



2014 OFFSHORE TECHNOLOGY CONFERENCE ASIA

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Kuala Lumpur Convention Centre

"Meeting the Challenges for Asia's Growth"

OTC-24958-MS

Middle East to India Deepwater Pipeline (MEIDP)

Crossing of the Owen Fracture Zone

Ian Nash, Peritus International Ltd



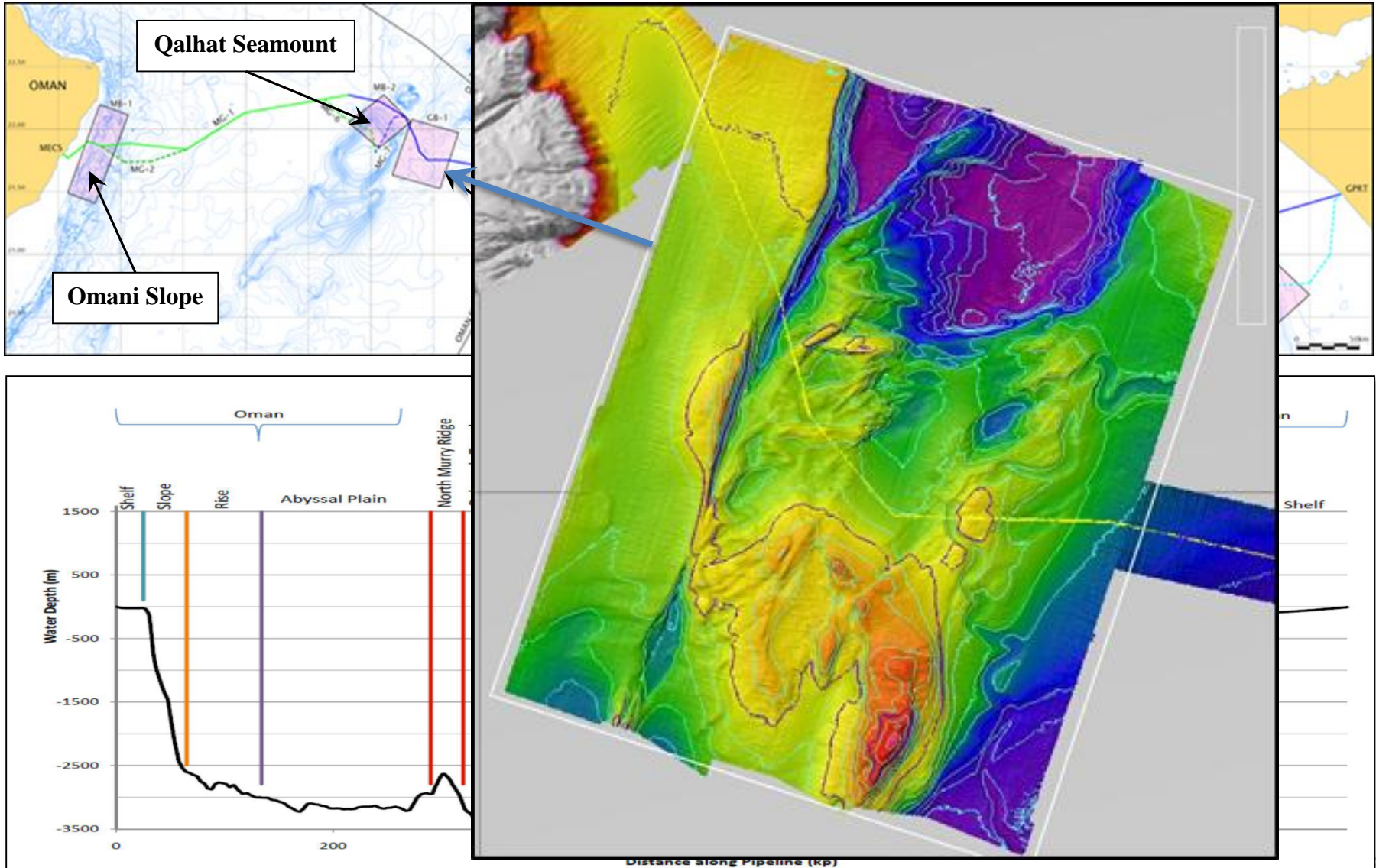
The Middle East to India Deepwater Pipeline (MEIDP) Project

- MEIDP 1 will be the first in a series of pipelines supplying gas to the Gujarat coast of India, from the vast available resources in the Middle east, by the **safest, most economic** and **reliable** means
- The SAGE MEIDP Project is envisaged as an transmission pipeline **Infrastructure project** allowing transportation of multiple sources of Middle East Gas to the West Coast of India
- In May-June 2013 SAGE undertook a **multi-million \$ Geophysical Survey** of the pipeline route across the Arabian Sea
- Assessments are now underway in all key areas along the route
- This presentation gives details of the pipeline crossing of the **Owen Fracture Zone** (OFZ) and the **Fault movement analysis** performed to confirm the pipeline is safe on the planned route.

