Subjunctive Geo

GeoCom

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

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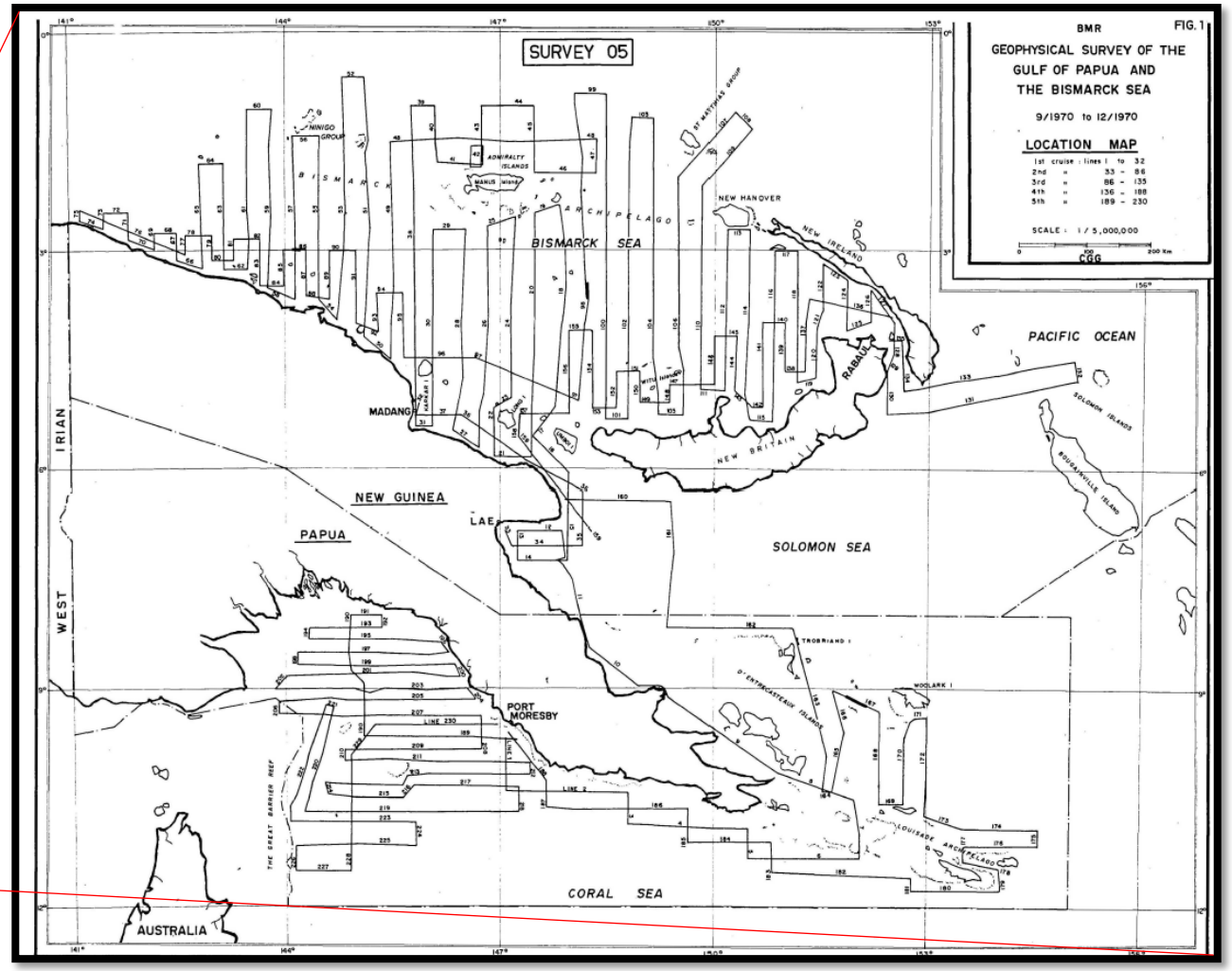
# In 1970…..

# BMR-5 Survey

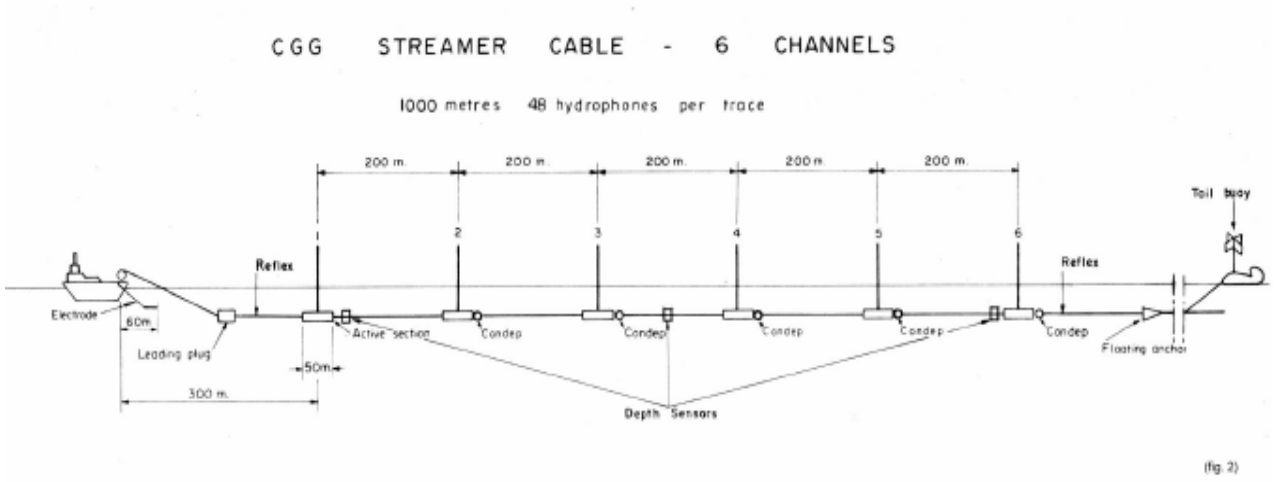




Total data acquired in BMR-5 ~33,000 km between September and December 1970

# State-of-the-Art Technology

- BMR-5 survey conducted between September and December 1970
- MV Lady Christine (renamed from M/V Hamme)
- 6 channel 1000m cable with 200m receiver group
- Geotech channel
- 4 x 30,000 joule sparker source
- Ampex 1” tape recording




Equipment

The 1970 survey was the first BMR survey to include on-line computers for data acquisition and digital seismic stacking. These systems were designed to collect, process, and store large quantities of survey data.

FR-1300
INSTRUMENTATION RECORDER/REPRODUCER

. . . the smallest portable 14-track recorder, yet (24 x 18 x 12½ inches), offering outstanding instrumentation performance with 300 KC on Direct, 20 KC on FM and IRIG compatible PDM.

APPLICATIONS:

Full instrumentation capabilities including plug-in amplifiers and heads makes this an ideal recorder for field and laboratory use. Useful for telemetry, materials testing, process control and testing, and related applications in manufacturing, chemical, aircraft, petroleum, medical and aerospace installations.

FEATURES:

New transport design based on refinements and improvements of time-proven Ampex systems. Unique capstan servo system insures speed accuracy under varying frequency and phase conditions. Electrical switching selects 6 speeds from a single, front panel control. Tape threading is simplified, straight-line path. Tape lifters reduce head wear in fast modes; can be defeated for high speed search. Controls are interlocked to positively prevent tape damage. Available in a rack-mounted version. Uses Ampex's solid-state ES-100 electronics.

SPECIFICATIONS:

**Tape Speeds:** 1⅞, 3¾, 7½, 15, 30, 60 ips standard.
**Tape Specifications:** ½ or 1-inch versions, 10½-inch reels.
**Heads:** 7 on ½ inch, 14 on 1 inch.
**Recording Modes:** Direct, FM, PDM (IRIG compatible).
**Frequency Response:** Direct: 300 cps to 300 KC ±3 db.
**FM:** DC to 20 KC within 1.0 db. IRIG compatible PDM.

