Fletcher Challenge Energy Taranaki's Onshore Exploration Strategy

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Abstract

Fletcher Challenge Energy Taranaki Limited's (FCET) exploration strategy, is to strive for short term results whilst maintaining longer term capabilities. It is a central tenet that deep local knowledge, combined with worldwide experience in the international oil business, will provide the blueprint for success. The 1979-86 boom in the oil business, driven largely by the oil price escalation effect of the Iranian Revolution, caused a massive increase in exploration activity. In retrospect, many dollars were spent chasing new opportunities that would fail to meet current risk/reward criteria. A poor prospect is still a poor prospect, however, even at $100 per barrel.

In the late eighties and early nineties, both Shell and Amoco published information on wildcat success ratios with remarkably similar results. These showed that where a petroleum system could be proved to exist, considerable financial returns could be made from exploration. FCET has recently used a similar approach by focussing on proven play concepts in the Taranaki Basin, where it has built up a large knowledge base from its extensive exploration activity.

In addition, this data base has enabled it to perform rigorous benchmarking to provide reality-checks in reserves estimation and chances of commercial (rather than merely geological) success. The utilisation of project management techniques, and identification of all geological hazards, has ensured a safe and timely delivery of drilling programmes.

In 1997, Fletcher Challenge Limited (FCL) concentrated its onshore exploration activity in the commercially-proven Overthrust Belt of eastern Taranaki, and was rewarded with the discovery of the Piakau Field.

Introduction

FCL entered the New Zealand oil business as an operator with the purchase of the Government-owned Petrocorp in 1988. Initial drilling activity was confined to the fields previously discovered by Petrocorp. In the early nineties, FCL focussed its exploration activities in south-east Asia. In 1992, following a strategic re-evaluation, the Company decided to return to Taranaki, where it had the advantage of the deep local knowledge gained through its purchase of Petrocorp.

A series of farm-ins and asset-swaps provided the vehicle to access the necessary acreage to conduct an exploration programme

In the period from 1992-95, three exploratory wells were drilled, Paritutu-1, Kaipikari-1 and Mystone-1. All failed to find commercial hydrocarbons and in each case tested non-proven play concepts. Minor commercial success at Kaimiro in 1988 had led to an extensive effort to find further commercial production in the shallow Miocene Mt Messenger sandstones. It was hoped that the Mt Messenger, consisting of thinly-bedded slope turbidite facies at Kaimiro, would yield far better reservoir properties in a basin-floor fan setting. A sequence stratigraphic project was undertaken to pin-point possible locations for these sand bodies. Kaipikari-1 found good quality sands but no hydrocarbons. In 1995, FCL participated in three wells drilled by New Zealand Oil and Gas: Cheal-1, Cheal-2, Salisbury-1. Although Cheal-1 and Cheal-2 flowed minor amounts of gas from thinly-bedded Urenui sandstones, the major sands in the Mt Messenger and Moki formations were effectively dry.

In 1996, it was decided to focus on areas of proven productivity, ie the Tarata Thrust Belt, which contains the McKee, Tariki, Ahuroa, Ngaere and Waihapa fields, and the deep gas potential of the inversion structures such as Kapuni and Kupe (Figure 1).