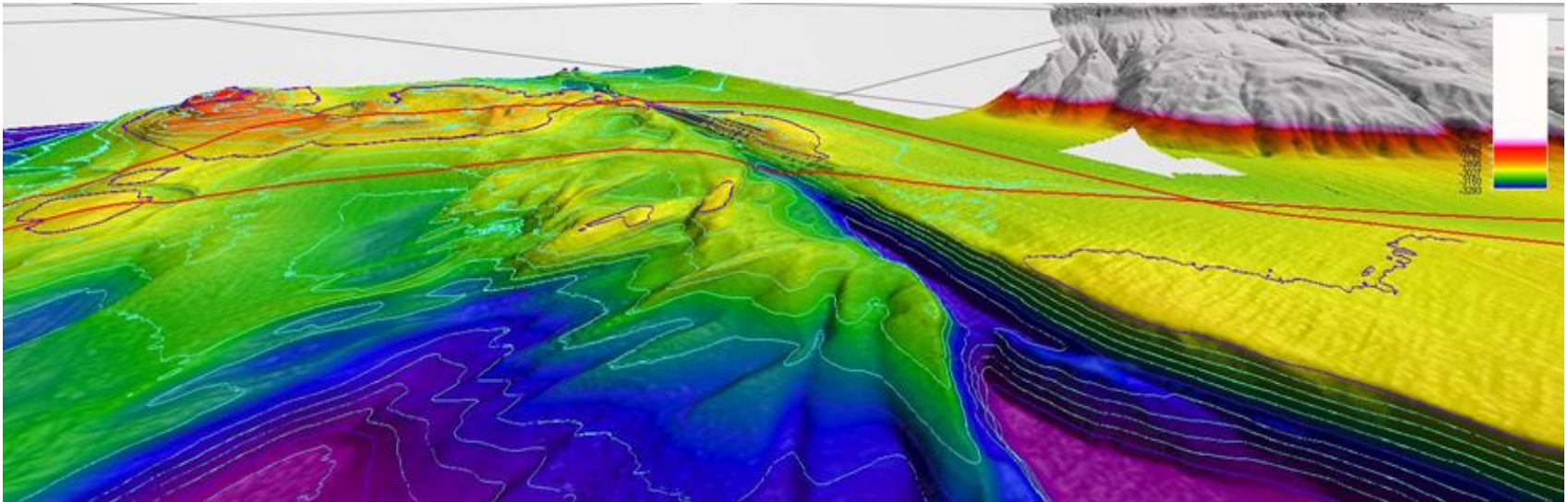
MEIDP Details

- Potential Start Points
 - Chabahar, Iran
 - Ras al Jafan, Oman
- End Point- South Gujarat
- Diameter 27.2”, 32.9-40.5mm WT (DNV OS-F101)
- Flowrate 1.1BSCFD (31.1mmscmd)
- Maximum Depth- 3,450 meters
- Length- 1,200- 1,300 kilometers
- Project to be executed over 7 year period
- Pipeline Construction over 2 years

MEIDP Survey Route



Owen Fracture Zone Characteristics



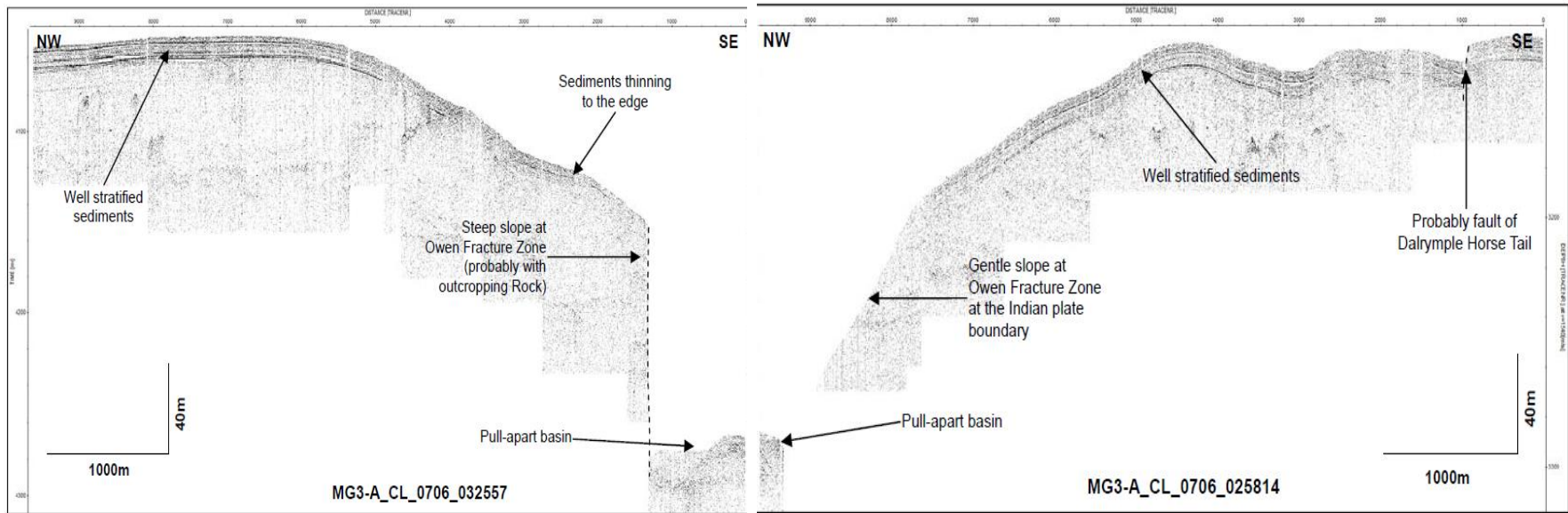
At the MEIDP Crossing the Owen Fracture Zone is characterized by two main structures:

- The deep basins of the Dalrymple Trough and horsetail in the North
- An arch formed bathymetrical high in the South

The Owen Fracture zone stretches for more than 1200km with the Dalrymple Trough forming the last 350km at its Northeastern end and reaching a depth in excess of 4000m.

The bathymetric high is about 6km wide and approx. 19km long, rising to 2630m water depth at its shallowest part.