AMPEX FR-1300 Instrumentation Recorder/Reproducer—½-inch (1.27 cm), 7-Track, IRIG Heads, 7 Direct Record Amps, 7 Direct Reproduce Amps, 7 Direct Reproduce Equalizers

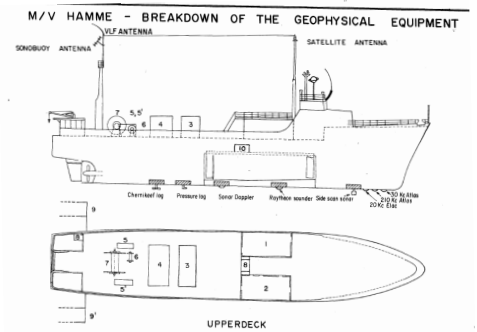
**SELLING PRICE:** $9,030.00

**Seismic Recording System**

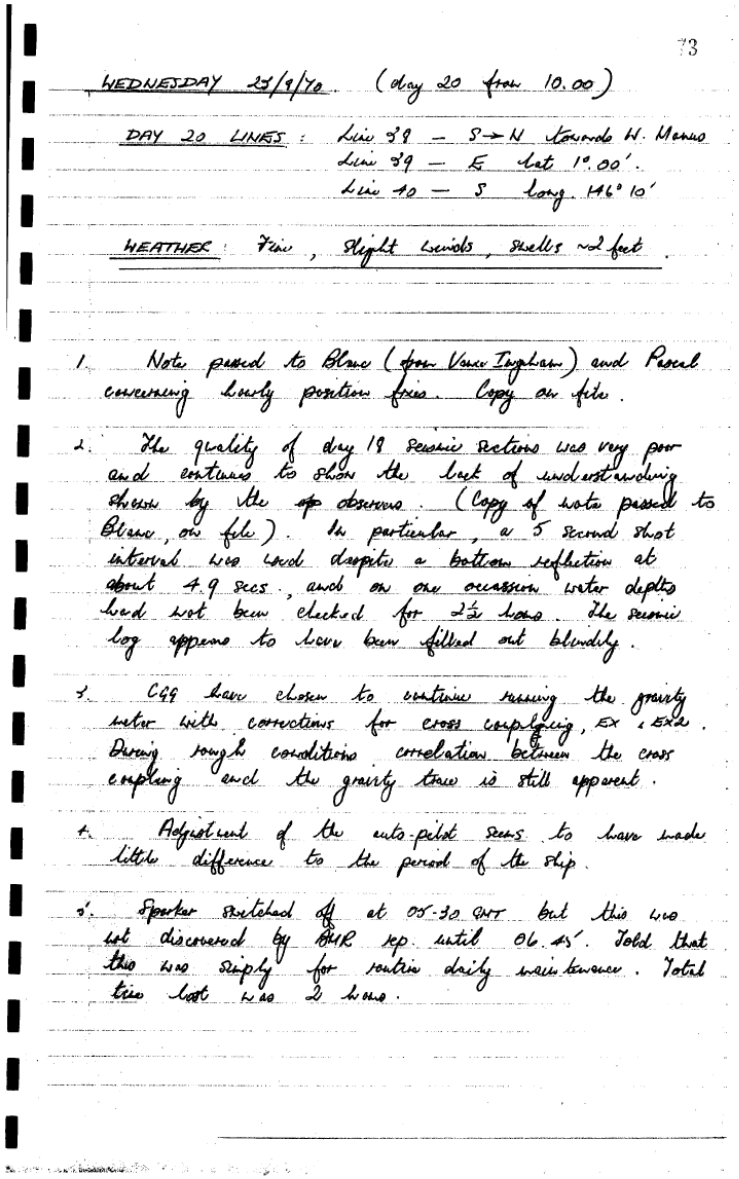
An AMPEX FR 1300 tape recorder was used for all of the surveys. It was capable of recording 14 channels of data to 1 inch magnetic tape with a tape speed of 15/16ths of an inch /second.

The channels recorded were

| | |
|---|---|
| 1 | CGG channel 1 |
| 2 | CGG channel 2 |
| 3 | CGG channel 3 |
| 4 | CGG channel 4 |
| 5 | CGG channel 5 |
| 6 | CGG channel 6 |
| 7 | Stacked trace |
| 8 | Geotech shallow cable |
| 9 | Refraction |
| 10 | 100Hz |
| 11 | Time Break |
| 12 | 10 minute mark |
| 13 | Nil |
| 14 | Spit out (move out corrected) |



# Observers Logs



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WEDNESDAY 23/9/70 (day 20 from 10.00)

DAY 20 LINES : Line 39 — S→N towards W. Mews
Line 39 — E Lat 1°.00'.
Line 40 — S Long. 146° 10'

WEATHER : Fine, Slight Swells ~2 feet.

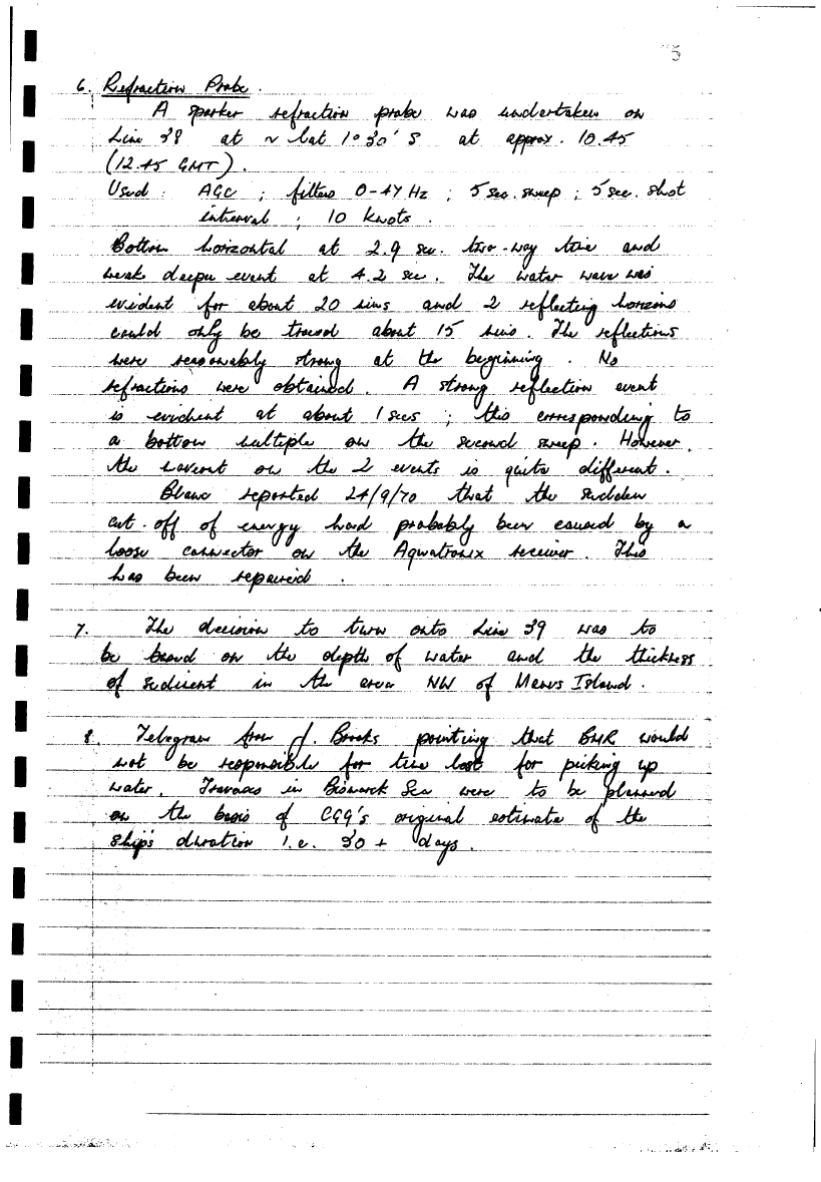
1. Note passed to Blaw (from Vere Ingham) and Pascal concerning hourly position fixes. Copy on file.

