GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

PROSPECTIVITY OF STATE ACREAGE RELEASE AREAS L06-1, L06-2, L06-3, L06-4, AND L06-5, OFFSHORE NORTHERN CARNARVON BASIN

Perth 2006

Prospectivity of State Acreage Release Areas L06-1, L06-2, L06-3, L06-4 and L06-5, offshore Northern Carnarvon Basin

Introduction

The Northern Carnarvon Basin, particularly the Barrow and Dampier Sub-basins, is one of the more intensively explored areas of Australia. Islands such as Barrow, Airlie, Varanus, and Thevenard provide excellent locations for production facilities and bases (Fig. 1).

Area L06-1 covers parts of the Dampier Sub-basin and the Lambert and Peedamullah Shelves (Fig. 2). It is only 10 km east of the Harriet Joint Venture production licences and 20 km southwest of the Stag (oil) production licence. Area L06-2 is immediately southwest of the Thevenard Production Facility, in the southern part of the Barrow Sub-basin. Areas L06-3 and L06-5 lie on the Peedamullah Shelf, south and southwest respectively of the Thevenard Production Facility (Fig. 3). Area L06-4 lies in the easternmost part of the Exmouth Sub-basin (Fig. 3).

Water depths are less than 50 m in the release areas, which is ideal for the use of jackup drilling rigs. There is good coverage of 2D seismic data (Figs 2 and 3) and partial coverage of 3D seismic data in the release areas (see also **Available data** section — **Data listings** on this CD).

Stratigraphy

Major depocentres in the basin are estimated to contain up to 15 km of Mesozoic sedimentary rocks (Fig. 4). In the Barrow, Dampier, and Exmouth Sub-basins, Mesozoic and Cenozoic successions overlie (commonly at considerable depth) Paleozoic sedimentary rocks.

Triassic, Jurassic to lowermost Cretaceous, and Lower to Upper Cretaceous (siliciclastic) successions reflect the development of the Northern Carnarvon Basin as a rift system related to breakup of Greater India and Australia. The Triassic succession is pre-rift trough infill, and the Jurassic succession represents rift-valley infill. Post-breakup trough-infill was formed by progradation of the continental shelf in the Upper Cretaceous and Cenozoic, and is characterized by carbonate-dominated, restricted-circulation trailing-edge deposition (Hocking, 1988).

Structure

The Northern Carnarvon Basin is dominated by southwest-trending troughs, the most prospective of which are the Barrow and Dampier Sub-basins. The Dampier Sub-basin may be regarded as a northeastern extension of the Barrow Sub-basin, the two distinguished from each other by a gradual change in structural style.

The Barrow Sub-basin contains more than 10 km of Jurassic–Cretaceous strata, and has been largely controlled by the east-trending Long Island Fault System and northeast-trending Flinders Fault System, which form the boundary between the sub-basin, and the Peedamullah Shelf to the southeast (Fig. 1). The Dampier Sub-basin is flanked to the southeast by the Lambert Shelf. A mid-basin high formed by the Alpha Arch and Rankin Platform bound the Barrow and Dampier Sub-basins to the west and northwest respectively.

The Exmouth Sub-basin forms part of the Exmouth–Barrow–Dampier intracratonic rift system of the Northern Carnarvon Basin. The Exmouth Sub-basin has been defined as the area immediately to the east of the Exmouth Plateau where Jurassic syn-rift sediments attain significant thickness (Tindale et al., 1998).

The Peedamullah Shelf is a northwest-dipping block of Paleozoic and Triassic strata downthrown by the Sholl Fault near its eastern margin (Fig. 1). The shelf extends both onshore and offshore, and is covered by an onlapping veneer of Cretaceous and Tertiary sedimentary rocks.

The Lambert Shelf lies to the north of the Precambrian Pilbara Craton. The western and northwestern boundaries of the shelf are defined by the down-to-the-west Sholl Fault and its connecting northeast-trending faults (West Australian Petroleum Ltd, 1979).

Petroleum geology

The petroleum potential of the region is demonstrated by its numerous oil and gas fields. The largest oilfield in Western Australia, Barrow Island oilfield, had in-place oil of 200 GL (1250 MMBBL; Ellis et al., 1999).

