

HISTORY of PETROLEUM EXPLORATION

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Chapter 3

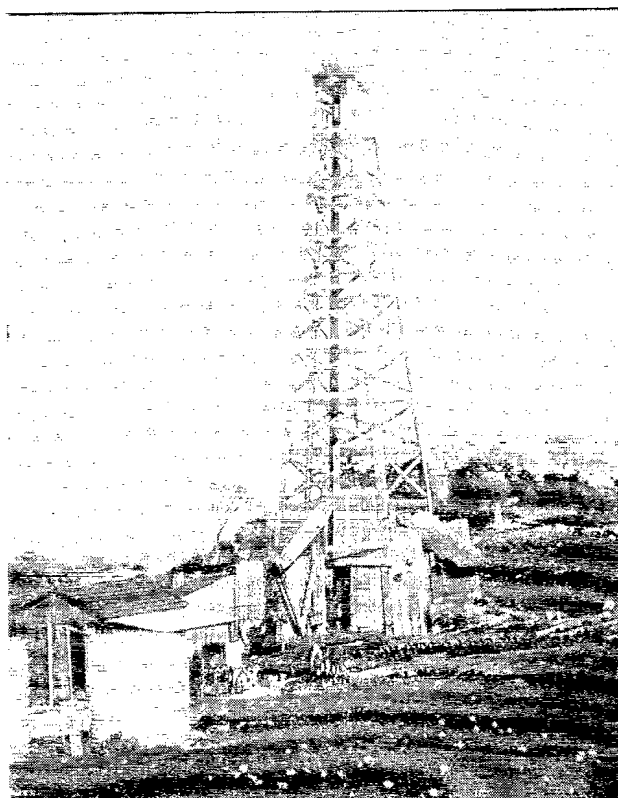
EARLY EXPLORATION: 1866-1950

Petroleum exploration commenced near the Otway Basin, rather than within it, in 1866, when a well was dug to a depth of 7.6 m in the Coorong area. Exploration was initiated following the discovery of a rubber-like material within dried up interdune lakes landward of the Coorong in 1852. The material, named coorongite, was thought to be weathered crude oil, the product of oil seeps. Coorongite was eventually confirmed as desiccated algal material (*Botryococcus braunii*) which grows in freshwater lakes following winter rains.

The first exploration drilling was carried out by the Salt Creek Petroleum Co. in 1882 at Alfred Flat near Salt Creek (north of the Otway Basin). The Alfred Flat well was drilled to TD 281 m to find a subsurface source of the coorongite 'seeps', but no hydrocarbons were reported. This well was the first serious attempt to find oil in Australia. Salt Creek Petroleum drilled at least one more hole to 100 m in the same area before going into liquidation in 1883.

Exploration continued in the Otway Basin with promoters forming companies and obtaining public finances by using the presence of coorongite and stranded coastal bitumen as evidence of locally sourced oil. The late 1800s promoter-funded drilling operations in the Otway Basin were unsuccessful. A well was reported to have been drilled in the Hundred of Riddoch to a depth of 318 m by the Adelaide Oil Exploration Co. (drilling date possibly 1915). Robe 1, drilled 12.5 km east of Robe during 1915-16 by South Australian Oil Wells Co., was a serious attempt to test the anticlinal theory of oil entrapment. Robe 1 was proposed by Dr Herbert Basedow, a former South Australian Government Geologist who believed coorongite was weathered crude oil. The well reached 1 373 m in what is believed to be sediments of the Crayfish Group. Limited data are available on Robe 1 but it was reported that gas-cut water was recovered at several depths, and most significantly below 917 m, during the cable tool operation; the gas was reported to be inflammable. The well did not test an anticline but was located on a remnant Pleistocene coastal sand-dune known as the Woakwine Range.

South Australian Oil Wells continued drilling operations from 1918 to 1922 in the Hundreds of Caroline and Hindmarsh, with five wells drilled to depths ranging from 256 to 556 m. All are reported to have finished in the Early Tertiary Wangerrip Group with no hydrocarbon shows. Near Albert Flat in the Coorong area the Coorong Oil Co. and Enterprise Oil Co. carried out a program of six wells to depths ranging from 137 to 284 m between 1924 and 1933. This was in spite of an opinion given by a geologist, Professor Sir Edgeworth



Drilling Robe 1, 1915. The well was sited on the Woakwine Range, a fossil sand dune, in the mistaken belief that it was a surface anticline. The well encountered gas shows in the Eumeralla Formation. Photo 28775.

David in 1921, that coorongite was a vegetable scum which occasionally filled dried up swamps and was not related to crude oil pools.

