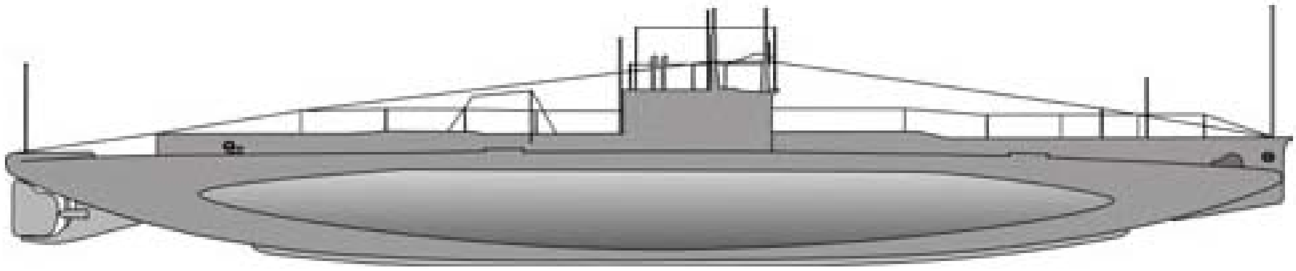
The search for the *AE1*: magnetometer and side scan sonar survey Duke of York Islands, East New Britain, 22–28 November 2003



Jeremy Green

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Department of Maritime Archaeology, Western Australian maritime Museum, Cliff Street, FREMANTLE, WA 6160

Introduction

The Department of Maritime Archaeology of the Western Australian Maritime Museum was invited to assist in a project to locate the RAN submarine *AE1* lost in East New Britain in 1914. The *AE1*, the Royal Australian Navy's first submarine, was commissioned in the United Kingdom on 28 February 1914. After commissioning, *AE1* accompanied by AE2, sailed to Australia crewed jointly by British and Australian sailors, arriving at Sydney in May 1914. Following the outbreak of war in August 1914, both submarines proceeded to New Guinea for operations against the German colonies. On 14 September, the *AE1*, accompanied by HMAS *Parramatta*, left Blanche Bay, New Britain, to patrol off Cape Gazelle. She was last seen by *Parramatta* at 3.30 pm that day and no trace has been found of her, or her company, since. It has been presumed that *AE1* struck an uncharted reef in the Duke of York Islands (see Figure 1–3) and sank.

The project to search for the *AE1* was sponsored by the Australian Broadcasting Commission (ABC), the project leader and coordinator was Commander John Foster RAN (rtd.). The team consisted of Richard Smith of the ABC together with Peter West of NUMA, Queensland together with this author. The 14-m survey vessel, *J Michelan* was provided by Simon Foo of Rabal. The project was initiated following information by a local trocus shell diver that about 10 years ago he had sighted a submarine in about 60 m of water off Mioko Island. This was thought to be the *AE1*.

Surveys using a high resolution Marine Sonic side scan sonar and an ELSEC proton magnetometer were undertaken over a 5-day period in and around Mioko Island and is the subject of this report.

The survey

The initial survey area (Figure 3) was defined by John Foster based on information provided by a local informant. This was a rectangular search area 350 m by 1000 m off the east end of Mioko Island (see Figure 5).

Table 1. Coordinates of search area (see Figure 5) related to AUS 679

Corner	Latitude	Longitude
NE	-4° 13.100	152° 29.049
NW	-4° 12.972	152° 29.197
SW	-4° 13.494	152° 29.446
SE	-4° 13.397	152° 29.588

Starting on 23 November, trials were carried out with the equipment in Mioko Harbour. The side scan sonar was then deployed in the search area, however, because of moderate to strong winds and a choppy sea the side scan performance was poor and the side scan survey gave poor bottom images (see Figure 10). It is a feature of side scan sonar that in anything but flat calm conditions, the sea bed details are lost in noise and are the records are generally useless. During the latter part of this survey the magnetometer was deployed and it was noted that the background noise level was good and there was a minor geomagnetic anomaly at the southern end of the search area, giving about 800 nano Tesla (nT) anomaly. Although this anomaly covered a large area and was thought to be related to the extension to the southern reef on Mioko Island. The anomaly of this size and extent would be unlikely to affect the ability of the magnetometer to detect the *AE1*.

