THE WOODADA DISCOVERY — ITS IMPLICATIONS FOR EXPLORATION

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Geological Setting

The Woodada discovery lies in the northern Perth Basin on the east flank of the Beagle Ridge (Figure 1). The Dandaragan Trough on the east was active from the Early Permian to Early Cretaceous with deposition of perhaps 12 kilometres of sediments near the Darling Fault (Jones and Pearson, 1972). The Beagle Ridge was a positive feature during the subsidence of the Dandaragan Trough and there may have been additional uplift during the Neocomian phase of faulting that ended the rifting of the Perth Basin. The Woodada discovery is on one of the intermediate fault blocks that step down from the crest of the ridge into the trough (Figure 2).

The discovery at Woodada was not a total surprise; Arrowsmith 1 had flowed gas from a tight sandstone in the Carynginia Formation and several other wells had staining or bleeding of oil or gas in cores cut in Lower Triassic and Permian beds. However the area had not attracted much attention because of the apparent lack of a reservoir. The basal Triassic sand found around Dongara was absent in wells to the south and sandstone in the Irwin River Cogl Measures was tight. The discovery of a limestone reservoir has greatly up-graded the potential of the area.

Limestone Reservoir

The Woodada gas is reservoired in a limestone bed about 122 metres thick near the top of the Carynginia Formation. This Formation is unconformably overlain by the early Triassic Kockatea Shale. The limestone was previously encountered in Jurien 1 where a core was described as coquinite with very coarse fragments of crinoids, corals and bryozoans in a siltstone matrix. Mount Adams 1 encountered seven metres of the limestone and in Arrowsmith 1 there is an 18 metre unit of interbedded shale and limestone with the thickest limestone bed being about six metres.

Cadda 1 and Woolmulla 1 penetrated a more basinal facies with dark shale and thin limestone interbeds. The beds in the last two wells cannot be regarded as potential reservoir and are shown as shale in Figure 3.

At Mingenew there is a small outcrop of ferruginised brachiopod sandstone and siltstone known as the Mingenew Formation (Johnstone and Wilmott, 1966; Playford...
et al., 1976) that probably represents a shallow water siliciclastic equivalent.

In the Dongara area the top of the Carynginia Formation is truncated by a marked angular unconformity and the limestone bed (or its equivalent) is absent due to erosion. The same probably applies to Beharra 1 and BMR 10A. The limestone might be a restricted biothermal build-up involving sediment trapping by crinoids or other organisms, or it might be a wave-sorted biostromal accumulation, or a combination of both. Whatever the case, there is the likelihood of similar accumulations being developed in contiguous shallow water areas (Figure 4). This speculative map suggests that it could be developed along the Beagle Ridge and the tectonically analogous Turtle Dove Ridge, and that it might have been eroded from the Edwards Island Block (Jones and Pearson, 1972).

There is no shortage of hydrocarbons potentially available for filling structures along the Beagle Ridge. If only the Kockatea Shale is considered, then taking Melville's (1967) conversion factor and other parameters as listed in Figure 5, there could be as much as seven trillion cubic feet available for reservoiring in the Woodada structure and a further 26 trillion cubic feet along the remainder of the east flank of the Beagle Ridge. If this amount were reservoir, about two thirds might be recoverable.

**Porosity**

Simple intergranular porosity is inadequate to explain the high flow rates and rapid pressure recovery reported from Woodada 1. The reservoir apparently involves fracture porosity and this makes evaluation of the reserves very difficult. There simply must be more wells and longer tests.

**Trap**

I understand that the Woodada feature area can be mapped as having dip closure, but the closure also could involve fault seals. Much of the Late Triassic to Early Cretaceous sequence in the Perth Basin is very sandy and there is some risk in such objectives if the structure relies on fault closure. However the Woodada reservoir is sandwiched between two shaley units about 300 metres thick and prospects involving fault closure can be regarded as an attractive proposition.

**Exploration Strategy**

Figure three indicates that carbonate banks similar to that at Woodada could be developed in a coastal belt extending south to Wedge Island. Petroleum exploration tenements for this area are shown in Figure six. The illustrations show that any comparable prospect close to Woodada will be in the same EP 100 and that to the south the trend may extend into EP 24. The more speculative Figure four suggests that the limestone could be an objective in offshore permit WA115P and the surrounding area currently under application.

The Woodada reservoir is marked by a very strong event on the old French Petroleum Company "thumper" seismic lines. However seismic data have not been obtainable in the Hill River area because of the rough terrain, or along the coast because of the Coastal Limestone. It remains to be seen whether modern seismic techniques can produce data...
in these areas. There are indications of a strong Top Permian event on seismic lines at the southern end of the Beagle Ridge, and there are reports of a similar event on offshore seismic lines to the west of the Beagle Ridge.

Pursuing the Woodada play will involve the examining and reprocessing of old seismic lines, the acquisition of new data and perhaps seismic modelling. These efforts should answer the questions:

- is there a substantial limestone bed?
- is there a trap situation?
- Answers to the questions:
- is it porous and permeable?
- does it contain oil or gas?
- must await drilling.

Another aspect of the Woodada discovery is the report of a basal Kockatea sand. The sand is absent in Beharra 2 and wells to the south, so it was assumed that the sand was restricted to a halo around the Precambrian Northampton Block. Although it was silty and tight at Woodada it upgrades the potential of the area because it raises the possibility of a basal sand objective on the flanks of the Beagle Ridge.

Discovering New Plays

The question arises - where is the next new play? If a new reservoir can be discovered after 20 years of exploration, what else have geologists missed in the Perth Basin? This is a slightly embarrassing question; it is also impossible to answer. It is like asking a blind man what else he has not seen. In lieu of revealing the next new play, I will make some remarks on how to look for it.

Geologists do not respond very well to a broad request to discover a new play - it is hard to sit down with a stratigraphic column and a structure map of the Perth Basin and dream up a new play. Rather, geologists respond to an immediate pressure. Usually a geologist will be working for a company with a particular permit area. The seismic interpreter is told to find a structure and the geologist is told to say why it is full of oil. This is the time for imaginative geology. The geologist should look at each part of the section and ask:

- suppose oil turned up here, how would I explain it to management? Or put it another way - under what conceivable circumstances could oil occur?
- what evidence can I find that these circumstances might in fact occur?

This inverted logic is not very elegant, but it is very effective in developing a new play. Hindsight in exploration is always much clearer than foresight so the idea is to trick yourself into trying to see the play as if in hindsight.

Woodada is a geologically successful new play. Further exploration may show it to be a one-shot affair, but with luck, exploration will convert it into a commercially successful old play.

References


