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INSTITUT TEKNOLOGI BANDUNG 1920

GLOBAL GeoPressure ADVICE

The Resistivity Log and its role in understanding sediment unloading, Lower Kuai Basin Stephen 'Connor, Agus Ramdhan, Arifin and Amy Ellis


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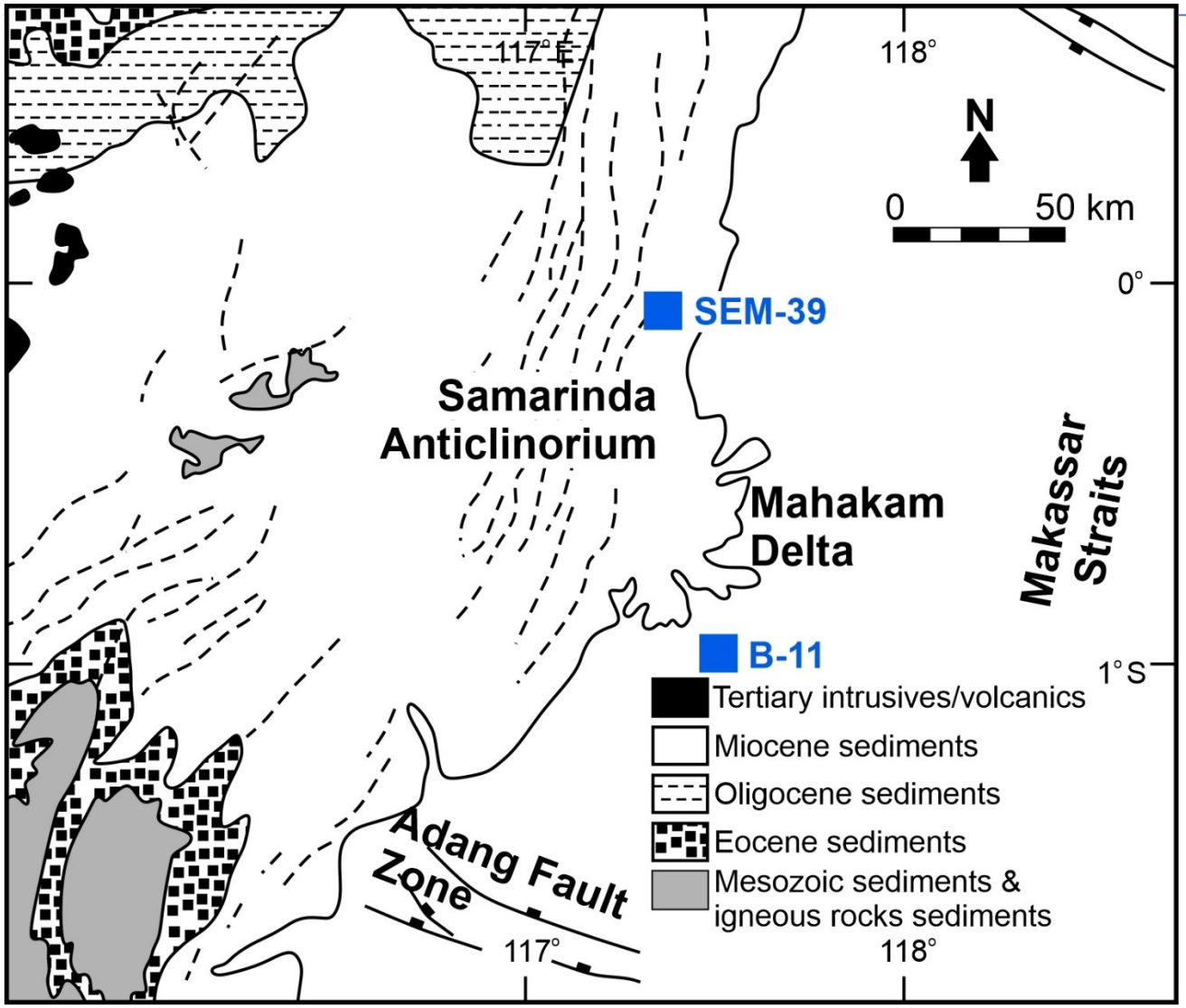
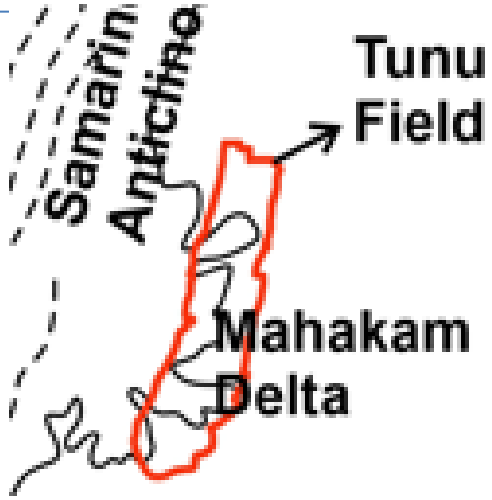
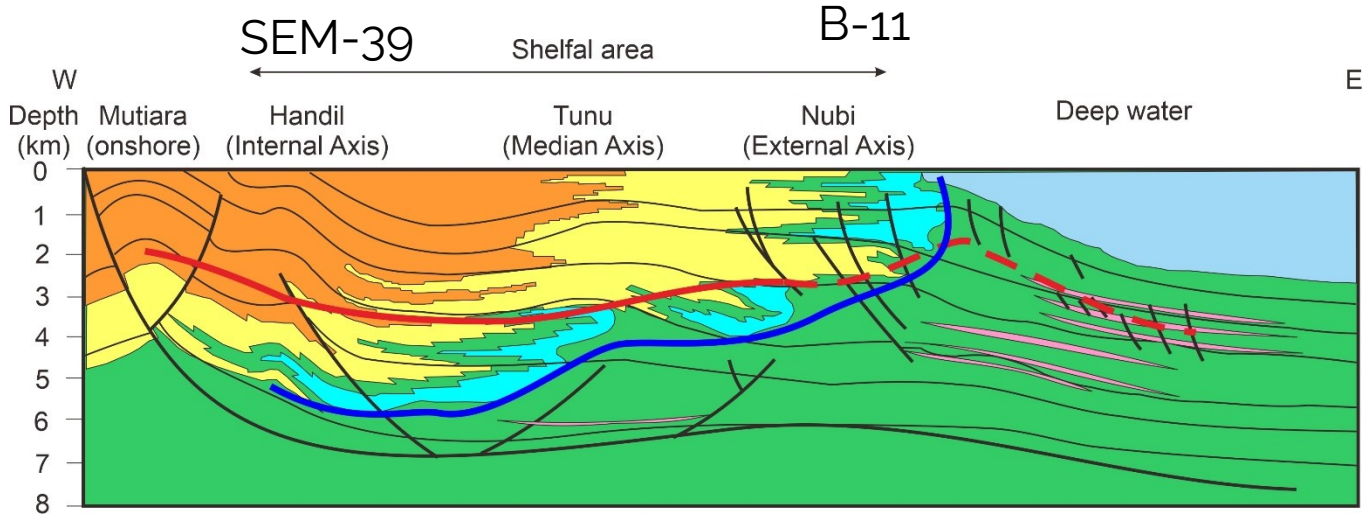
Simplified geological map of Lower Kutai Basin

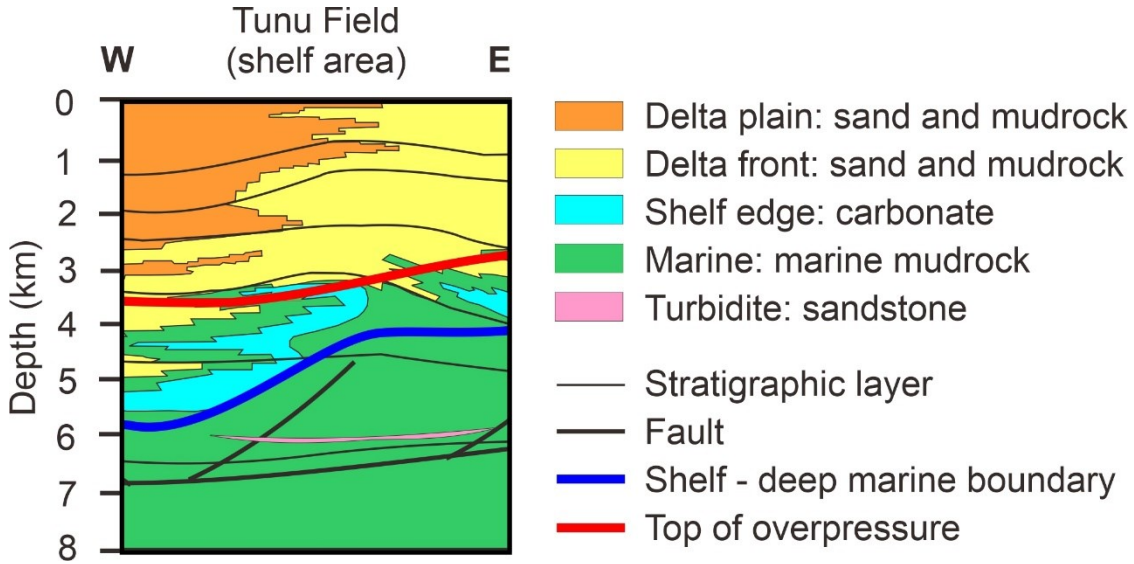




Chambers, J. L. C., I. Carter, I. R. Cloke, J. Craig, S. J. Moss, and D. W. Paterson, 2004