On 24 November the sea was calm and the survey was repeated. A series of runs were made in the search area. Initially, from 07.25 hrs to 08.24 hrs a magnetometer was used to survey the area for magnetic targets. No large magnetic anomalies were found in the area. Given that the *AE1* was about 800 tonnes, according to the Hall equation:

$$\Delta M = 10^4\left(\frac{A}{B}\right)\left(\frac{W}{d^3}\right)$$

Where ΔM = the size of the magnetic anomaly in (nT), (A/B) is the length to breadth ratio (55/7)=7.8; w = mass in kg and d is distance in metres. Thus in general the proton magnetometer can easily resolve a 100 nT anomaly, so for the *AE1* one would expect a detection range is about 85 m, well within detection range over survey area. Then from 09.31 hrs to 10.11 hrs the side scan was deployed and good sonar records were obtained (24NOV008.MST to 24NOV014.MST). The bottom sonar trace was good quality (see Figure 9) and the area was covered in detail. It was noted that there was a bank running north-south along the east side of Mioko Island with depths up to about 3 m 100 m off-shore. The bank sloped sharply to about 20 m and then the bottom sloped gradually down to about 40 m where it then flattened out, gradually deepening to the east to around 60–80 m at east side of survey area. At the south end of the search area, a reef extended out from the southern side of Mioko Island towards the east. Along the whole of the western edge of the survey area on the edge of the bank numerous detached reefs were noted (see Figure 9). These were of the same approximate size as the *AE1* but were clearly natural features. The vessel then conducted a side scan sonar sweep along

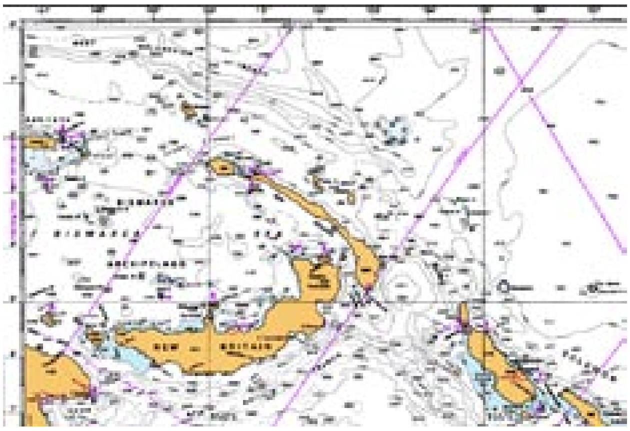

Figure 1. The Duke of York Islands are between East New Britain and New Ireland.

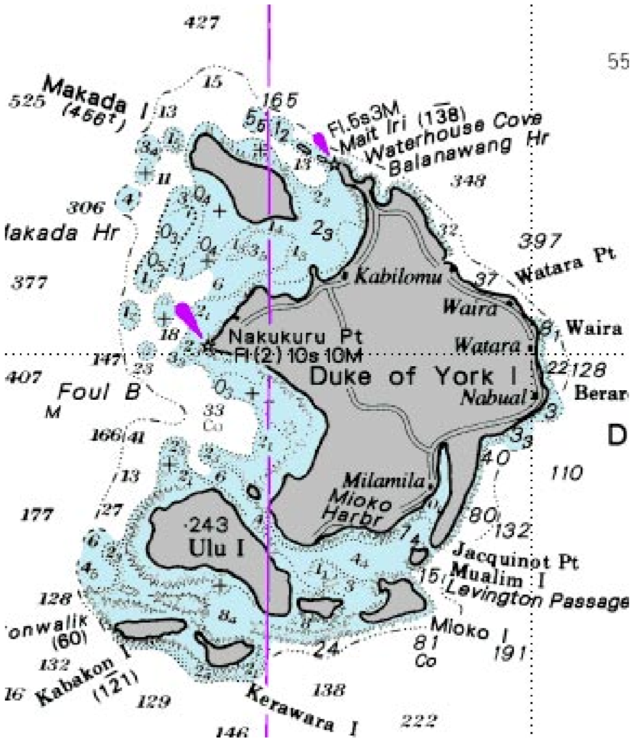

Figure 2. Duke of York Islands.