Further drilling was carried out in the period 1923 to 1934 by a number of companies including Associated Oil Co., Southern Ocean Oil Co., Point Addis Oil Wells NL, Oil Search Ltd and Amalgamated Oil Wells. Five wells were drilled to depths ranging from 357 to 811 m and included Comaum bore in the north of the basin, which reached a total depth in Early Cretaceous sediments. Enterprise Oil drilled two shallow wells during 1933-34 in the Hundred of Lacepede. None of the wells encountered hydrocarbons.

The unsuccessful drilling and lack of outcrops led to the need for geophysical methods to determine the subsurface geology prior to drilling. The first known geophysical exploration for petroleum in the Otway Basin was a magnetometer survey on the Knight Dome by J.M. Rayner in 1930 (which coincided with the drilling of Knight Dome 2 in the same

year). The South Australian Producers Oil Syndicate drilled a 372 m well in the Hundred of Blanche at some time in the period 1940-1944.

The first aeromagnetic survey in the Otway Basin was flown in 1948 by Zinc Corporation between Cape Jaffa and Portland. Gravity surveys commenced in 1949 when the Bureau of Mineral Resources (BMR) conducted a traverse from Adelaide to Melbourne. BMR and the South Australian Department of Mines, together with the Frome-Broken Hill group, recorded a number of gravity and aeromagnetic surveys from 1949 to 1960 in an effort to obtain a better understanding of the subsurface geology. Mines Department regional gravity surveys defined the Robe-Penola Trough and the Kalangadoo and Beachport basement highs.

COMMENCEMENT OF MODERN EXPLORATION: 1959-80

The first petroleum licence issued in the Otway Basin in South Australia was OEL 22 granted to General Exploration Co. (Aust.) Pty Ltd in May 1959. The licence covered all of the onshore area of the Otway Basin and the coastal offshore three nautical mile strip. The licence was later split into PEL 8 for the onshore area and EPP 8 for the offshore area. During 1960-61, General Exploration recorded a seismic survey and during 1961-62 Beach Petroleum NL also recorded further seismic within PEL 8.

After a break of almost 20 years, drilling recommenced in 1960 at Tarpeena 1, 8 km east of Nangwarry. Drilling was undertaken by the Kaniva Syndicate and the well reached TD 622 m in the Wangerrip Group, but no hydrocarbons were encountered. The first drilling within the original exploration licence commenced in 1961 when, in a series of farm-out agreements, Oil Development NL drilled Penola 1 and the South East Oil Syndicate Ltd drilled Beachport 1. Penola 1 recorded minor gas shows in the Crayfish Group, but failed to reach the Pretty Hill Formation sands.

The early seismic surveys used explosives as an energy source and were displayed as single fold reflection data. The quality was poor to fair and structural mapping was only possible to the base of the Tertiary. In 1962, Oil Development tried a new method of determining subsurface structure before drilling. Five holes were drilled on the Mount Salt structure all to ~300 m. Depth intersections of the Tertiary formations were mapped to determine the shape and location of the structure before Mount Salt 1 was drilled to TD 3 061 m in the Late Cretaceous Sherbrook Group.

The same structural drilling technique was used by Beach Petroleum in another farm-out arrangement in PEL 8. Nine holes of 366 to 488 m were drilled to define the Geltwood Beach structure before Geltwood Beach 1 was drilled to 3 749 m in 1963. Beach Petroleum recorded a small refraction seismic survey over the Geltwood Beach structure prior to commencing the well. In August 1961, OEL 26 (offshore) was granted to Hematite Petroleum Pty Ltd. The licence covered most of the offshore Otway Basin seaward of the three nautical mile strip; OEL 26 was later renamed EPP 2.

The South Australian Department of Mines conducted extensive regional seismic surveys between 1961 and 1964. Alliance Oil Development Aust. NL farmed into PEL 8 and

carried out gravity and seismic surveys in 1964. At the same time, BMR undertook two small experimental seismic surveys in the South Australian portion of the basin using a vibroseis energy source in one survey. Alliance Oil drilled Kalangadoo 1 in 1965 to TD 2 758 m. The well penetrated a thin Crayfish Group before entering fractured Palaeozoic metasediments. A test of the basement produced a commercial flow of CO₂, but declining pressure indicated that the resource was small.

In 1966, Alliance Oil recorded gravity and seismic surveys, with further seismic in 1967. The first offshore seismic in the South Australian Otway Basin was recorded by Esso Exploration in 1966, and a total of five surveys were completed in South Australian waters to 1969. Energy sources were explosives or an oxygen-propane mixture (aquapulse).

