

Reviving Legacy Seismic Data: Challenges and Insights from the Bismarck Sea, Papua New Guinea

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SUMMARY

Seismic data from the Bismarck Sea, north of Papua New Guinea, had remained inaccessible for decades due to its storage on obsolete tape formats. This paper details the investigative process undertaken to recover and transcribe these unique datasets.

The successful retrieval required locating compatible legacy tape drives, overcoming technical and logistical challenges, and adapting modern transcription techniques. The restored data provide valuable insights into a geologically complex and underexplored region, demonstrating the continued relevance of archival preservation in geophysical research.

This work underscores the potential of legacy seismic data to enhance contemporary quantitative interpretation and reduce geological uncertainty.

Key words: Bismarck Sea, PNG, Seismic Data Recovery, Obsolete Data Formats, Legacy Data

INTRODUCTION

Introduction

In 1970, the Bureau of Mineral Resources (BMR, a fore-runner of Geoscience Australia) acquired 33,000 km of 2D seismic data across the Bismarck Sea, north of Papua New Guinea. The survey employed a Sparker source and a 1 km towed cable with six seismic channels, along with a near-vessel high-resolution geotechnical channel. At the time, near-trace sections were plotted onboard the survey vessel for immediate interpretation and later used in subsequent studies. However, the full dataset was also recorded onto one-inch magnetic reel tapes using an AMPEX drive, ensuring long-term archival storage.

While the plotted sections provided valuable initial insights, the original seismic records remained largely inaccessible due to the obsolescence of the AMPEX tape format. The transition from analogue to digital seismic processing, along with the decline in compatible tape-reading technology, rendered the data effectively lost to modern geophysical analysis. However, given the Bismarck Sea's geological complexity and underexplored nature, recovering these legacy data presents a unique opportunity to enhance our understanding of the region's subsurface.

This paper details the process and efforts since 2015 of locating, transcribing, and restoring these historical seismic records. The effort required sourcing operational legacy tape drives, overcoming technical and logistical challenges, and adapting modern data processing techniques to integrate the recovered seismic data into contemporary interpretation workflows. The successful recovery underscores the importance of archival preservation and highlights the potential of legacy seismic data to inform present-day geological and geophysical studies.

METHOD AND RESULTS

The recovery of the Bismarck Sea seismic data involved two primary approaches: attempting to extract information from archived paper records and direct transcription from the original magnetic tapes.

Archival Data Extraction Attempts

The onboard paper monitor records from the 1970 survey were stored as TIFF format files in the Geoscience Australia archives. To assess their usability, these files were downloaded and processed in early 2018 using scanning and vectorisation techniques at PT Horizon Geoconsulting in Jakarta, Indonesia. However, due to the poor quality of the scanned images, extracting meaningful seismic information was unsuccessful. Given these limitations, an alternative approach was required.

Locating and Restoring AMPEX Tape Drives

With the failure of image-based reconstruction, attention shifted to transcribing the original magnetic tapes recorded in the now-obsolete AMPEX format. A major challenge was the near-total disposal of AMPEX tape drives, making transcription seemingly unfeasible. After an extensive search, and with the assistance of Keith Woollard of GeoCom, a small number of AMPEX tape drives and spare parts were located in a garden shed in Canberra. These were purchased and transported to Perth in February 2022 for reconstruction.

Data Recovery and Transcription Process

Parallel to the hardware restoration efforts, discussions with Geoscience Australia secured access to two seismic lines from the survey:

1. A line from the Gulf of Papua, selected as a test dataset due to the availability of more recent seismic coverage in the area. See fig. 1.
2. A north-south transect across the Bismarck Sea, representing unique and irreplaceable data. See fig 1.

Graeme Murray and Keith Woollard rebuilt the AMPEX tape drives and developed an analogue-to-digital conversion system to transcribe the seismic data. The system comprised:

- Wiring to connect the 14 analogue RCA outputs to a standard SCSI cable.
- A commercial PCI-based analogue-to-digital interface card installed in a desktop PC.
- Software to digitise the 14 signals and output them as a 1ms-sampled comma-separated ASCII (CSV) file.
- Software to process the CSV, detect shot signals from the time break channel (typically channel 11), split the data into individual shot records, and output standard SEG-Y files.

Each tape contained just over nine hours of recording, equating to approximately 35 million samples on each of the 14 channels.