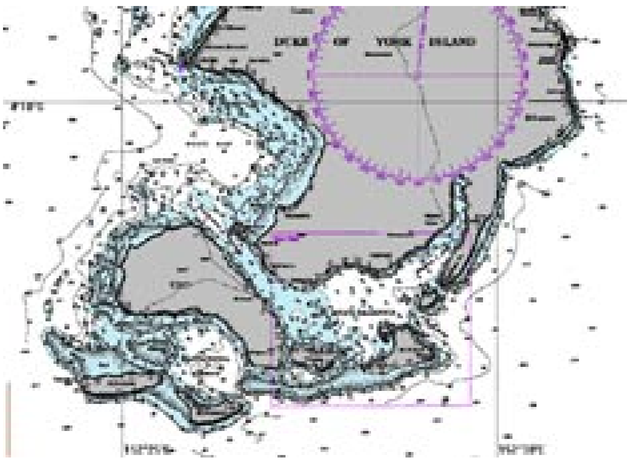

Figure 3. Detail of survey area near Mioko Island.

the south-east side of Duke of York Island from Berard Point to Jacquinot Point, this was completed between 11.29 hrs and 12.14 hrs. No significant sonar targets were noted.

On the 25 November a magnetometer survey was conducted along the southern side of Mioko Island, hoping to locate a magnetic target close to the reef. However, the weather conditions were bad, with a large swell and heavy sea, so the survey was abandoned.

On the 26 November the weather conditions improved and the magnetometer survey was continued. The reef was surveyed from Wirian on Mioko Island to Kerawara Island, a distance of about 10 km. Again no magnetic anomalies of any significance were found. The marine survey work was terminated at this point.

Navigation

There are two main charts of the area: Admiralty AUS679 Plans of the Bismark Archipelago (Duke of York Group 1:50 000 and Mioko Harbour 1:18 000) and AUS680 Approaches to Blanche Bay 1:75 000, the former chart cannot be used for GPS derived navigation whereas AUS680 has the WGS84 chart datum and can be used for GPS. Unfortunately AUS 680 only covers the very eastern end of the Duke of York Group, so that AUS679 was useless for survey work. It was decided therefore to attempt to georeference the chart so that the survey could be plotted on the chart. Initially, the survey vessel was taken to an easily identifiable point on Mioko Island and the GPS coordinates recorded and compared with the chart. Since the position on Mioko was not clearly defined, a common point on the two charts (AUS680 and AUS679) was used to refine the measurement (see Table 2). It should be noted that chart AUS679 is 2 098m (-1.133') too far to the east 783 m (0.423') too far south.

Conclusion

There is little doubt that the *AE1* does not lie in the defined search area. This area was searched thoroughly with both magnetometer and side scan sonar; subsequently, diver inspection indicated that the side scan sonar observation of large detached reef formations was correct and these could have been mistaken for a submarine by the informant. Search area along the reef both to the east and west of the main search area were not systematic and are unlikely to have found the *AE1* except by chance. The area, in spite of volcanic activity in the area, is relatively quiet with minor geomagnetic anomalies, particularly the anomaly noted at the SE corner of Mioko Island. It is unlikely that a towed seaborne magnetometer is the best detection instrument for this search, as it is far from clear where the position of the *AE1* is. Records indicate that the vessels parted company of the eastern end of the Duke of York Islands, the *AE1* sailing around the south. The site could therefore be located anywhere between Berard Point and the Pigeon Islands.