A drilling program by Alliance Oil in 1967 included Caroline 1 southeast of Mount Gambier. A flow of CO₂ was tested from the Late Cretaceous Waarre Sandstone, and the well was completed as a producer. A small purification plant was built and commercial CO₂ production commenced in 1968. Further drilling by Alliance Oil in 1967 included Robertson 1 and 2 north of Penola near the northern margin of the basin; both were abandoned after failing to intersect reservoir rocks. The company also drilled Lake Bonney 1 southwest of Mount Gambier, which was plugged and abandoned after reaching TD 2 111 m in Early Cretaceous Eumeralla Formation sediments.

Esso drilled the first offshore well in the South Australian Otway Basin in 1967. Crayfish 1A was plugged and abandoned at 3 199 m, but found a thick porous section of Early Cretaceous Pretty Hill Formation with minor oil and gas shows.

In 1968, a number of new onshore petroleum licences and offshore permits were granted. Hematite Petroleum obtained EPP 1 and 3 as extensions to EPP 2, and Planet Exploration Co. Pty Ltd was granted PEL 1 and 2 along the northern onshore margin of the basin.

Esso continued offshore drilling in 1968 to earn an interest in the Hematite Petroleum EPP 2 area. Esso's second well, Argonaut A-1 which proved to be a dry hole, was drilled to 3 707 m in the Late Cretaceous Waarre Formation. Esso continued an expanded exploration program in 1969 with a seismic survey and three onshore wells in PEL 8 as part of a farm-in arrangement to earn an interest in the licence. The wells tested gravity highs which represented basement structures with Early Cretaceous targets. Lake Eliza 1, drilled on the Lake Eliza basement high on the southern margin of the Robe Trough, reached TD 1 473 m in metasediments and tested a gas show at the top of the Pretty Hill Formation. A non-commercial flow of gas with a large water recovery was the result. Lake George 1 on the Beachport basement high failed to find Early Cretaceous reservoirs and was plugged at TD 1 369 m in weathered tuff basement. Lucindale 1 in the north of the basin was drilled on the Lucindale gravity high. The well penetrated the Crayfish Group target but recorded no hydrocarbons, and was plugged after reaching 980 m in quartzose metasediments.

Beach Petroleum recorded a small onshore seismic survey near Geltwood Beach in 1969. Also in 1969, the Lamont-Doherty Geological Observatory of Columbia University

(USA) conducted a continental margins seismic survey which included two seismic lines over the continental margin at the southwestern extremity of the Otway Basin. In 1970, the only drilling was offshore at Chama 1A in EPP 2, by Esso. The well reached 2 748 m in the Laira Formation but was plugged before reaching the Pretty Hill Formation target. Alliance attempted to improve seismic quality onshore by using a weight-drop energy source. In 1970, Hematite Petroleum recorded a reconnaissance seismic and gravity survey from southeastern Kangaroo Island to the northwestern margin of the Otway Basin. Esso also tried weight-drop as an onshore seismic energy source in 1971.

In 1972, Shell Development (Aust.) Pty Ltd conducted the Petrel Continental Margins Seismic Survey. Four lines of the survey were recorded between the 1 000 and 5 000 m isobath in the offshore Otway Basin area of South Australia.

Onshore drilling resumed in 1973. Douglas Point 1 was drilled by General Exploration and tested Late Cretaceous Timboon Sandstone to a depth of 1 205 m. Diamond Swamp 1 and Beachport East 1 were drilled on basement highs by John Henry Resources. Both were relatively shallow and reached total depth in quartzite and phyllite basement. Lake Eliza 2 was drilled updip of Lake Eliza 1 which had tested Pretty Hill gas shows. The well was drilled by General Exploration. The sands producing the gas shows in the No. 1 well had pinched out on the flanks of the basement high. Gas shows in other Pretty Hill sands were tested but recovered only water. During 1972-73, Esso conducted offshore seismic surveys in the vicinity of Crayfish 1A using airgun energy sources. This marked the introduction of the airgun as the preferred offshore seismic energy source.

Offshore in 1973, Esso drilled Neptune 1 to 2 436 m to test the Crayfish Group, and Trumpet 1 tested the same target to 2 256 m; both wells proved dry and were plugged. Alliance Oil carried out the Tartwaup Seismic Survey using vibroseis to improve data quality in a poor record area. Following the Tartwaup Survey, vibroseis became the accepted onshore energy source for the Otway Basin.

