

# Gidgealpa 2: 50th anniversary of the first gas flow in the Cooper Basin

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On 31 December 1963 an open-hole test of a Permian sandstone in the exploration well Gidgealpa 2, drilled by Delhi–Santos in the Far North East of South Australia, produced an estimated flow of natural gas of 83 000 m<sup>3</sup>/d. It was the beginning of the Cooper Basin development. The story of the complex events leading up to the discovery is told in this article by one who was there.

In the first half of 1963 Delhi–Santos completed Putamurdie 1, their seventh dry hole drilled on top of an anticline (Fig. 1). The well, situated in the Sturt Stony Desert, 55 km southeast of Birdsville, penetrated Mesozoic sedimentary rocks typical of the Great Artesian Basin and bottomed in a folded, dark-coloured sandstone and shale succession of Ordovician age.

Delhi–Santos's newly acquired farm-in partner French Petroleum Company (Australia) Pty Ltd, FPC(A), operating in the Simpson Desert, favoured the pre-Permian succession as an exploration target, modelling their targets on the giant oil field of Hassi Messaoud which they had discovered in the Algerian Sahara (Fig. 2). Indeed, there are striking similarities between the two basins as evident from a comparison of Figures 2 and 3.

The thinking of FPC(A) no doubt influenced the exploration philosophy of Delhi–Santos, diverting their focus from the Mesozoic–Permian sequence to pre-Permian rocks of what is now known as the Warburton Basin (Wopfner 1970). The lack of success of their on-structure drilling and the prospect to 'investigate the lower Paleozoic sequence for some thousands of feet' (Delhi–Santos 1964, 1966) prompted Delhi–Santos to drill an off-structure well on the Gidgealpa Anticline, about 80 km southwest of Innamincka homestead (Fig. 1).