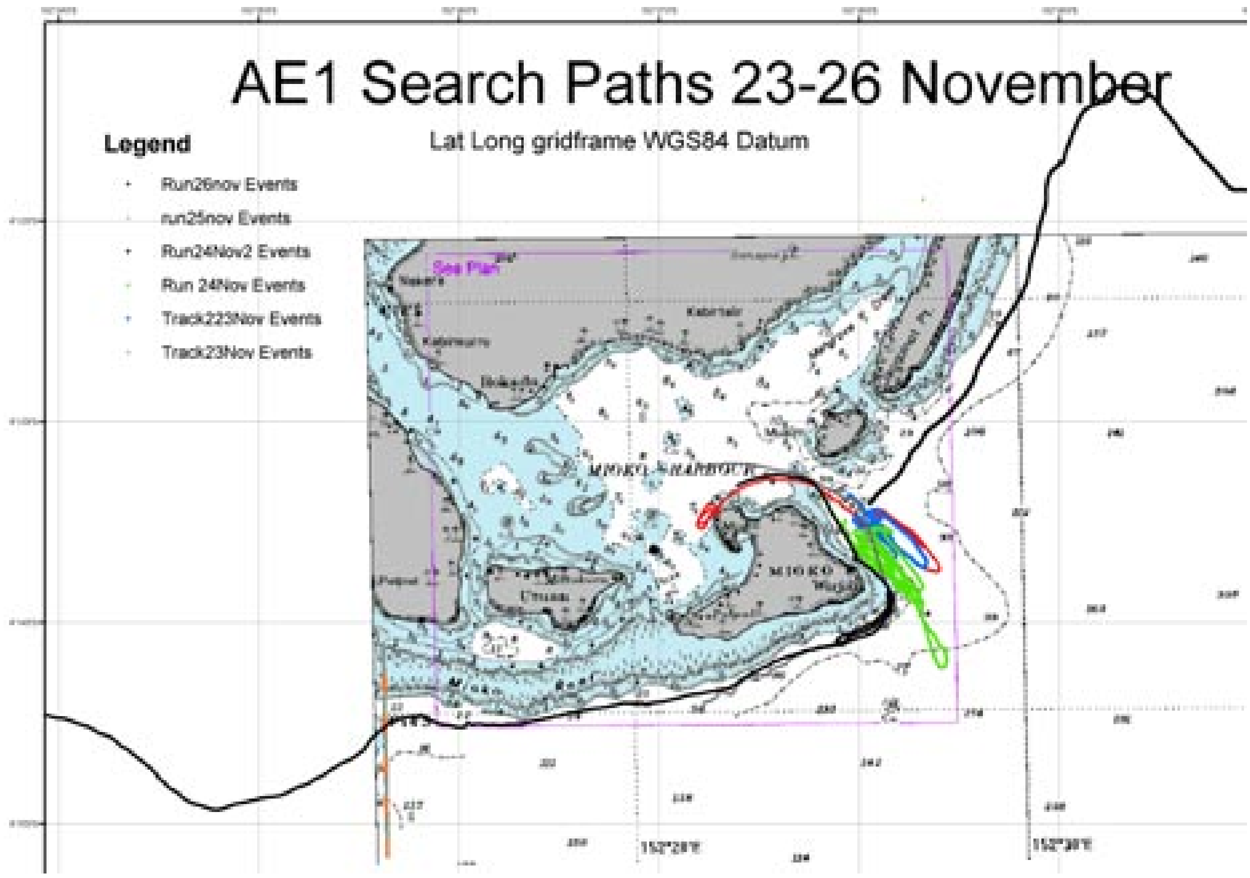

Figure 4. The search paths 23–26 November showing track of survey vessel.

