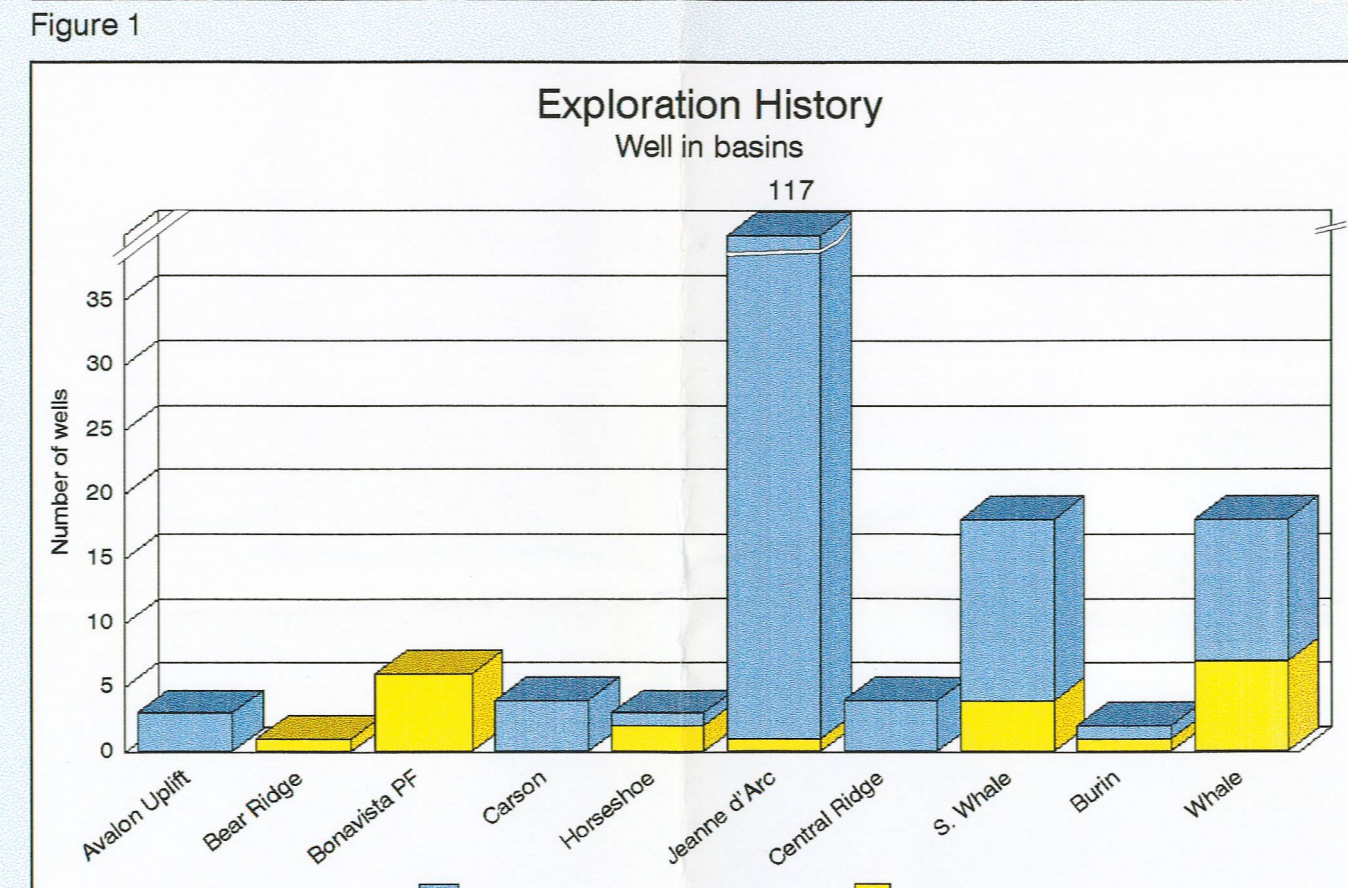
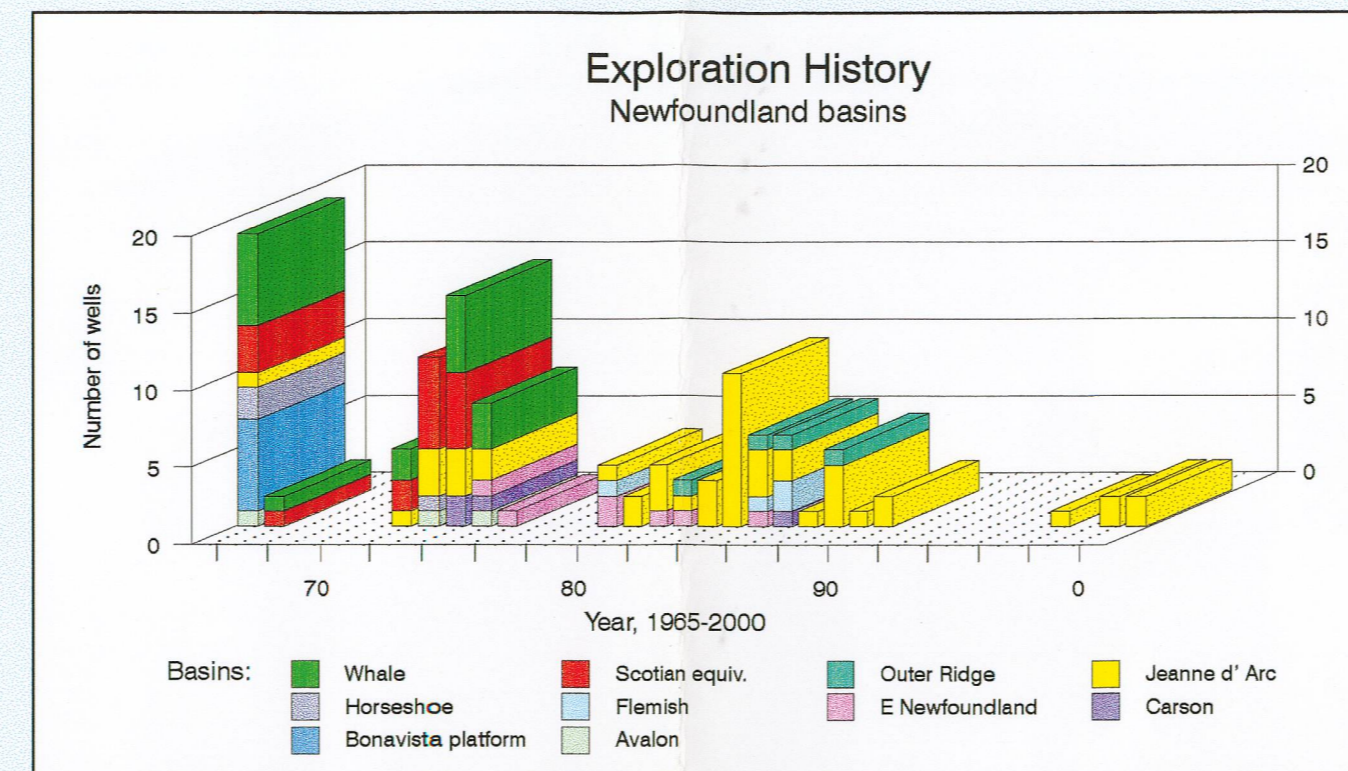


Figure 2

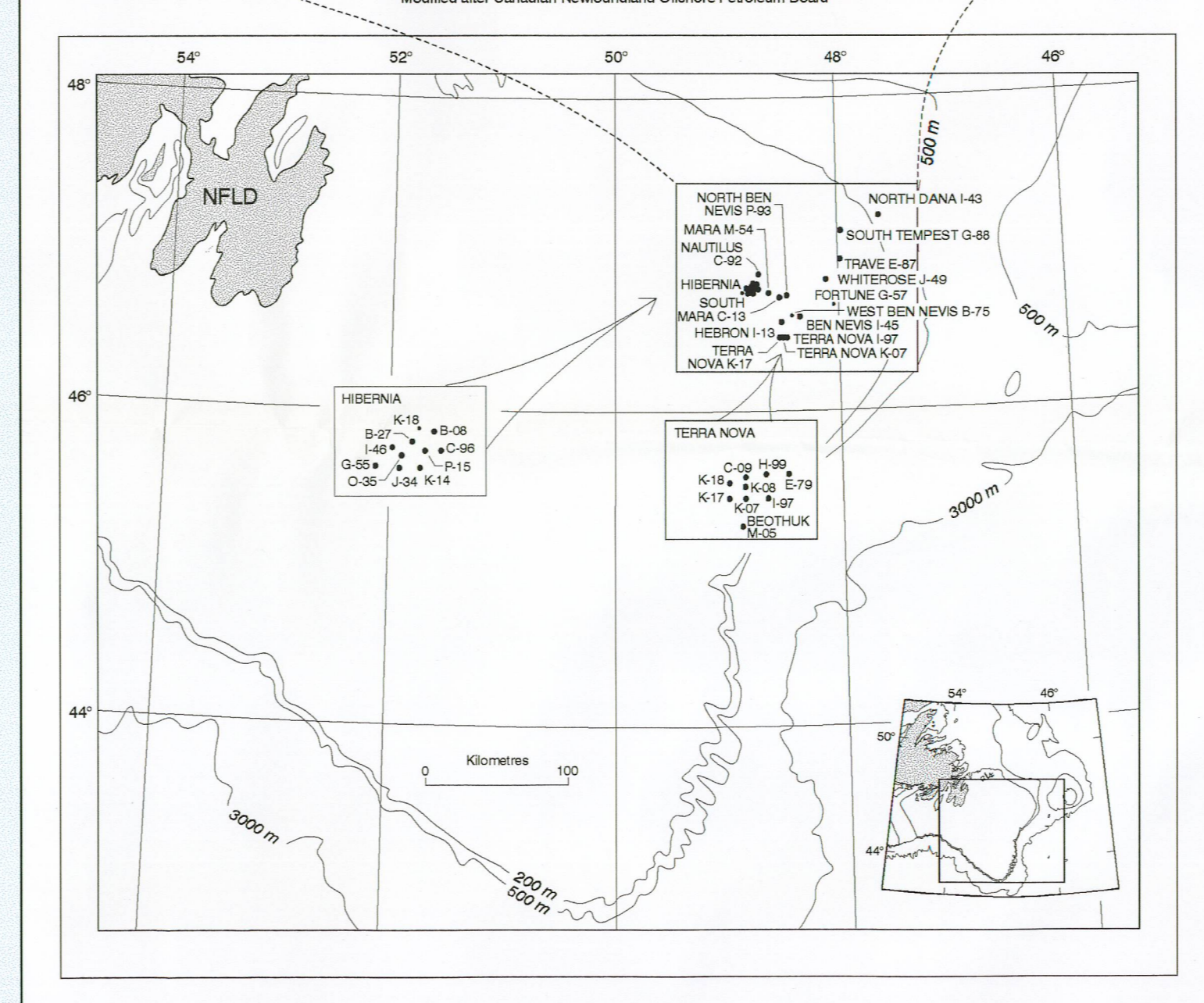
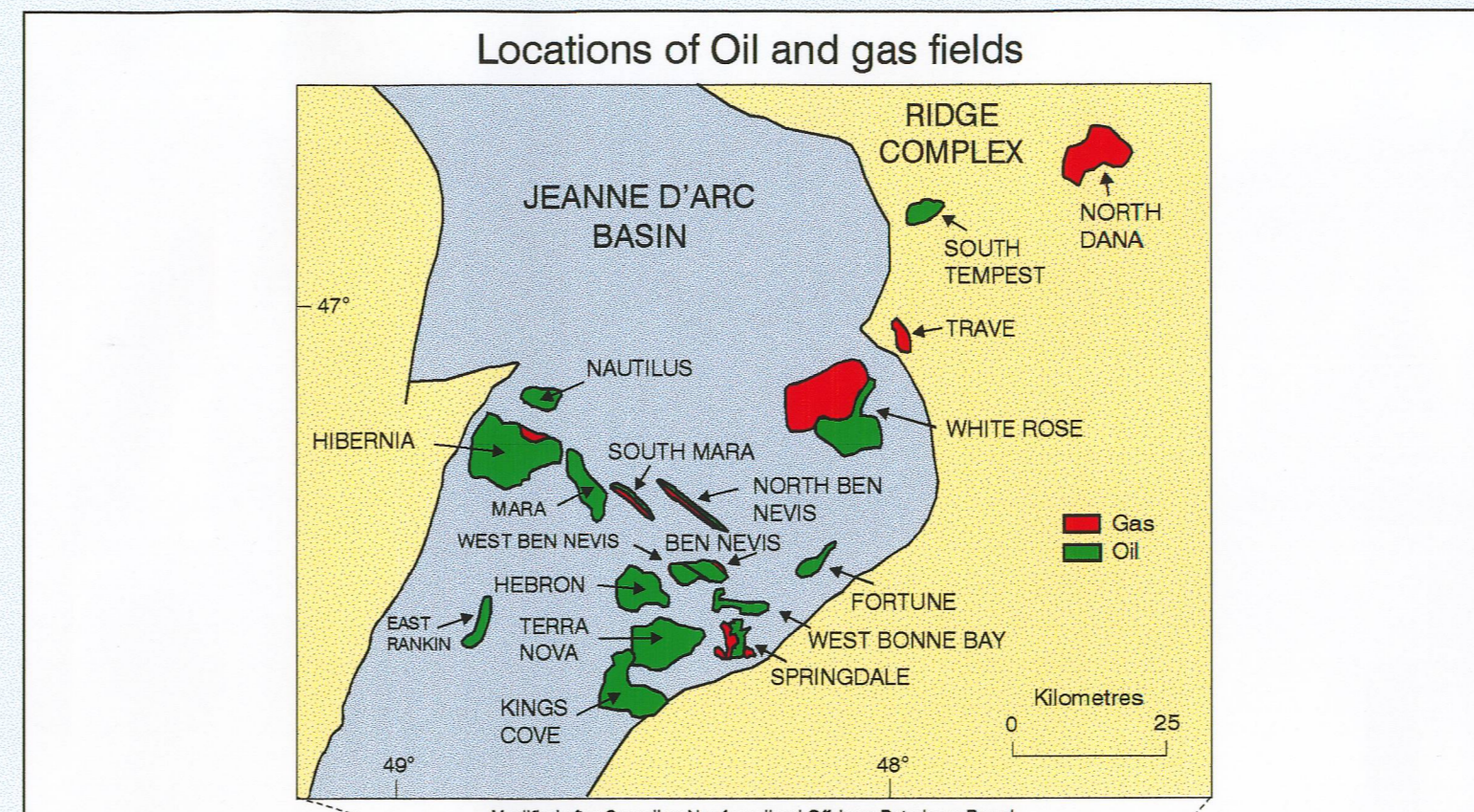
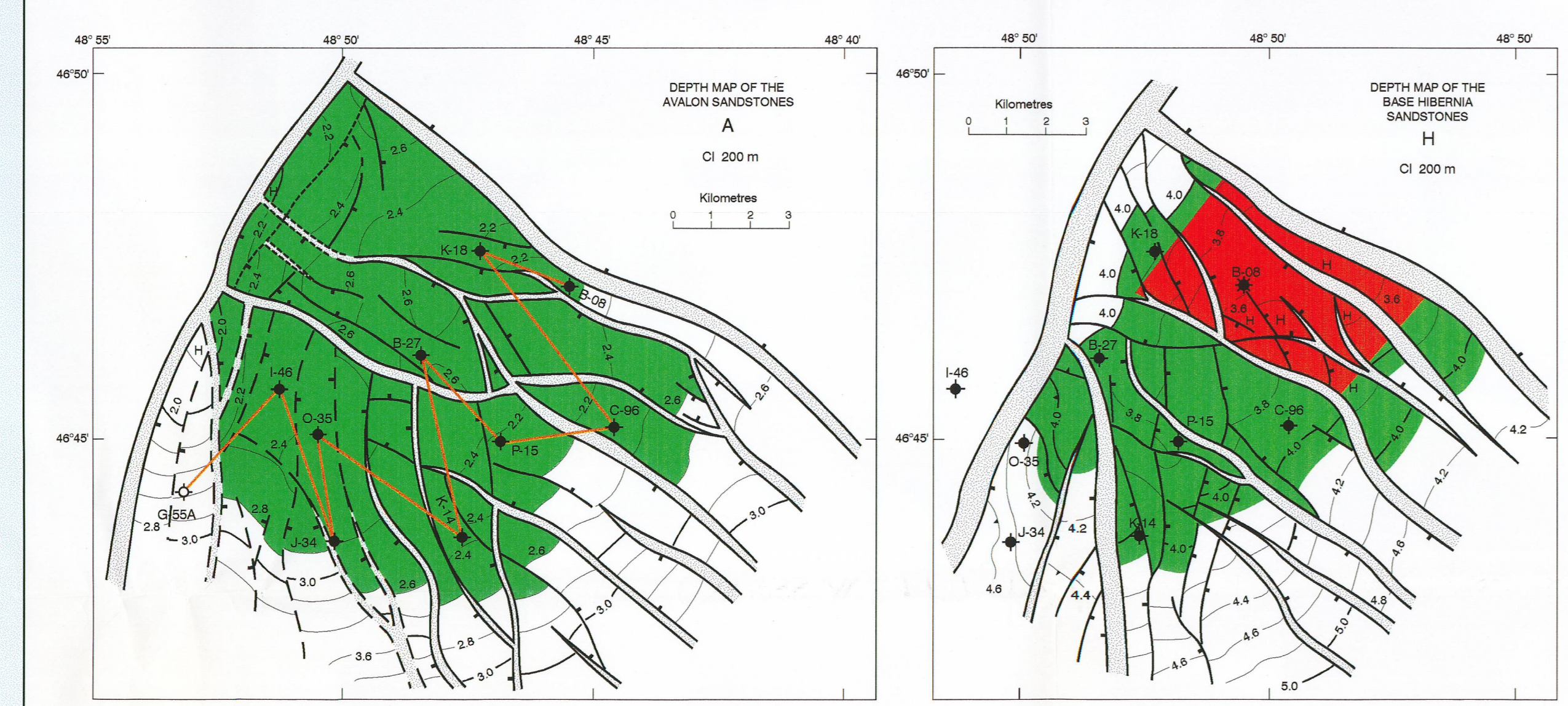
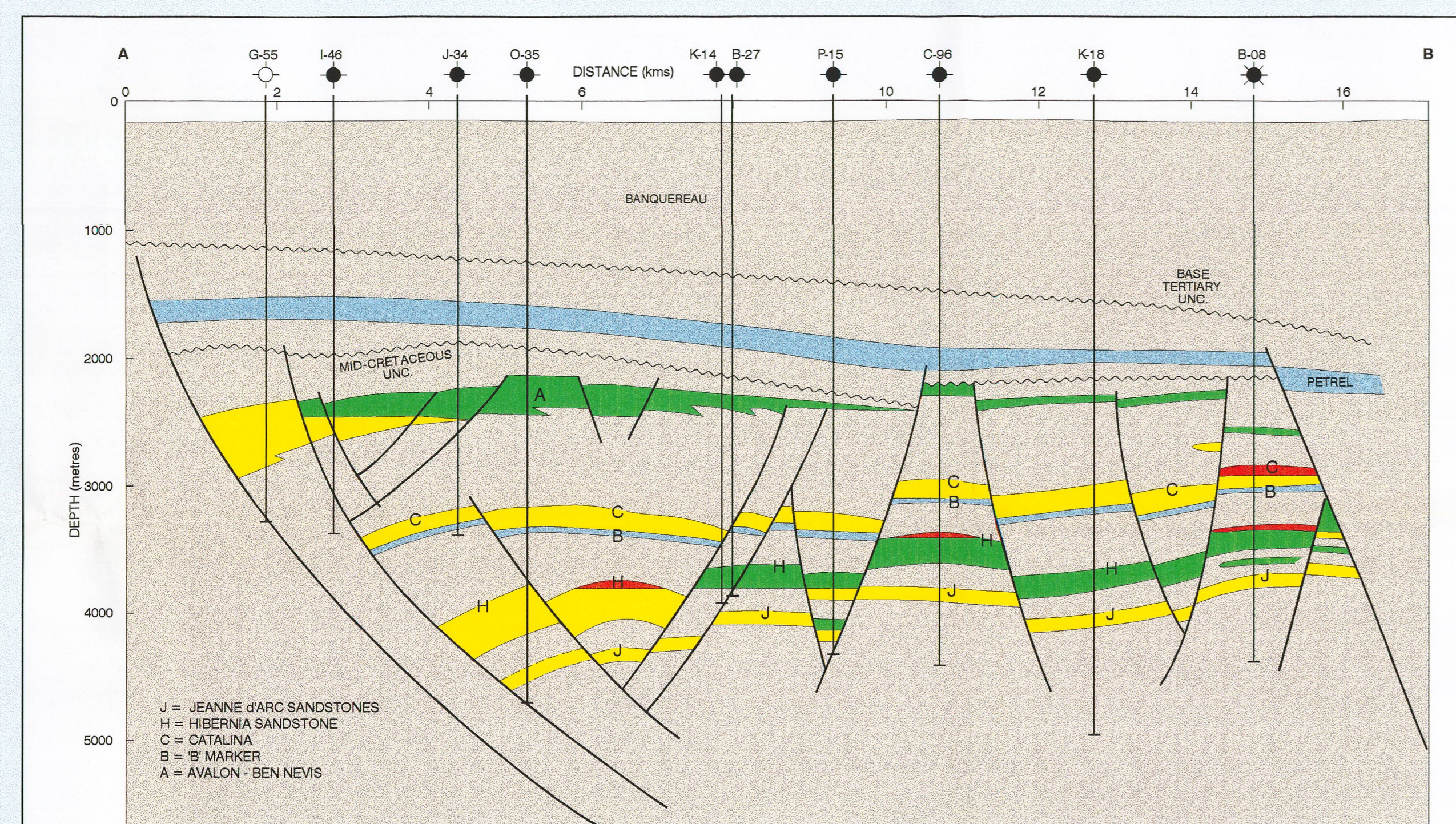
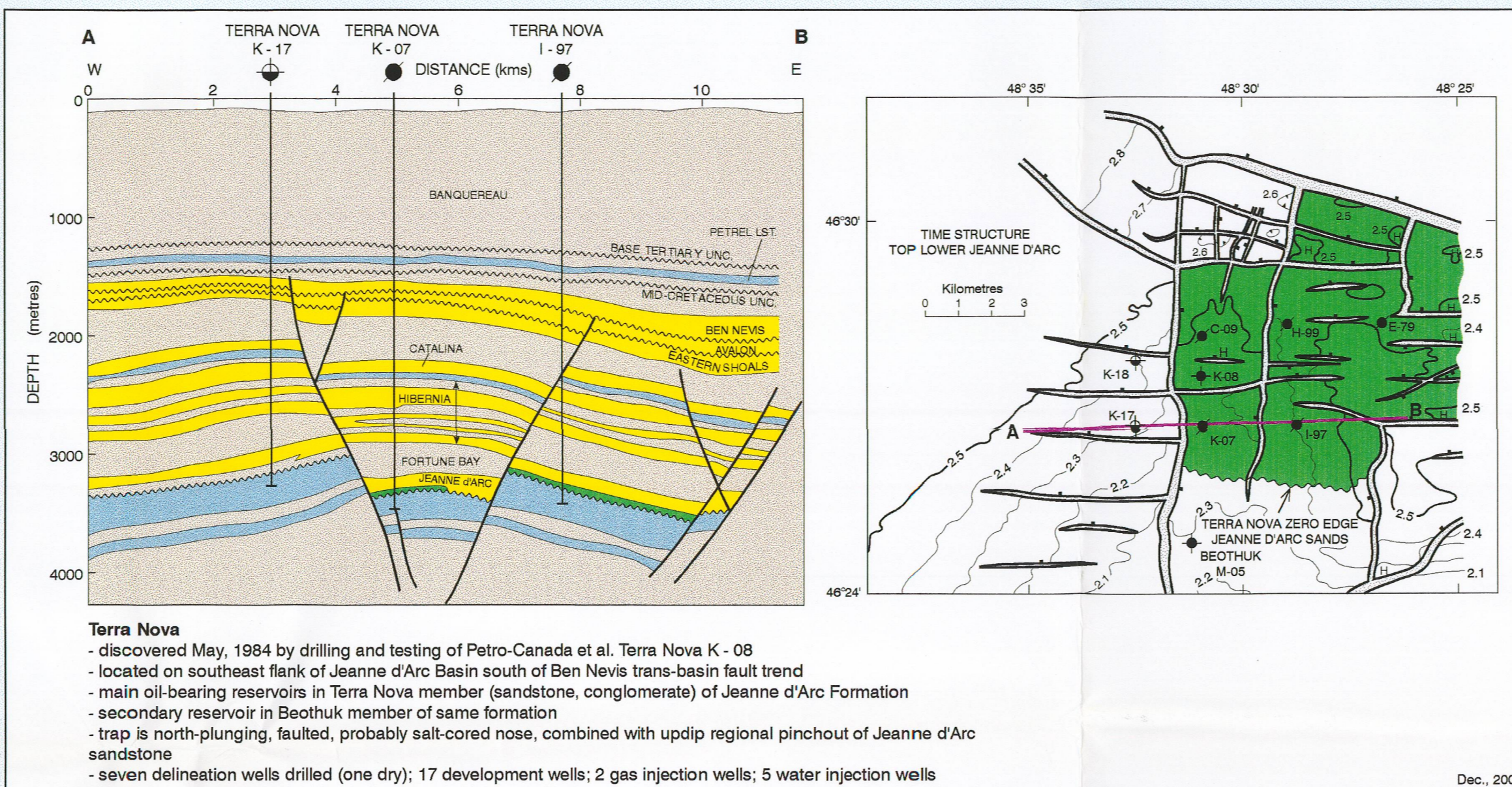


Figure 3



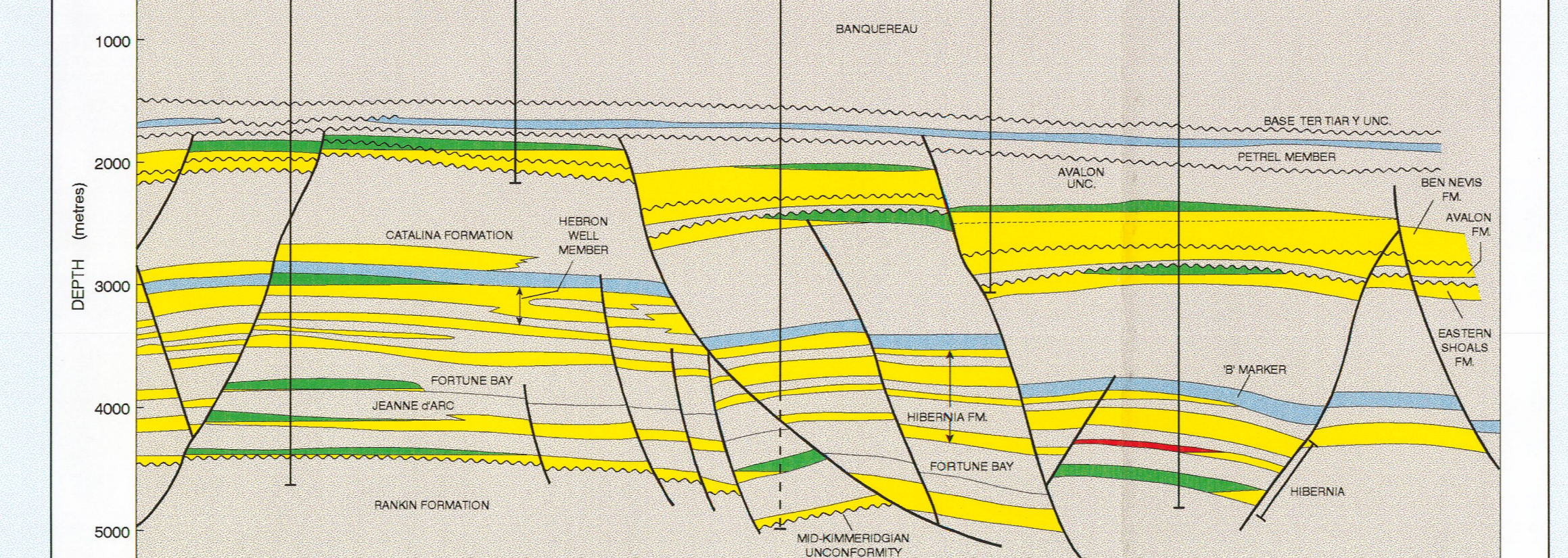
Hibernia - discovered September, 1979 by drilling and testing of Chevron et