2. The quality of day 19 seismic sections was very poor and continues to show the lack of understanding shown by the op observers. (Copy of note passed to Blaw, on file). In particular, a 5 second shot interval was used despite a bottom reflection at about 4.9 secs, and on one occassion water depths had not been checked for 2½ hours. The seismic log appears to have been filled out blindly.

3. CGG have chosen to continue running the gravity meter with corrections for cross coupling, Ex & Exe. During rough conditions correlation between the cross coupling and the gravity trace is still apparent.

4. Adjustment of the auto-pilot seems to have made little difference to the perform of the ship.

5. Sparker switched off at 05-30 GMT but this was not discovered by BHR rep until 06.45'. Told that this was simply for routine daily maintenance. Total time lost was 2 hours.



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6. Refraction Probe.
A sparker refraction probe was undertaken on Line 39 at ~ Lat 1°30' S at approx. 10.45 (12.45 GMT).
Used AGC ; filters 0-14 Hz ; 5 sec. sweep ; 5 sec. shot interval ; 10 knots.
Bottom horizontal at 2.9 sec. two-way time and weak deeper event at 4.2 sec. The water wave was evident for about 20 secs and 2 reflecting horizons could only be traced about 15 secs. The reflections were reasonably strong at the beginning. No refractions were obtained. A strong reflection event is evident at about 1 secs ; this corresponding to a bottom multiple on the second sweep. However the record on the 2 events is quite different.
Blaw reported 24/9/70 that the suspected cut-off of energy had probably been caused by a loose connector on the Aquatronix receiver. This has been repaired.

7. The decision to turn onto Line 39 was to be based on the depth of water and the thickness of sediment in the area NW of Mews Island.

8. Telegram from J. Brooks pointing that BHR would not be responsible for time lost for picking up water. Traverse in Bismark Sea were to be planned on the basis of CGG's original estimate of the ships duration i.e. 30 + days.

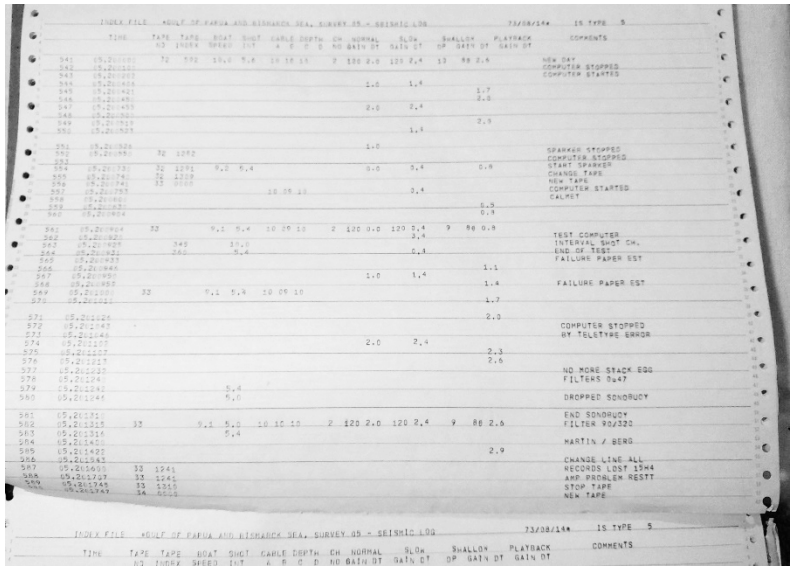
All available as .tiffs
- Could we use AI to transcribe?

# Navigation process

Upon firing, Julian time recorded with Field ID

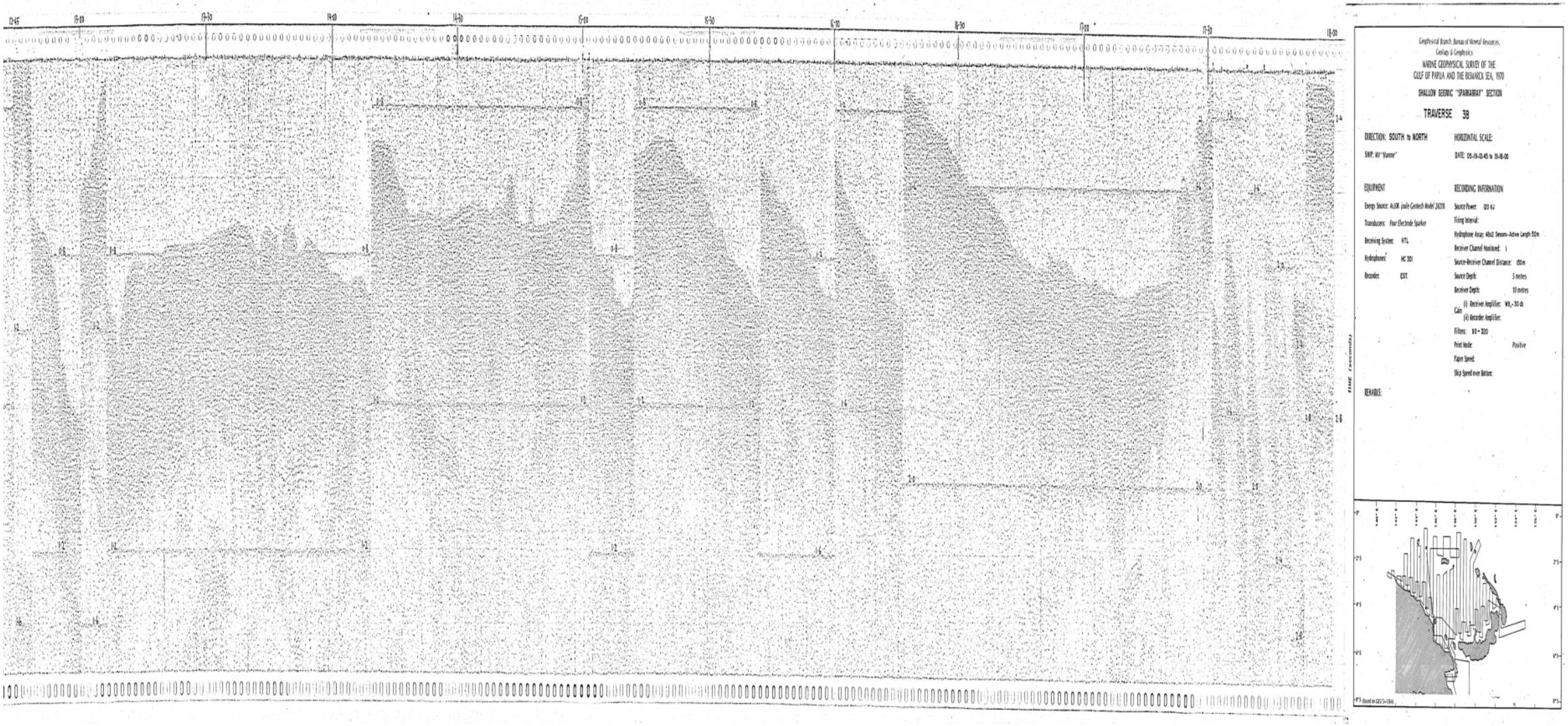
Lat-Long locations recorded with Julian time of boat at that position