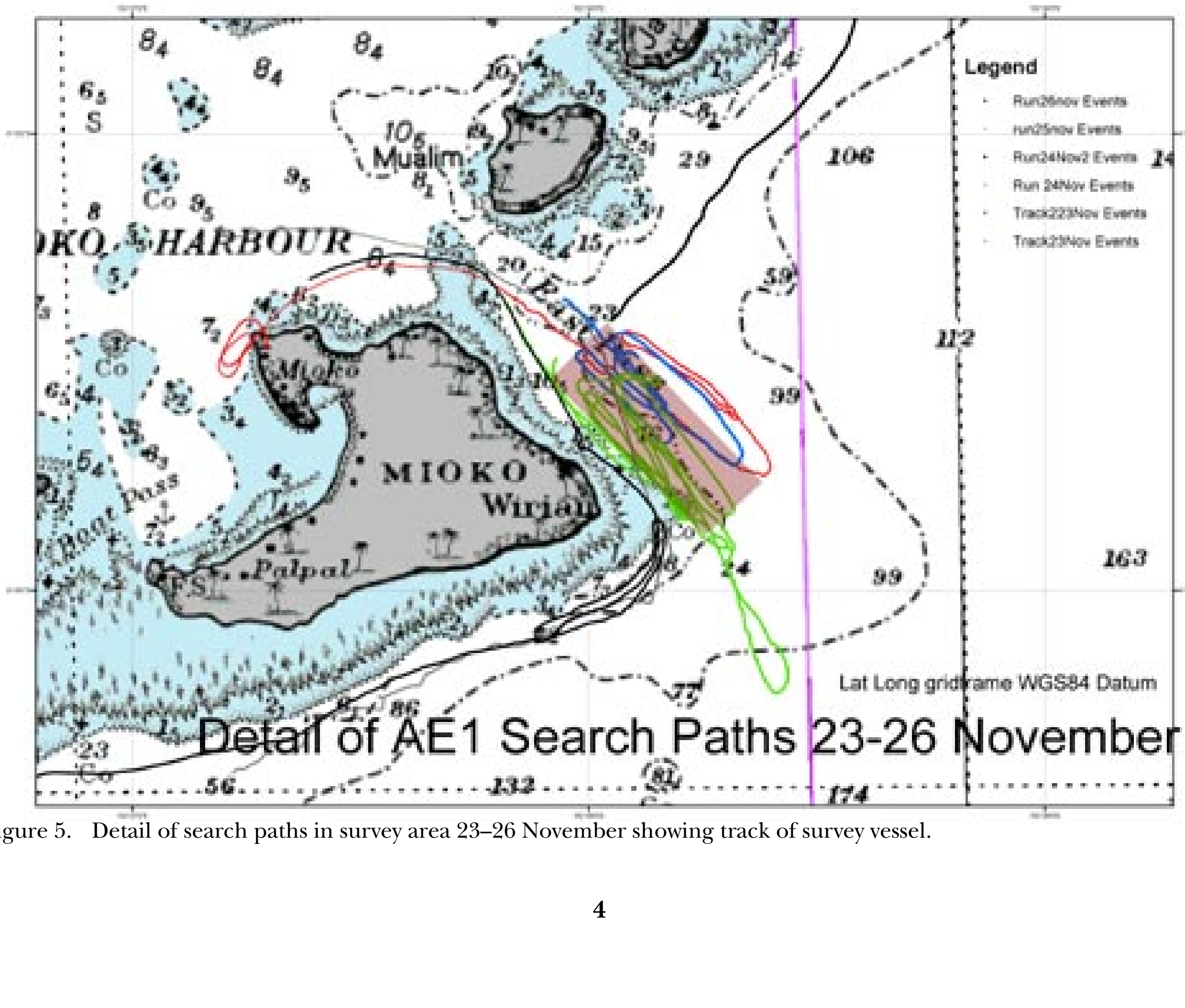

Figure 5. Detail of search paths in survey area 23–26 November showing track of survey vessel.

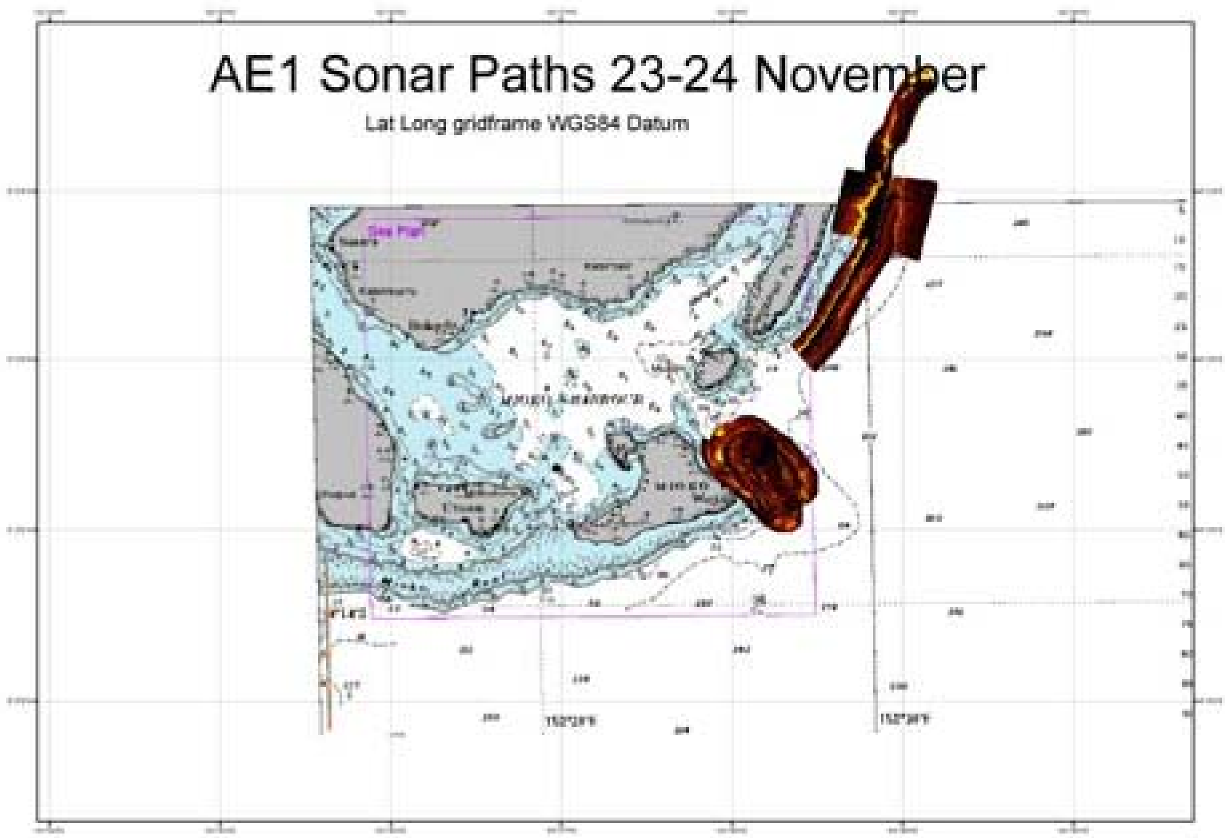

Figure 6. Plan showing the side scan sonar traces recorded during survey.