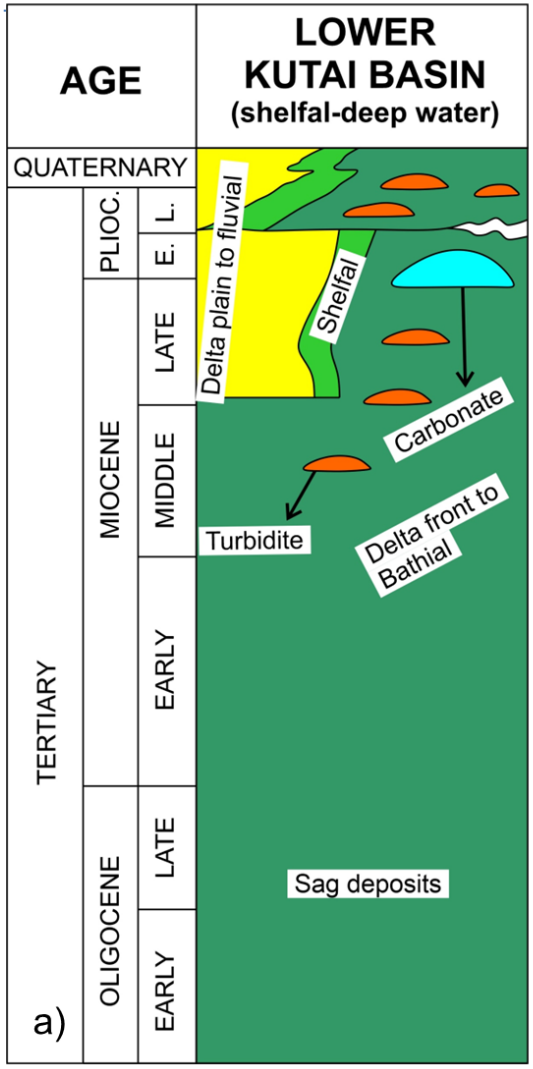
Structure and Stratigraphy

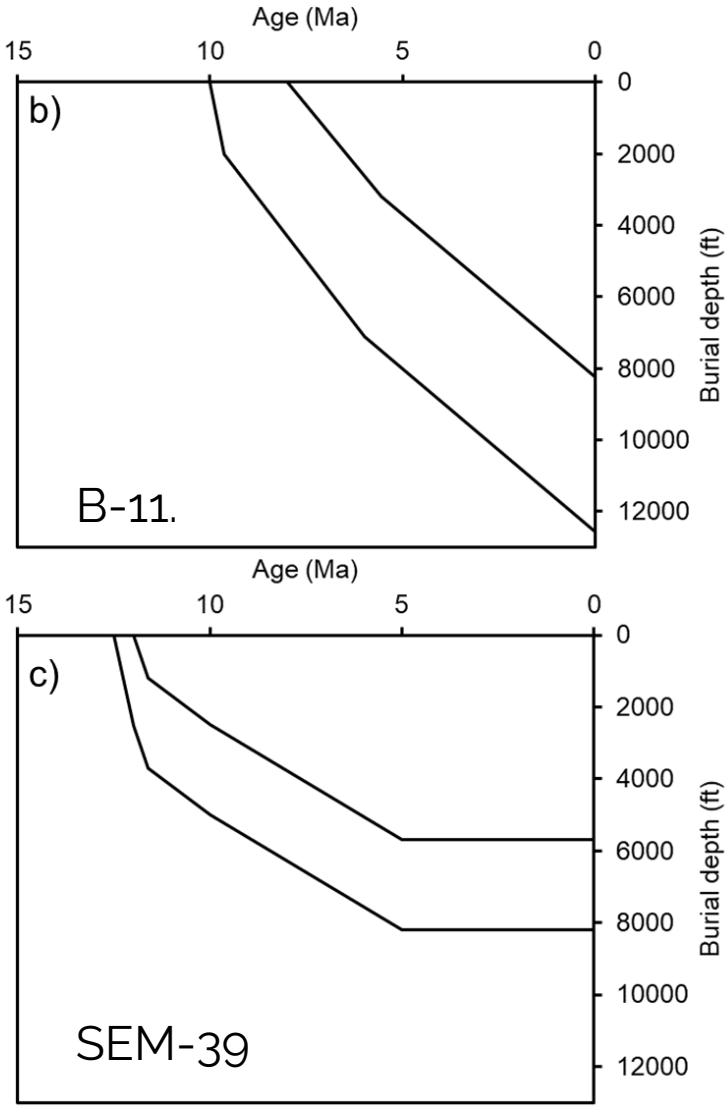


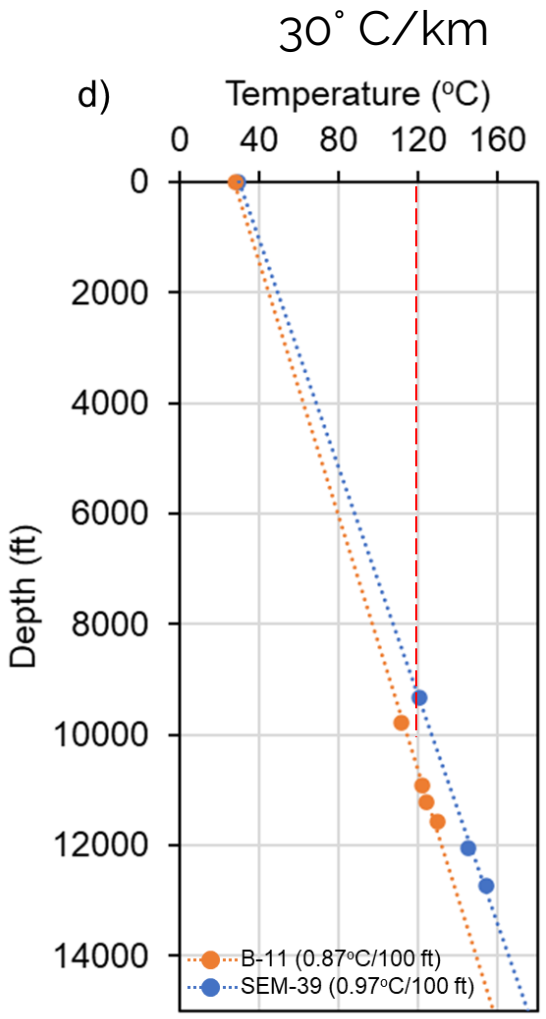


Sequence interpretation showing key depositional packages and associated structures present in the Lower Kutai Basin (modified from Ramdhan and Goulty, 2011).

Burial History and Temperature

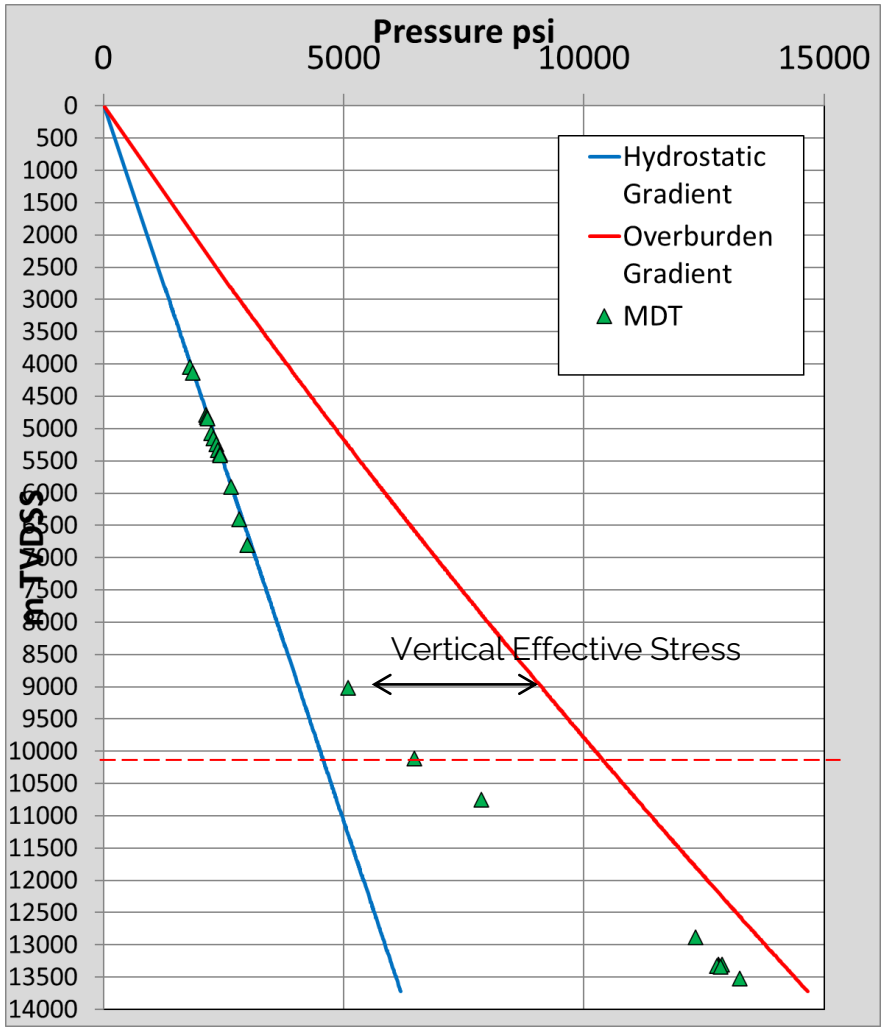


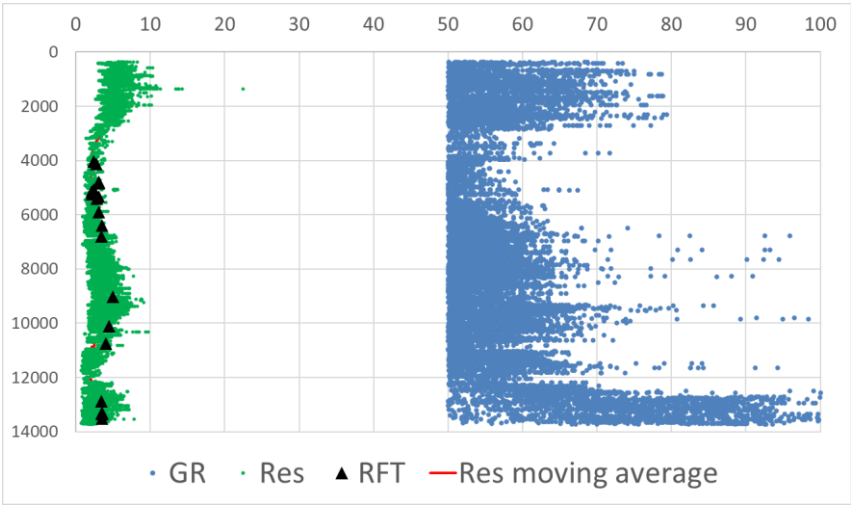




Blue temperature data (SEM-39) are from RFT, while the orange data (B-11) are BHT corrected using Horner and DST.