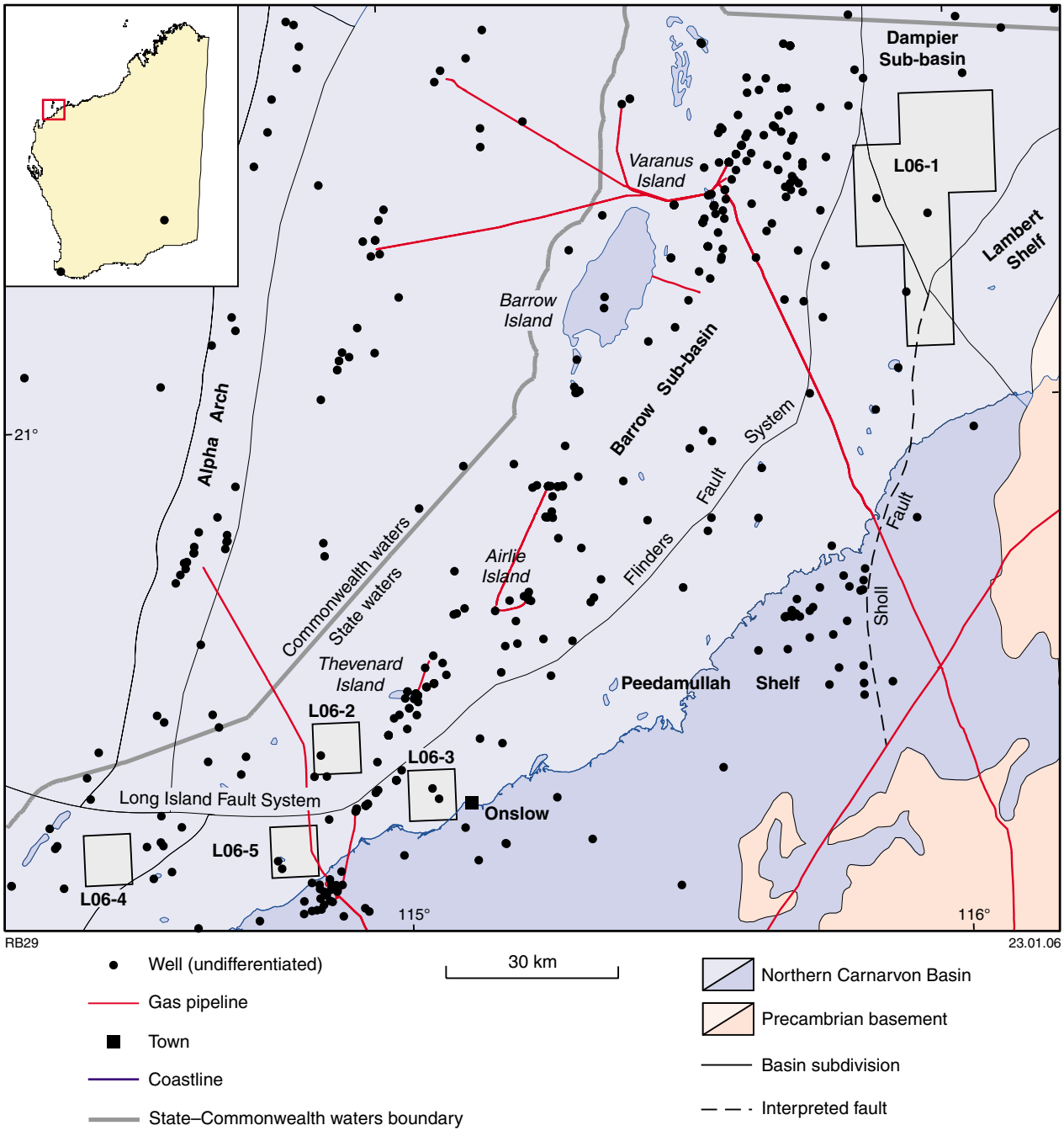

Figure 1. Simplified tectonic subdivisions of Northern Carnarvon Basin and release areas