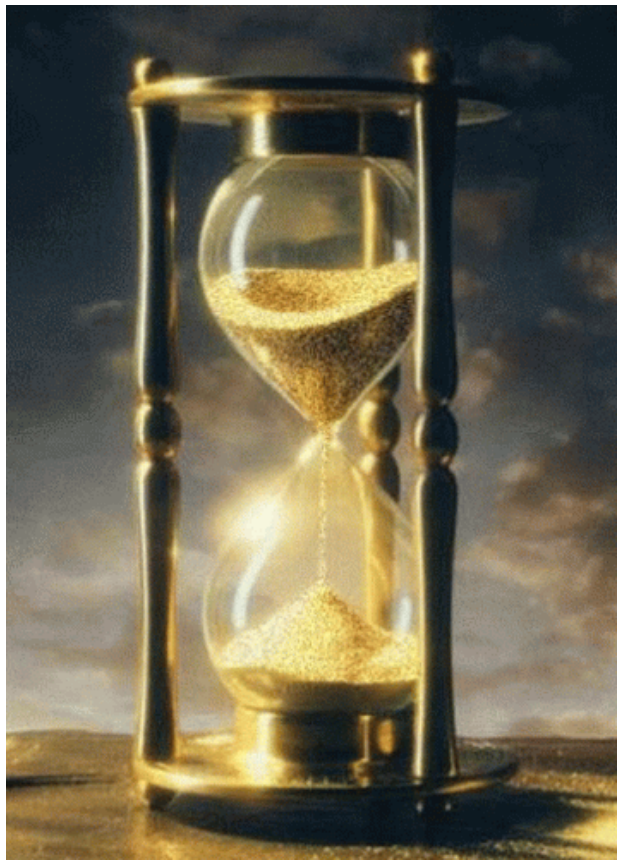
Two measurement sets merged to create Shotpoint and Lat Long



Navigation printout

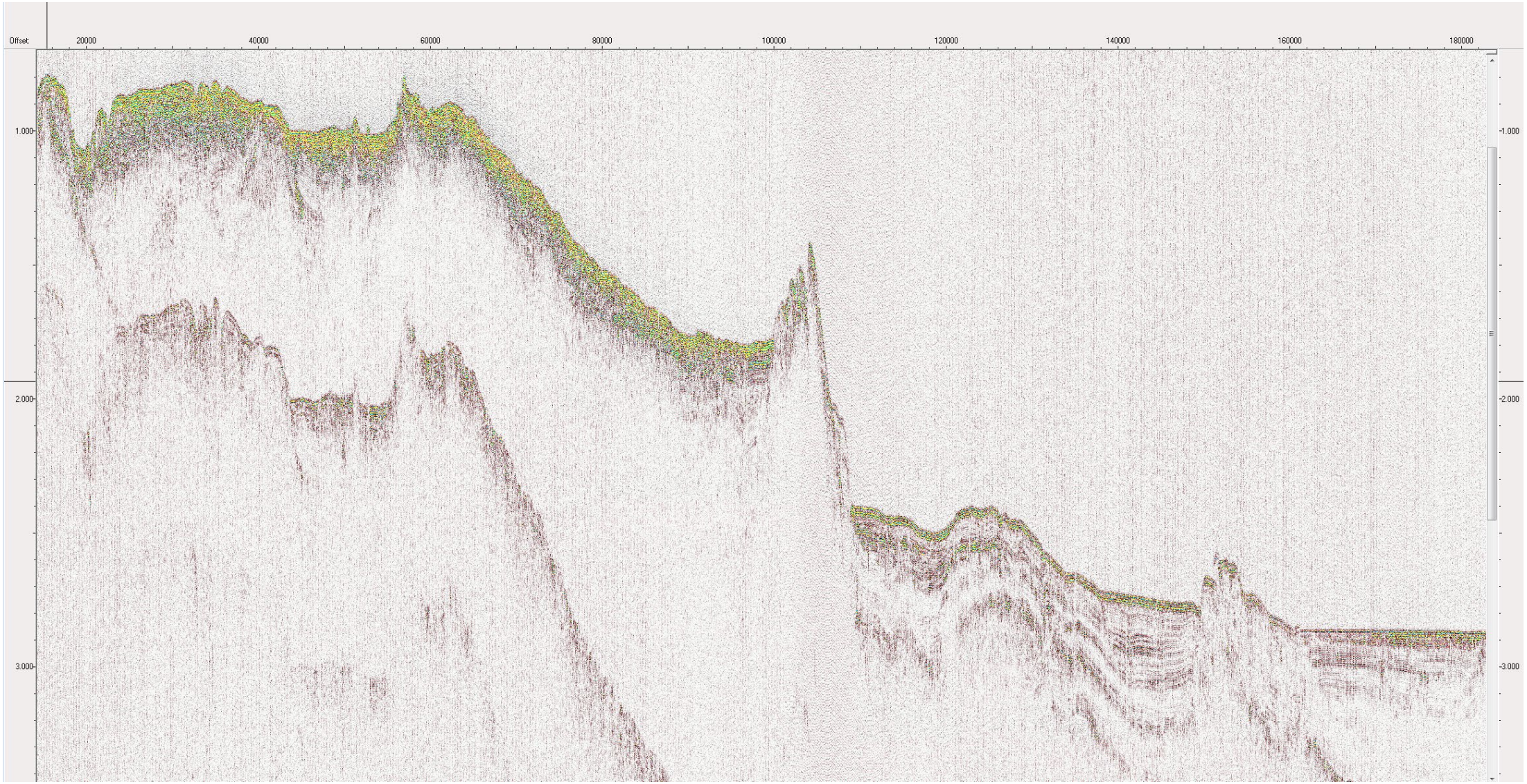
# Boat section only available in .tiff





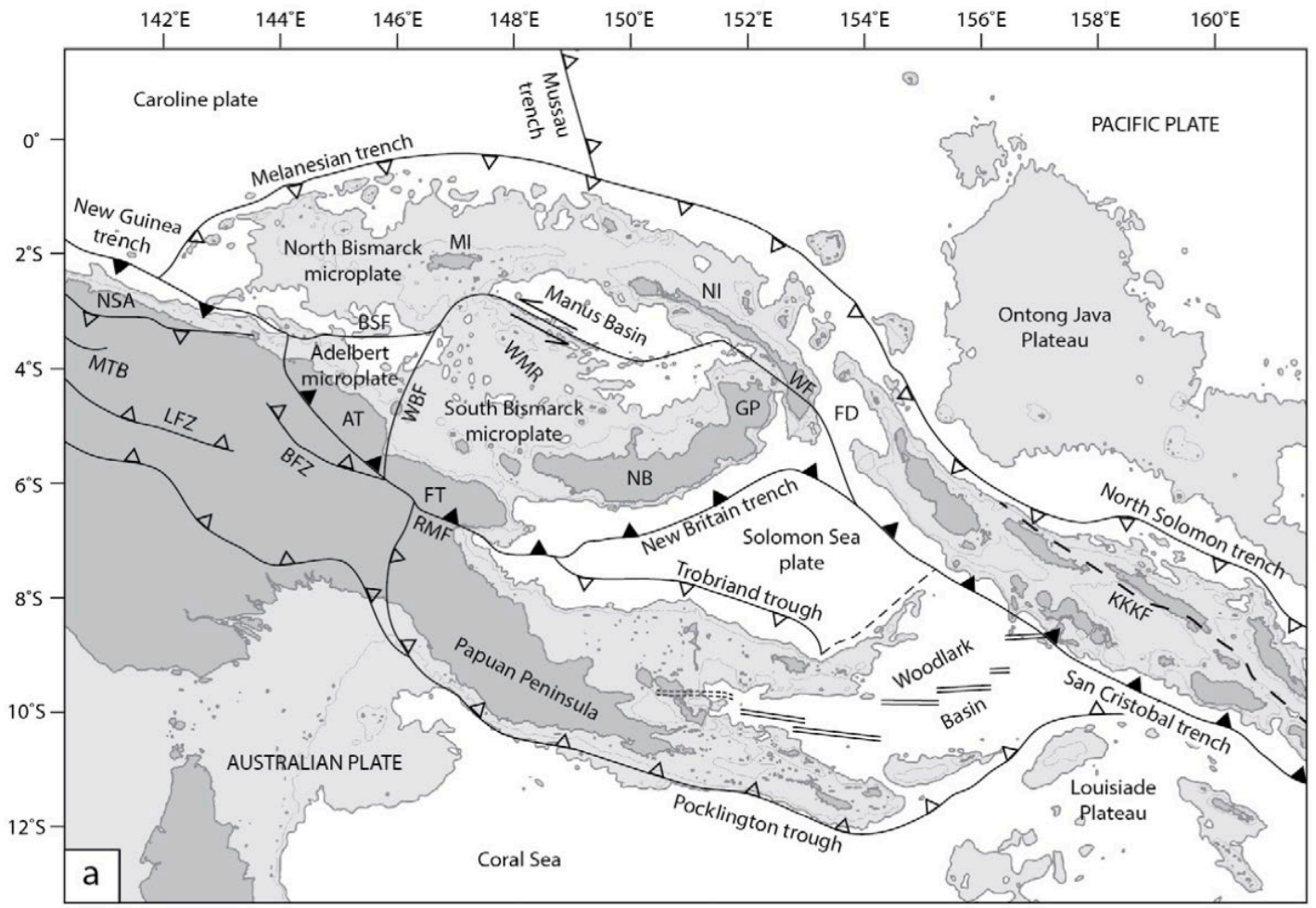
52 years later…..

