Seismic stratigraphy of the High Plateau, Manihiki Plateau, as seen in seismic reflection data measured during cruise SO224

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Introduction

Manihiki Plateau is a Large Igneous Province (LIP) formed during the Cretaceous (~ 120 Ma ago) with a history of multiple phases of volcanic activity and a complex geodynamic evolution.
High resolution seismic data gathered during cruise SO224 are used to study the sedimentary distribution, the plateau's development following the initial phase of creation, and with respect to role in the oceanic palaeocirculation.

Objective

- What is the sedimentary distribution of the plateau?
- How has the Manihiki Plateau developed after its initial phase of creation?
- What role did it play for the ocean palaeocirculation?

The Manihiki Plateau

Schematic sketch of evolution

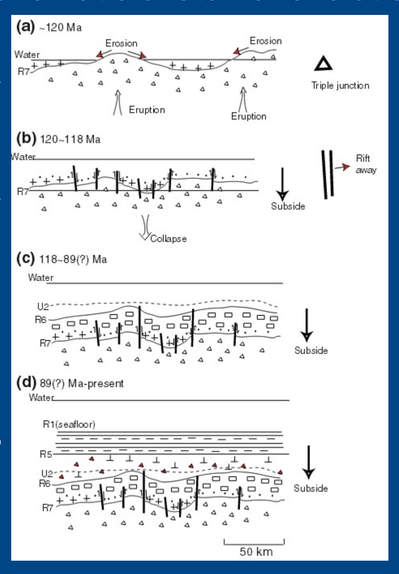


Fig. 1 Schematic sketch showing the evolution of the High Plateau region of the Manihiki Plateau (Ai et al, 2008)

- Three geomorphological units (Winterer et al., 1974): Western Plateau, Northern Plateau, High Plateau

(a) +120 Ma: Activity of hotspot → plateau partly above sea level

(b)120-118 Ma: hotspot activity dies away → cooling → subsidence → deposition of calcareous sediments overlying volcaniclastic layers

(c)118-89 (?) Ma: deposition of calcareous sediments continues, subsidence continues

(d)since Early Eocene: subsidence continues

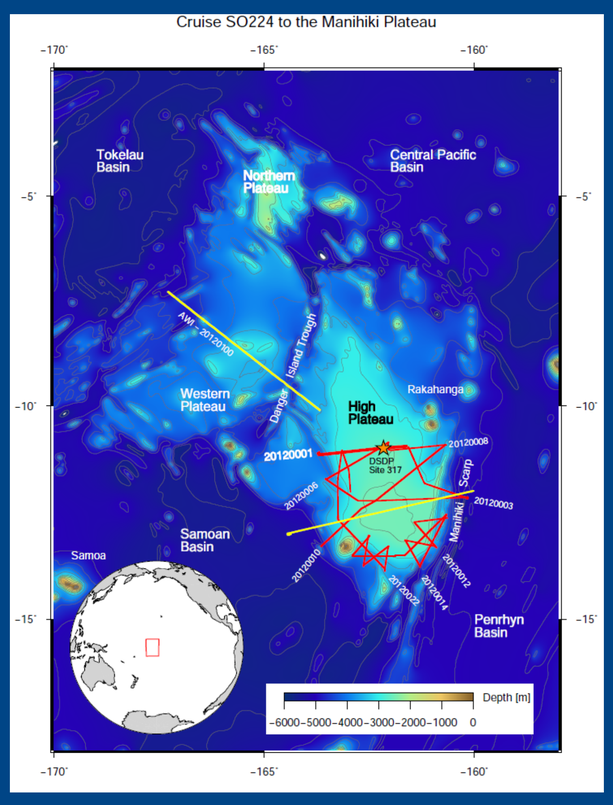


Fig. 2 The Manihiki Plateau, located in the equatorial Pacific is a subarial plateau. The reflection profiles (red and yellow lines) collected during cruise SO224 focus on the High Plateau sediment layers and its faults. Also shown is DSDP Leg 33 Site 317 borehole location (orange star) (Shipboard Scientific Party, 1976)

Method

- High resolution reflection seismic
- Source: Cluster of four GI-guns with 2.8 l volume
- Receiver: 3000 m streamer with 240 channels
- 10 s shot interval
- 1 ms sampling rate
- 0 - 250 Hz frequency