al. Hibernia P-15 - located at western margin of Jeanne d'Arc Basin along Ben Nevis trans-basin fault trend - main oil-bearing reservoirs in lower zone of Hibernia Formation and Avalon (Ben Nevis Formation sandstones); secondary reservoirs in Jeanne d'Arc Formation (oil) and Catalina Formation (oil and gas) - trap is rollover anticline into Mura basin-bounding fault, modified by salt migration and faulting along Ben Nevis fault trend - ten delineation wells drilled; one dry; 26 development wells; 8 gas injection wells; 12 water injection wells; 3 wells of unknown designation

Figure 4



Terra Nova - discovered May, 1984 by drilling and testing of Petro-Canada et al. Terra Nova K-08 - located on southeast flank of Jeanne d'Arc Basin south of Ben Nevis trans-basin fault trend - main oil-bearing reservoirs in Terra Nova member (sandstone, conglomerate) of Jeanne d'Arc Formation - secondary reservoir in Beothuk member of same formation - trap is north-plunging, faulted, probably salt-cored nose, combined with updip regional pinchout of Jeanne d'Arc sandstone - seven delineation wells drilled (one dry); 17 development wells; 2 gas injection wells; 5 water injection wells

Figure 5

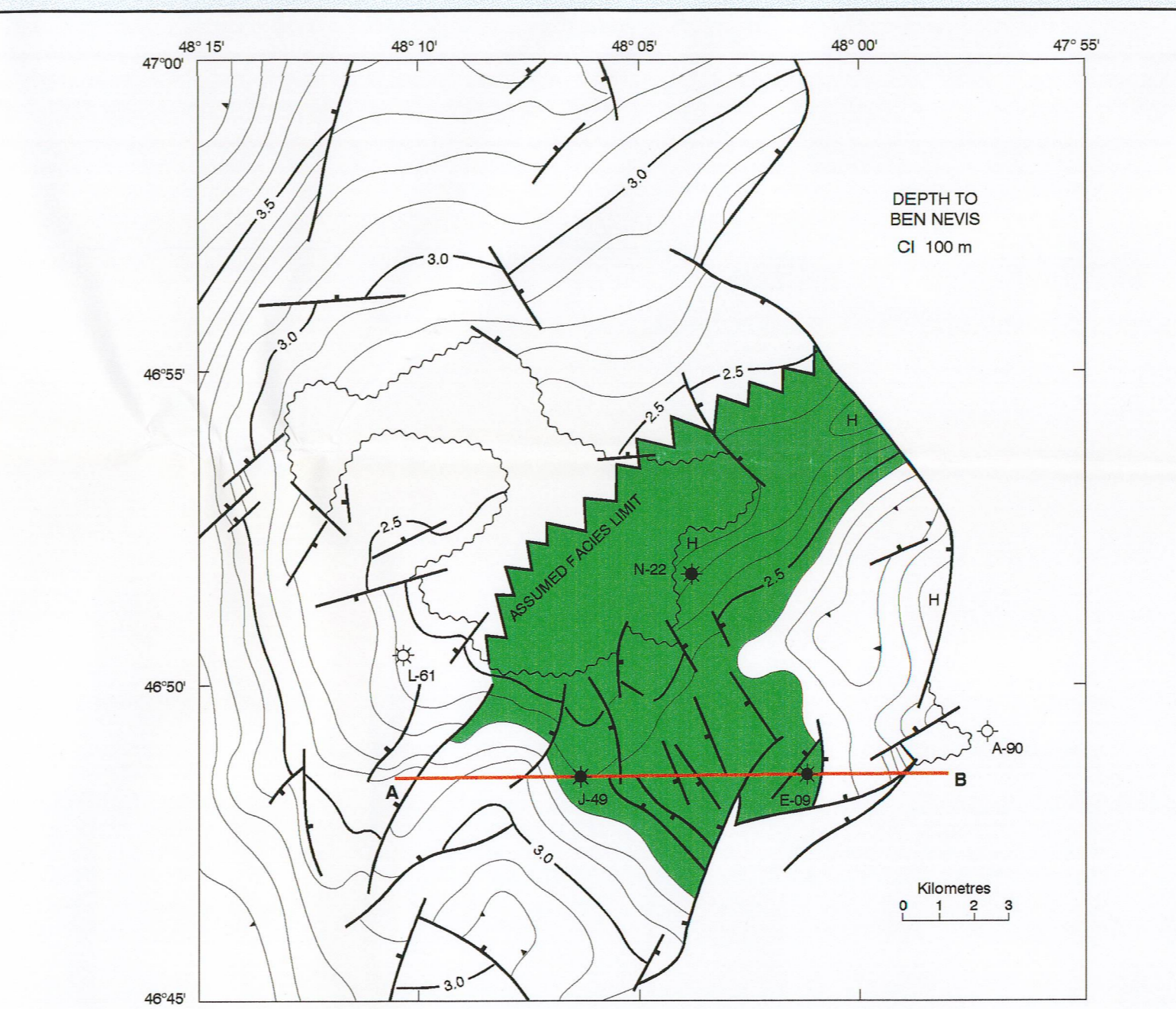


Ben Nevis - discovered July, 1980 by drilling and testing of Mobil et al. Ben