# Raw Near Trace



# Tectonic Framework

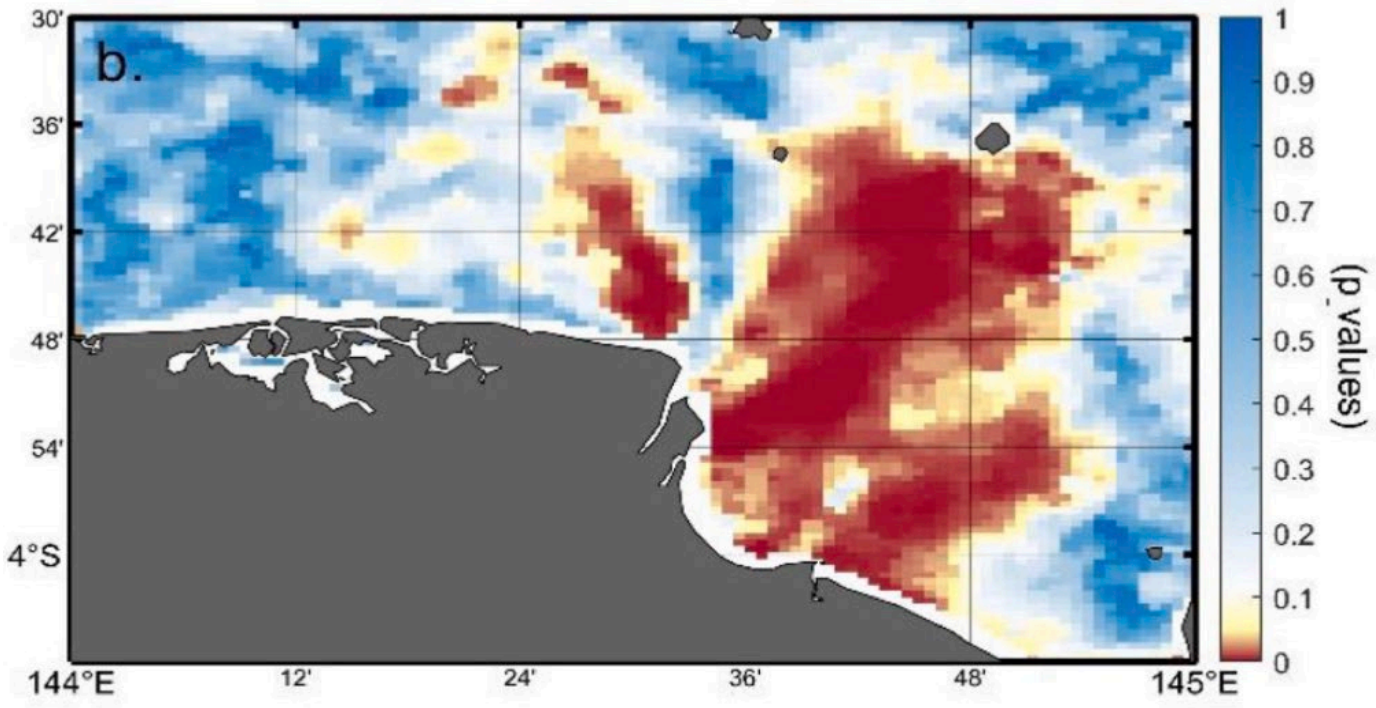
- The survey provides data north of PNG in a very complex tectonic setting where several tectonic plates interact.
- The Bismark Sea is a tectonic jigsaw found between the Pacific Plate to the north and the Indo-Australian Plate to the south, dominated by subduction-driven volcanism, back-arc spreading, and hydrothermal activity, making it both geologically dynamic and resource-rich.
- Several microplates (the Bismarck, Solomon, Caroline, and Woodlark plates) interact, producing rapid and complex motions.
- Major geological features include the New Britain Trench (subduction zone where the Solomon Sea Plate is descending beneath the South Bismarck Plate); back-arc basins in central Bismarck Sea formed by seafloor spreading behind the New Britain volcanic arc; and chains of volcanoes, including New Britain and New Ireland, formed from subduction-related magmatism.
- The PNG orogenic belt formed formed from 12 to 4 Ma with over 4 km of uplift and subsequent erosion and transport of sediment into the offshore area though major depositional systems.