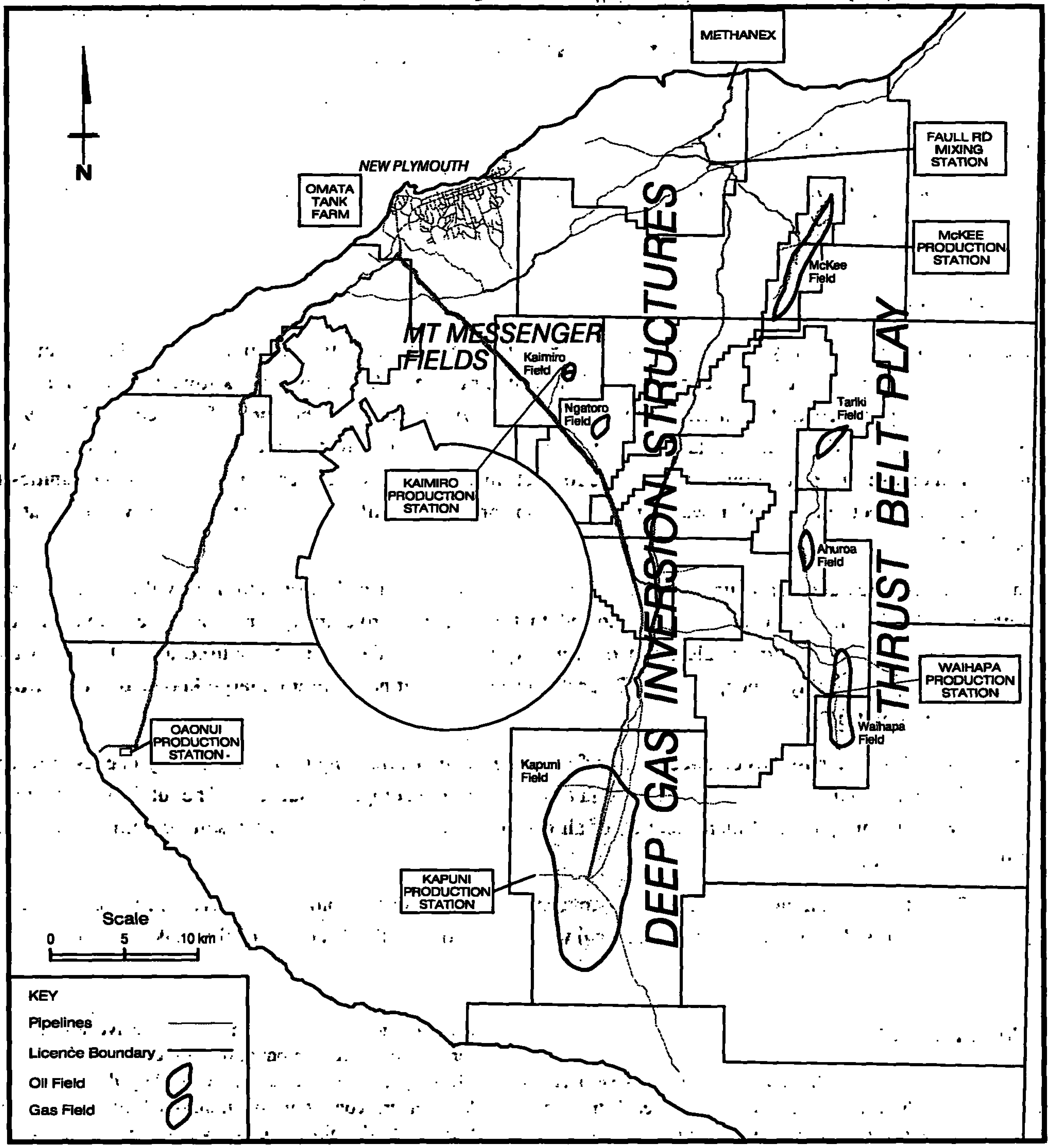

Figure 1. Onshore Taranaki play fairways.

(It is not the intention of this paper to discuss the Mangahewa Project, which is the subject of another paper at this Conference).

This strategy had three major advantages: the possession of a large data base from field development activity and 3D seismic; proven petroleum systems (Magoon and Dow 1995) which significantly reduced risk; local infrastructure to minimise development costs. The presence of a proven petroleum system is considered to be the key concept in value creation through exploration and will now be considered further.

Discussion

In 1988, Hart delivered a paper at the Houston Geological Society which examined the success rates of 1200 Shell Oil Company exploratory wells. Three hundred of these wells were classified as "high risk" and every single one failed to find commercial hydrocarbons. In contrast 900 "low to moderate risk" wells had a success rate of between 35% and 40%.

In 1994, Carragher presented a paper at the American Association of Petroleum Geologists Convention in

Denver. The paper, entitled "Probability and the Petroleum System", compared the Shell results with those of Amoco's exploration programme. The results were remarkably similar. Although there was a fewer number of wells, those wells that had a probability of success of less than 25% were all failures, whereas the remainder had success rates of 40%. Carragher evaluated the Shell results using the binomial probability method and demonstrated that even if there was just 1% chance of success, there was virtually no chance of drilling 300 dry holes in succession.

Two key points arise from this analysis. First of all, there is a "rule of thumb" in the industry that wildcat wells have about a one in ten chance of success. These data suggest that where geoscientists have a reasonable level of confidence in the presence of a connected petroleum system, success rates may lie between three and four in ten. More importantly, "high risk" may well mean "no chance". Secondly, it is not likely that many oil company managers would permit their exploration teams to continue drilling wells with a predicted chance of success of 1% or less.