The last well drilled by Esso offshore in South Australia was Morum 1 in 1975, near the border of EPP 2 and EPP 14 (EPP 14 had been granted in 1974). Morum 1 was plugged after reaching TD 2 439 m in the Late Cretaceous Belfast Mudstone and failing to reach the Waarre Sandstone target. Onshore, Burrungule 1 was drilled in PEL 8 by Alliance Oil. The well reached 2 438 m in the Eumeralla Formation with no significant hydrocarbons.

Kentgrove 1 was drilled onshore by Shoreline Exploration Co. in 1976. The shallow well reached 991 m in the Late Cretaceous Timboon Sand. The largest offshore permit, EPP 2, was surrendered by Hematite Petroleum in 1976.

IMPROVED TECHNOLOGY: 1980-94

Petroleum exploration in the basin ceased until 1980 when Australian Aquitaine Petroleum Pty Ltd recorded the Rendelsham Seismic Survey in 1980, which marked the beginning of a new era of better seismic resolution. In the same year, Alliance Oil recorded an onshore seismic survey in the Caroline CO₂ field following the grant of the PPL 21 production licence. Western Mining Corporation was

granted PEL 18 in the north of the basin in 1981 and conducted a seismic survey in the same year. Aquitaine recorded further seismic surveys in 1981 and 1982. Offshore, Ultramar Australia Inc. took up EPP 18 over the southeastern end of the basin during 1981, and carried out two seismic surveys during 1981 and a further survey in 1982. In 1982, drilling onshore resumed after a six-year break, when Aquitaine drilled Banyula 1 to 2 789 m in PEL 8. The well penetrated the Pretty Hill Formation but found no significant hydrocarbons.



Rendelsham Seismic Survey (PEL 8), Canunda National Park, 1980. Photo 42324.

Ultramar followed up its offshore seismic surveys with the drilling of Breaksea Reef 1 in 1982. The well reached TD 4 468 m after a number of down-hole mechanical problems. Gas shows were recorded in the Late Cretaceous Waarre Sandstone, and a possible oil reservoir was encountered in intra Belfast sands. The Waarre gas zone appeared to be over-pressured and because of parted drill-pipe could not be logged or tested and the well was abandoned.

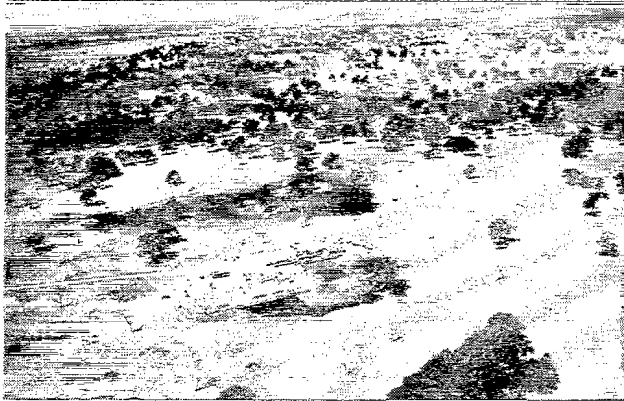
In 1983, Shoreline Exploration recorded a 1 634 km marine hydrocarbon detection survey together with high resolution sparker seismic and side scan sonar surveys. A 'seepage' anomaly was detected ~16 km south of Port MacDonnell which, because of the abundant propane content, was interpreted to be from an oil source.

The northern offshore Otway Basin was covered by EPP 20 when granted to Pan Pacific Petroleum NL in 1981. The permit was surrendered in 1993 as was PEL 18 along the northern margin onshore. The PEL 18 area was renumbered PEL 27 when granted to a group led by Hartogen Energy Ltd in 1984. Beach Petroleum was granted PEL 28 in the southern onshore area of the basin in 1984 (the company expanded its smaller PEL 22 area). Hartogen also took over operatorship of PEL 8 onshore.

In 1985, BMR conducted a combination seismic and seafloor dredge sampling survey. In the South Australian area 1 555 km of seismic were recorded on the continental shelf and in deeper water out to the 5 000 m isobath. Four rock and mud samples were obtained by dredging in the survey area.

Onshore drilling recommenced in 1987 and continued each year up to and including 1994. In 1987, Ultramar drilled Katnook 1, the first commercial gas discovery in the South Australian Otway Basin in PEL 32 which had been granted

to the Ultramar-led consortium in 1985. It was drilled to 2 520 m in the Laira Formation and tested gas in the Windermere Sandstone at the base of the Early Cretaceous Eumeralla Formation. McNamara 1, drilled in 1987 by Beach Petroleum in PEL 28, reached 680 m in the Paaratte Formation but with no hydrocarbon shows. Hartogen drilled Camelback 1 and Killarney 1 in 1987. Camelback 1, in the north of PEL 8, revealed an oil show in the Crayfish Group but testing proved the reservoir to be wet. Killarney 1, in PEL 27, also penetrated the Crayfish Group but with no shows. Both wells intersected basement metasediments or metavolcanics.