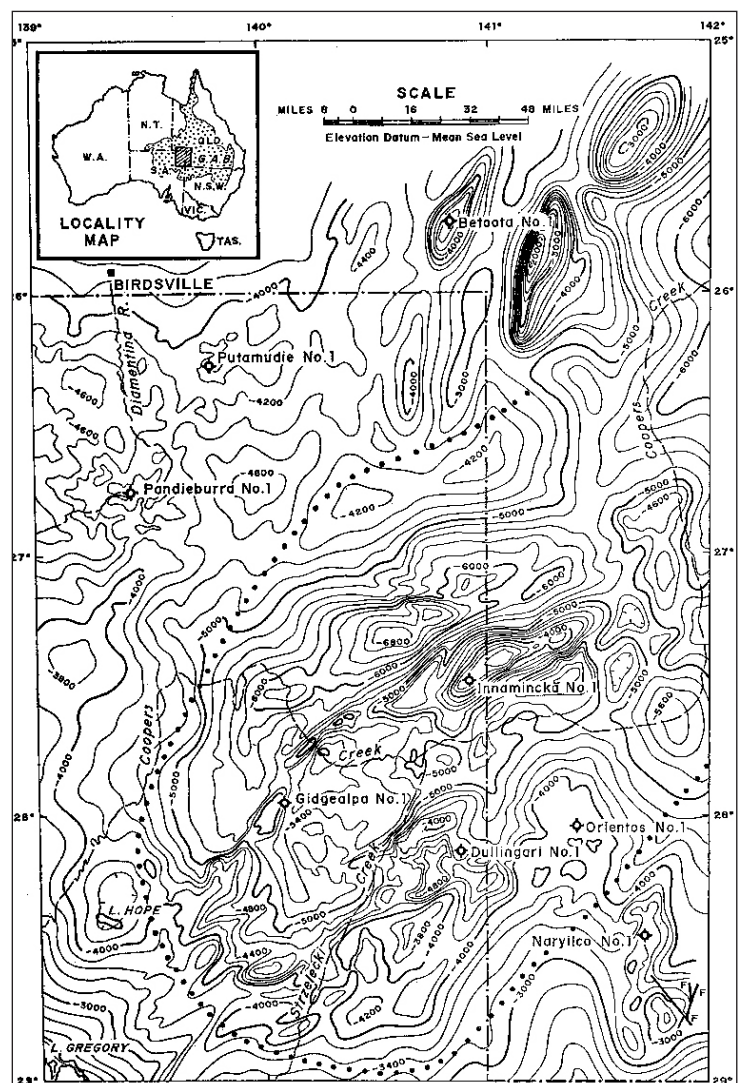


Figure 1 Structure contour map of top Early Cretaceous Cadna-owie Formation showing locations of the eight unsuccessful exploration wells drilled in the Great Artesian Basin by Delhi–Santos prior to the Gidgealpa 2 discovery. (From Wopfner 1966, 1968)

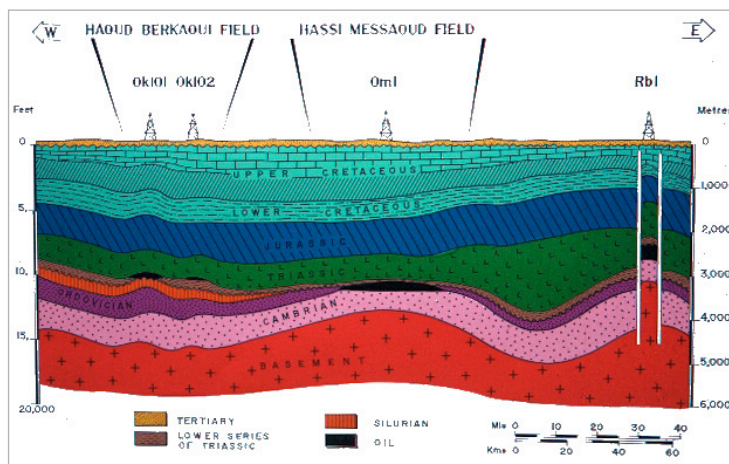


Figure 2 Geological cross-section showing structural and stratigraphic setting of the giant oil field Hassi Messaoud discovered by Total in the Algerian Sahara. (Courtesy of Total)

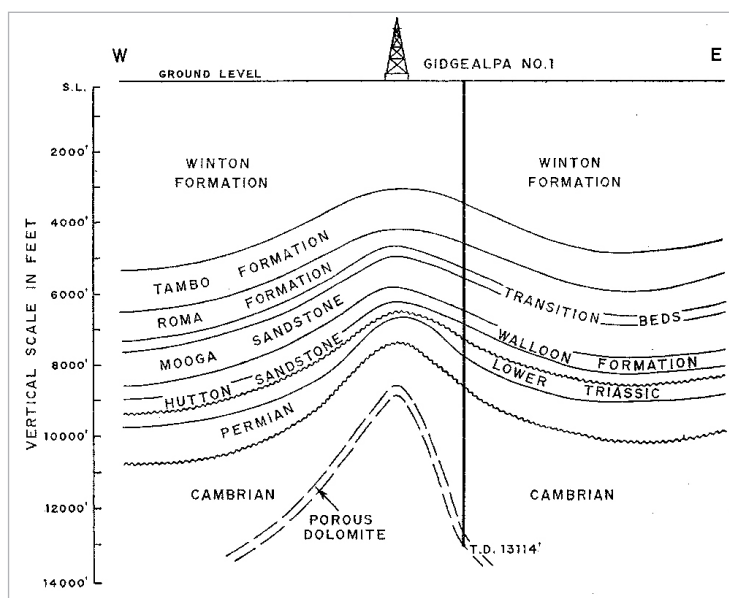


Figure 3 Cross-section of the Gidgealpa Anticline after drilling Gidgealpa 1. (From Wopfner 1966, 1968)