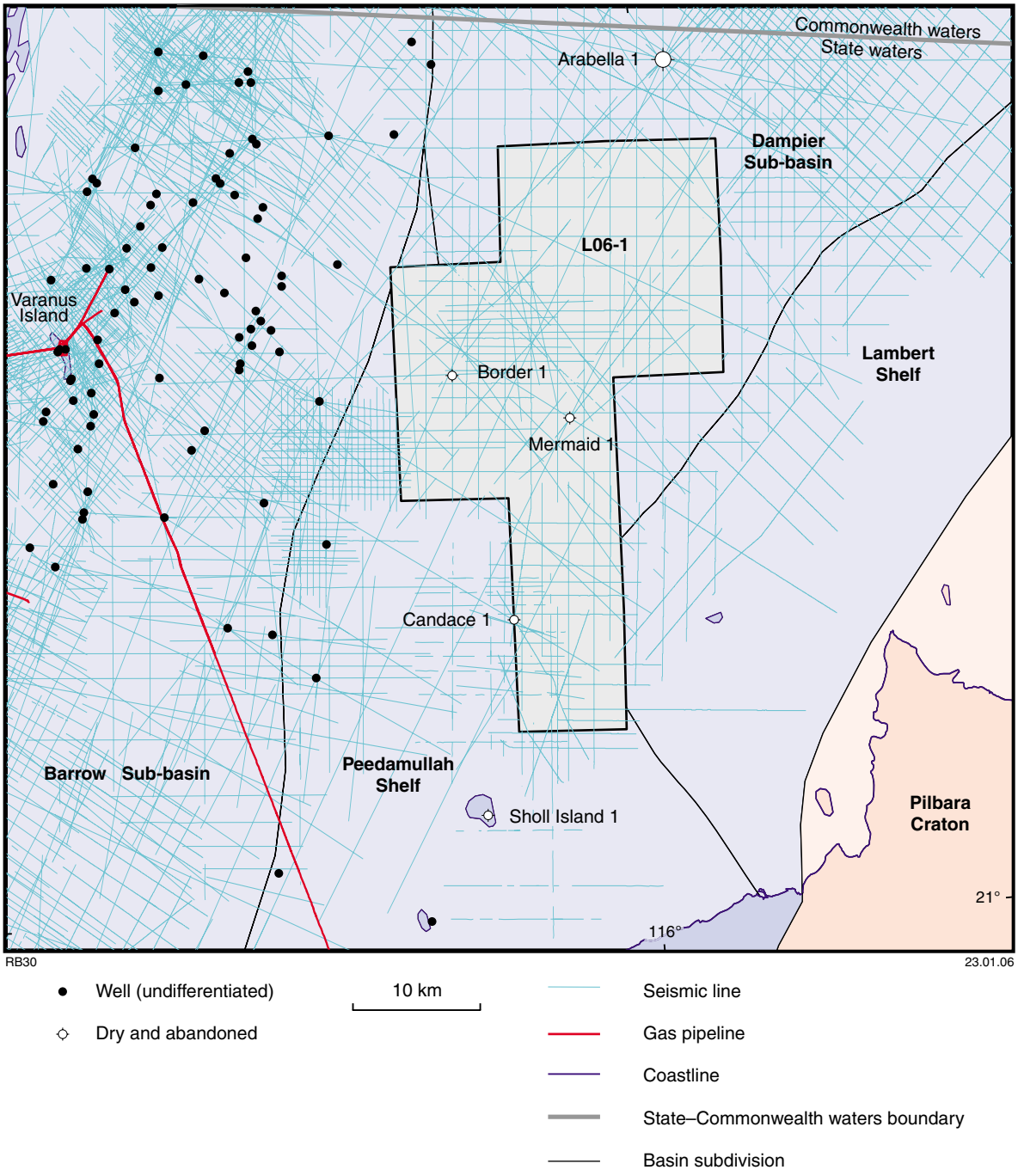

Figure 2. Seismic lines, wells, and release area L06-1

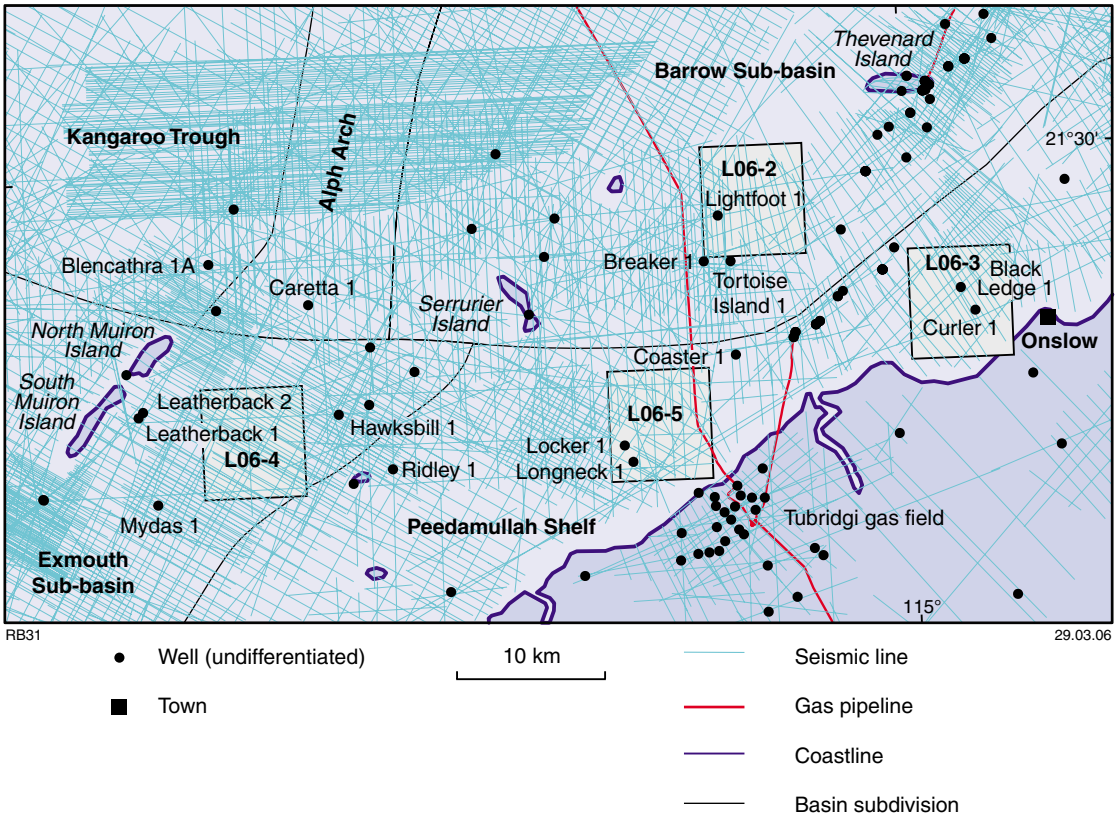

Figure 3. Seismic lines, wells, and release areas L06-2, L06-3, L06-4, and L06-5

The offshore Northern Carnarvon Basin is Australia's leading producer of both liquid hydrocarbons and gas. To date, most oil production has come from the Barrow Sub-basin. Key factors leading to this success include: good Mesozoic source rocks, which have generated hydrocarbons over a long period of time; Lower Cretaceous reservoir rocks with excellent porosity and permeability; and a thick and effective regional seal (Muderong Shale; Baillie and Jacobson, 1997).

Most of the oil fields discovered in the Barrow Sub-basin rely on fault closure, where the Winning Group shales (Muderong Shale and Gearle Siltstone) provide a seal for accumulations in the Barrow Group, Windalia Sandstone Member, and Birdrong Sandstone (West Australian Petroleum Ltd, 1995).

The Exmouth Sub-basin and adjacent Kangaroo Trough have had numerous petroleum finds since 1998. These include oil at Coniston 1, Stybarrow 1, Stickle 1, and Harrison 1, as well as oil and gas at Vincent 1, Enfield 1, Laverda 1, and Ravensworth 1.

Table 1 lists a number of wells drilled in and around the Northern Carnarvon Basin release areas. Areas L06-2, L06-3, and L06-5 lie within 10 km of the Thevenard production area. Within area L06-1, Border 1 had excellent gas shows. Bordering area L06-2, Lightfoot 1 had good oil shows. Within 20 km of area L06-4, Leatherback 1 had excellent oil shows, Blencathra 1 had good oil and gas shows, and Caretta 1 and Ridley 1 had good oil shows. Within L06-5, Longneck 1 had good oil shows and 3 km to the northeast of L06-5 Coaster 1 had excellent oil shows.