Aerial view of Katnook 1, April 1988. This was the first commercial discovery of natural gas in the Otway Basin in South Australia.
Photo 36321.

Prior to commencing the 1987 drilling, Hartogen, Beach Petroleum and Ultramar each carried out a number of onshore seismic surveys in PEL 8, 27, 28 and 32. Offshore, Chevron Overseas Petroleum Ltd and Ultramar undertook seismic surveys in EPP 18 and 22, respectively. Both permits were relinquished when farm-in partners could not be found to drill commitment wells. In 1987, BMR conducted an offshore bottom sampling cruise, part of which was in offshore South Australia. Grab, core and dredge samples were obtained together with heat flow measurements. Head space gas analysis of samples gave highest hydrocarbon readings adjacent to near sea bottom faults. Samples were taken in water depths of 50 to 5 000 m. The 1988 drilling program consisted of three wells including Compton 1 drilled by Beach Petroleum in PEL 28 to test the basal Tertiary Pebble Point Formation and Lake Hawdon 1 drilled by Hartogen in PEL 8 with a Pretty Hill Formation primary target; both wells were plugged. The third well, Katnook 2, was an important step out on the Katnook discovery. A record gas flow of 450 000 m³/day was recorded from the Early Cretaceous Pretty Hill Formation, a new pool discovery in the field. Further onshore seismic surveys were undertaken by Beach Petroleum, Ultramar and Hartogen. Cultus Petroleum NL carried out an offshore seismic survey on the recently granted EPP 23 adjacent to the Victorian border.

A soil-gas geochemical survey was carried out for Ultramar in PEL 32 over the Katnook gas discovery and in the areas around Banyula 1 and Kalangadoo 1. Anomalous methane to butane values were obtained but could not be correlated to the known gasfield.

In 1989, PEL 8 expired after 20 years of exploration and was divided into three areas and relicenced to Beach Petroleum (PEL 38), Gas and Fuel Exploration NL (PEL 39) and

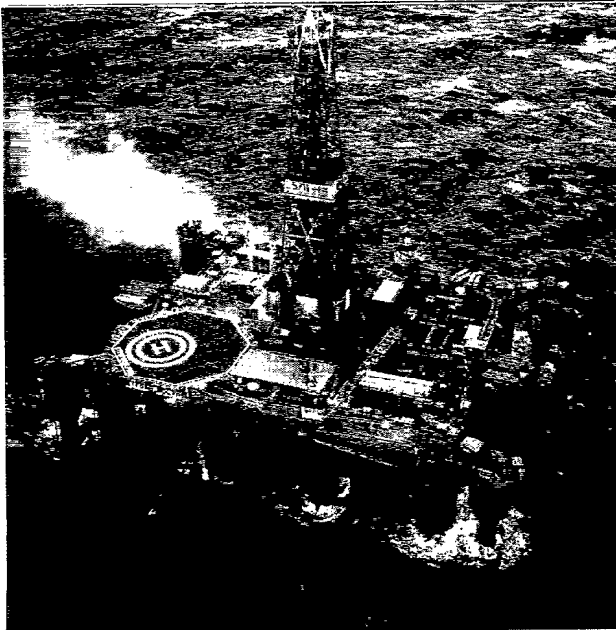
Sagasco Resources (PEL 40). Five wells were drilled in 1989. Ladbroke Grove 1, drilled by Ultramar in PEL 32 as a follow-up to Katnook, discovered gas in the Pretty Hill Formation, the second gas find in the licence; high CO₂ in the gas has delayed field development. Katnook 3 was drilled to appraise the Pretty Hill Formation pool and was successful in adding sufficient reserves to allow the field to be declared commercial. Hartogen drilled Bool Lagoon 1 in PEL 27 near the northern boundary of the basin. The well was plugged after finding minor gas shows but no reservoirs. Ultramar drilled Laira 1 to the west of Katnook with the Pretty Hill reservoir as the primary target. Tests of gas shows produced a small flow from wet reservoirs. Copa 1 was drilled offshore by Cultus Petroleum but the Pretty Hill target was at a much greater depth than expected and was not reached before the well was plugged and abandoned.

