DEEP MYSTERIES OF THE
PERTH CANYON
One of Australia’s biggest underwater canyons, the submerged geological feature stands out on bathymetric and contour charts.

The Perth Canyon, known also as the Rottnest Trench or Swan Canyon, is situated at 32 degrees south, beginning its deep-sea course almost immediately at the 50 metre-deep water contour about 20 kilometres west of Rottnest Island.

From there, it winds west to depths of up to four kilometres, emptying into a vast abyssal plain about 200 kilometres off the west coast. Scientists are only now scratching the surface of this unique underwater feature formed thousands of years ago.

The depth of the continental shelf at the head of the canyon rises rapidly from 200 metres to 1000 metres, where most blue whales gather to feed. Perth Canyon has a bend at its mid-point, with two short tributaries, called “blind canyons”, extending along its southern rim.

A bathymetric image of the canyon reveals a deep indentation across the continental shelf.

Had sea levels not settled to their present level about 8000 years ago, the mouth of the Swan River could have opened further west - instead of east - of Rottnest Island.

**IT is deeper and longer than the Grand Canyon. It attracts hundreds of hungry whales to the Western Australian coast each summer.** And it is right off the coast of Perth, just west of Rottnest Island. **Carmelo Amalfi delves into the mysteries of the so-called Perth Canyon - the biggest submarine canyon on the west coast and a biological hotspot supporting a diversity of marine life.**
‘A huge scar’

“It is like a huge scar in the underwater landscape,” University of WA oceanographer Chari Pattiaratchi explains. “It’s the major feature on the west coast and stands unrivalled in terms of marine life and productivity.”

The Perth Canyon, like any river canyon, formed after thousands of years of scouring by out-flows from the ancient Swan River system, whose flow rates were probably much higher than today – possibly due to a wetter climate than we have today.

Professor Pattiaratchi said that nearly every river in Western Australia from North-West Cape to Eucla had an offshore canyon associated with it. There are huge canyons off Yardie Creek, the Murchison and Kalbarri.

Research by teams of scientists from University of Western Australia, Curtin University of Technology and the WA Museum, with Geoscience Australia and the Australian Defence Force, has improved knowledge of why blue whales aggregate in certain areas of the giant canyon at different times of the year. The researchers have conducted several trips out to sea over the past few years, recording whale numbers, water temperature, salinity and other environmental and oceanographic factors influencing biodiversity in the canyon, particularly the abundance of nutrients which mushroom to the surface from the bottom of the canyon.
Perth Canyon supports a “biomass bonanza” of krill that attracts hundreds of blue and pygmy blue whales during summer. Each whale, which can weigh up to six to seven tonnes, needs about 150 tonnes a day of krill to survive.

Professor Pattiaratchi said in terms of marine biodiversity, “nothing can match the productivity and biodiversity in this canyon”.

Life in the canyon is fed by organic material from rivers, while blind canyons, which are confined to the continental slope below 500 metres, receive much less nutrient run-off. This difference can affect the productivity and diversity of life in the canyon.

The small krill which visiting whales feed on reach the near-surface waters of the canyon in periodic up-wellings of plankton-rich waters, mostly between the months of December and May.

These deep ocean eddies, which are often spin-offs from the southward-flowing Leeuwin Current and Leeuwin Undercurrent, can reach big sizes, often migrating away from the coast as pairs of nutrient-rich pools of warm water.

Eddy formation in the Leeuwin Current is particularly strong during winter, when the current is stronger. Satellite data collected by the research group has identified three main regions on the Western Australian continental shelf where such eddies are generated. One region is situated right over the head of Perth Canyon.

Using computer modelling and data from survey trips, Australian researchers are compiling an accurate picture of the south-west coast of Western Australia and the interaction of surface and sub-surface currents with life forms in the canyon. They found the eddies were strongest or well formed at the depth of the Leeuwin Undercurrent, 400 metres to 600 metres.

According to the team, these cyclonic eddies are manifest near the surface, often in cyclonic-anti-cyclonic pairs. Anti-cyclonic eddy regions include the continental shelf area south of the Abrolhos group of islands off Geraldton, Perth Canyon and the continental shelf south-west of Cape Leeuwin.

The canyon’s curves allow eddies of different directions to form inside them, constrained only by steep walls and opposing sea currents. The canyon’s size and complexity mean that multiple eddies could form within it, taking nutrients to where whales need it.

The Leeuwin Current interacts with the canyon only at about 200 metres. When the Leeuwin Undercurrent encounters the canyon, it breaks away from the shelf at about 500 metres to form a cyclonic eddy over the southern rim of the canyon.

Avoiding a collision course

The Western Australian Exercise Area is a key military training area for the Australian Defence Force (ADF). It also is a popular haunt for hundreds of “noisy” whales passing through Perth Canyon on their annual migration run up and down the coast.

Northbound whale traffic begins around May and ends in July when the gentle giants of the sea begin to move south again. This southward traffic peaks in September.

However, humpback whales move through the area until November, with an estimated 12,000 to 14,000 humpbacks using the offshore migration lanes compared to the few hundred left after commercial whaling stopped in Western Australia in the early 1960s.

Other marine species crossing the exercise area to feed on swarms of krill included dolphins, sperm whales and beaked whales.

The area, which includes HMAS Stirling naval base at Garden Island off Rockingham, is a major military training area, gazetted since World War Two. Defence Department records show that more than 24,000 “units” (ship, submarine and aircraft) were scheduled to be deployed in the exercise area from 2000 to 2002.

Most manoeuvres occur in January, February, March, May, October and November - months in which whale numbers are high. The Department says to date there have been no collisions or strandings associated with Defence activities in the exercise area.

To ensure it stays that way, the ADF has funded and supported research focused on where and when whales visit the Perth canyon area. Expensive subs and whales do not mix.

When whales communicate with one another or emit “sounds” to study their ocean environment over hundreds and thousands of kilometres, they can also interfere with navigation and communications systems used on submarines and ships. Whales emit low-frequency “rumblings” when they feed and frolic in the water.

The calls or “noise” (depending on who is listening) can reach levels of up to 188 decibels - louder than a jet plane. This noise affects communications between navy vessels that operate in an area between Lancelin and Cape Naturaliste and out to sea to about 500 to 600 kilometres. Knowing the movement and migration patterns of whales passing through the canyon allowed Defence planners to avoid these areas at certain times of the year.

Funded by the Australian navy, researchers in Western Australia have been able to study a number of areas in the canyon, particularly at the head of the canyon about 20 kilometres west of Rottnest Island.

“The navy has taken a positive attitude ... they want to get an idea about when the whales may be there and plan their exercises accordingly,” Professor Pattiaratchi said.

He said researchers also used the recently-acquired University of Western Australia “sea glider” to survey the sea down to 200 metres. Deployed in February this year, the underwater robot covered 500 kilometres of ocean off WA, completing about 2500 “drops”.

The Curtin whale tracking project was launched in 1999 following an increase in sightings off the south coast. Additional aerial acoustic surveys in 1999 and 2001 confirmed that the Perth Canyon was a favoured habitat for the pygmy blue whale, a sub-species which can grow to 25 metres. The true blue whale, the biggest and loudest marine mammal on earth, can grow up to 30 metres.

Knowing this, the Australian Defence Force launched in 2001 a two-year project to study the movement of blue whales in the military exercise area.

The location and size of the eddy depends on where the undercurrent crosses the canyon. Wind currents also affected coastal up-wellings of nutrients.