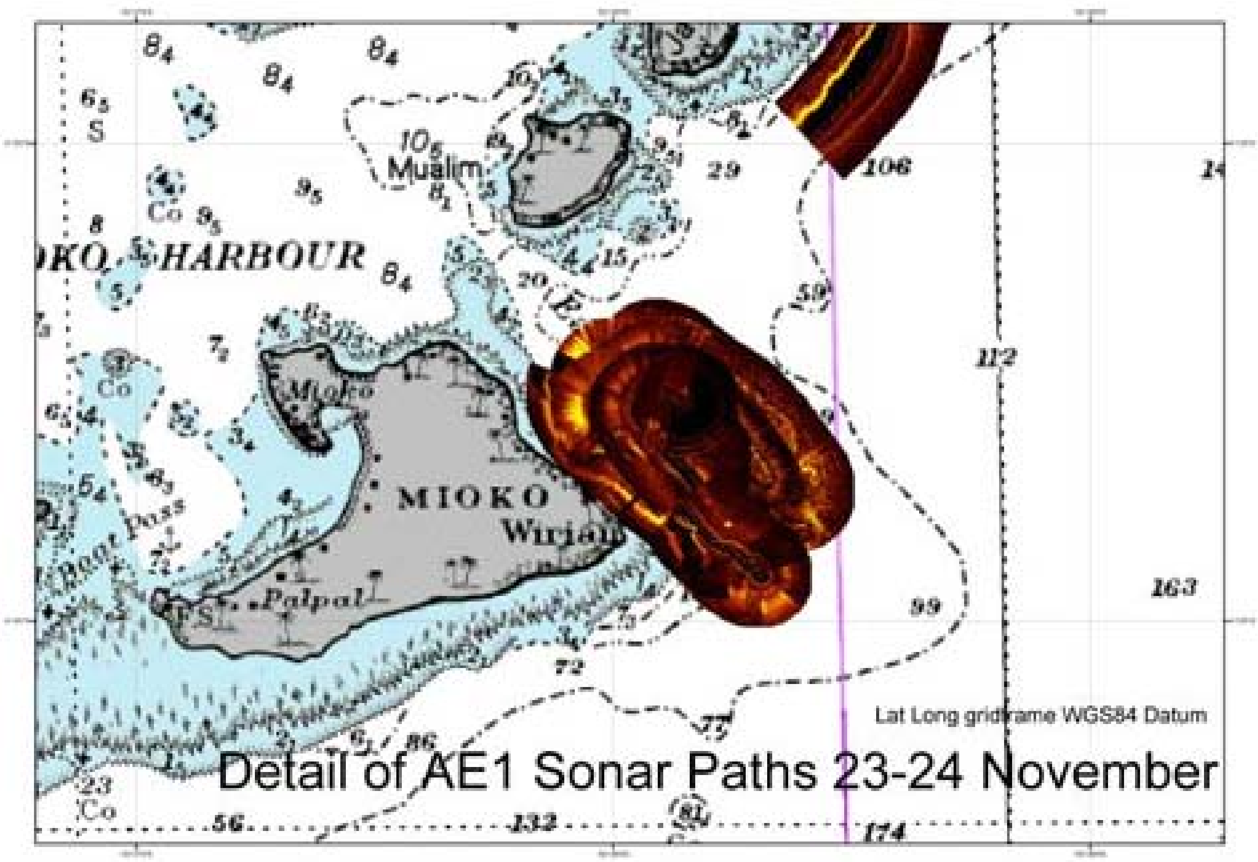

Figure 7. Detail of side scan sonar trace in main survey area.