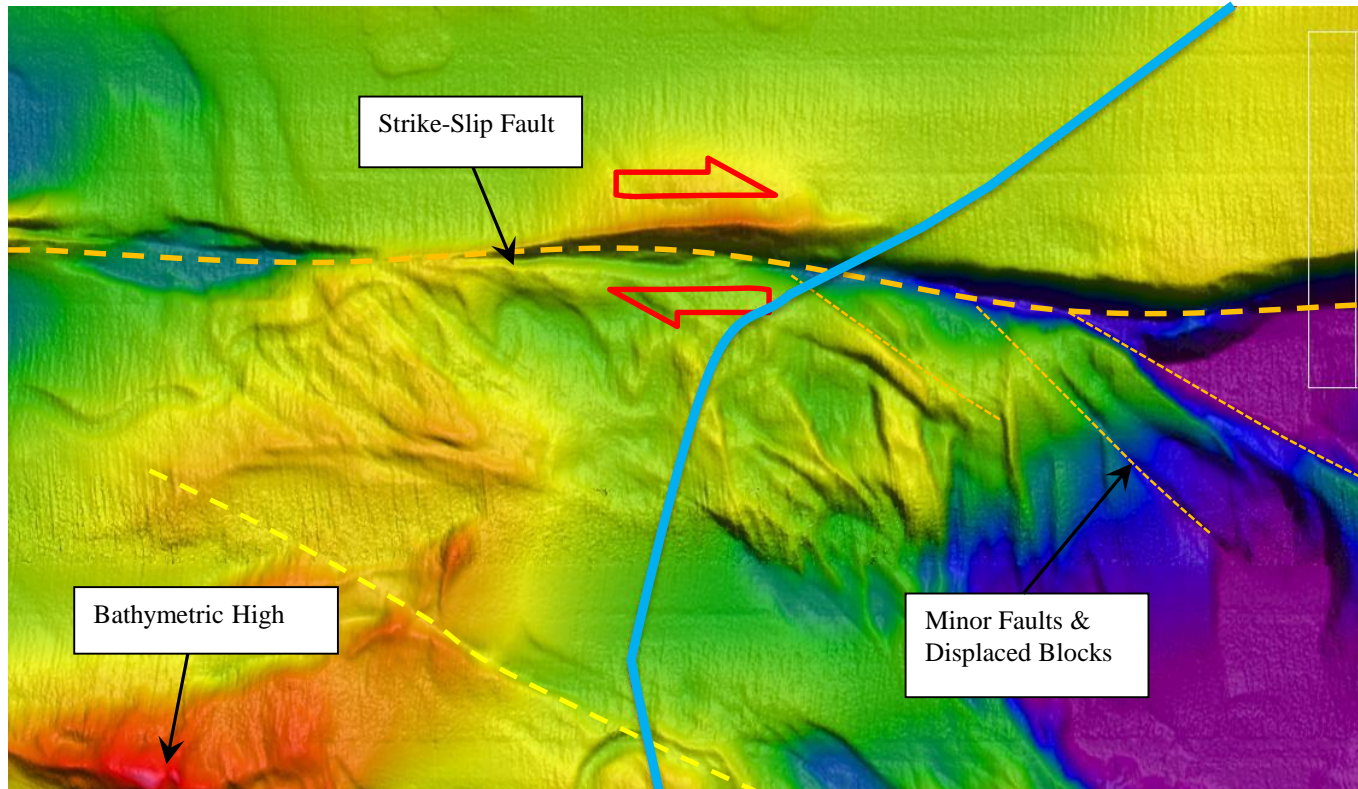
Owen Fracture Zone Characteristics



The stratified sediments and slump deposits that exist north of the Qalhat Seamount diminish rapidly as the route descends into the canyon of the Dalrymple Horsetail.

Coming out of the canyon the route enters an area with very uneven seabed and crosses several ridges of displaced blocks that probably trace active and inactive faults of the Dalrymple Horsetail.

3D Bathymetry from Survey

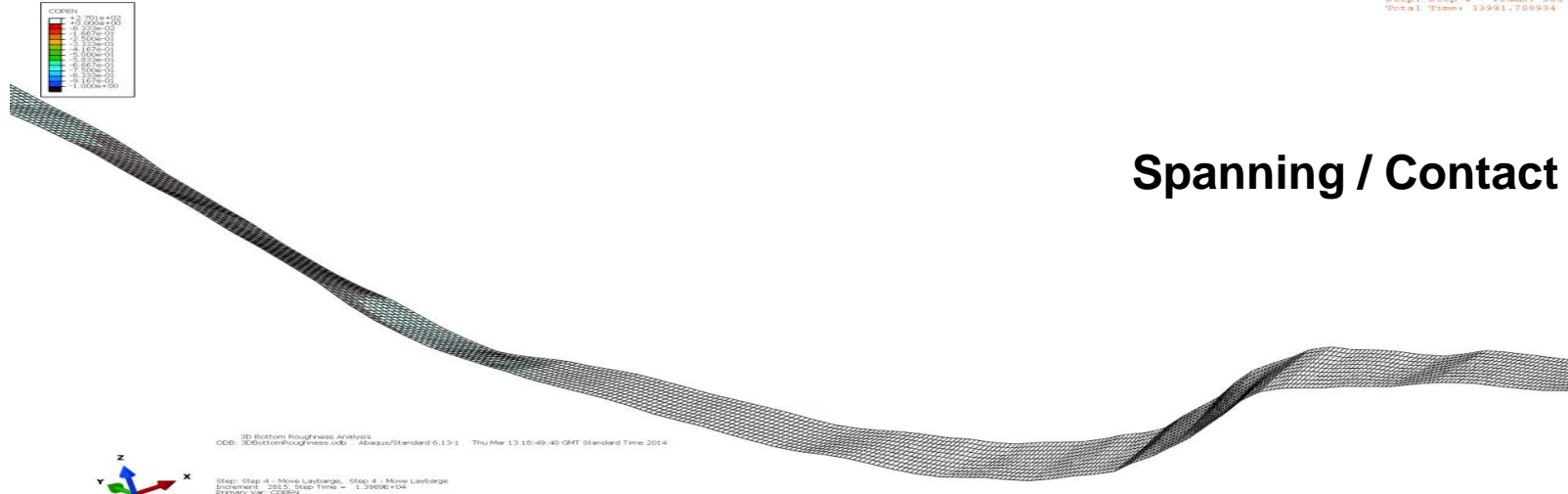


This fault is the tectonic plate boundary of the Indian and Arabian plates.