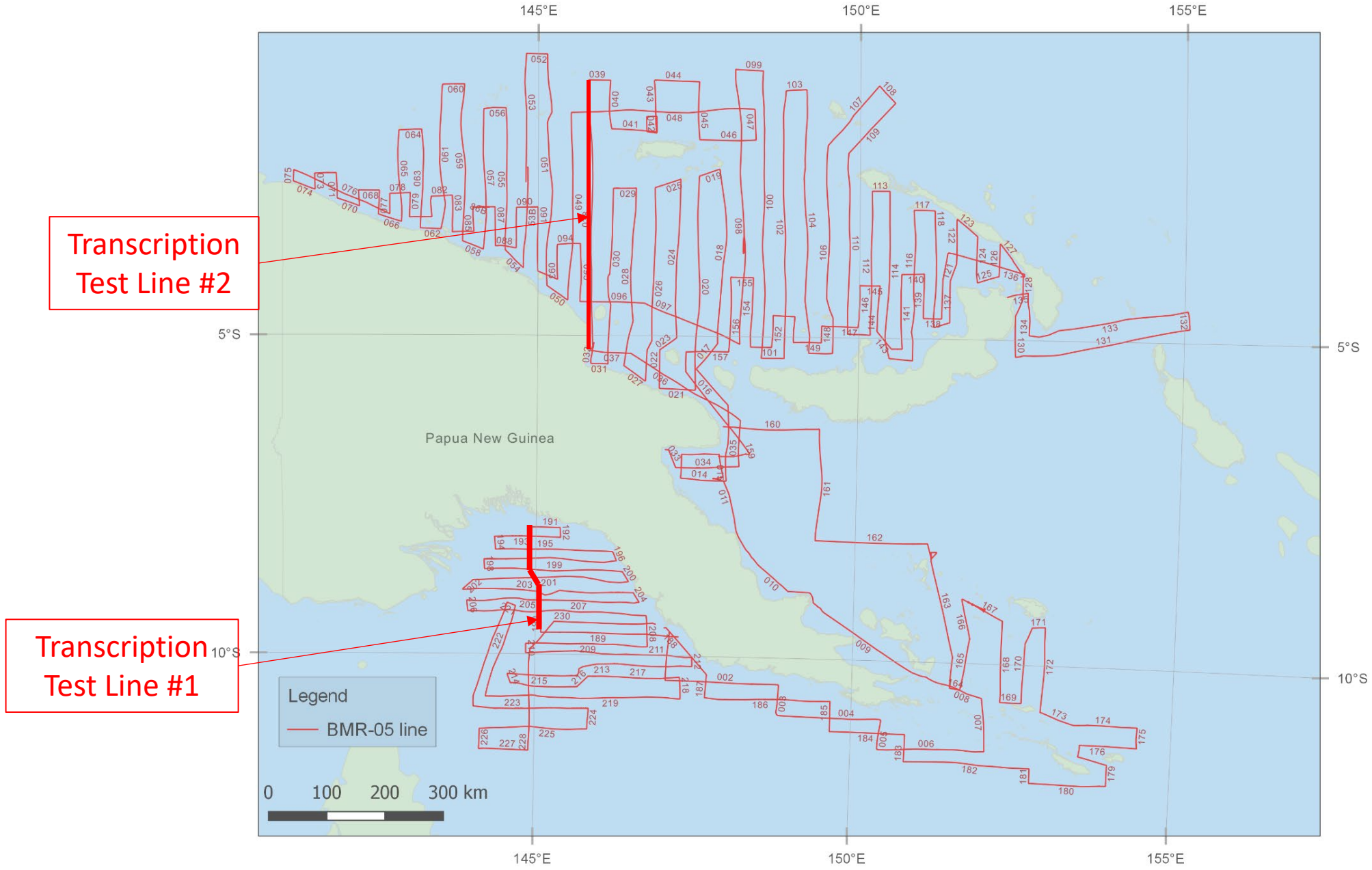

*Holm et al., 2016, Earth Science Reviews*

# Depositional Systems

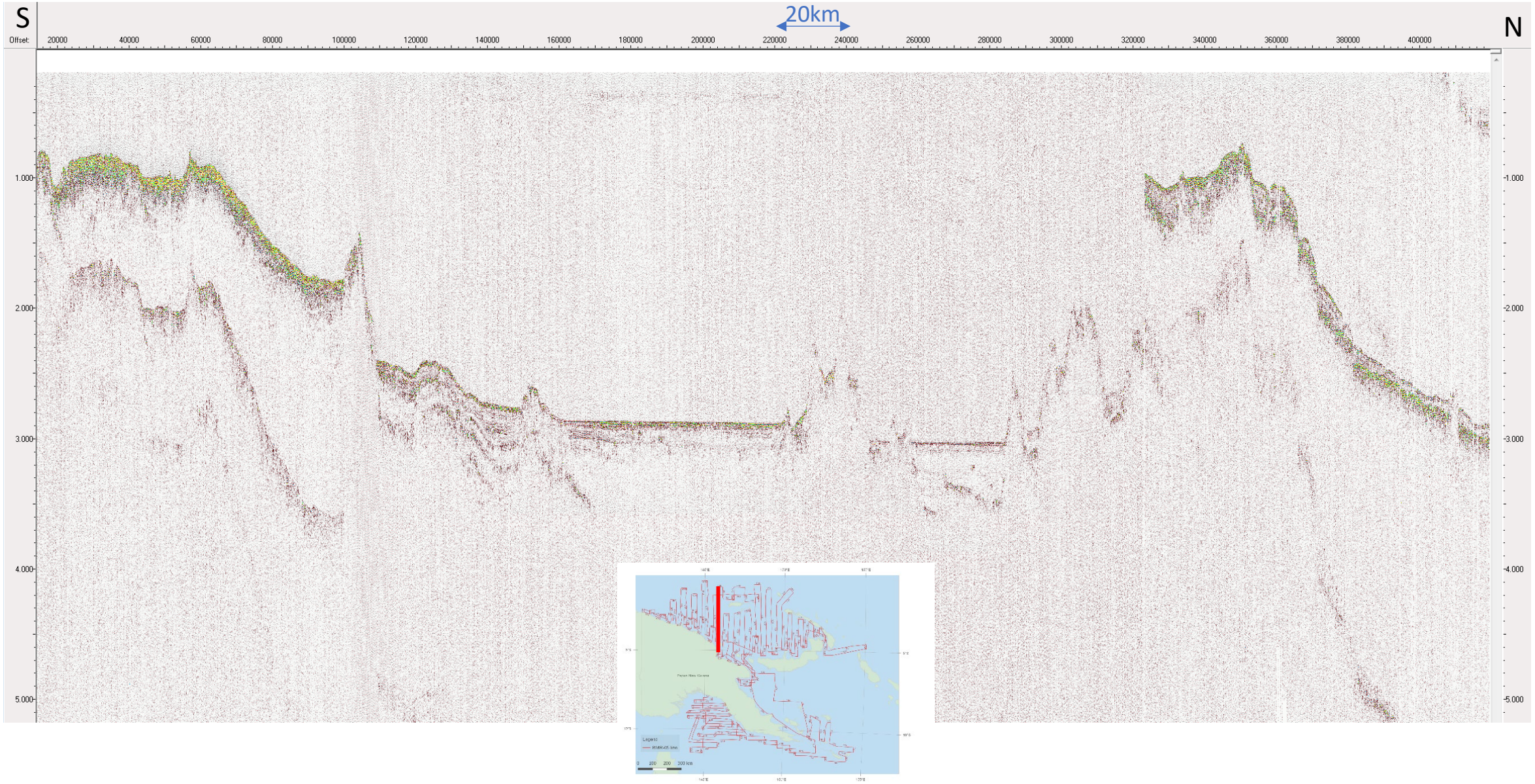
- Data north of PNG will provide important information on depositional systems which have transported sediments from the emerging New Guinea highlands into the deep sea over the past 12 million years.
- Major sediment sources include the Sepik and Markham systems
- The Sepik River is the largest contributor of solute and particulate material to the world ocean. Sites U1484 and U1485, drilled during International Ocean Discovery Program (IODP) Expedition 363 provide a continuous, ~555 kyr long, high-resolution record of mainly siliciclastic slope sedimentation on the northern continental margin showing that potential reservoirs are present in deep water.
- Only about 7–15% of the Sepik River sediment discharge accumulates on the adjacent open shelf and slope; the remainder presumably escapes offshore via gravity flows into deeper water settings.
- Given the geographic location of the Sepik River, it is likely that all sediments would be organically rich, similar to the Mahakam system of eastern Borneo (Indonesia) where turbidite sands have been shown to be source rocks for important hydrocarbon deposits.




*Offshore sediment plume, Sepik River. Fu et al., 2024, Estuarine, Coastal and Shelf Science.*


Transcription Test Line #2
Transcription Test Line #1
145°E
150°E
155°E
5°S
10°S
Papua New Guinea
Legend
BMR-05 line
0
100
200
300 km