Direct Pressure Data





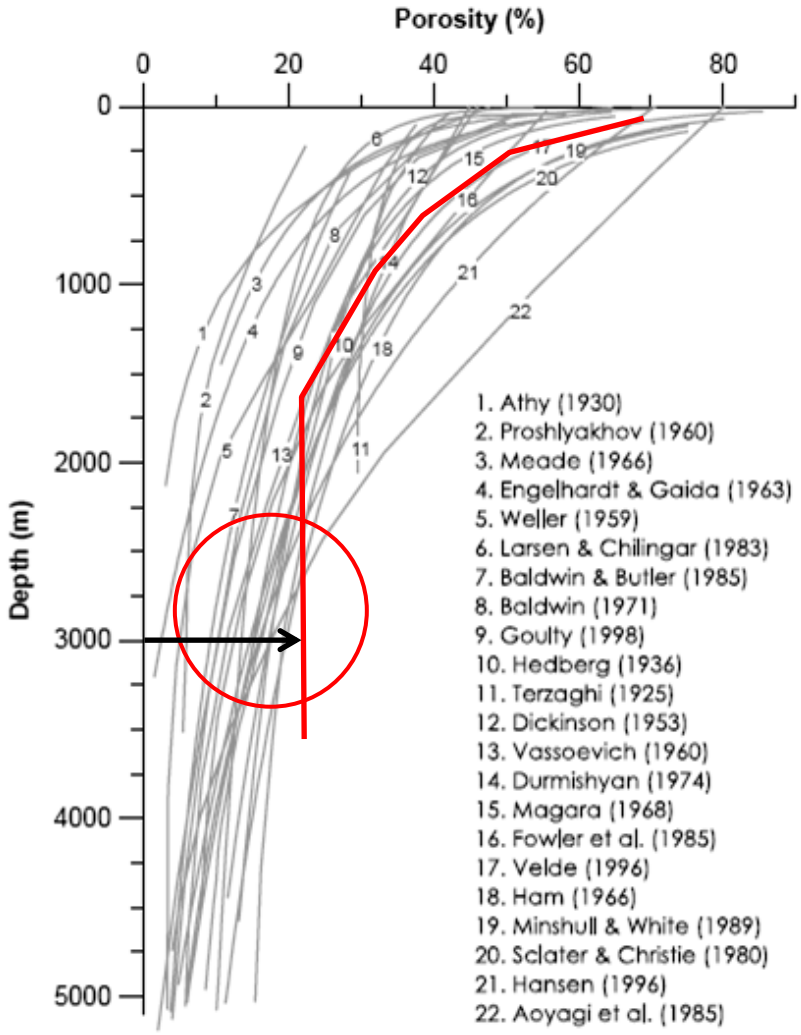
Res moving average

GR cut-off

120°C

e.g., SEM-39

Disequilibrium Compaction (Loading)