To validate the process, the Gulf of Papua line was transcribed first. As this dataset was not critical, it provided a safe test case for potential tape degradation or damage.

Following the successful transcription of the Gulf of Papua line, work proceeded on the Bismarck Sea dataset. The transcription process yielded an excellent digital seismic profile extending from the western tip of Manus Island to the town of Madang on the north coast of Papua New Guinea. This newly recovered dataset provides a high-quality seismic section of a geologically complex and underexplored region, demonstrating the value of legacy data recovery.

Figures

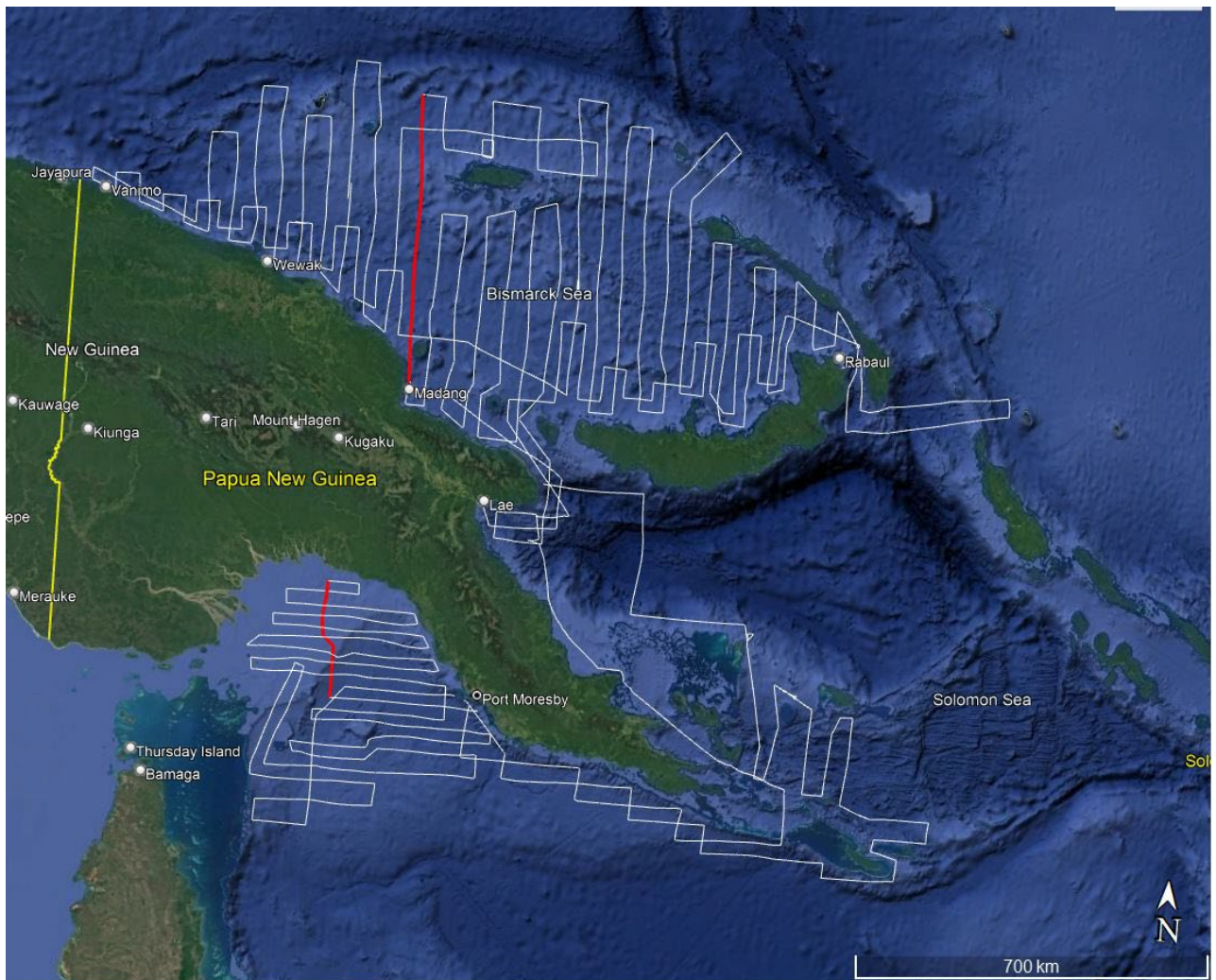


Figure 1: Line map of BMR5 survey with Bismarck Sea test lines in red



Figure 2: AMPEX FR1300 Tape Drive

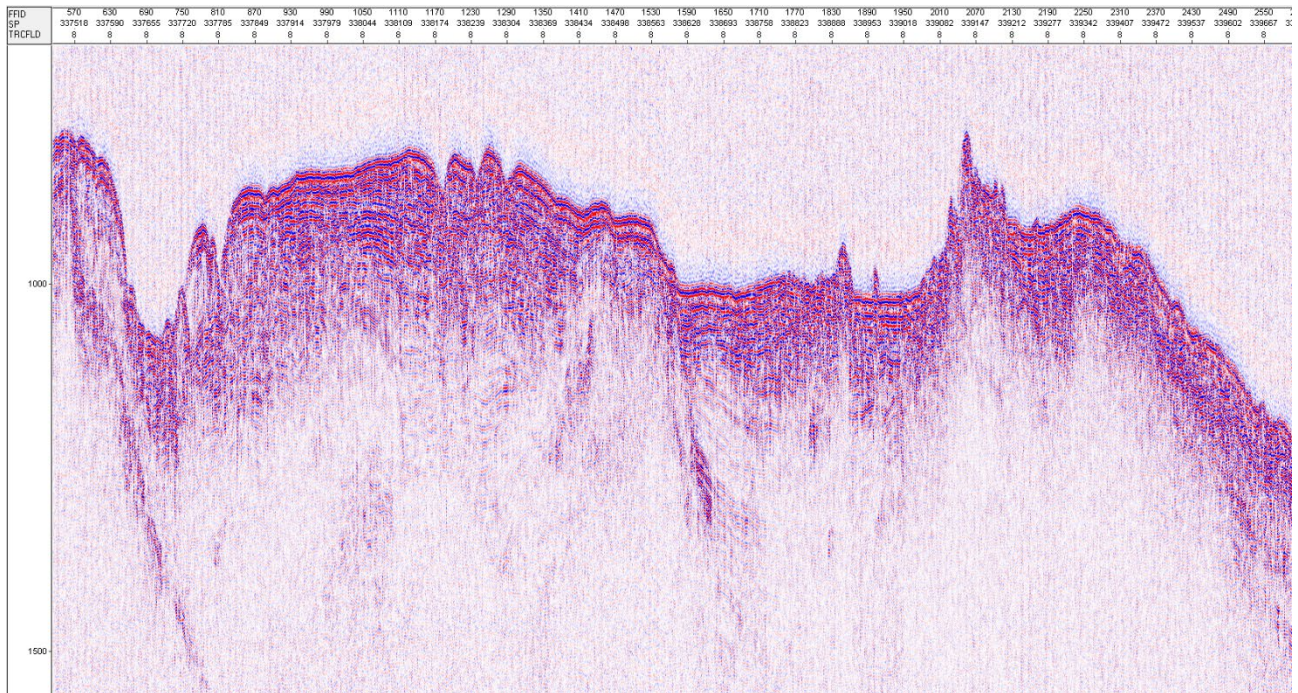


Figure 3: Raw Near Trace Display of part of BMR5 survey Bismarck Sea test line

CONCLUSIONS

This study demonstrated that vintage AMPEX tapes could be successfully transcribed, allowing the recovery of valuable seismic data from the Bismarck Sea. Despite the challenges posed by obsolete recording formats and the scarcity of compatible tape drives, the restoration and transcription process yielded high-quality digital seismic profiles. In addition, the tapes have a far better dynamic range than the fathometer style displays that were used for the original regional interpretation and when transcribed and processed, have the multi-fold advantage.

The Bismarck Sea dataset represents a unique and irreplaceable geological record, as no regional seismic transects have been acquired in this area since 1975. Given the Bismarck Sea's significance in Asian tectonics, the recovered data hold both academic and commercial value, providing insights into the region's complex geological history and potential resource potential. This work highlights the importance of preserving and re-evaluating legacy geophysical data, which can continue to inform contemporary geological interpretation and exploration efforts.

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REFERENCES

Tilbury, L., 1975, Geophysical Results From the Gulf of Papua and Bismarck Sea: Bureau of Mineral Resources, Geology & Geophysics Record 1975/115.