- A strike-slip right lateral fault
- Moving at a slip rate of 3mm/year (7mm/yr max).
- Fault forms a 200m deep canyon 1.3km wide at MEIDP crossing

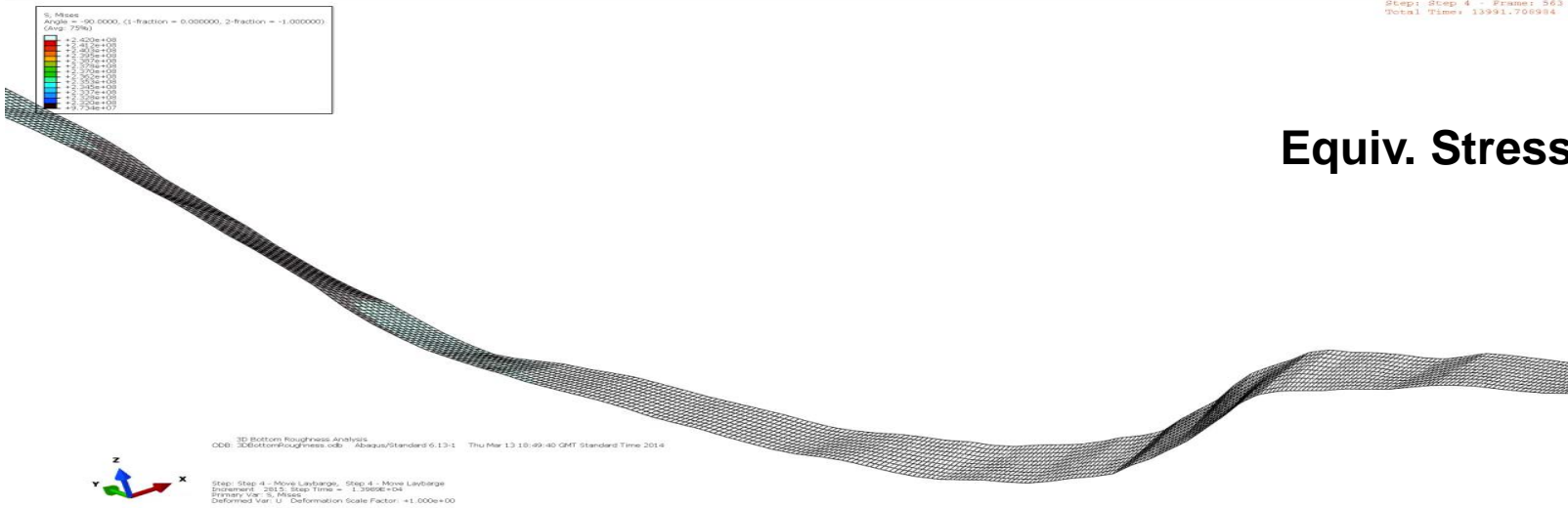
Pipeline Installed on 3D Seabed from survey across the Owen Fracture Zone

Step: Step 4 - Frame: 563
Total Time: 13991.706984



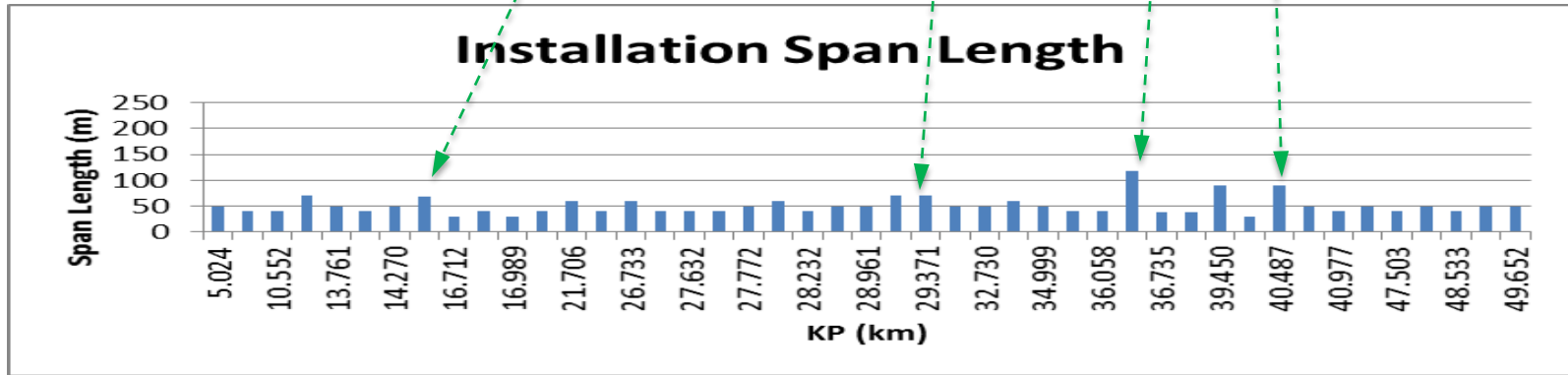
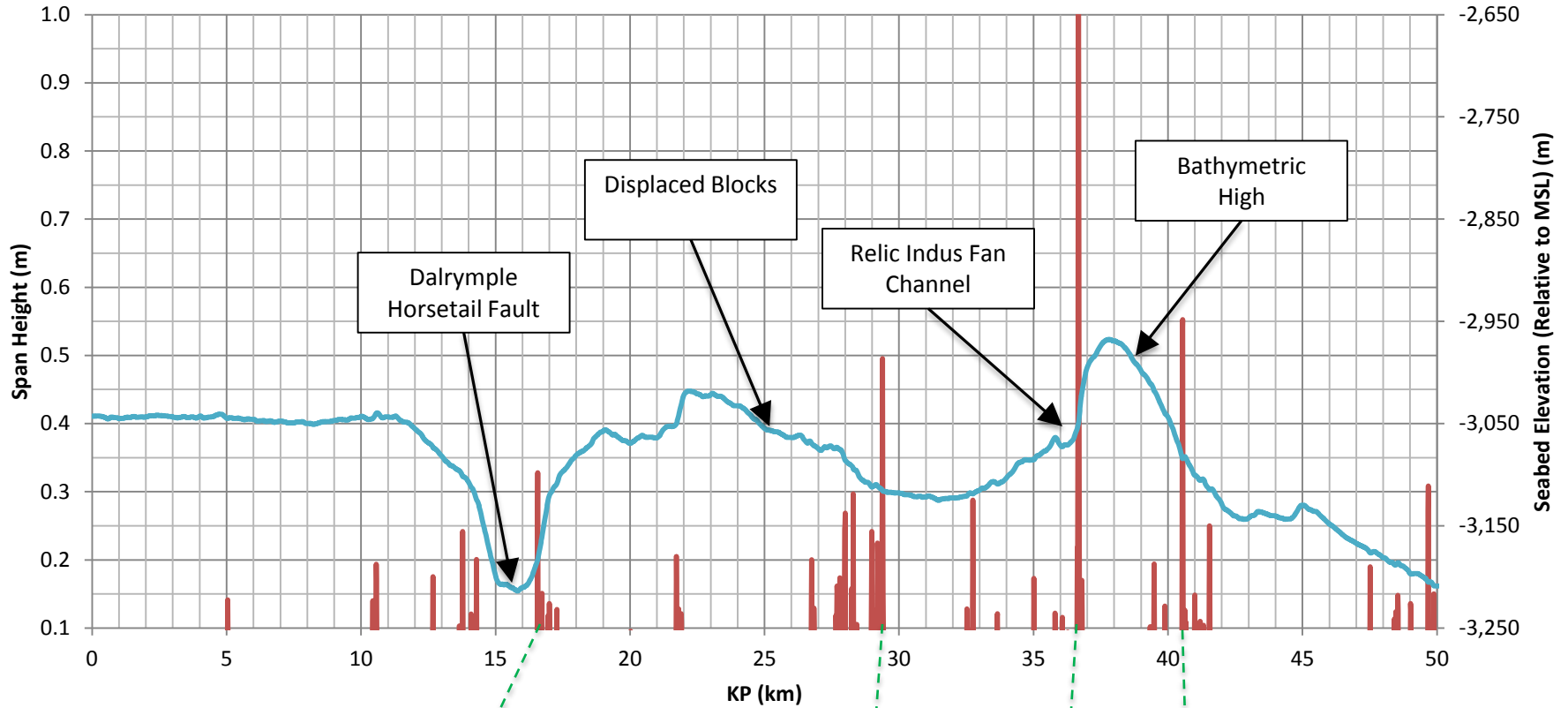
Spanning / Contact