The Gidgealpa trend had been discovered in 1962 by the seismic crew of the South Australian Mines Department who, following the 1961 tracks of the premier of South Australia's party down the Cooper Creek, identified a turn over of structural dips near Gidgealpa waterhole. Subsequent detailed seismic surveys by Delhi-Santos established the existence of an unbreached anticline. Gidgealpa 1, located on the eastern flank of the anticline, penetrated 228 m of Tertiary strata, 2116 m of Mesozoic rocks, 305 m of coal-bearing Permian deposits and 1348 m of inclined, argillaceous limestone and dolomite of Cambrian age. A drillstem test of a porous dolomite between 3888 and 3896 m produced 'heavily gas-cut' water. Drilling stopped in tuffaceous limestone and agglomerate at 3997 m (Delhi-Santos 1964, 1966; Fig. 3).

When Gidgealpa 1 turned out to be another dry hole, Delhi-Santos proposed to suspend further drilling operations for an undefined duration to review the results obtained so far and to redefine their exploration philosophy, especially in terms of early Paleozoic oil. As mentioned above, the well encountered a thick, coal-bearing Permian section with many porous interseam sandstone beds. Because of their freshwater origin, the Permian sedimentary deposits were regarded as non-prospective by a large faction of Delhi professionals. This view was not shared by the Petroleum Section of the South Australian Department of Mines where I was senior petroleum geologist. Our stance was based on the occurrence of gas in the Permian of Innamincka 1, our interpretation of petrophysical logs and on new geochemical evidence on hydrocarbon generation from plant matter obtained by CSIRO.

Poor drilling through the pre-unconformity section resulted in the hole being very oversized and badly caved in the Permian section. Delhi engineers justified this by the fact that no hydrocarbons were indicated on the gas detector during drilling. On the other hand our scrutiny of petrophysical logs showed low water saturations in some of the Permian sandstones, suggesting that other fluids, possibly hydrocarbons, were present.

After re-checking the seismic records across the structure, I suggested to the Director of Mines that the government should insist that all major porous zones within the Permian in Gidgealpa 1 be tested. Due to the caved and oversized conditions of the drillhole it was obvious that testing would be almost impossible; there was no test tool available in Australia which could perform that task. As an alternative, the companies were given the option to drill another well on top of the structure. The suggestion was supported by the Director of Mines and subsequently approved by the Minister of Mines and the premier (Minute dated 18/11/63 in Department of Mines confidential file SR 11/5/111; Wopfner 1990; O'Neil 1995).

The companies opposed this decision and a meeting held at the office of the Director of Mines on 20 November 1963 between executives and consultants of Santos, Delhi and FPC(A) on the one side and the Director of Mines, his deputy, and myself on the other did not resolve the differences of opinions (Wopfner 1990, 2011). Ultimately, the companies asked for more time to consider their options.

Three days later I was scheduled to fly to Oodnadatta to conclude that year's mapping campaign, departing on the regular 7:45 am TAA flight. I had barely entered the taxi that was to take me to the airport when the taxi driver burst out, 'It

just came over the radio, President Kennedy was assassinated in Dallas'. It was an absolute shock and I could barely believe it, but the girl at the check-in counter repeated the news even before asking me where I was going. Ian Freytag met me at Oodnadatta airport and the two of us spent a fortnight measuring detailed sections of the sediment succession of the western Great Artesian Basin.

The top executives of Delhi Taylor, based in Dallas, Texas, flew into Adelaide to decide on the company's stance on the issue of Gidgealpa 2. The delegation included vice president Cliff Smith, chief geologist Norm Miller and chief geophysicist Ike Newton. They met the Minister of Mines, Sir Lyell McEwen, and the premier, Sir Thomas Playford, whose 'gentle persuasion' convinced them that the government would not be prepared to take no for an answer. I believe the same 'gentle persuasion' was applied also to board members of Santos. Finally the companies succumbed and agreed to the drilling of an on-structure well, Gidgealpa 2. Without my insistence, fully supported by my superiors at the department, the minister and the premier, Gidgealpa 2 would not have been drilled.