A period of extensive seismic surveys onshore and offshore occurred during 1990-91. One of the most interesting surveys was in the Caroline PPL 21, where Liquid Air Australia Ltd unsuccessfully tried to obtain a better definition of the Caroline structure. Two rounds of seismic surveying were undertaken in onshore licences PEL 27, 32, 39 and 40. From 1990 onwards, there was an improvement in seismic data quality, especially in the detail of the pre-Tertiary section, due to longer offsets, more traces and advances in vibrator electronics. Offshore, Cultus Petroleum conducted surveys in both EPP 23 and 24; BHP Petroleum took over operatorship of the permits in 1991 and further surveys were completed in both. BHP Petroleum and Cultus Petroleum were granted EPPSA-1 in the three nautical mile strip. Sagasco Hatherleigh 1 in PEL 40 was the only well drilled in 1990; it was plugged after finding no reservoirs. Greenways 1 was the only well drilled in 1991; Mosaic Oil, the operator, drilled the well to farm into PEL 38. Gas shows in the Windermere Sandstone on test recovered a small flow of gas with a large quantity of water; the well was plugged. In 1990, PEL 52 was granted to Irv Weitzman by joining areas relinquished from PEL 32 and 28 into a single licence. Initial seismic surveying was undertaken in 1991.

In February 1991, gas production commenced at the Katnook plant south of Penola. The gas was sold to domestic users in Mount Gambier, and industrial users at the Safries chip factory and the paper factory at Snuggery.

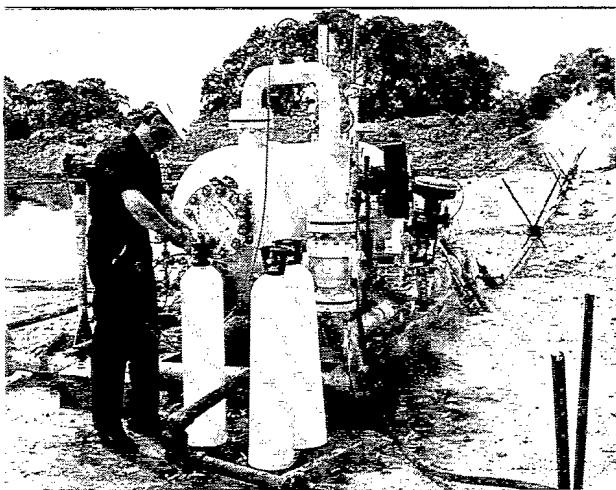
An extensive drilling program commenced in 1992. Crankshaft 1 was drilled in PEL 52 and tested a small flow of gas with a large volume of water from the Windermere Sandstone. Sagasco Resources took over the operatorship of PEL 32 and drilled Zema 1 updip of Laira 1. It recorded oil and gas shows in the top of the Pretty Hill Formation but flowed gas at an uneconomic rate with a large recovery of water. Reedy Creek 1 was the first well drilled in the St Clair Trough within PEL 39. The well was plugged after encountering minimal gas shows in the Pretty Hill Formation. Sawpit 1 was drilled in PEL 27 east of Penola near the northern margin of the Otway Basin. Minor oil shows were recorded in Crayfish Group sandstones as well as in fractured andesite and mudstone basement. A test of the basement interval recovered 1.5 barrels of oil, at that time the most significant recovery of oil in the South Australian area of the basin. Biscuit Flat 1, drilled in PEL 40 on the northern margin of a faulted basement high, failed to find hydrocarbons and was

abandoned. Troas 1 was drilled offshore in EPP 24, southeast of Robe, by BHP Petroleum. The well reached TD 3 506 m in what appeared to be Laira Formation. Gas shows in thin sands over a 1 000 m interval were confirmed by a repeat formation testing wireline tool, but no cased hole tests were carried out and the well was abandoned. Troas 1 is considered to be a non-economic gas discovery, based on electric log response and mud log shows, and appears not to have reached the primary target, the Pretty Hill Formation.



Offshore semi-submersible rig Byford Dolphin drilling Troas 1, December 1992. Courtesy: BHP Petroleum Pty Ltd.

Seismic surveys were also recorded during 1992. In PEL 38, Mosaic Oil followed the drilling of Greenways 1 with a small seismic survey in an attempt to prove an updip location to the well. The licence was relinquished after the seismic was interpreted. Oil Co. of Australia recorded seismic in PEL 27, Sagasco in PEL 40, Gas and Fuel in PEL 39 and, offshore, BHP Petroleum recorded a seismic survey prior to drilling. EPP 23 was surrendered by Cultus Petroleum in 1992 following the withdrawal from the permit by BHP Petroleum, and the area has remained vacant.



Gas sampling at Katnook 3, January 1993. Photo 38794.