Step: Step 4 - Frame: 563
Total Time: 13991.706984

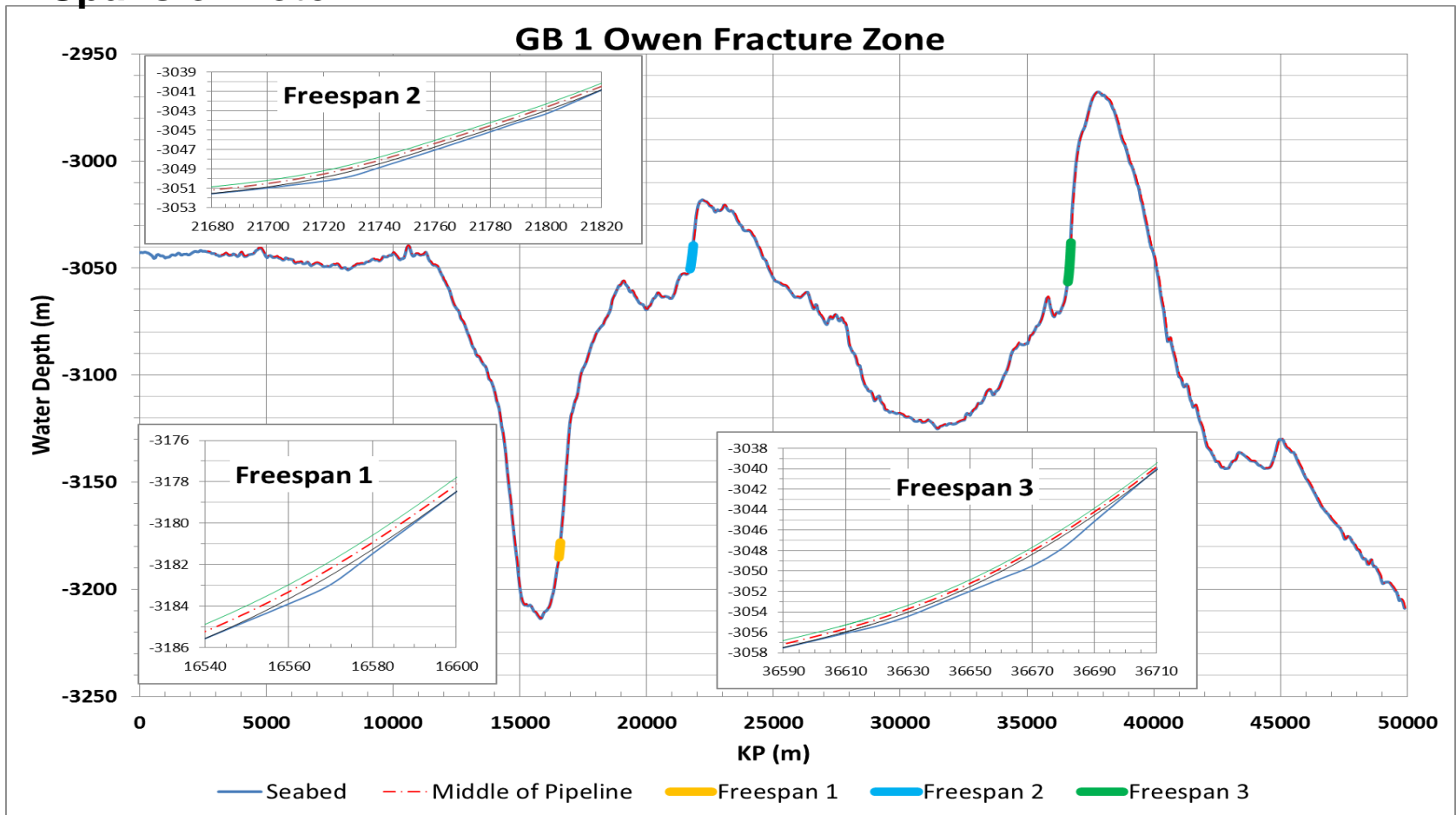


Equiv. Stress

Span Assessment overview