The evening prior to the departure of the Dallas executives, Ralph Freeman, an American senior geologist at Delhi, gave a big farewell party at his home. I was the only non-American guest at the party. At that stage I had known the Dallas executives for almost six years. They did not show the slightest resentment over the fact that they had to succumb to the South Australian Government, but I had a feeling that they would save their revenge if the hole should turn out to be dry.

Ralph and I had been kangaroo shooting some weeks earlier and Ralph's wife had made very tasty meat balls and sausages. When she arrived with the tray I exclaimed, 'Oh, your famous kangaroo sausages, they are delicious!' and, turning to Dallas executives Cliff Smith and Norm Miller, 'They are a delicacy, you really must taste them'. Thus they could not refuse tasting kangaroo meat. Gingerly each took a piece and, after having sampled two more offerings, Cliff drawled, 'Frankly, I thought you couldn't eat kangaroo meat, tastes good'.

During the evening Frank Hinson, Delhi's senior geophysicist, involved Ike Newton in a heated argument about giving in to the government's demands. He believed that the Gidgealpa Anticline would be 'bald headed', meaning that Permian strata would wedge out towards the apex of the structure. Finally, Frank lost control and told Ike in no uncertain terms what he could do with his job and resigned on the spot. I had had that argument with Frank before, pointing out the presence of a faint, low-amplitude seismic reflector above the high-velocity 'Z' reflector emanating from the

pre-Permian unconformity. To me this indicated the presence of low-velocity coal deposits above the pre-Permian folded rock suite below the unconformity, later termed the Warburton Basin (Wopfner 1970).

Geoff Greer, the exploration manager, avoided mentioning that theme and Charles Easely, the managing director, whom I knew well from various premier's and ministerial inspection trips (Wopfner 2010) took me aside and inquired, 'Just how confident are you, Heli?'. 'Confident enough to stick my head out', I replied. 'Well, I guess that's good enough for me, let's have a glass of red on that.'

Thus, on 12 December 1963 Gidgealpa 2 commenced drilling 300 m north of the apex of the anticline. The structure is a NE-trending, closed anticline, measuring about 21 km along the axis and between 9 km and 5.6 km across the axis. It has two distinct culminations, separated by a shallow saddle. Vertical closure on top of the Permian is about 170 m (see Fig.12).

Given the controversies about the merit of the drilling target it was decided that a government observer should be on site during the drilling of the critical Permian section. As it was I who had insisted on the drilling of the hole it was self evident that I should be that observer. So, on 19 December 1963 I flew to the Gidgealpa location to join the two senior Delhi geologists, Jock Harrison and Ralph Freeman. Both of them were good friends so we decided that I should not just observe, but to take on a shift as a wellsite geologist. We drew lots, I drew the afternoon shift, Ralph the morning and Jock the night shift. Rarely was the drilling progress of a well supervised by such a concentration of senior geologists.

Casing measuring 9 5/8 inch had been set within the Walloon Formation at 1795.3 m. When Christmas drew near we were still drilling Hutton Sandstone, roughly about 150 m above the mark where the top of the Permian was expected. The Adelaide offices agreed that two of us could spend Christmas with their families. Again we drew lots. Ralph was the unlucky one who had to stay on location whereas Jock and I departed in a chartered



**Figure 4** The trailer-mounted camp located on a clay pan near Gidgealpa 2 drillsite. (Photo 413999)

Cessna 182 in midafternoon of Christmas Eve. It was a scorching hot day with shade temperatures around 47 °C and the pilot had been behind the controls all day. While retracting the undercarriage after take-off the aircraft lurched into a steep dip over the left wing and the sand dunes got frightfully close before the pilot regained control. Three and a half hours later we landed at Parafield airfield.

Early in the morning of 27 December Jock and I flew back to Gidgealpa. The camp consisted of comfortable, air-conditioned, trailer-mounted units, sitting on a small clay pan fairly close to the rig (Fig. 4). There was not a tree in sight and as the temperatures were close to 50 °C the air conditioners were labouring day and night.