AGSO (formerly BMR) carried out an experimental on-shore seismic survey and, based on the substandard results, proved that dynamite is not an appropriate energy source for the Otway Basin. In 1992, AGSO recorded a high sensitivity aeromagnetic and radiometric survey over the PENOLA 1:250 000 sheet and adjacent offshore area of the Otway Basin to the 500 m isobath. The survey was flown at a height of 80 m with a line spacing of 1.5 km to acquire high-quality regional data. The survey delineated the northern margin of the basin and distribution of recent volcanic eruption centres.

Only two wells were drilled in 1993. St Clair 1, operated by Gas and Fuel in PEL 39, was drilled in the deepest area of the St Clair Trough. A lack of reservoirs and hydrocarbon shows saw the well abandoned and the potential of the St Clair Trough downgraded. In PEL 57 near the coast at Cape Northumberland, Lakes Oil NL drilled Northumberland 1 to test basal Tertiary and uppermost Cretaceous targets at relatively shallow depth. The well was plugged after no hydrocarbon shows were encountered. In the same year, Oil Co. of Australia carried out a 3-D seismic survey over the Sawpit 1 area to follow up the oil shows; this was the first 3-D survey in the South Australian portion of the basin. Sagasco recorded seismic in PEL 32 and 40. In PEL 32, amplitude versus offset (AVO) analysis was undertaken on seismic lines over known gasfields. Amplitude anomalies corresponding to the depths and areas of a number of gas pools were identified. AVO analysis was then carried out on a number of undrilled prospects to upgrade their pre-drill potential. BHP Petroleum followed up the Troas 1 gas discovery with further seismic in EPP 24 before withdrawing from the permit and leaving Sagasco as operator. The South Australian Department of Mines and Energy, in partnership with three exploration licence joint venturers, flew an experimental detailed aeromagnetic and radiometric survey adjacent to the Victorian border. The survey, flown at a 400 m line spacing, was designed to test the effectiveness of aeromagnetics in mapping sedimentary structures (including known gasfields), fault trends and basin geometry. The aeromagnetic data helped to define fault patterns in the Penola Trough, and the size and depth of a magma chamber under Mount Gambier. The Department also undertook a gas sampling program of 15 water bores that were producing from the Tertiary Dilwyn Formation. Methane samples were analysed for stable carbon isotopic composition to determine the origin of the gas. The hydrocarbons are thought to be derived from biogenic and thermogenic sources.

CURRENT EXPLORATION ACTIVITY: 1994-95

Sagasco recorded seismic north of Troas 1 in 1994 to locate a further site for drilling. The only other 1994 seismic was a small survey in the east of PEL 39 by GFE Resources Ltd (previously Gas and Fuel Exploration NL).

Sagasco carried out all of the drilling operations during 1994. Wynn 1, 8 km northeast of the Katnook Gasfield in PEL 32, discovered oil and gas in a number of Pretty Hill sandstones. Three separate zones flowed gas with significant formation water. The shallowest zone also flowed oil at greater than 100 barrels per day, the first flow of oil to the surface in the Otway Basin. The persistent formation water

and pressure decline during testing indicated that the hydrocarbons in Wynn 1 are in thin discrete reservoirs with separate gas-water contacts and limited reserves. The well was cased and suspended.

Hungerford 1 was drilled 18 km west of Katnook on the Kalangadoo basement high. The Crayfish Group was found to be thin, with no reservoirs developed, and the well was abandoned.

Rendelsham 1 was drilled in PEL 40 in the Rivoli Trough ~15 km west-northwest of Millicent. Thin sands with gas shows were encountered in the Crayfish Group but results of testing indicated that the reservoirs were tight.

Haselgrove 1, ~4 km east of Katnook in PEL 32, discovered gas in the Early Cretaceous Pretty Hill Formation, the same reservoir as Katnook. The well was cased and suspended then production tested. Katnook 4 was drilled on a fault block located along the southern boundary of the field to test a potential trap with Early Cretaceous Windermere Sandstone and Pretty Hill Formation targets. The target reservoirs were structurally lower than expected and wet. The well was plugged and suspended for a future possible re-entry and deviated re-drill. Haselgrove 2 was then drilled as follow-up to the Haselgrove 1 discovery. It was sited 1.5 km to the east and confirmed the extension of a gas reservoir in the Pretty Hill Formation. The reservoir quality deteriorates from Haselgrove 1 to Haselgrove 2 but the latter is capable of economic gas production.

The success ratio has steadily improved due to better technology over the last three decades (Fig. 3.1), and for the 1990s is currently better than 30%. Drilling will continue in PEL 27, PEL 52, EPP 24 and probably PEL 32 during 1995. Four compulsory relinquishments were made in PEL 27, 32, 39 and 40 in late 1994 and early 1995. These areas will be made available for PEL applications in 1995.