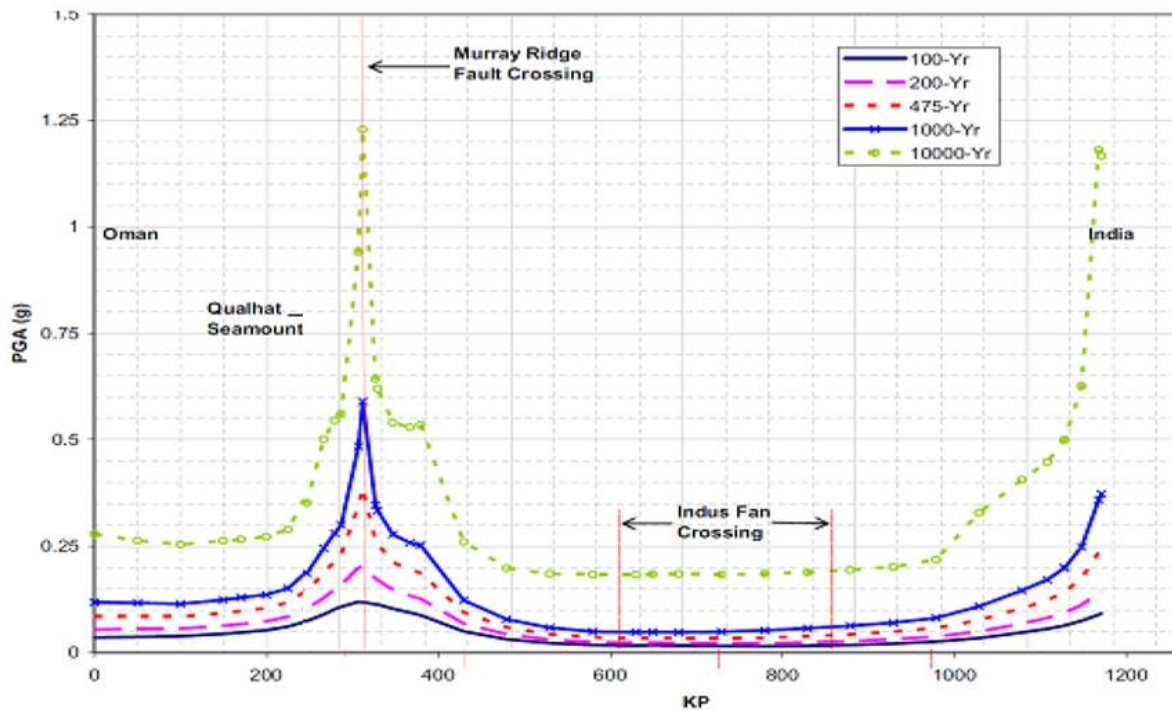
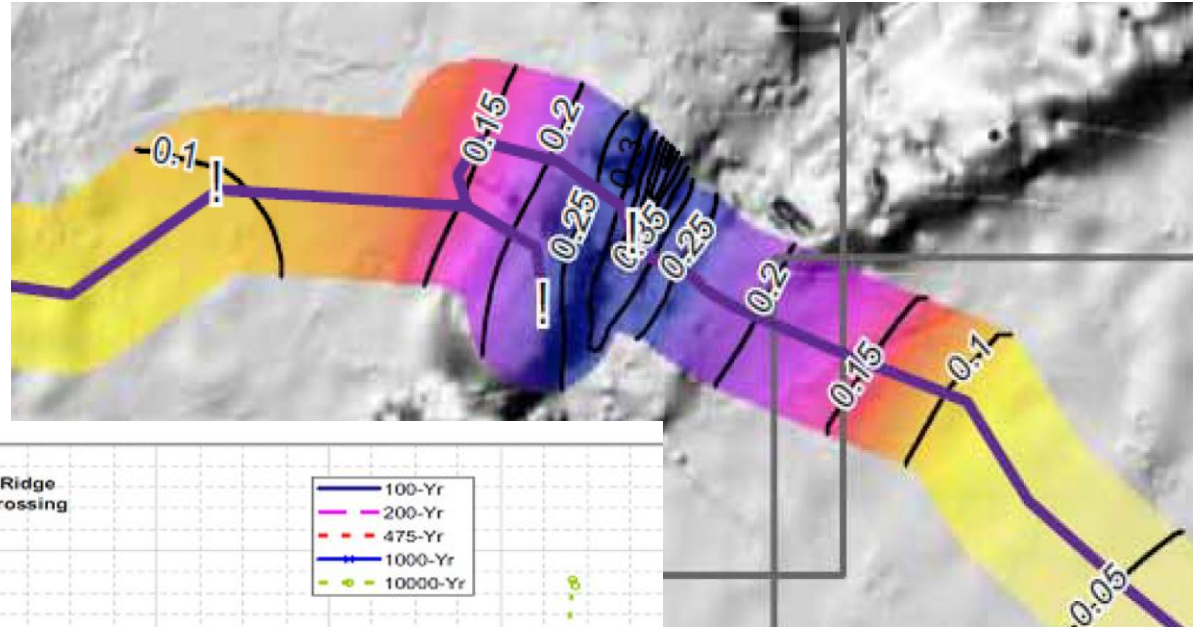
Spans of Note



There were 3 spans of note observed in the OFZ.