On 28 December the top of the Permian was reached at 2037.9 m. At 2057.4 m we encountered the first coal seam and immediately below we penetrated 4.6 m of sandstone, but without any indications of hydrocarbons. I was on duty on the afternoon of 29 December when again we encountered sandstone with stringers of coal. Like in the previous sandstone bed, I observed no fluorescence in the cuttings and no indication on the gas detector. All the same I asked the driller to take a core (core 3), but my call was too late and we only recovered tight sand and carbonaceous shale. In the afternoon of 30 December the drill entered a medium- to coarse-grained sandstone at 2090.0 m. We cut core 4 to 2092.5 m which recovered 2.1 m of coarse-grained, current-bedded sandstone with bands of granule conglomerate



**Figure 5** Porous gas-bearing sandstone which produced the first gas flow, core 4, 2090.3 m, Gidgealpa 2. It shows the surface cut perpendicular to the core axis. The changes in grain size are caused by the angle between current beds and the cut surface. Autogenic quartz overgrowth, indicated by reflecting crystal faces of quartz crystals, is typical for early diagenetic SiO<sub>2</sub> mobilisation in coal swamps (Wopfner 1983). (Photo 414000)

(Fig. 5). The core exuded a strong petroliferous smell and when Jock examined pieces of the sandstone under the microscope it showed strong golden fluorescence and excellent solution cut when treated with carbon tetrachloride. He immediately called the Halliburton operator Joe Weller to conduct a drillstem test over the interval 2088.5 to 2092.5 m (DST 2). He had Ralph and me woken up so we were all on site when the test tool was opened shortly after 6 am on New Year's Eve, 1963. One could feel the mounting tension amongst us as we waited for the last preparations being completed. As soon as the valve of the test tool was opened there was a strong 'blow'. Five minutes later the water cushion, which was placed in the drill pipe to buffer the first pressure surge, had been expelled and gas roared to the surface at an estimated rate of 2.9 mmcf through a quarter inch choke. One of the roughnecks lit a rag soaked with petrol and threw it up to ignite the gas rushing from the vertical flare line (fig. 6 in Wopfner 2011). The flame was barely visible against the morning sky, indicating that the gas did not contain much fluid hydrocarbon, but it did not diminish our sensation of experiencing a glorious moment in the history of Australian oil exploration. We all danced around with excitement, embracing and congratulating each other. When Joe Weller had closed the valve of the test tool to record the shut in pressure, which is indicative of the actual pressure within the gas producing formation, the Austrian driller Joe Pokowitz, his crew and Joe Weller gathered on the rig floor for a photograph to record the discovery crew for posterity (Fig. 6). Then we went back to the camp to inform city office of the successful test and the discovery.

When the news reached the Adelaide office, the plane carrying the supplies for New Years Eve was already on its way to Gidgealpa. The management



**Figure 6** The discovery crew: Austrian driller Joe Pokowitz (left) and his crew of Canadian, Australian and British roughnecks who cut and pulled the decisive core 4 from Gidgealpa 2. Joe Weller, the Halliburton operator, is standing in front. (Photo 047594)

ordered the plane to return to Parafield airfield to collect champagne to celebrate both the discovery and the New Year (O'Neil 1995).

At 4 pm I was back on duty, but the boys were still cleaning up after the test and conditioning the drillhole. Joe Weller came into the geology shack to show me the pressure curves of DST 2. It looked very good, especially the shut-in pressure which had almost reached equilibrium with formation pressure, demonstrating the excellent production potential of the reservoir sandstone. After the test we decided to cut another core.

Shortly before dinnertime as the supplies from the plane had been unloaded, the first champagne corks started to pop and during dinner a continuous staccato of popping sounds echoed across the dining caravan. When I got off my shift at midnight there was still general merrymaking throughout the camp and most of the champagne bottles had been emptied. Someone had the idea to drive to Gidgealpa waterhole for a swim. As the temperature was still above 35 °C it sounded like a good idea and we all piled into various vehicles bound for the waterhole. Obviously, no laws against drunken driving were thought of at that occasion and the cool water of the waterhole had a decidedly sobering effect.