# Raw Near Trace - Complete Line

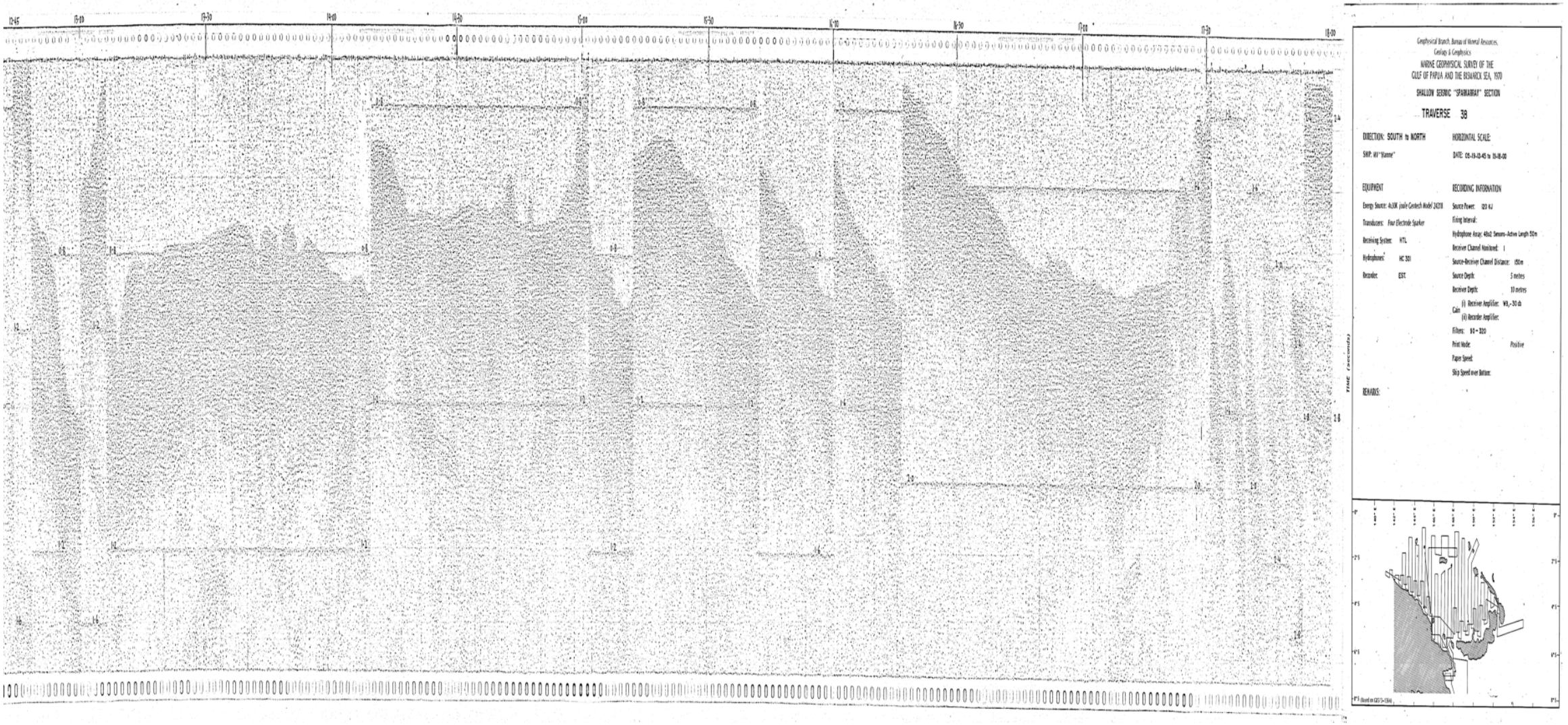


# Ampex Tape Drives today

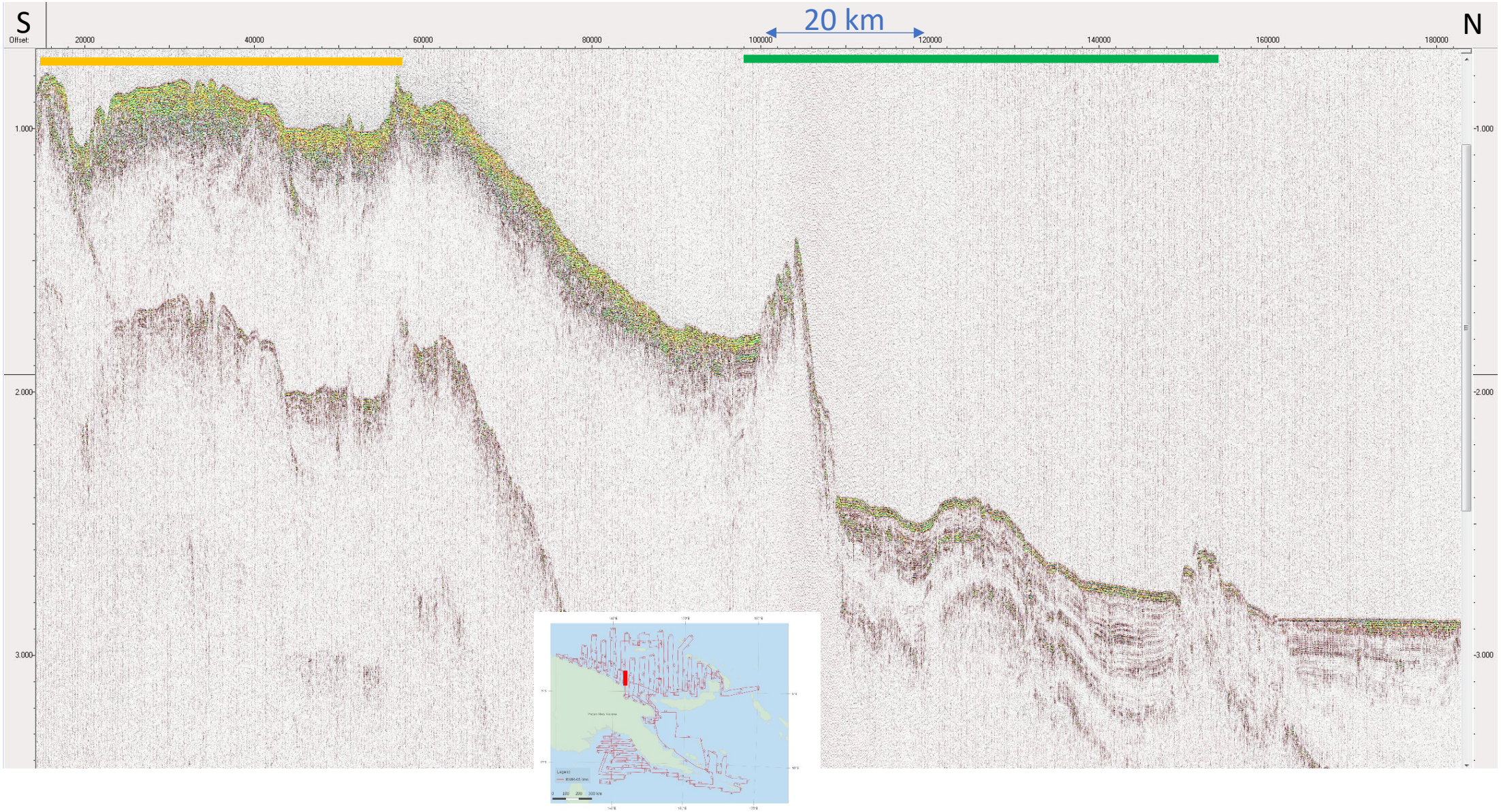


Same drives as were used on the vessel during acquisition

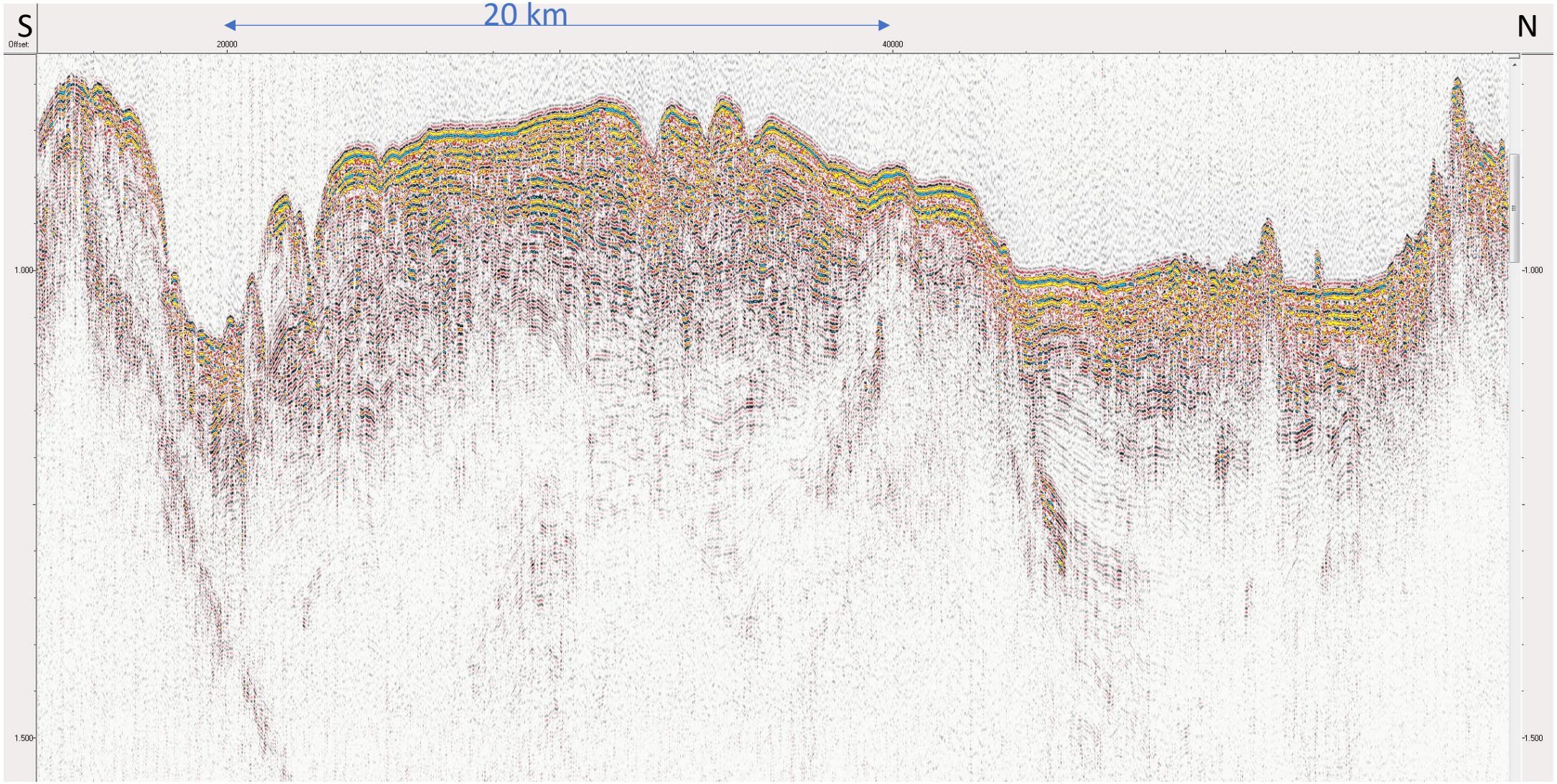
# Boat section – only in .tiff format



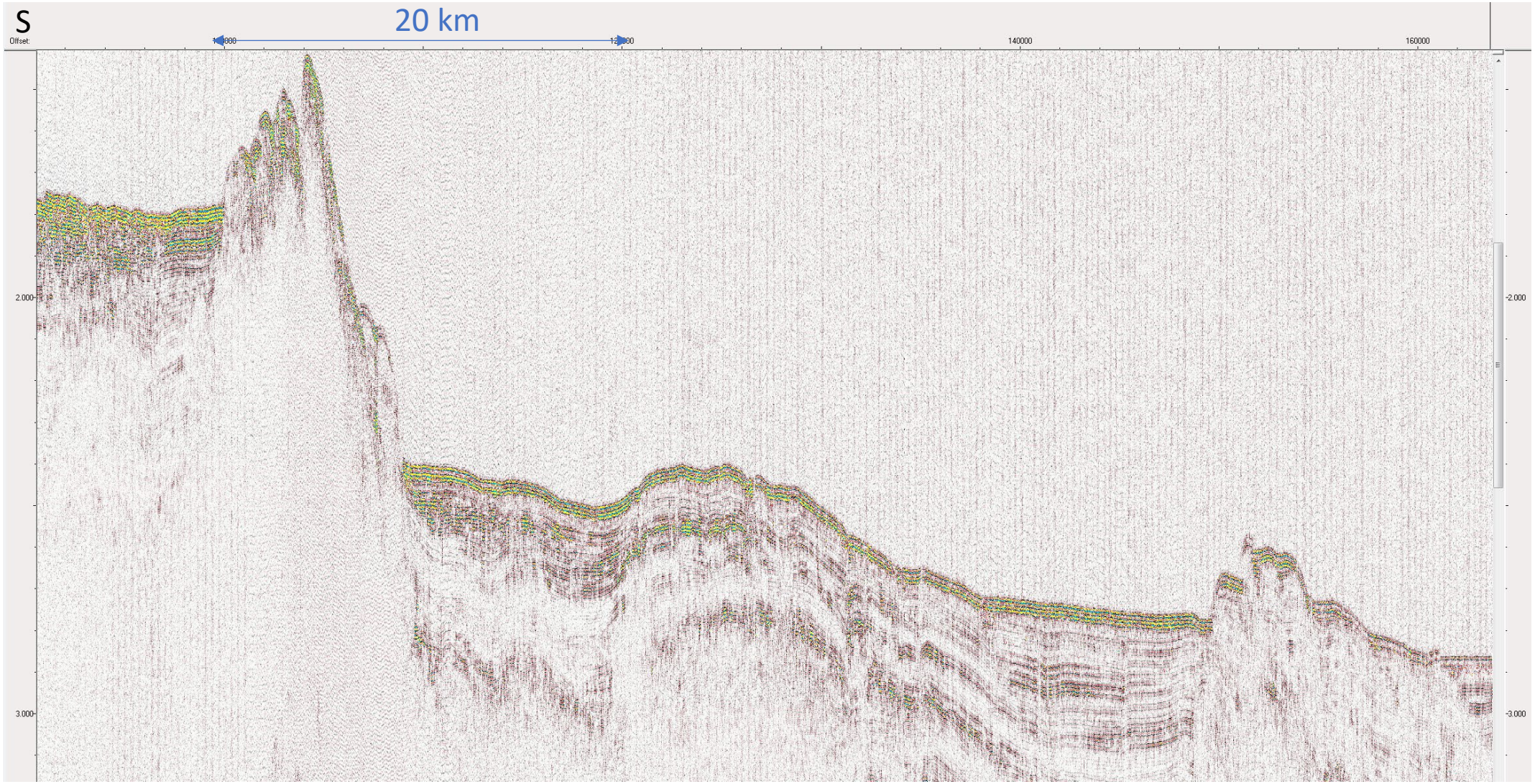
# Raw Near Trace



# Raw Near Trace - Zoomed



# Raw Near Trace - Zoomed



# Uses of BMR-5 Transcribed Data

- Better understanding of Bismarck Sea structural framework
- Better understanding of Bismarck Sea geology
- Use in design of subsequent surveys
- High grading of exploration for seabed mining
- Identifying areas for potential hydrocarbon exploration
- Generating income for Subjunctive Geo and GeoCom

# Summary

- Large comprehensive dataset
- Unique coverage in Bismarck Sea
- Complicated transcription process
- Complicated processing due to poorly defined navigation and records
- Project managers have significant prior experience in similar data
- We understand the PNG Government has approved release of this data (via DFAT)
- Phased approach to project
  - Next steps – more investigation on geometry and acquisition
  - Trial data processing to improve data

# Thanks & Acknowledgements


- Keith Woollard & Graeme Murray – *co-authors and tape drive restoration and data transcription*
- Michael Swift – *introduction of dataset*
- Geoscience Australia (esp. Susannah MacFarlane & Sarah Spinoccia) - *archives*
- Roy Whitworth – *foresight to save tape drives and subsequent advice*
- Rob Dean – *initial processing*
- Sam Howman – *help with future processing using Digger*
- Peter Baillie – *geological advice and input*
- Claritas – Andy Juniper & Mike Brumby - *loan of processing software and advice*
- Zebra Data – *very early processing attempts*
- Andy Livesey – *partner in early vectorizing project*
- And AEGC for allowing me to present
- Apologies to anyone missed!

# But wait, there's more…….

## Regional Surveys using Ampex tapes