- Maximum Span Lengths approx. 130m
- Maximum Span Heights approximately 1.2m

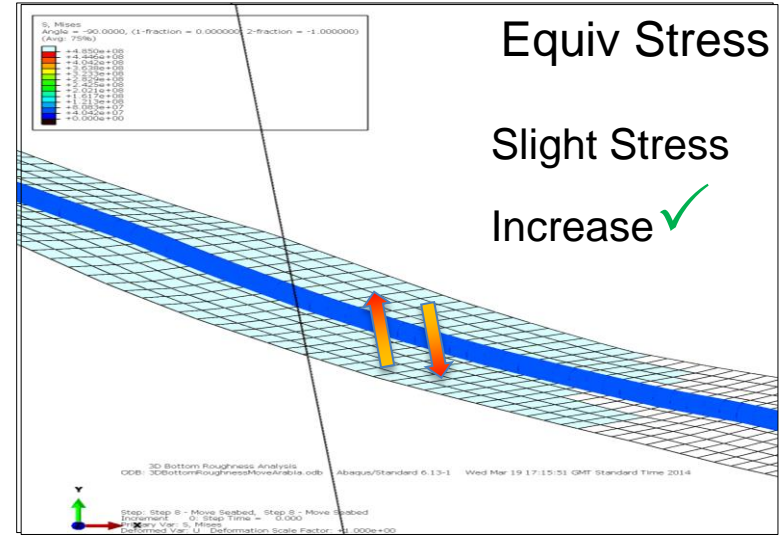
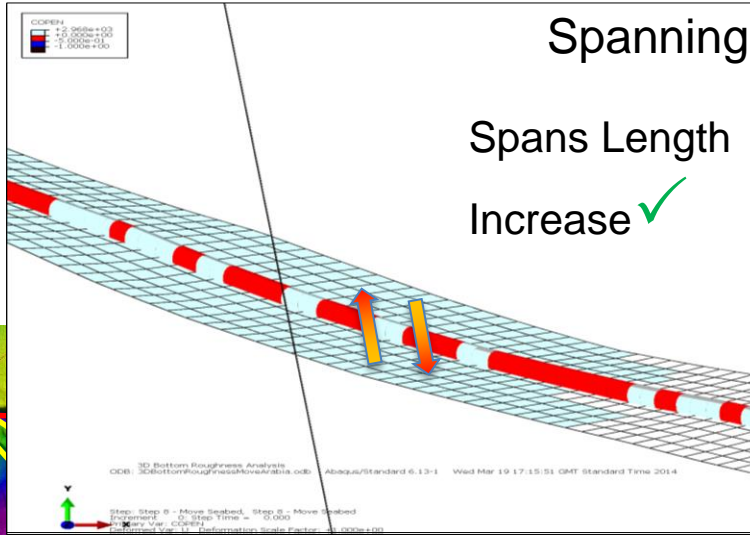
PGA Profiles and 475yr Isolines



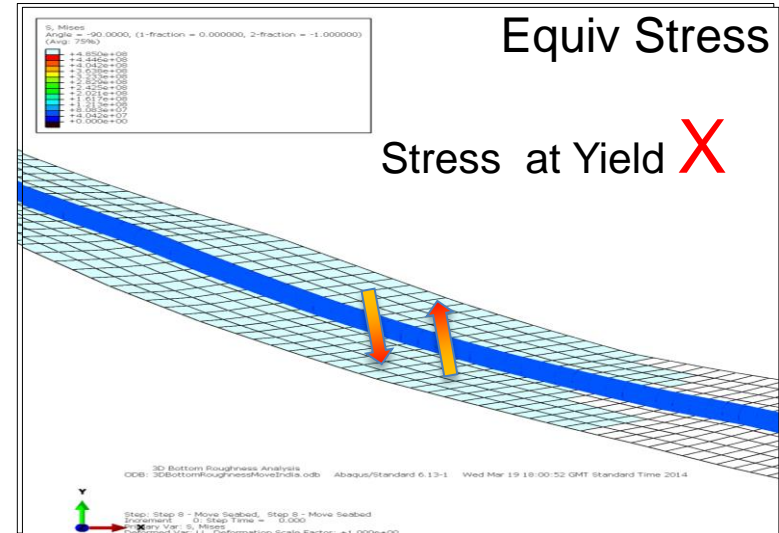
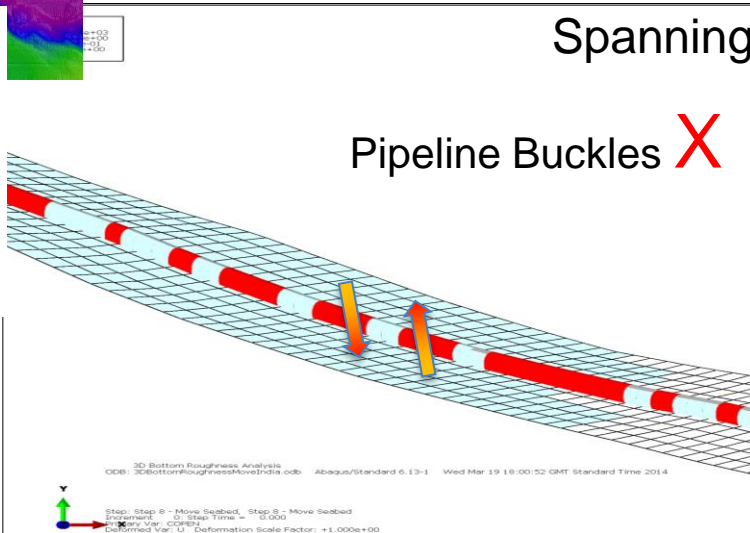
PGA Values @OFZ
 1000yr = 0.60g
 475yr = 0.37g
 200yr = 0.20g