When we pulled the core barrel next morning it was empty, but we knew from the cuttings and the drilling progress that at 2093.4 m we had transected the unconformity between the Permian deposits and the older, folded rocks of the Warburton complex. This dashed our hopes of finding more productive sandstones, but on the other hand we praised our luck, because we had tested the last sandstone at the very bottom of the Permian succession. Immediately after having pulled the core barrel we ordered electric logs be run to ensure optimal petrophysical information from the productive interval (Fig. 7).

Ralph and I returned to Adelaide on 4 January 1964, leaving Jock to look after the completion of the well. The Adelaide office instructed him to carry on drilling, hoping to intersect Cambrian dolomite below the volcanics. It goes to show that myths die slowly! What was thought to be Proterozoic rocks are now known as the Mooracoochie Volcanics. Drilling finally ceased at total depth of 2749.3 m. After that the well was plugged back and 7 inch production casing was inserted into the hole, landed at 2112.9 m and cemented with 240 sacks of cement. On 10 February 1964 Gidgealpa 2 was completed.

Early afternoon on 12 February 1964 I joined the premier, the minister, and the Department of Mines director and deputy director to fly to Gidgealpa 2

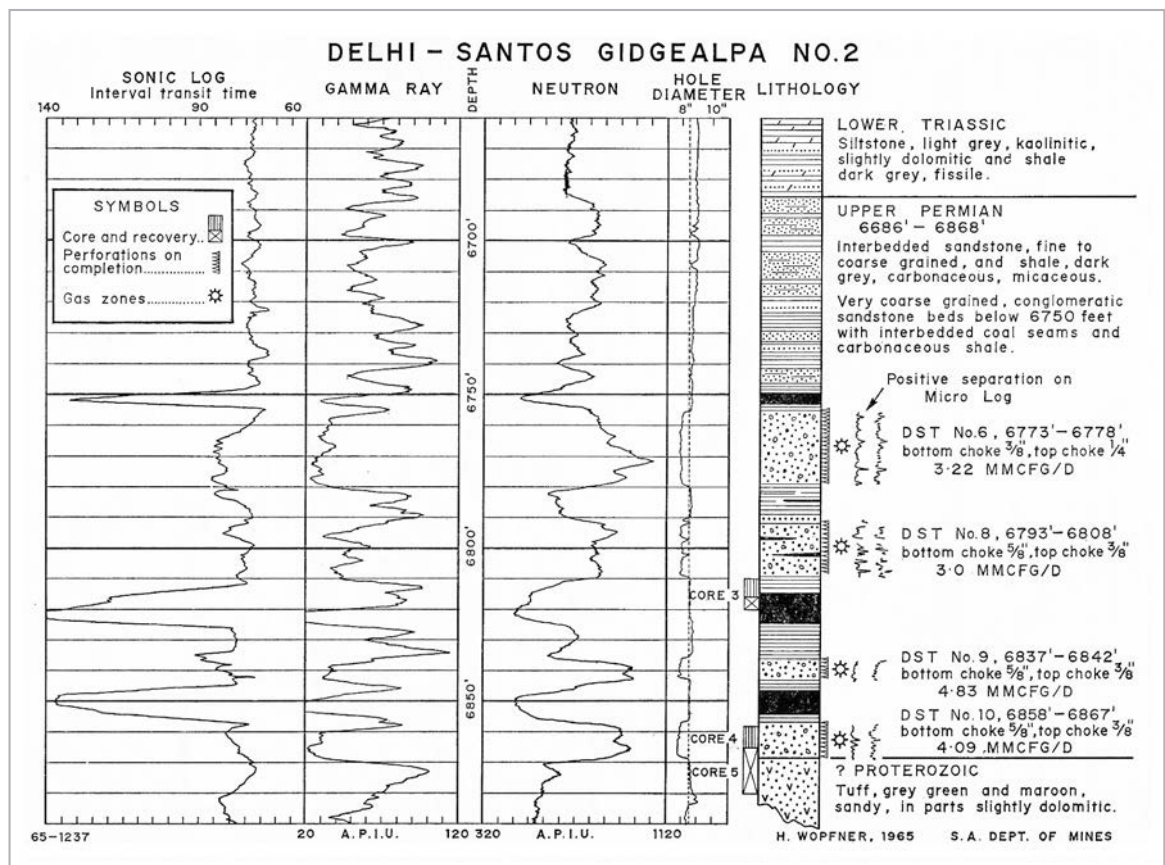


Figure 7 Composite log of the gas producing section of Permian sedimentary rocks in Gidgealpa 2. Note the thick build up of mud cake against the productive sandstones. (From Wopfner 1966, 1968)

to observe the testing of the Permian sandstones and some beds above. The party was welcomed by Delhi's petroleum engineer George Higginbotham who supervised testing procedures.

Testing was performed by perforating the 7 inch production casing with a hollow-charge perforation gun operated by Schlumberger Well Logging Co. The test intervals were selected from the curves of the petrophysical logs which had been recorded in the open hole (Fig. 7) and a new set of logs combining records of natural gamma-ray emission and casing-collars. After the discovery test (DST 2), further tests had been carried out, thus, the first test through perforated casing was DST 6. It tested the 'Top Sand' from 2064.4 m to 2065.9 m (Fig. 7). The sand produced 3.22 mmcf of gas per day and 49.2° API condensate. The premier and the minister were duly impressed and the premier, in his typical fashion, started to work his arithmetic to figure out possible ways to make use of the gas. Next day DST 7, from 2072.6 m to 2075.1 m, was to evaluate the second sand from the top (Fig. 7), but the results were meaningless due to an excessive water cushion. To soften the disappointment of the premier we emptied the fuel tank of a Land Rover and replaced the fuel with a few litres of condensate from the Gidgealpa gas separator (Fig. 8) then invited the premier to drive the vehicle. The engine fired immediately and, belching out big clouds of black smoke from the exhaust pipe, he drove the Land Rover around the clay pans behind the camp. Years later the event was recalled at the Cooper Cup Charities by the issue of a special tawny port produced by Hardys Wines and sold in a rig-shaped ceramic bottle made by Bendigo Potteries.

The premier and his party returned to Adelaide on the following day, the premier carrying a West End beer bottle full of Gidgealpa condensate with him (Fig.9; O'Neil 1995).



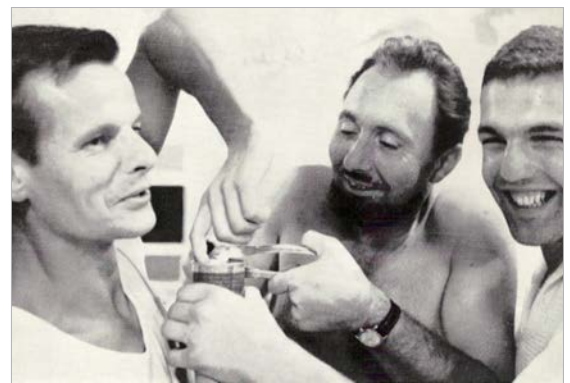
**Figure 8** Halliburton operator Joe Weller (left) and author at the gas separator during testing in February 1964. Joe called me for an urgent check hence my lack of safety clothing. (Photo 047596)

DST 9 successfully tested the second sandstone and the remaining porous sandstones, all of which proved to be productive (Fig. 7). Testing was completed on 20 February. When drilling through these reservoirs we had not the slightest indication that they were gas bearing, neither on the gas detector nor in the drill cuttings. We had tested the gas detector regularly and there was no indication of malfunction. We had the same experience during drilling of the follow up wells at Gidgealpa. There were many hypotheses to explain the lack of indications, but none of them were convincing.