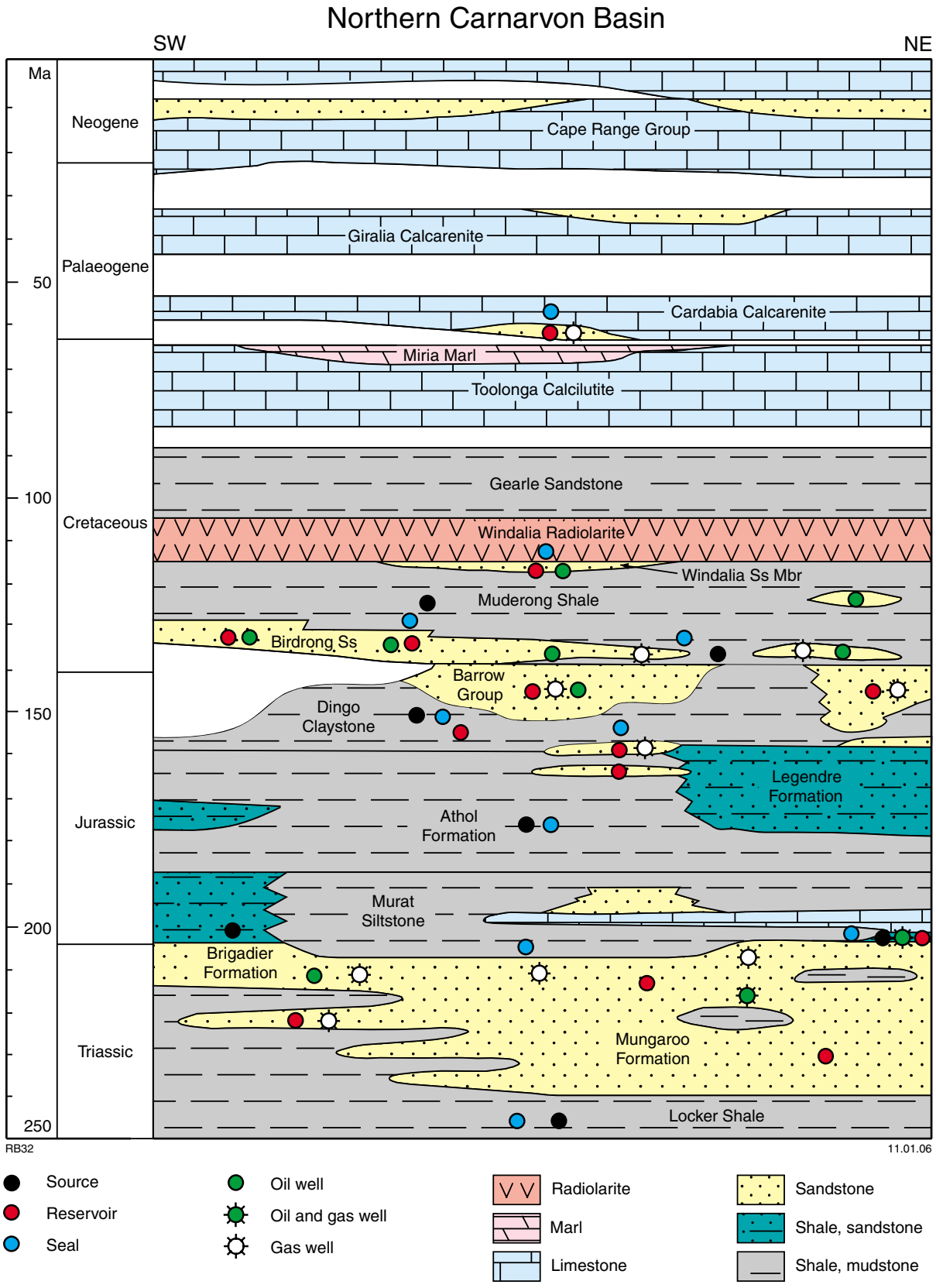

Figure 4. Stratigraphy and petroleum systems of the Northern Carnarvon Basin

Table 1. Selected wells drilled in and around L06-1, L06-2, L06-3, L06-4, and L06-5