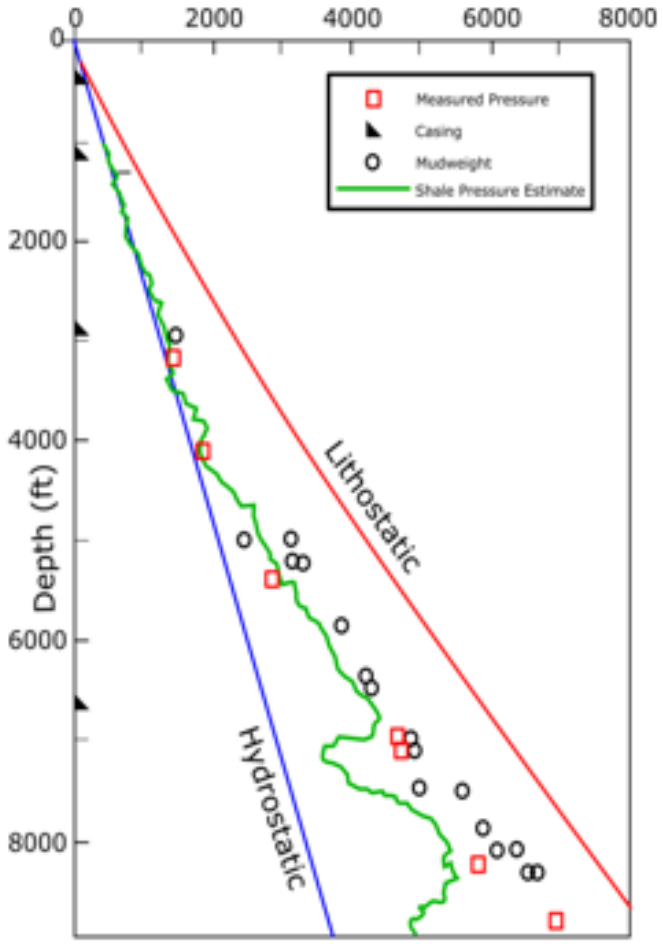
EFFECTIVE STRESS DRIVES COMPACTION

Overpressured shale generates a porosity anomaly

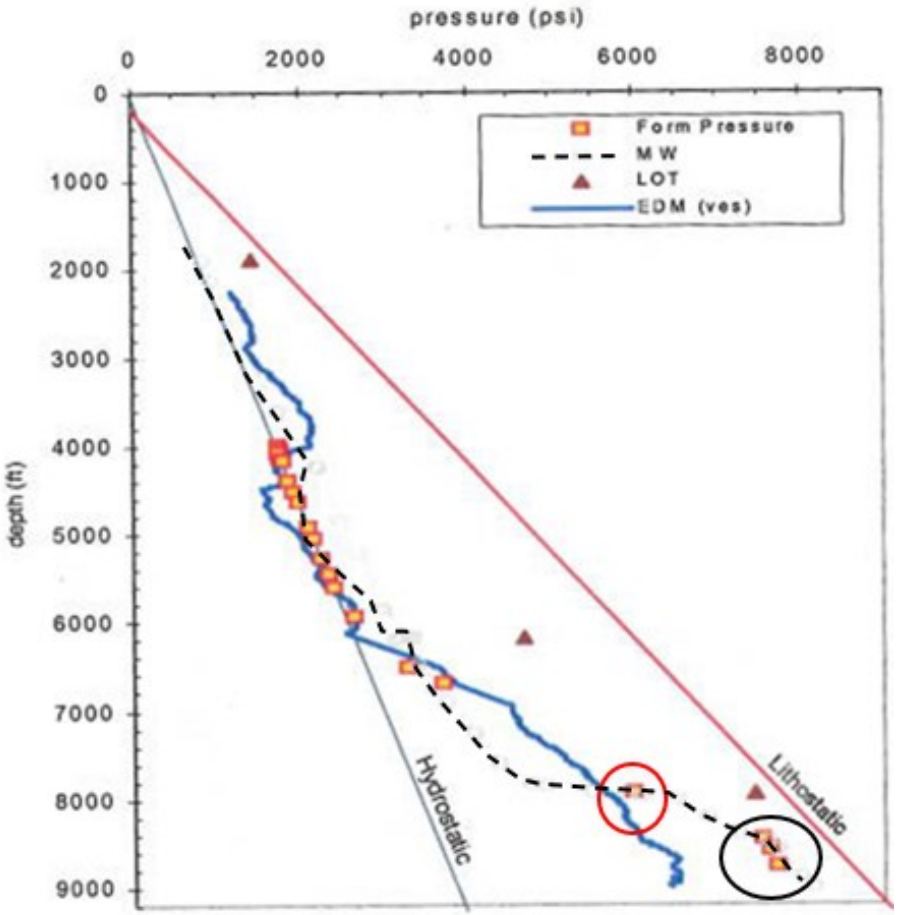
Eaton, Equivalent Depth, Bowers Loading

From Mondol et al., 2007

Malay Basin Examples

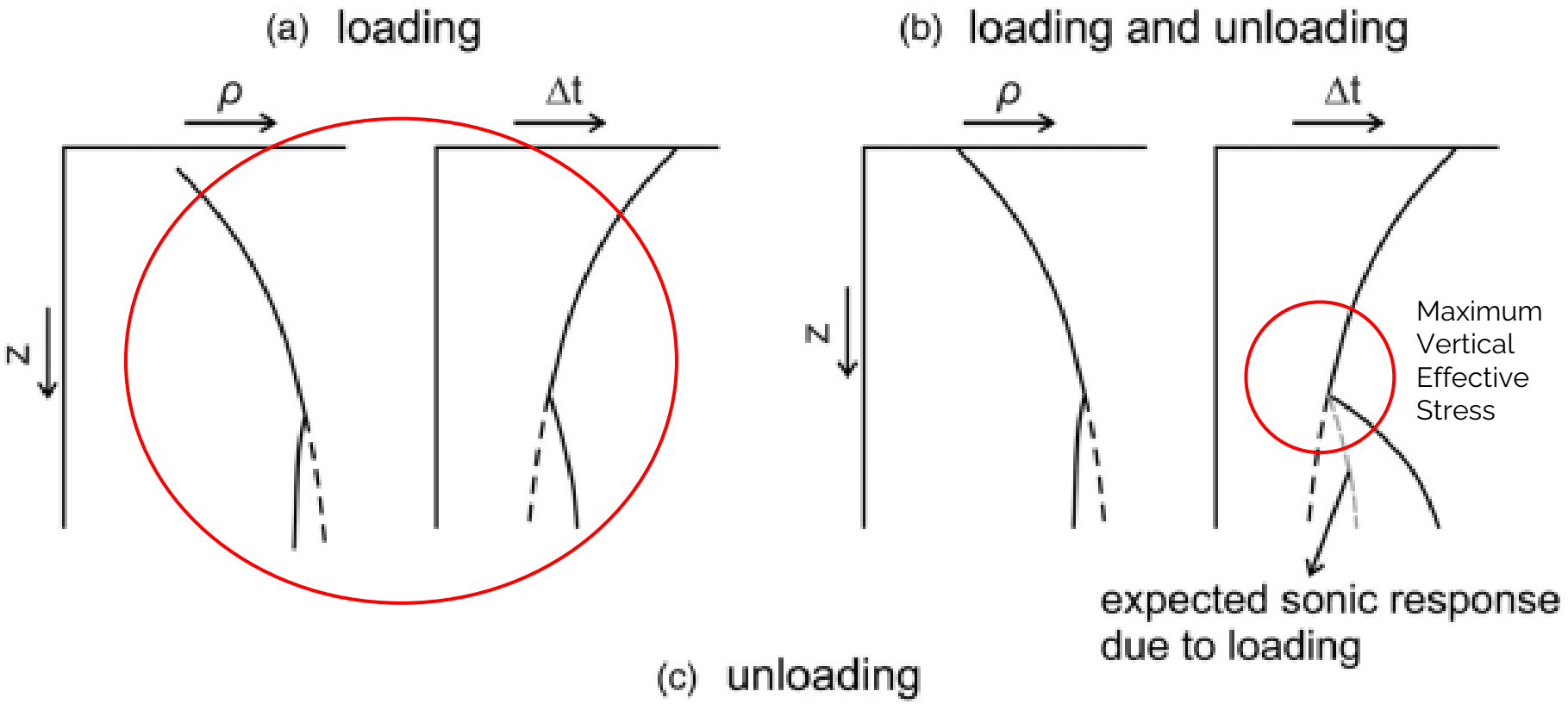


Hoskin et al, 2016



O'Connor et al 2011

Unloading



Ramdhan and O'Connor 2022

Smectite Dehydration
Smectite-Illite
Kaolinite-illite
Oil / Gas Maturation

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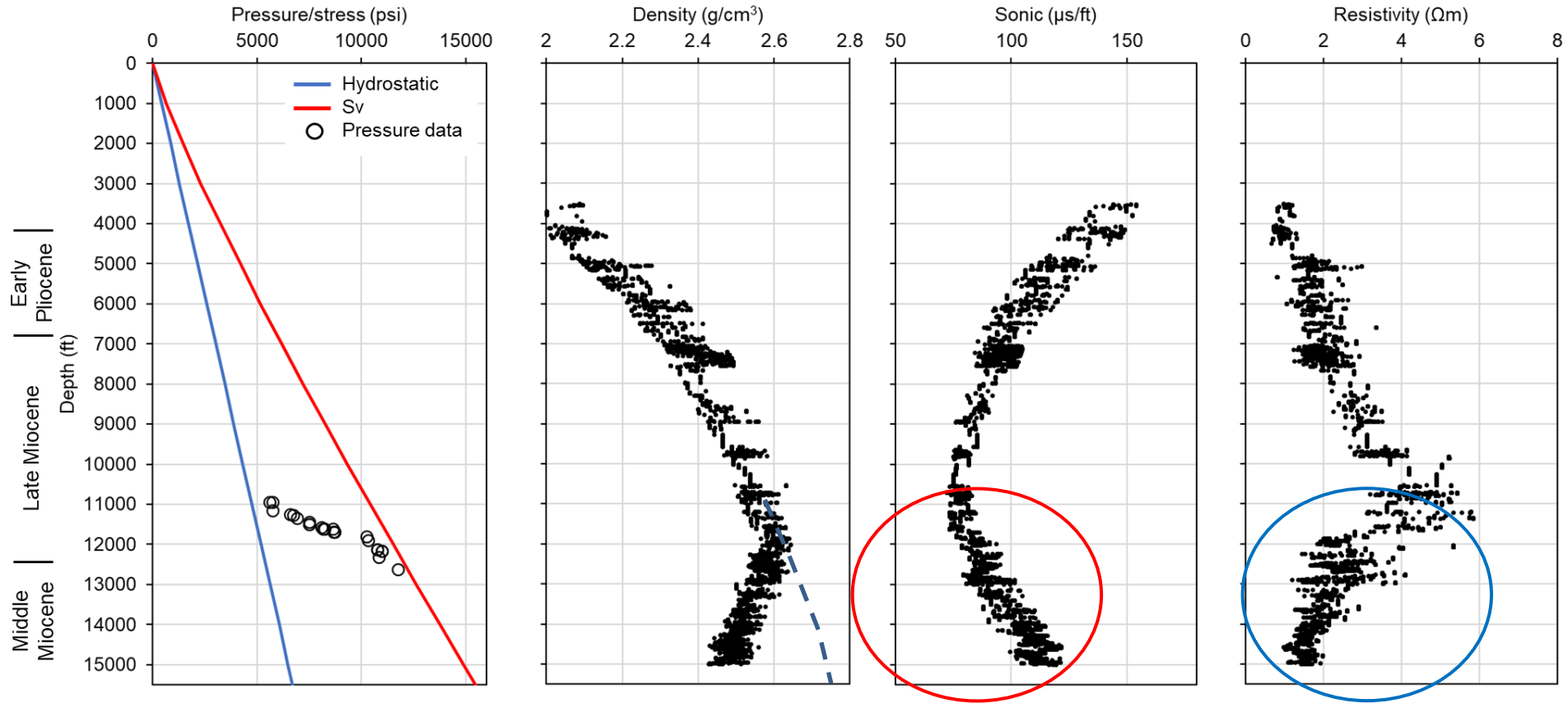
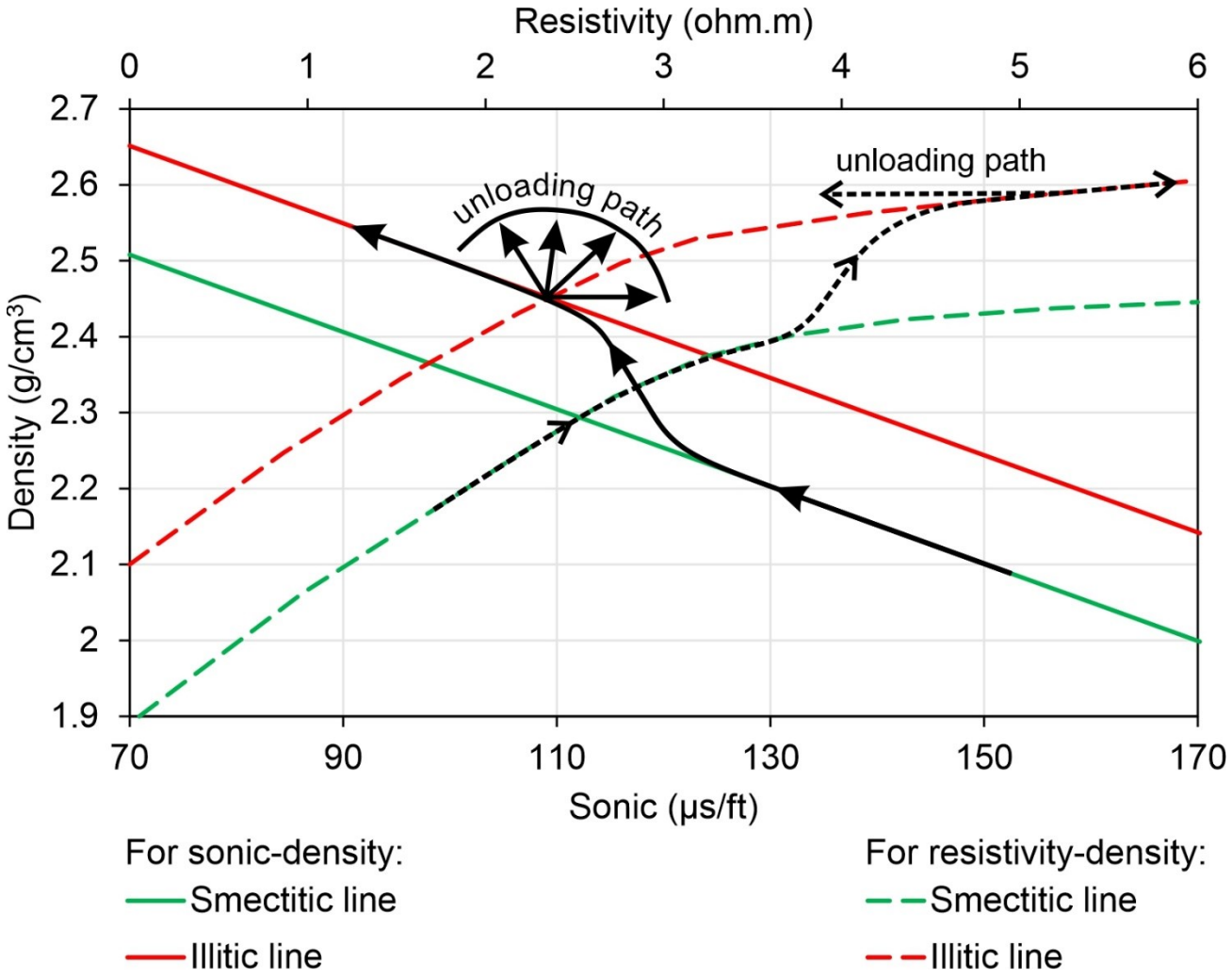
B-11 Well, Logs