A 3-D seismic survey covering ~150 km² is planned during 1995 by Sagasco to cover all of the gas discoveries and a number of adjacent prospects in PEL 32. Additional 2-D seismic will be recorded in PEL 32. Oil Co. of Australia will conduct seismic surveys in PEL 27 and a new licence, PEL 60 (granted in 1994), during 1995.

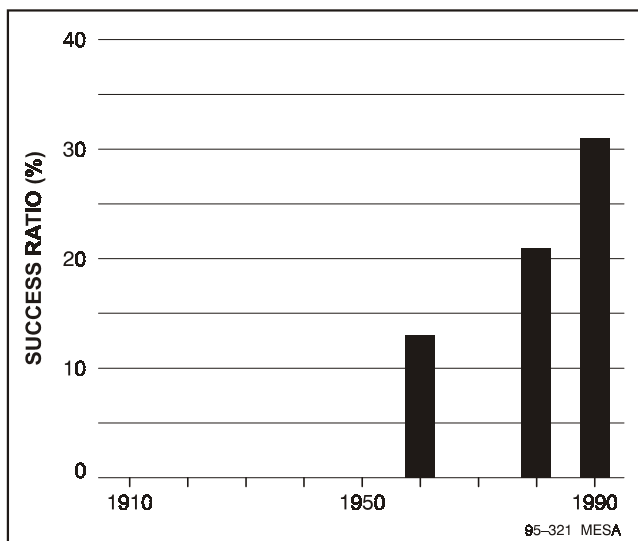


Fig. 3.1 Success ratio of Otway Basin exploration wells (1910-94).

Figures 3.2 and 3.3, and Appendices 3.1 and 3.2, summarise wells drilled and seismic acquired in the Otway Basin in South Australia.

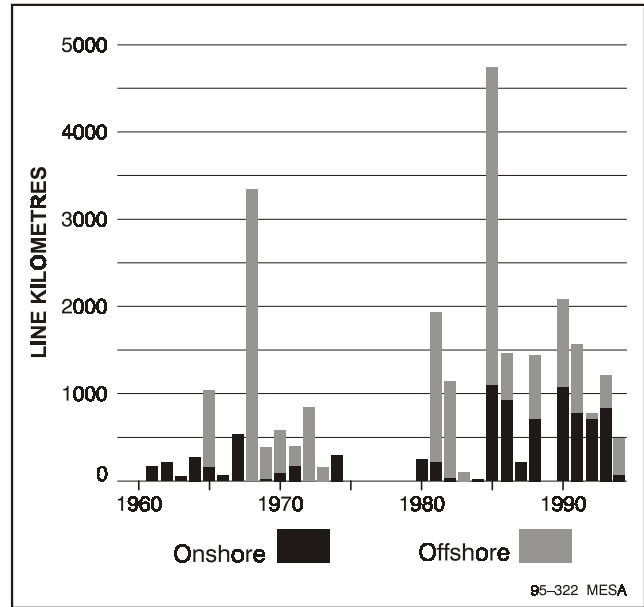


Fig. 3.2 Number of wells drilled in the Otway Basin, South Australia (1960-94, offshore and onshore).

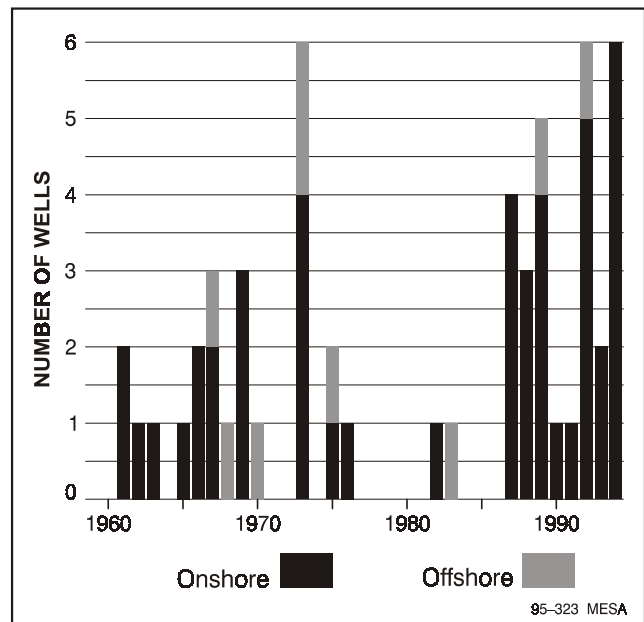


Fig. 3.3 Line kilometres of seismic data acquired, Otway Basin, South Australia (1960-94).