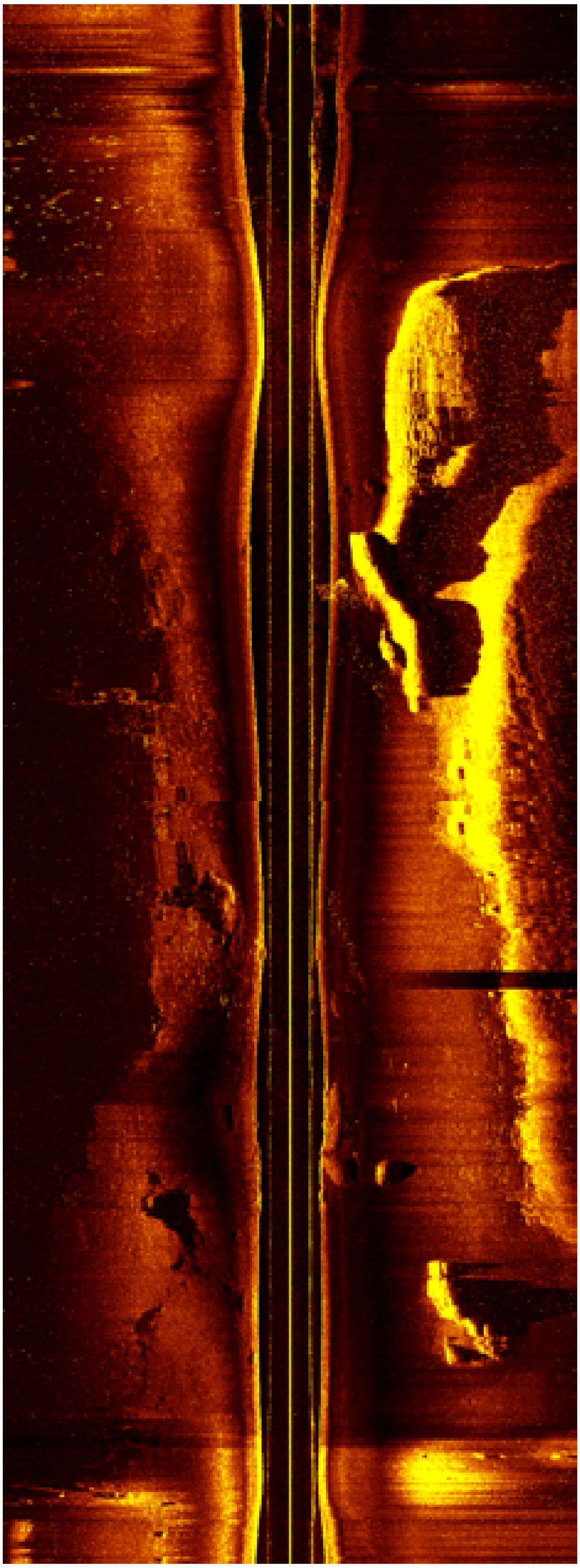

Figure 8. Side scan sonar trace ('waterfall' mode) showing reef area of Mioko Island (right) and detached reefs system on a flat seabed.

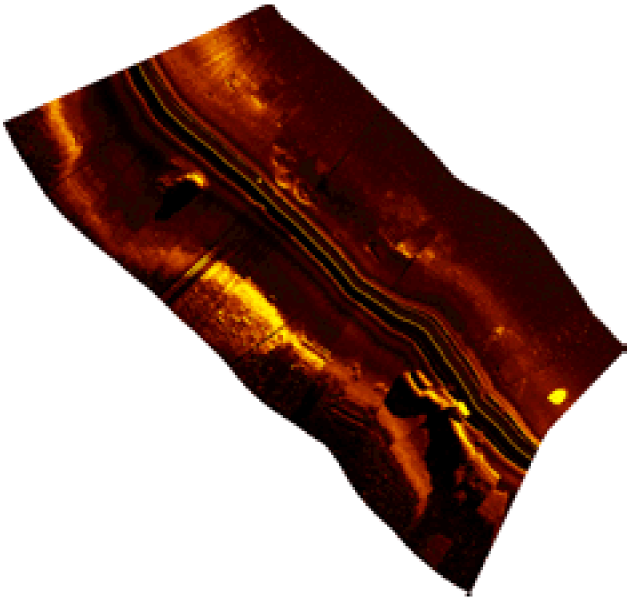

Figure 9, Section of Figure 8 georeferenced showing the side scan sonar trace in correct geographical orientation (north up).