A final anecdote concerns the changeover of the Schlumberger engineers in the second half of February. Pierre Maso, who had been in Australia for the past 18 months, was due to return to Paris. We gave a small party to wish him bon voyage. Pierre had a large collection of lewd jokes which made for fabulous entertainment. In his eagerness of storytelling he stuck his finger into the opening of a beer can in such a way that he was unable to withdraw it. Interrupting his story telling he muttered,



**Figure 9** Premier Tom Playford displaying a beer bottle containing the first distillate from Gidgealpa 2 while John Klug, Santos general manager, looks on. (Courtesy of the Advertiser; photo 042772)



**Figure 10** The author (centre) is freeing Schlumberger engineer Pierre Maso's finger from an empty beer can while Chris Collins (Pierre's replacement) on the right seems to relish the thought of sending Pierre home to Paris with an Australian souvenir attached. (Photo 414001)

'I cannot get out my finger from the can'. Obviously, he didn't relish the thought of running around Paris with a beer can attached to his finger. As can be seen in Figure 10, I came up with the saving solution: I got a can opener from the kitchen and cut off the top of the can.

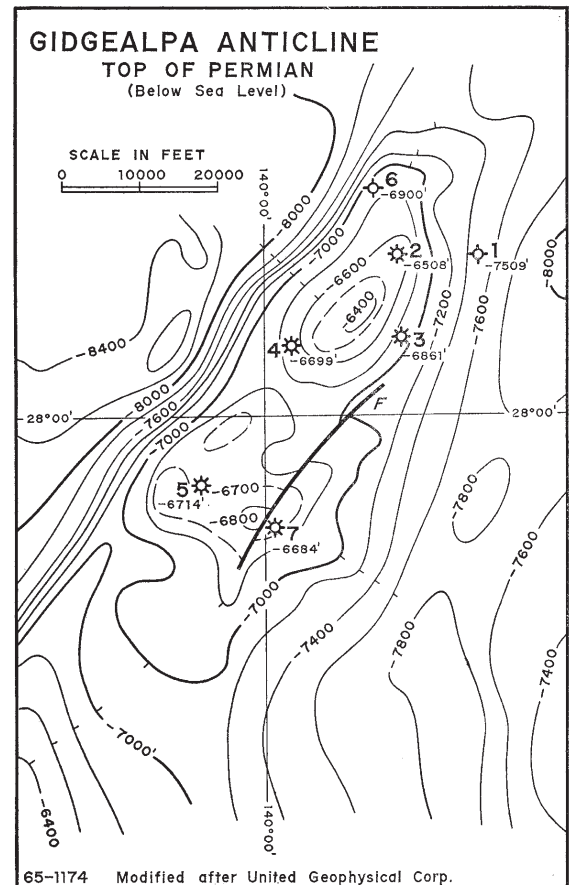
Following the successful testing, Gidgealpa 2 was fitted with a Christmas tree and completed as a potential gas producer. Upon completion the well flowed 11.6 mmcf of gas per day on a half inch choke and 43 bbl of condensate and light crude oil (Fig. 11). The follow up wells Gidgealpa 3 to 5 and Gidgealpa 7 turned out to be fair to excellent gas and condensate producers (Fig. 12). Gidgealpa 6 was a test on the NNW flank of the anticline to ascertain the position of the gas-water interface. It produced small amounts of gas and salt water. It was plugged back and completed as an artesian water well, producing water from the Hutton Sandstone (Wopfner 1966, 1968). These wells established Gidgealpa as a potentially economic gas-condensate field and started the development of the Cooper Basin which is now the largest oil and gas province of onshore Australia.



**Figure 11** Production test gas flare at Gidgealpa 2 heralding the beginning of the development of the Cooper Basin oil and gas province. (Photo 414002)

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**Figure 12** Structure contour map of top Permian, showing positions of the first seven wells which established the Gidgealpa gas and condensate field.

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