Carragher developed a new probability measure which he named the Uncertainty Index. The premise behind this is that although explorers tend to be overly optimistic, and are often far too narrow in their range of risk parameters (Capen 1976), there may be a problem in the way that probability of success is estimated. The probability of success for wildcats; ie Probability of Trap x Probability of Charge x Probability of Reservoir, is assumed to consist of independent variables. In some cases this is true: Carragher quotes the Nubian Sandstone play of the Gulf of Suez as an example. In contrast, the notion of complete independence may not hold for reservoir deposition and trap formation in growth-faulted fields, where deposition of sand is intimately linked to fault movement.

Carragher's Uncertainty Index is defined thus:

Uncertainty Index UI = Pn - (1 - Pn-1)

where: Pn = P minimum <= Pn-1 <= Pn-2

Essentially the equation is a measure of how far apart the lowest probabilities could be (think of a Venn diagram). The Uncertainty Index returns a negative value at around a probability of success of 25%. Thus a negative value is a warning flag that there may not be a connected petroleum system. If there is not a connected system, then no matter how many attempts are made at drilling that play, there will never be a success, despite a positive probability of success from the conventional approach (no-one ever puts in a zero value for one of the risk parameters).

It is this work that supports the concept of exploring in known petroleum systems. There is a perception in the business analyst community that exploration is a value-destroying activity, even though it is patently obvious that the whole of the multi-billion dollar oil industry is based on exploring for, and subsequently discovering hydrocarbons. Carragher's analysis, coupled with the petroleum system concept, suggests that a more appropriate paradigm would be that exploration based on knowledge rather than hope can certainly lead to significant financial returns.

Fletcher Challenge Energy Taranaki Onshore Exploration Strategy - Post 1995

Fletcher Challenge's current onshore exploration strategy is to:

- Strive for short-term results whilst maintaining longer term capabilities;
- Pursue proven play concepts in the Thrust Belt and Kapuni Group inversion structures;
- Perform rigorous benchmarking to generate realistic risk/reward profiles;
- Utilise Project Management techniques to ensure timely delivery of wells; and
- Ensure all geological hazards are correctly identified.

Focussing on the Thrust Belt achieves short term results through active exploitation of the Tikorangi Limestone oil play and the Tariki Sandstone gas play (Figure 2).

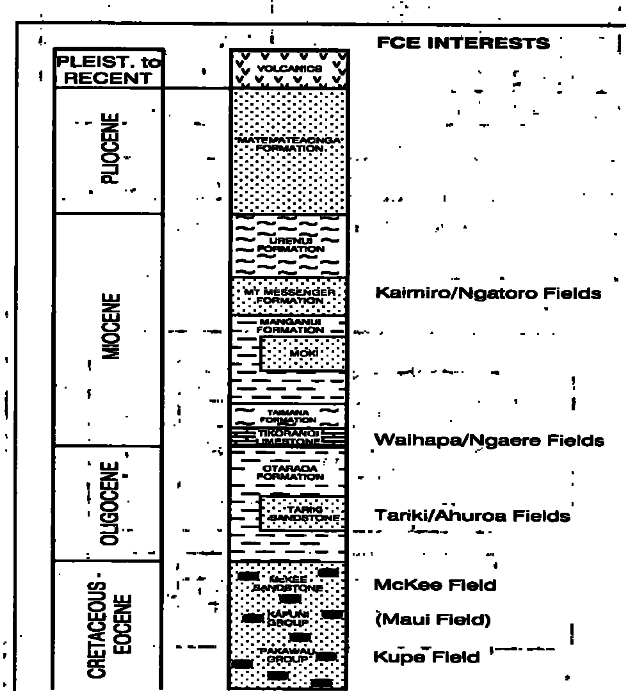

Figure 2. Generalised onshore stratigraphic column.

High initial flow rates from the fractured limestone delivers an early payback, particularly when close to existing infrastructure (Figure 3).

The Company's data base consists of around 300 wells (post-1940) in the Taranaki Basin, and 6807 km of onshore seismic, including eight 3D surveys, leading to a considerable local knowledge. This also permits the establishment of a quantifiable probabilistic determination of reserves sizes (Figure 4). P10, P50 and P90 reserves estimations so derived, lend credibility to explorationists' proposals.