Identifying unloading



Based on Dutta, 2002; Katahara, 2006

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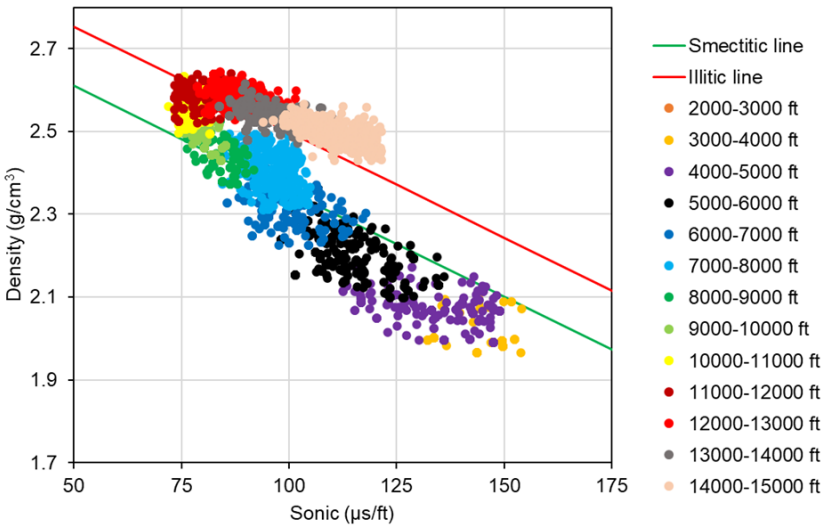
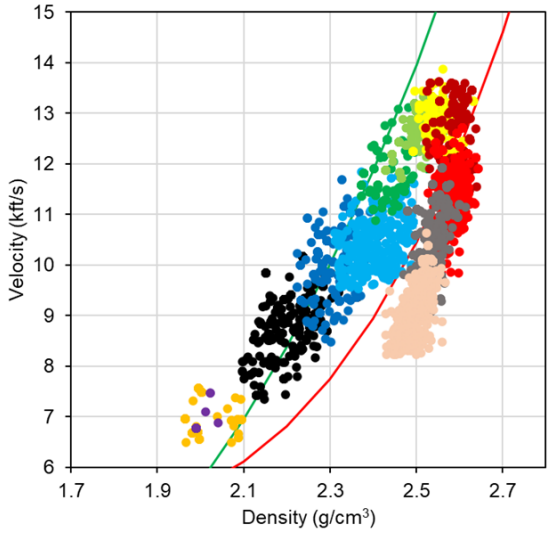
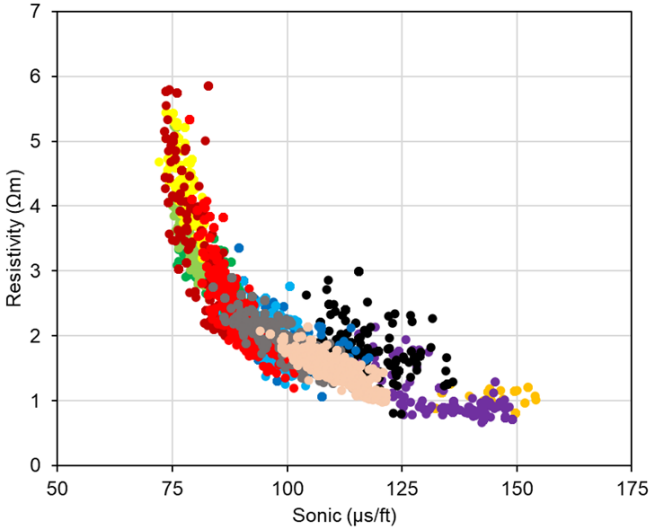
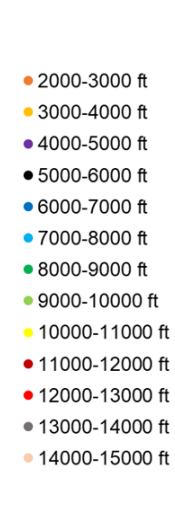
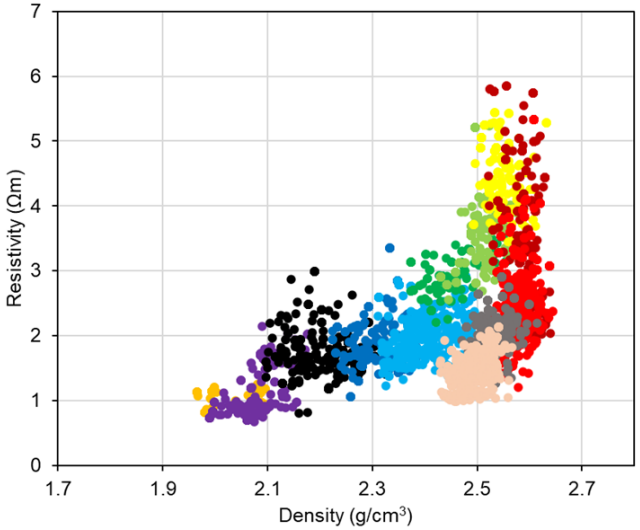
Petrophysical Cross-Plots