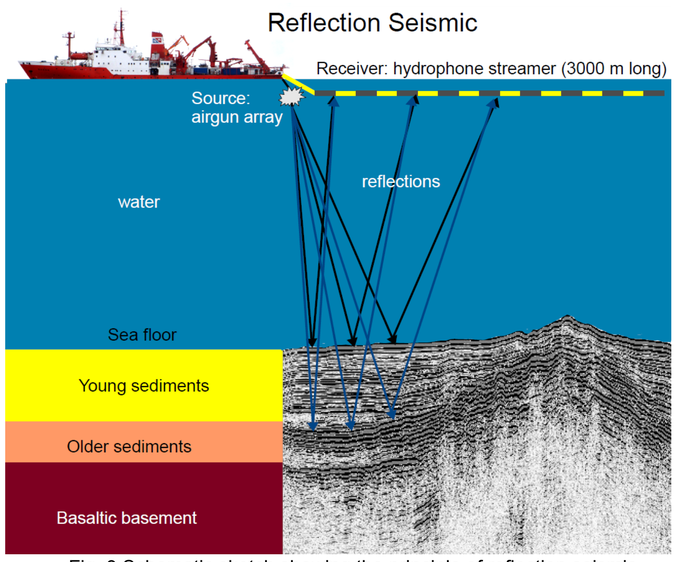


Fig. 3 Schematic sketch showing the principle of reflection seismic

Data acquisition

- Over 4000 km seismic reflection data
- Two profiles of seismic refraction (poster K. Hochmuth)
- Bathymetry
- Parasound

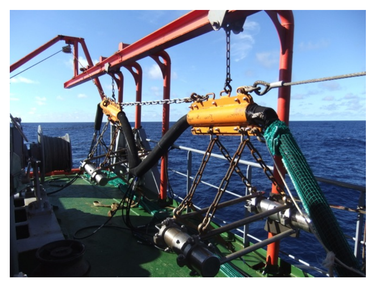


Fig. 4 Source: Cluster of four GI-guns

Fig. 5 Receiver: Streamer with hydrophones

Photos by M. Horn, AWI

First results

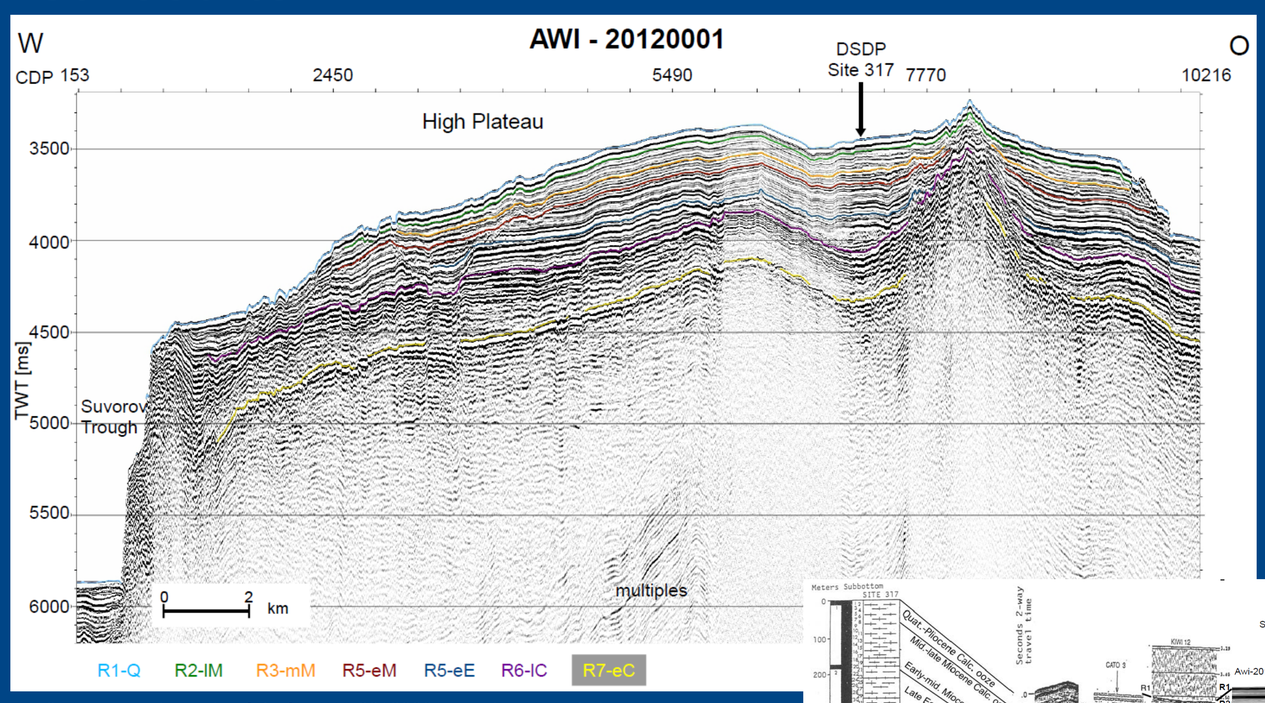


Fig. 6 Time-migrated data of Profile AWI-20120001 over the High Plateau are shown with Reflectors R1-R7. Q: Quaternary, l/m/eM: late/mid/early Miocene, e/lC: early/late Cretaceous

- Time-migrated data
- Six subbottom reflectors R2-R7
- Stratigraphy in agreement to previous works