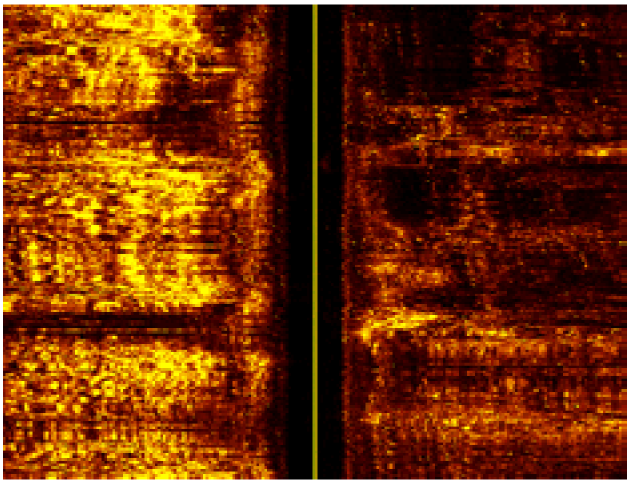

Figure 10. Side scan sonar trace in rough weather on 23 November, note it is almost impossible to distinguish the bottom, compare with Figure 8 taken in same area on the following day in calm weather.

It is assumed that the *AE1* would have kept out to sea, given that the vessel was operating in a relatively unknown area. Additionally, the *AE1* did not have a deck gun (these were fitted later), so that as a patrol vessel her ability to deal with enemy vessels would have been restricted to submerging and using torpedoes. At the time the *AE1* was known that one of her electric motors was out of commission. The vessel could go ahead on both diesel engines but to reverse on the surface required disconnecting the diesel engines and engaging the electric motors. This means that the *AE1* would have had difficulty both engaging reverse on the surface, and additionally, would have had only one engine for underwater operation.

Two scenarios have been suggested to explain the

Table 2. Differences between AUS 679 and GPS (WGS84) and AUS 680 (WGS84), difference is what has to be added to or subtracted from AUS 679 to give WGS84 datum derived positions.

	AUS 679	Side Scan GPS	AUS 680 (WGS84)	Difference
Mioko Island	**4° 13.030S** **152° 28.417E**	**4° 13.469S** **152° 27.281E**		**+0.439'** **-1.136'**
Nakukuru Point	**4° 09.447S** **152° 25.830E**		**4° 09.870S** **152° 24.697E**	**+0.423'** **-1.133'**

loss of the vessel: first, she struck a reef and then got into difficulties and sunk; or the vessel was engaged by an armed German Kolonial Gesellschaft yacht known to be operating in the area. (J. Foster, pers. com.) and it is possible that it was disabled and sank, or submerged and was unable to resurface. There is an account that the *Kolonia* was discovered on fire near Cape Pomas a few days after the loss and a Nordenfelt gun was found on board with spent shell casings. Additionally, there is an account that one of the captured Germans spoke of sinking the *AE1* with gunfire, although this is possibly a made-up story to lower moral among the Australians (J. Foster, pers. com.).

It is worth considering if, for the depth of water off the SE part of the Duke of York Islands, the *AE1* could be within the detection range of a magnetometer. The *AE1* was 800 tonnes and with a marine proton magnetometer, a reasonable detection range would be 85 m. This confines the search area to a strip from the top of the reef out to about 250 m, at about the 20 fathom contour. With an airborne magnetometer, the detection range would be much greater, because the sensitivity can be greatly increased, as the detector head is not in a 'noisy' marine environment. Generally, marine proton magnetometers have a background noise of around 5 nT, whereas, aerial caesium vapour magnetometers have sensitivities of about 0.01 nT. Recent experiments in the Deepwater Graveyard off Rottnest in Western Australia (Green, 2002) have shown that 2000 tonne vessels can be detected in 200 m of water. Applying the same parameters as the Deepwater Graveyard operation, it is likely that an aerial magnetometer would be able to detect the *AE1* in about 430 m of water, thus greatly increasing the potential search area. Additionally, the aerial magnetometer flies at about 300 km/hr so that the survey is both fast and independent of weather conditions. Should targets be located in deep water, or beyond conventional diving operations, a ROV (Remotely Operated Vehicle) would be the ideal method of identification. It this author's opinion that this system is the most likely method of finding the *AE1* and there are numerous Australian survey companies operating in this area who could be persuaded to assist in locating this important part of Australia's naval history.

Acknowledgements

The author would firstly like to thank John Foster for the kind invitation to take part in the operation. The Western Australian Museum granted permission for me to take part in this operation, providing the Museum equipment and my service free of charge. Stefan Moore, Executive Producer Science, ABC provided logistic support and travel expenses. Simon Foo provided boat and local logistics. Richard Smith directed the documentary shoot for the ABC.

References

Green, J.N., 2002, The application of side scan sonar and magnetometer to the location of archaeological sites, Bulletin of the Australasian Institute for Maritime Archaeology, 26: 119–130.