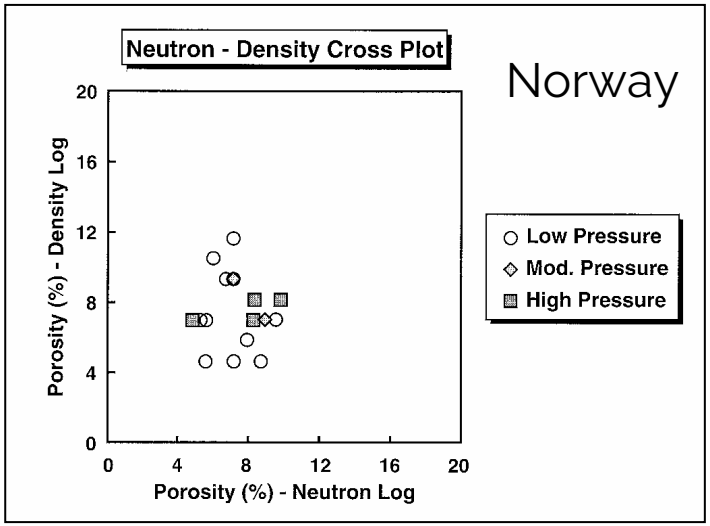


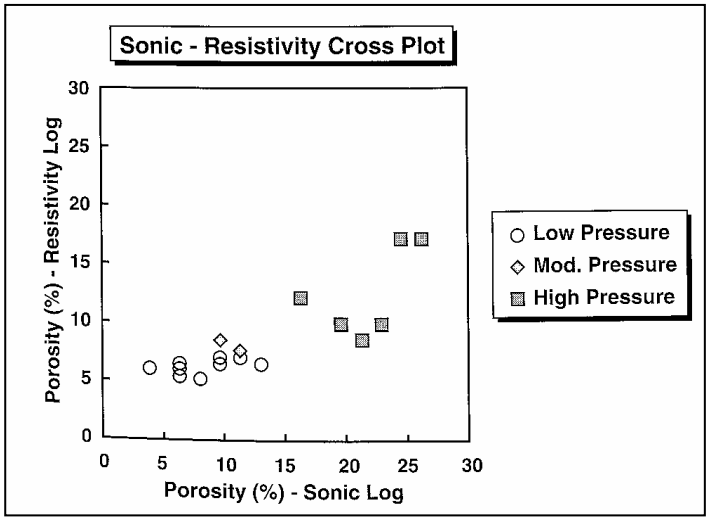


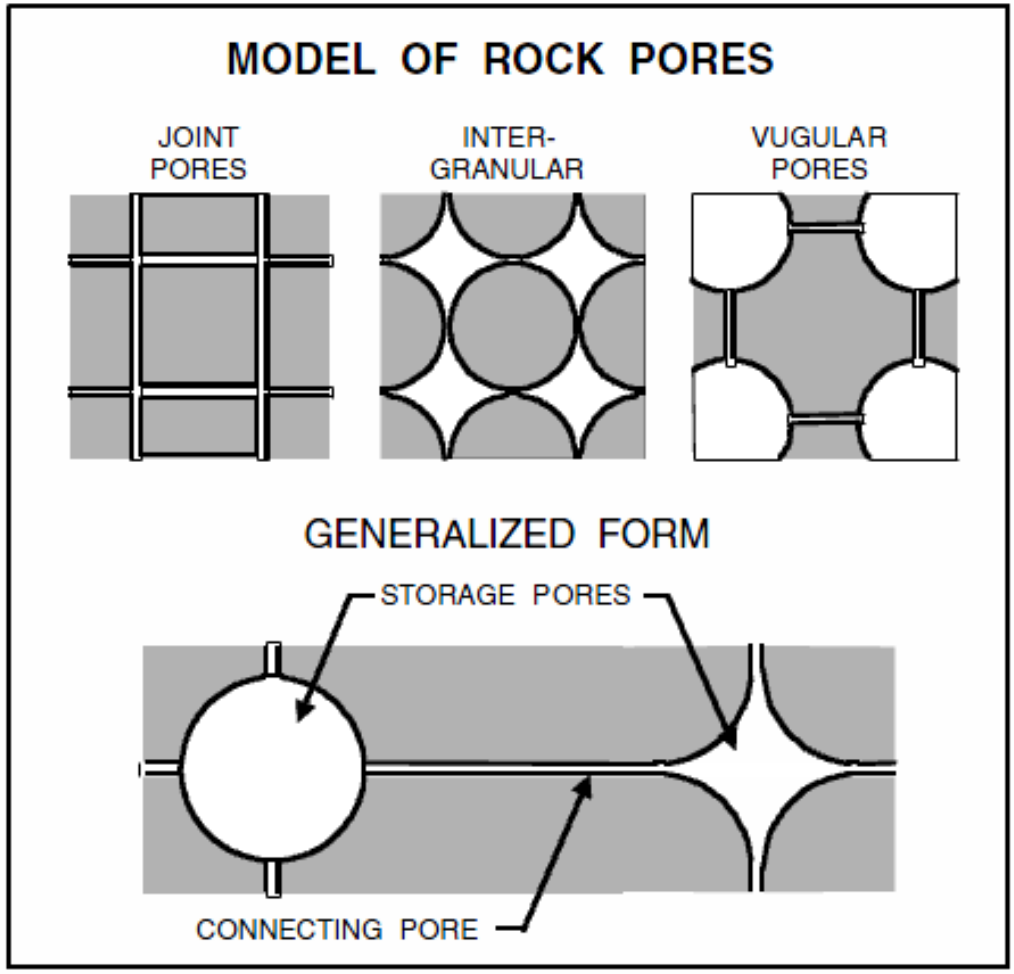




Pore Structure





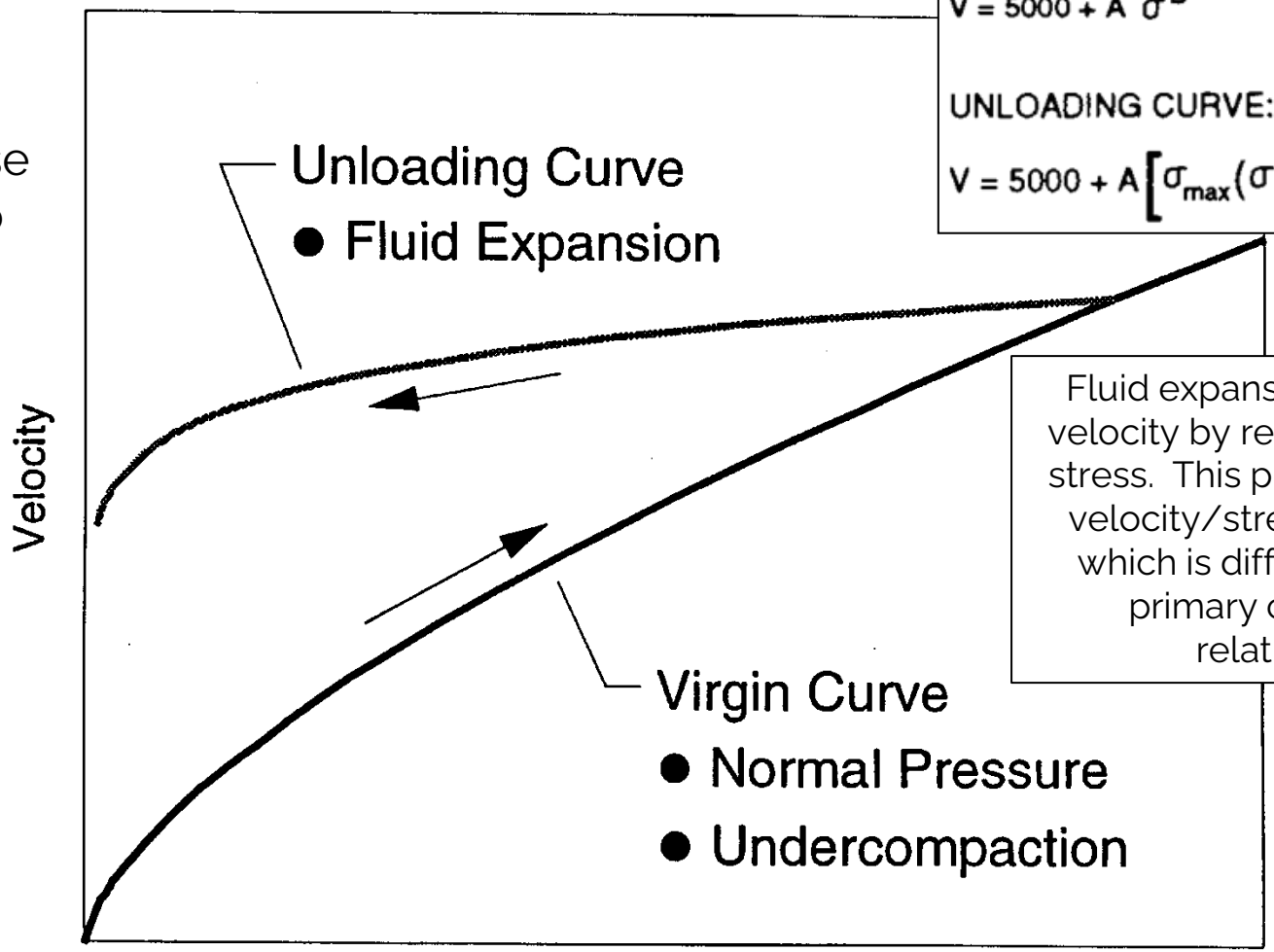


Hermanrud et al (1998)

Katsube & Bowers 2002

Bowers Unloading 1994

Where unloading operates, we can use Bowers to solve for pressure



Fluid expansion can reduce velocity by reducing effective stress. This process creates a velocity/stress relationship which is different from the primary compaction relationship.

After Bowers (1994)

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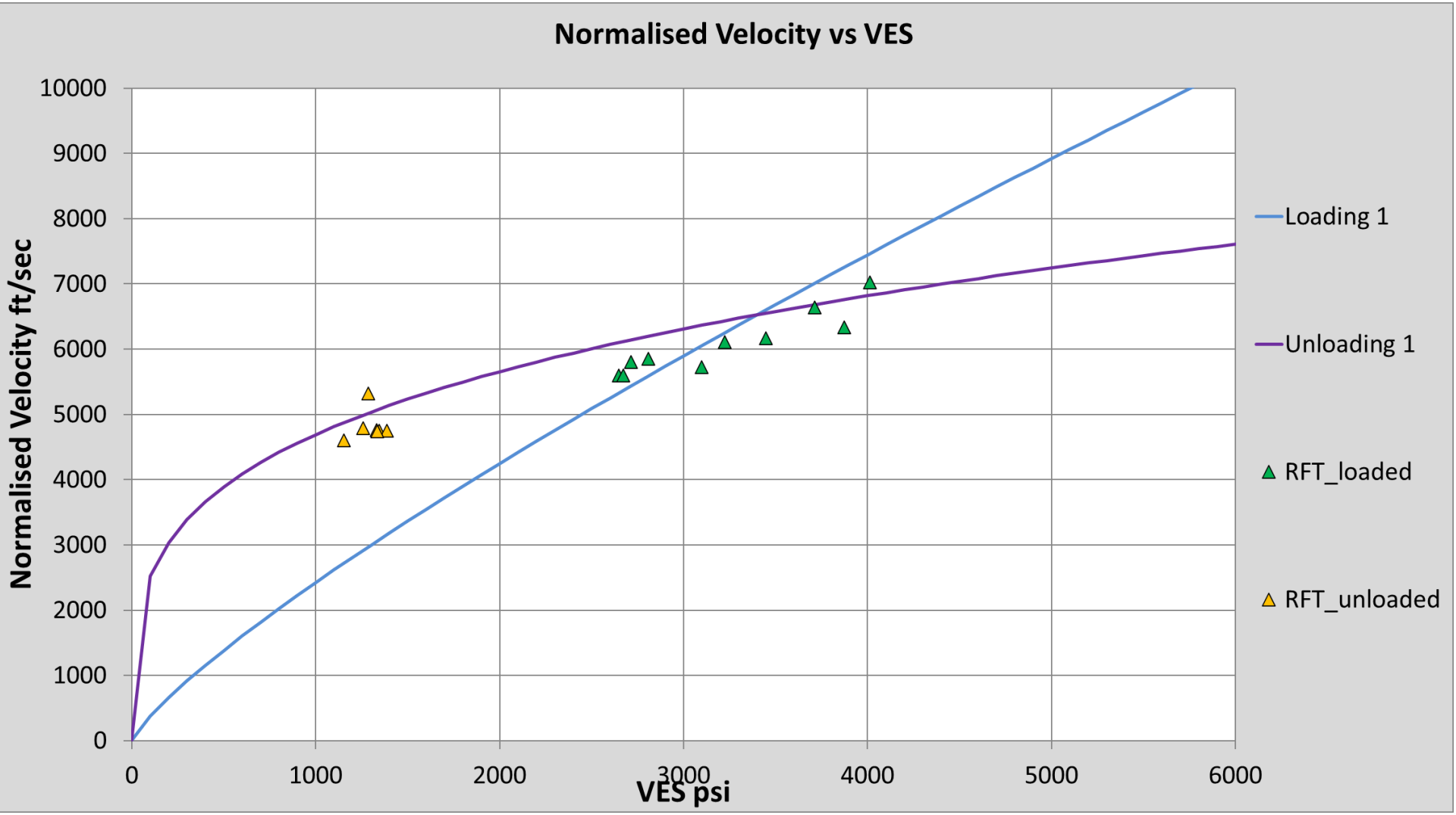
Velocity-VES relationship