Overthrust structures are historically the most successful play type in the Taranaki Basin (Figure 5) and these statistics closely match those demonstrated by Carragher, and which represent significant exploration-generated value creation.

In 1996/97 the Company drilled three exploratory wells in the Thrust Belt: Manu-1 in PEP 38718, Piakau-1a in the Ahuroa Mining Licence PML 38139, and Kupara-1 in the Tariki Mining Licence, PML 38138 (Figure 6).

Tikorangi Limestone

Well	Production
Waihapa-1	4,000 bopd
Waihapa-2	3,000 bopd
Waihapa-4	2,500 bopd
Waihapa-6A	4,500 bopd
Ngaere-1	10,000 bopd
Ngaere-2	3,500 bopd
Ngaere-3	10,000 bopd
Piakau-1A	1,400 bopd

Tariki Sandstone Production Test Results

Well	Gas mmscfd	Cond bpd	Choke	FTHP psi
Tariki-1A	29	1390	48/64	1200
Ahuroa-2	23	828	48/64	1310
Tariki-4A	12 *	500 *	48/64	-

Figure 3. Tikorangi Limestone initial clean oil production and Tariki Sandstone production test results.

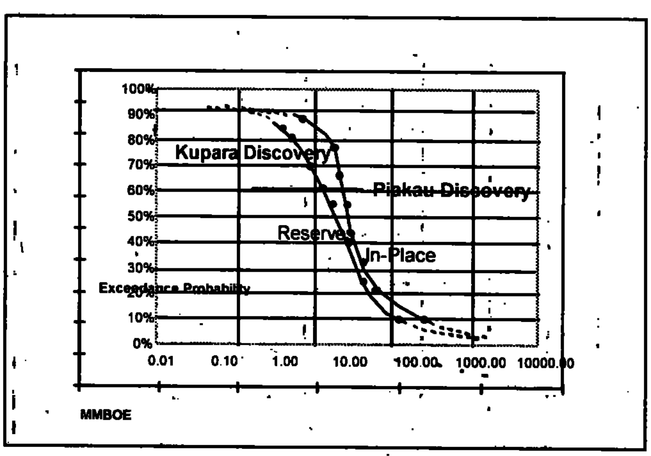

Figure 4. Thrustbelt exploration discovery field/size distribution.

Manu-1 is currently suspended with gas shows pending revised structural interpretations. Piakau-1a (a re-entry and sidetrack of the Piakau well drilled in 1986) tested at initial rates of 1400 bopd through a 48/64" choke. Kupara-1 flowed minor oil and gas to surface on the production test. The well proved the existence of mobile hydrocarbons, but the tight nature of the reservoir at this location prevented the well being declared commercial. A horizontal sidetrack is being drilled at the time of preparation of this paper.

Execution Skills

The existence of a sound strategy is useless without the ability to execute it effectively.

FCET operates a Project Management-based organisation. Exploration Project Managers have received training from the New Zealand Institute of Management. These techniques and associated tools document clear accountabilities and, importantly, the critical path in terms of timing. In most cases, unless the well is drilled from an existing site, it appears that land access issues control the length of time from concept to drilling.

Play Type	Reservoir	No. of Valid Tests	Historical POGS		Historical POS		Fields	Tests
			n	Rate	n	Rate		
Overthrust Structures	Tikorangi / Tariki	15	6	40%	4	27%	Piakau, Tariki, Ahuroa, Waihapa-Ngaere	Ahuroa-1, 1A, Hu Road, Mokoia, Piakau-1, 1A, Wharehuia, Rotokare, Tariki-1, Tariki N, ToeToe, Totara, Waihapa, Kupara, Manu
	Kapuni	20	9	45%	1	5%	McKee	Ahuroa, Makara-1, 1B, Makuri, McKee, Tuhua-1, -7, Onaero, Pouri-1, 1A, Pukemai-1, 1B, ToeToe, Rimu, Tauteka, Toko, Waihapa, Urenui, Wharehuia, Tariki
Total:		35	15	43%	5	14.3%		

Figure 5. Thrustbelt exploration - historical play statistics.