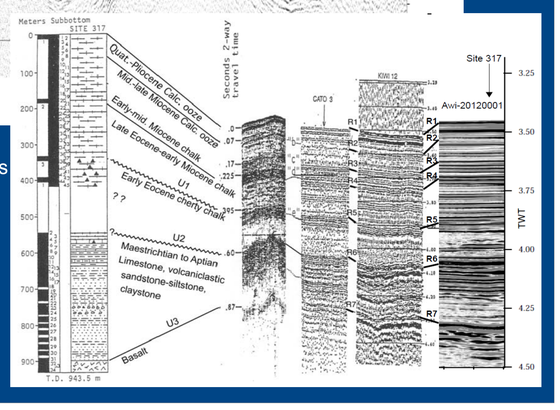


Fig. 7 Comparison of stratigraphy of previous works Cato 3 (Schlanger et al. 1976) and Kiwi12 (Ai et al. 2008) to new seismic Profile AWI-20120001

Synthetic seismogram

- Correlation of seismic data to information of borehole data

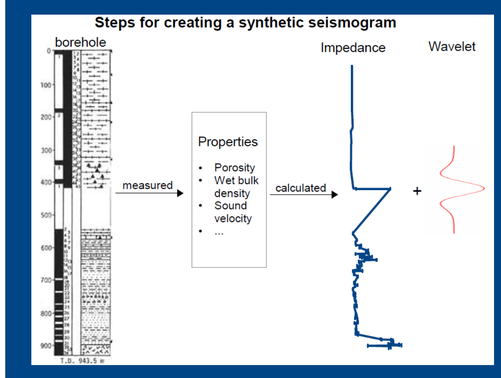
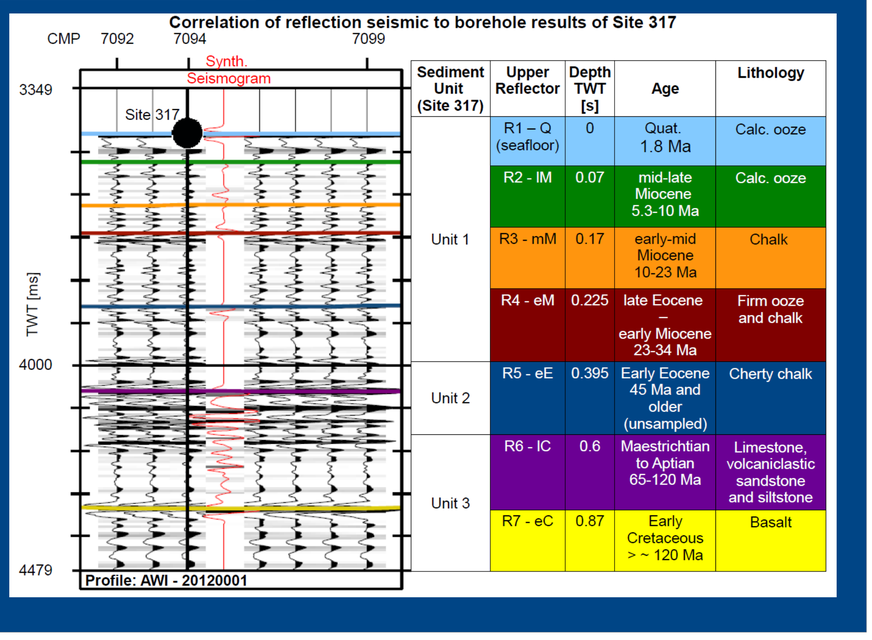


Fig. 8 Processing steps for a synthetic seismogram



Sediment Unit (Site 317)	Upper Reflector	Depth TWT [s]	Age	Lithology
Unit 1	R1 – Q (seafloor)	0	Quat. 1.8 Ma	Calc. ooze
	R2 - lM	0.07	mid-late Miocene 5.3-10 Ma	Calc. ooze
	R3 - mM	0.17	early-mid Miocene 10-23 Ma	Chalk
	R4 - eM	0.225	late Eocene – early Miocene 23-34 Ma	Firm ooze and chalk
Unit 2	R5 - eE	0.395	Early Eocene 45 Ma and older (unsampled)	Cherty chalk
Unit 3	R6 - lC	0.6	Maestrichtian to Aptian 65-120 Ma	Limestone, volcaniclastic sandstone and siltstone
	R7 - eC	0.87	Early Cretaceous > ~ 120 Ma	Basalt

Fig. 9 The synthetic seismogram calculated by using borehole properties of Site 317 correlates well with seismic data of AWI-20120001.

Summary

- Investigation area: Manihiki Plateau, located in equatorial Pacific
- High resolution seismic reflection data obtained during cruise SO224
- Time-migrated data shown for profile AWI-20120001
- Synthetic seismogram in agreement to the six subbottom horizons defined for borehole data DSDP Leg 33 Site 317 (Schlanger et al. 1976)

Outlook

- Finishing data processing for profiles 20120002 – 201200028
- Correlation to geological Units, Age, etc.
- Investigation of ocean current features
- Depth-migration

References

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Acknowledgements

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