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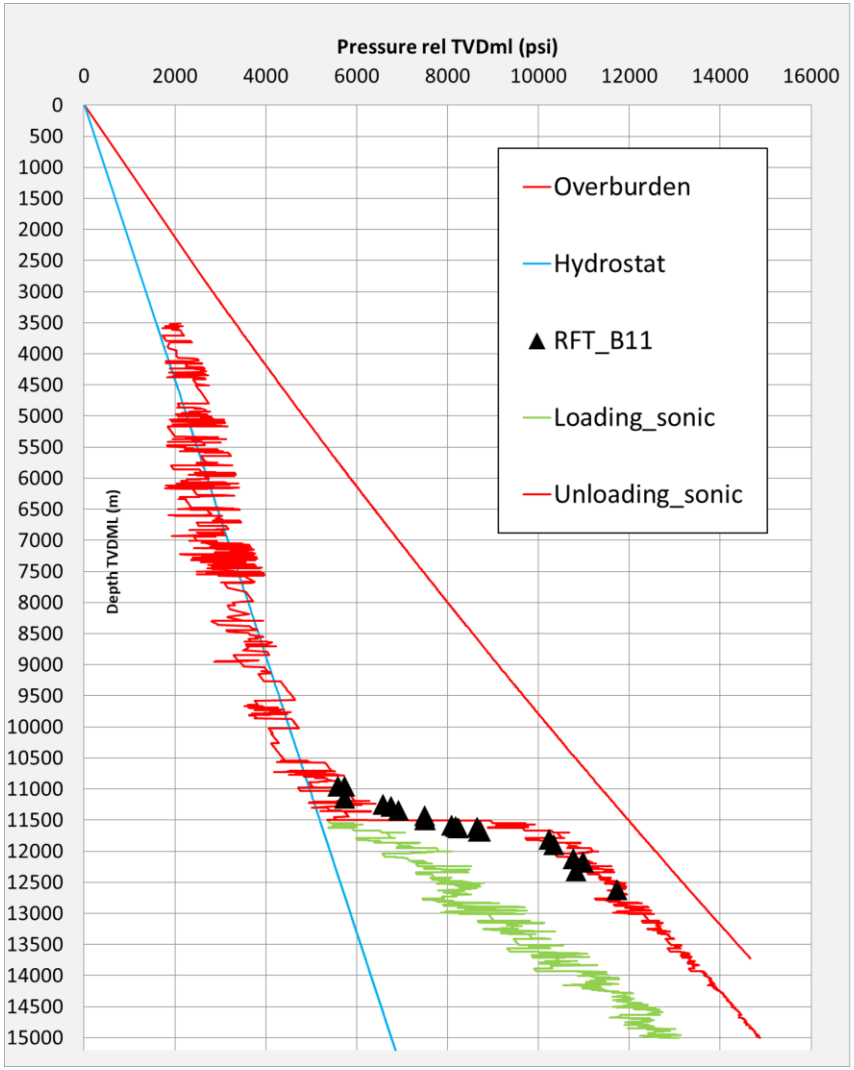
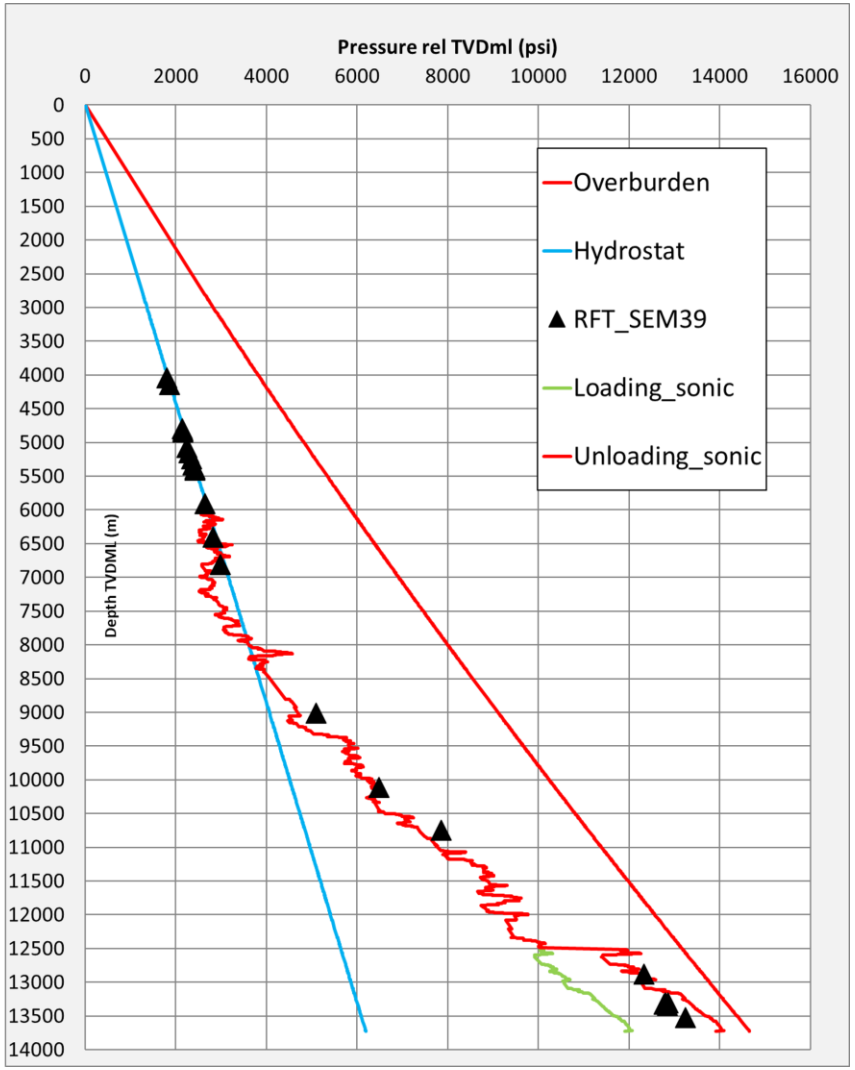
B-11 and SEM-39 Wells Sonic





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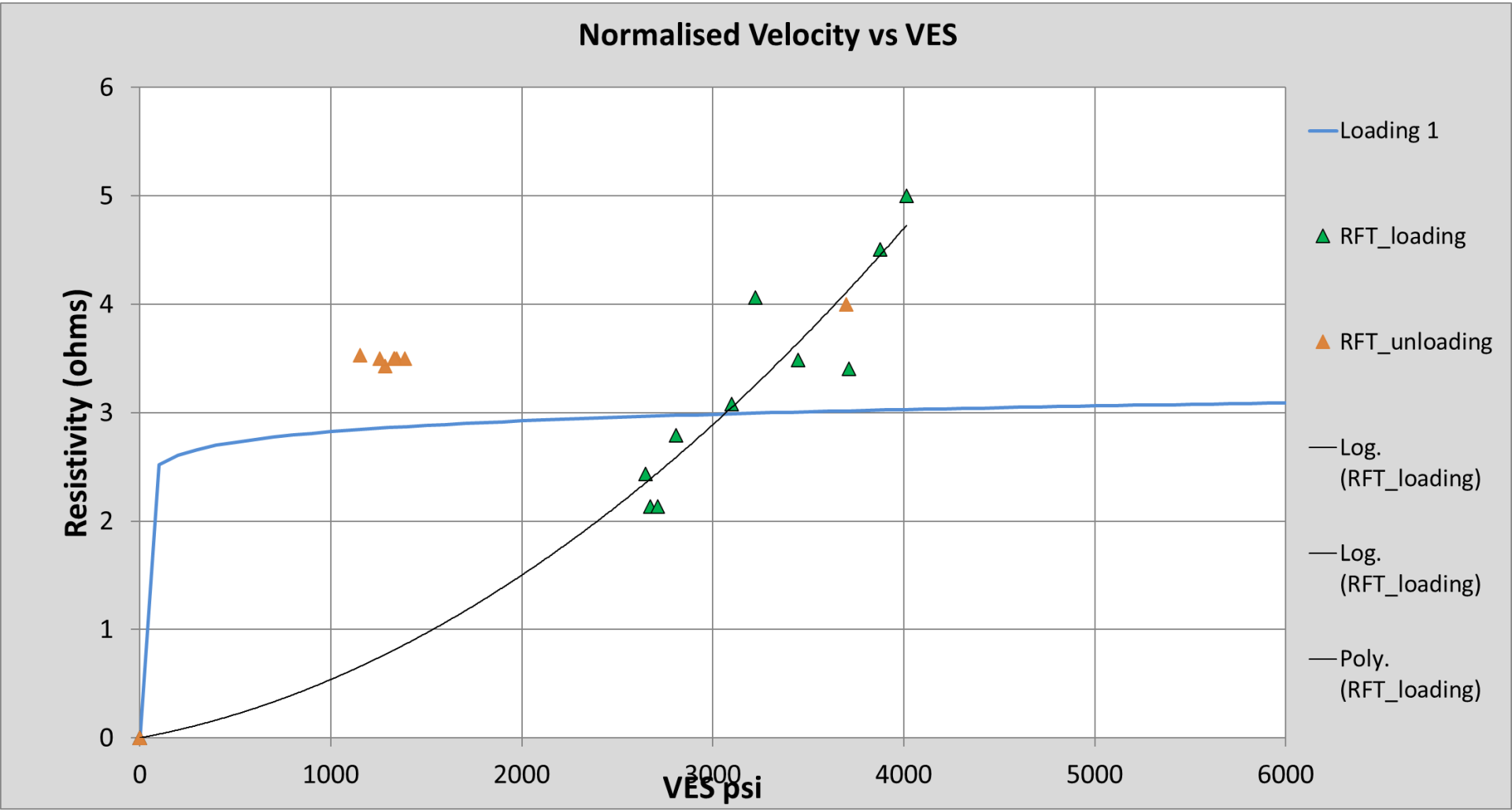
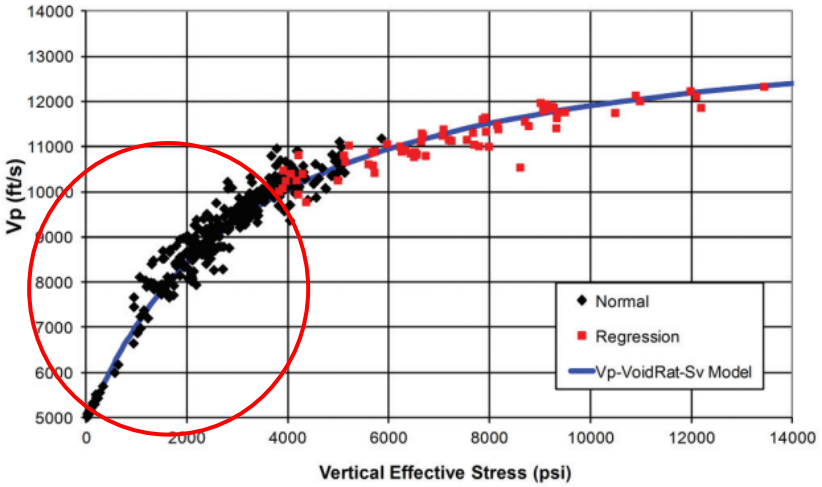
RES-VES relationship