Nevis I-45 - located within Jeanne d'Arc Basin on Ben Nevis trans-basin fault trend - sandstone reservoirs in Hibernia Formation (oil zone - gas/condensate); Avalon Formation (gas/condensate); and Ben Nevis Formation (oil) - trap is down-to-basin fault block - 1 delineation well drilled

Hebron - discovered July, 1981 by drilling and testing of Mobil et al. Hebron I-13 - located within Jeanne d'Arc Basin on Ben Nevis trans-basin fault trend - oil-bearing reservoirs in basal sandstone of Jeanne d'Arc Formation; Hibernia Formation (upper zone); Catalina Formation; and Ben Nevis Formation - trap is horst-graben pair - two delineation wells drilled (North Trinity H-71 - dry)

West Ben Nevis - discovered June, 1985 by drilling and testing of Petro-Canada et al. West Ben Nevis B-85 (fermout from Mobil) - located at eastern margin of Jeanne d'Arc Basin on Ben Nevis trans-basin fault trend - oil-bearing sandstone reservoirs in Jeanne d'Arc Formation (Beothuk member); Avalon Formation (Beothuk member); and Ben Nevis Formation - trap is down-to-basin, tilted fault block between Ben Nevis and Hebron fault structures

Figure 6



WhiteRose - discovered December, 1984 by drilling and testing of Husky-Bow Valley et al. WhiteRose N-22 (fermout from Mobil) - located at eastern margin of Jeanne d'Arc Basin - main oil and gas-bearing reservoir in sandstones of Ben Nevis Formation; secondary reservoirs in lower zone of Hibernia Formation (oil); Avalon Formation (gas/condensate); and South Mara Member of Banquetueau Formation (gas/condensate) - trap is large, probably salt-cored, complexly faulted dome sealed by Nautilus and Dawson Canyon shales - eight delineation wells drilled (of which three oil and gas, two gas, one oil)

Figure 7