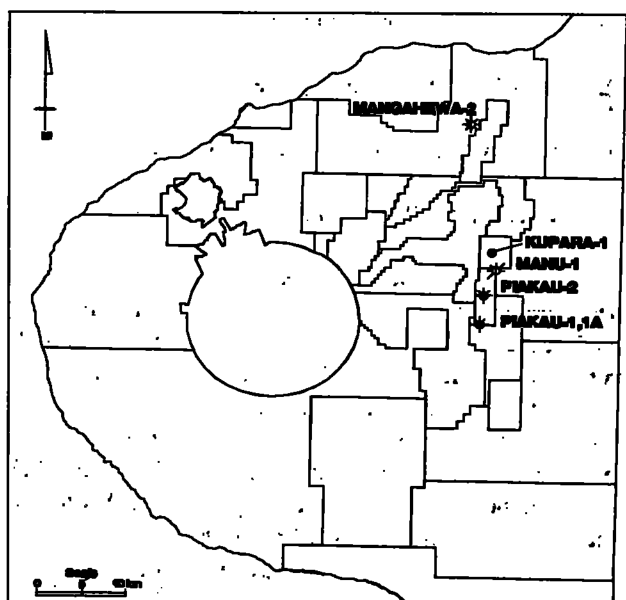

Figure 6. 1996/97 drilling locations.

Safety

This paper is about exploration strategy, but it would be inappropriate to conclude it without a discussion on safety.

Since 1995 FCET has been involved in the development of a comprehensive safety system. This includes both the emplacement of procedures and a cultural awareness in the organisation of the positive benefits of an effective safety policy. Geoscientists contribute to this in several ways. Seismic acquisition can often take place in rough terrain. The company follows guidelines documented in the Land Geophysical Operations Safety Manual, Seventh Edition, produced by the International Association of Geophysical Contractors. This is supplemented by local fit-for-purpose addenda. In well planning, it is most important to document potential geological hazards. Figure 7 shows the template for minimum requirements in every well proposal.

Future Plans

The company will continue to pursue its activities in the Thrust Belt. Ongoing studies at McKee are examining potential pools trapped by local faulting and enhancements to reserves through improved petrophysical determinations. At TAWN, the complexities of the structural configuration bring both challenges and benefits. The complexity requires a high level of detailed structural interpretation, but it also delays the "creaming" effect present in mature acreage with much simpler mapping problems. Modern seismic techniques such as pre-stack depth and time migration, and improved velocity/ imaging analysis, permit the identification of new prospects. Each discovery adds to the depth of the local knowledge and improves the quantification of risk.

- Shallow Gas
- Base of Potable Groundwater
- Lost Circulation
- Abnormal Formation Pressures
- High Temperatures
- H_2S and CO_2 Corrosion
- Unstable or Sticky Formations
- Solid Control
- Weak Formations
- Other

Figure 7. Geological hazard analysis in well programmes.

And there is always Serendipity - a proven technique for finding new petroleum systems.

Postscript

An obvious response to this paper is: "What about new plays, new frontiers, new petroleum systems, where is Fletcher Challenge in these?" Of course, someone has to be the first entrant to a new basin, or unproven petroleum system (unless discovered by accident, not design). Exploration personnel may recommend exploration strategy, but ultimately power to enact it must come from the business owners, or in the case of the medium-to-large sized companies, from the corporate office.

What this paper attempts to demonstrate is that the "tyranny of averages" and a rigid belief in independent probability-based estimated monetary value (EMV) prospect analyses can lead to severe value erosion, unless there is an understanding that the determination of the presence of a petroleum system is the key factor in the exploration programme. It is to be reiterated that the absence of one key factor will condemn the play, even if all the other attributes have exceptional appeal. Once a petroleum system has been discovered, efforts should concentrate on exploiting the trend through detailed prospect analysis. Amoco and Shell statistics indicate that in a proven petroleum system, a talented workforce will generate discovery rates sufficient to create great value for shareholders. Knowledge gained by maintaining a presence in an area (and for Fletcher Challenge this certainly means New Zealand), expands the understanding of other petroleum systems. On the other hand, new players to an area bring new ideas. Ultimately, however, concepts must be tested with the drill bit. The acquisition of onshore seismic in New Zealand is a costly business. In frontier areas, extremely cost-effective downhole stratigraphic information should be acquired at the earliest possible stage. This information should not necessarily be prospect-specific driven, but geared to determining what, and where, petroleum systems may exist. A strong case can be made that co-operation between participants in immature areas on obtaining stratigraphic information may lead to win-win situations in the future.

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Authors

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