3D Analysis of Effects of 1000yr - 7m Fault movement on MEIDP during Operation using 200m corridor of 3D Seabed

Crossing the Fault in direction of Strike-Slip Movement

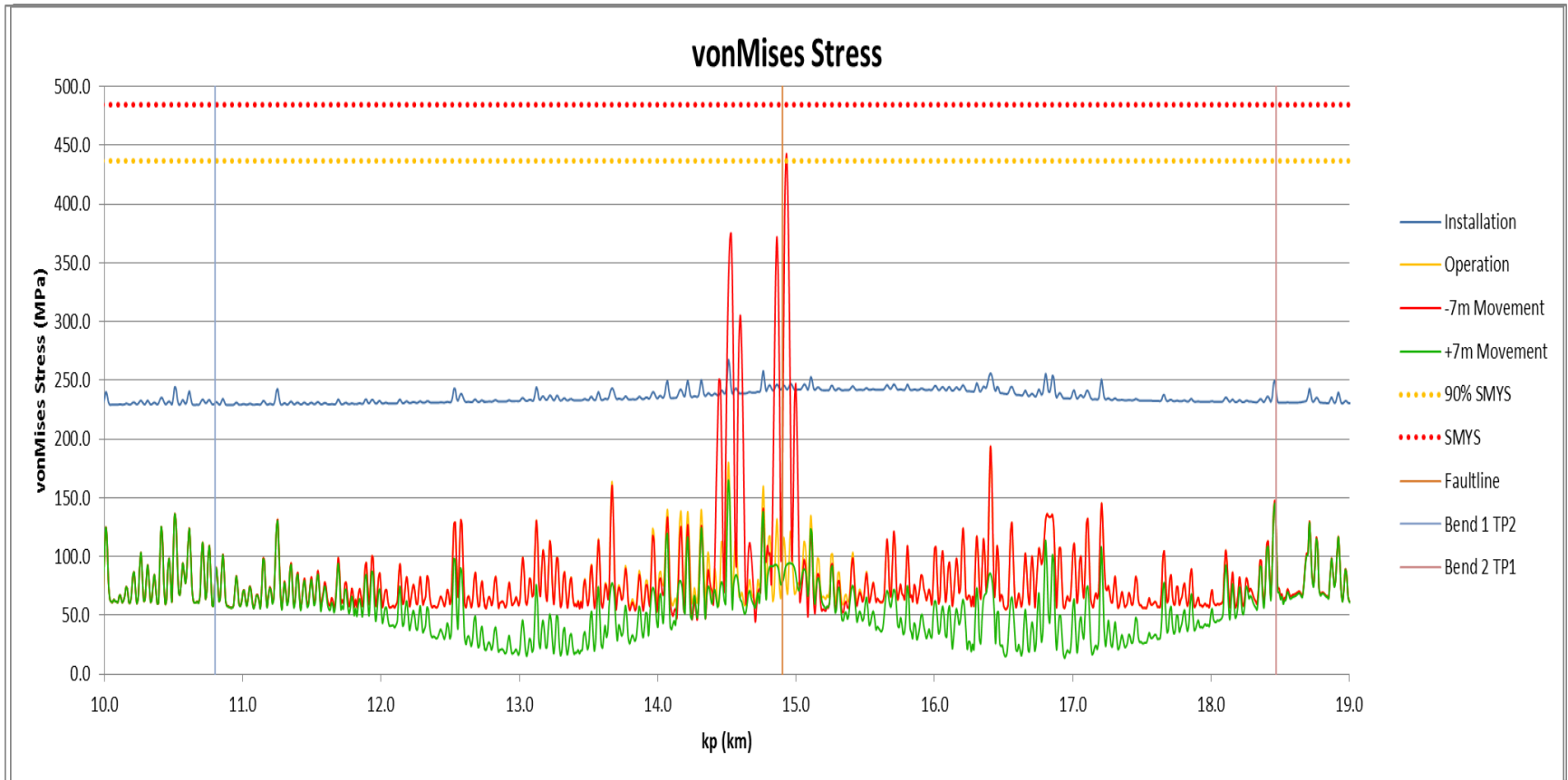


Crossing the Fault against the direction of Strike-Slip Movement



1000yr Fault movement Summary Results

+7m Correct Routing, -7m Incorrect Routing



Possible Intervention Equipment for OFZ

Equipment Type	Owen Fracture Zone Water depth Range 3000m-3250m	Pre-lay Intervention				Post-lay Intervention			
		Trenching	Rock Dumping	Mattresses	VIV Suppression Strakes	Trenching	Rock Dumping	VIV Suppression Strakes	Pipeline Repair System
Trenching Machine	Current maximum working depth 2050m. Upgrade required to reach 3500m.					✓			
Mass Flow Excavation Spread	Current maximum working depth 3000m. Upgrade required to reach 3250m.	✓				✓			
Rock Dumping (Fall Pipe) Vessel	Current maximum working depth 2000m. Vessel/Fallpipe upgrade required to reach 2500m. Vessel modification and strengthening required to reach 3250m.		?				?		
ROV for Installing Mattresses, Mechanical Supports & Post-lay VIV Strakes	Current maximum working depth 4000m.			✓	✓			✓	
Pipeline Repair System	Current maximum working depth 3000m. Upgrade required to reach 3500m.								✓

Conclusion

The Owen Fracture Zone (OFZ) is a significant feature to be crossed by MEIDP and due account of the potential seismic event associated with a slip rate of 7mm/yr must be taken into account in design

The assessments made of installation across the OFZ and operation during a seismic slip event indicate that with correct routing, the pipeline can cross this plate boundary fault safely and without major intervention.



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Acknowledgements / Thank You / Questions

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