Well name	*Type*	*Latitude*	*Longitude*	*Kelly bushing elevation (m AHD)*	*Total depth (m)*	*Bottomed in*	*Year*	*Operator*	*Status 1*	*Status 2*	*Gas show*	*Oil show*
Arabella 1	NFW	20°28'07.66"	116°01'56.61"	35	2 209	Permian	1983	Occidental	Dry	P&A	Nil	Nil
Black Ledge 1	NFW	21°36'45.42"	115°02'36.97"	32	2 680	Triassic	1991	WAPET	Dry	P&A	Nil	Poor
Blencathra 1	NFW	21°34'15.73"	114°25'45.64"	22	1 510	Jurassic	1995	BHP	Oil, gas	P&A	Good	Good
Border 1	NFW	20°40'11.89"	115°52'23.25"	37	935	Jurassic	1997	Ampolex	Gas	P&A	Excellent	Fair
Breaker 1	NFW	21°35'06.41"	114°50'04.00"	30	1 250	Barrow Group	1998	Apache	Dry	P&A	Nil	Nil
Candace 1	NFW	20°49'32.64"	115°55'11.82"	32	2 063	Permian	1982	Occidental	Dry	P&A	Nil	Nil
Caretta 1	NFW	21°36'21.52"	114°26'1.96"	33	1 782	Jurassic	1991	Lasmo	Oil	P&A	Fair	Good
Coaster 1	NFW	21°39'22.91"	114°51'26.41"	29	1 112	Cretaceous	1999	WAPET	Oil	P&A	Poor	Excellent
Curler 1	NFW	21°37'48.24"	115°03'16.92"	29	759	Jurassic	1997	WAPET	Dry	P&A	Poor	Poor
Hawksbill 1	NFW	21°41'18.75"	114°31'49.61"	29	2 112	Triassic	1993	Hadson	Dry	P&A	Nil	Nil
Leatherback 1	NFW	21°41'03.30"	114°21'59.35"	26	2 258	Triassic	1991	Lasmo	Oil	P&A	Fair	Excellent
Leatherback 2	EXT	21°40'49.28"	114°22'13.64"	37	1 840	Triassic	1997	Apache NW	Dry	P&A	Fair	Fair
Lightfoot 1	NFW	21°33'03.30"	114°50'50.53"	30	1 360	Cretaceous	1993	WAPET	Oil	P&A	Fair	Good
Locker 1	STR	21°43'16.72"	114°45'47.07"	5	766	Triassic	1967	WAPET	Dry	P&A	Poor	Nil
Longneck 1	NFW	21°44'02.88"	114°46'10.51"	31	1 410	Triassic	1997	Apache NW	Oil	P&A	Fair	Good
Mermaid 1	NFW	20°41'50.22"	115°57'44.29"	31	1 271	Precambrian	1978	WAPET	Dry	P&A	Nil	Nil
Mydas 1	NFW	21°45'02.39"	114°22'45.28"	31	1 476	Triassic	1993	Hadson	Dry	P&A	Nil	Poor
Ridley 1	NFW	21°43'53.60"	114°34'21.62"	25	1 029	Jurassic	1996	Apache NW	Oil	P&A	Poor	Good
Sholl Island 1	STR	20°57'01.24"	115°54'01.79"	9	1 272	Permian	1967	WAPET	Dry	P&A	Nil	Nil
Tortoise Island 1	STR	21°35'08.29"	114°51'22.80"	9	2 134	Jurassic	1966	WAPET	Dry	P&A	Nil	Nil

NOTES:
Apache: Apache Energy Limited
Apache NW: Apache Northwest Pty Ltd
BHP: BHP Petroleum (Australia) Pty Ltd
Hadson: Hadson Carnarvon Pty Ltd
Lasmo: Lasmo Oil (Australia) Limited
WAPET: West Australian Petroleum Pty Ltd
EXT: extension
NFW: new field wildcat
STR: stratigraphic
P&A: plugged and abandoned
Occidental: Australian Occidental Oil Pty Ltd

References

BAILLIE, P. W., and JACOBSON, E. P., 1997, Prospectivity and exploration history of the Barrow Sub-basin, Western Australia: APPEA Journal, v. 36(1), p. 117–135.

ELLIS, G. K., PITCHFORD, A., and BRUCE, R. H., 1999, Barrow Island Oil Field: APPEA Journal, v. 39(1), p. 158–176.

HOCKING, R. M., 1988, Regional geology of the Northern Carnarvon Basin, *in* The North West Shelf, Australia *edited by* P. G. PURCELL and R. R. PURCELL: Petroleum Exploration Society Australia, North West Shelf Symposium, Perth, W.A., 1988, Proceedings, p. 97–114.

TINDALE, K., NEWELL, N., KEALL, J., and SMITH, N., 1998, Structural evolution and charge history of the Exmouth Sub-basin, Northern Carnarvon Basin, Western Australia, *edited by* P. G. PURCELL and R. R. PURCELL: The Sedimentary Basins of Western Australia 2: Proceedings of Petroleum Exploration Society of Australia Symposium, Perth, W.A., 1998, p. 447–472.

WEST AUSTRALIAN PETROLEUM LTD, 1979, Annual Petroleum Exploration Appraisal of the Offshore Carnarvon Basin Permit WA-23-P from 4th October 1978 to 3rd October 1979: Western Australia Geological Survey, Statutory petroleum exploration report, S5023 A8 (unpublished).

WEST AUSTRALIAN PETROLEUM LTD, 1995, Annual Petroleum Exploration Appraisal of the Offshore Carnarvon Basin Permits WA-24-P and TP/3 from 22 June 1994 to 21 June 1995: Western Australia Geological Survey, Statutory petroleum exploration report, S7003 R1 A2 (unpublished).