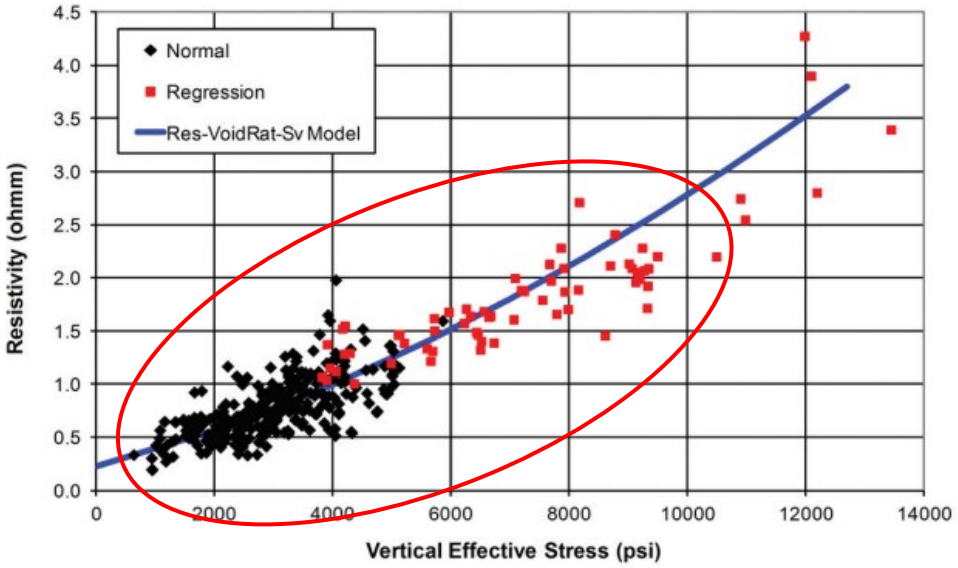


Gulf of Mexico Data



velocity provides a more stable pressure estimate for low vertical effective stress

resistivity displays a much flatter response to stress over the entire range represented in the data set, resulting in resistivity-based pressure estimates extrapolating in a much more stable manner to higher vertical effective stress.



Hauser et al 2013

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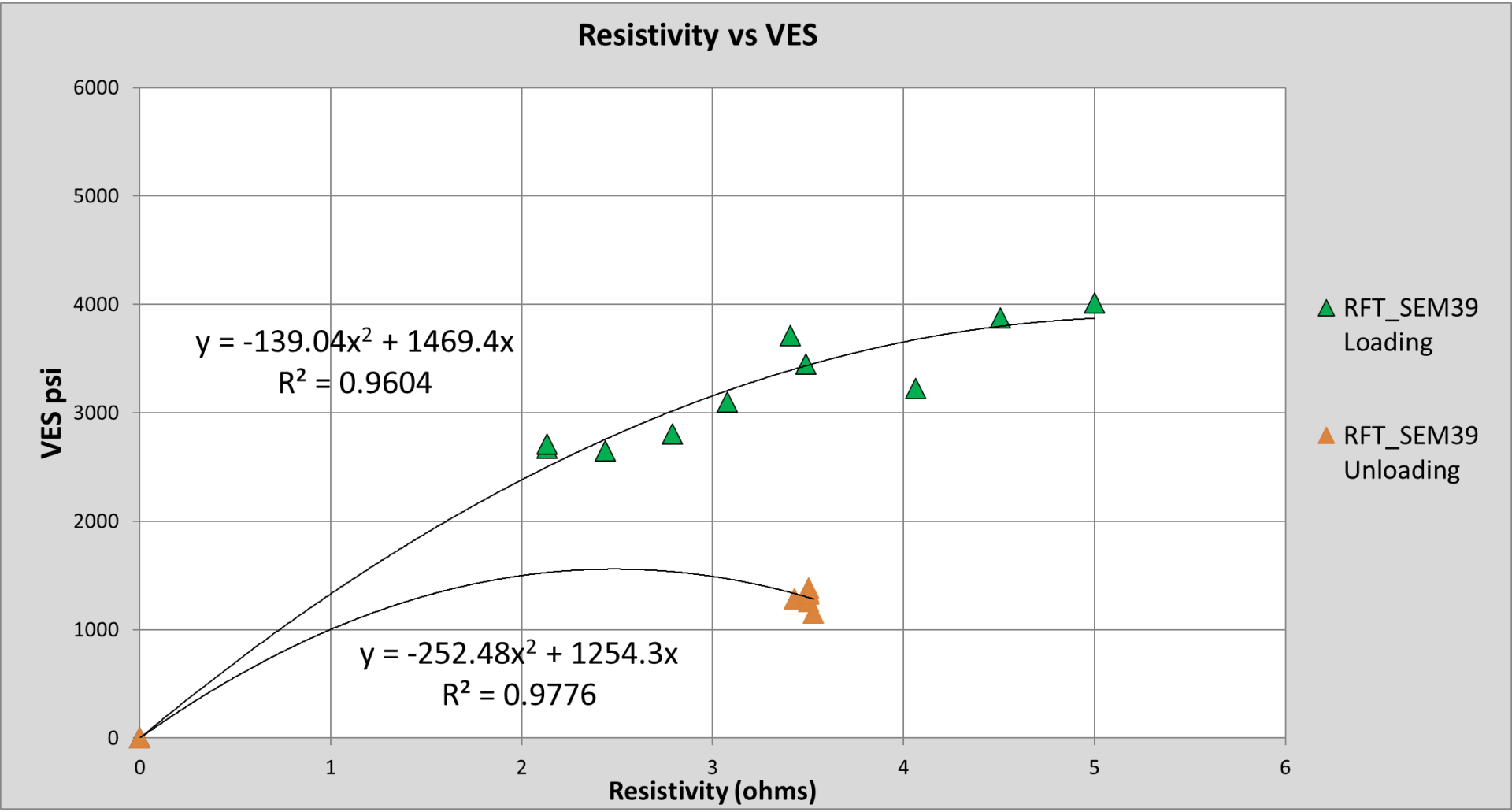
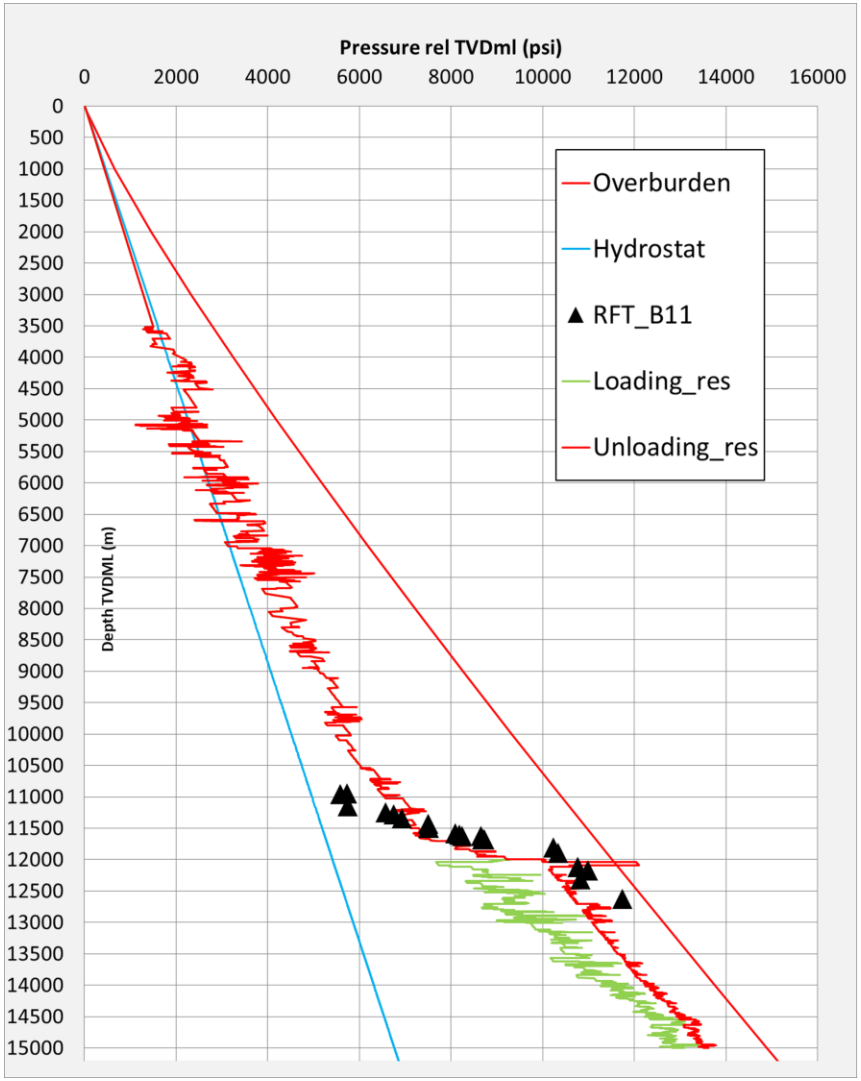
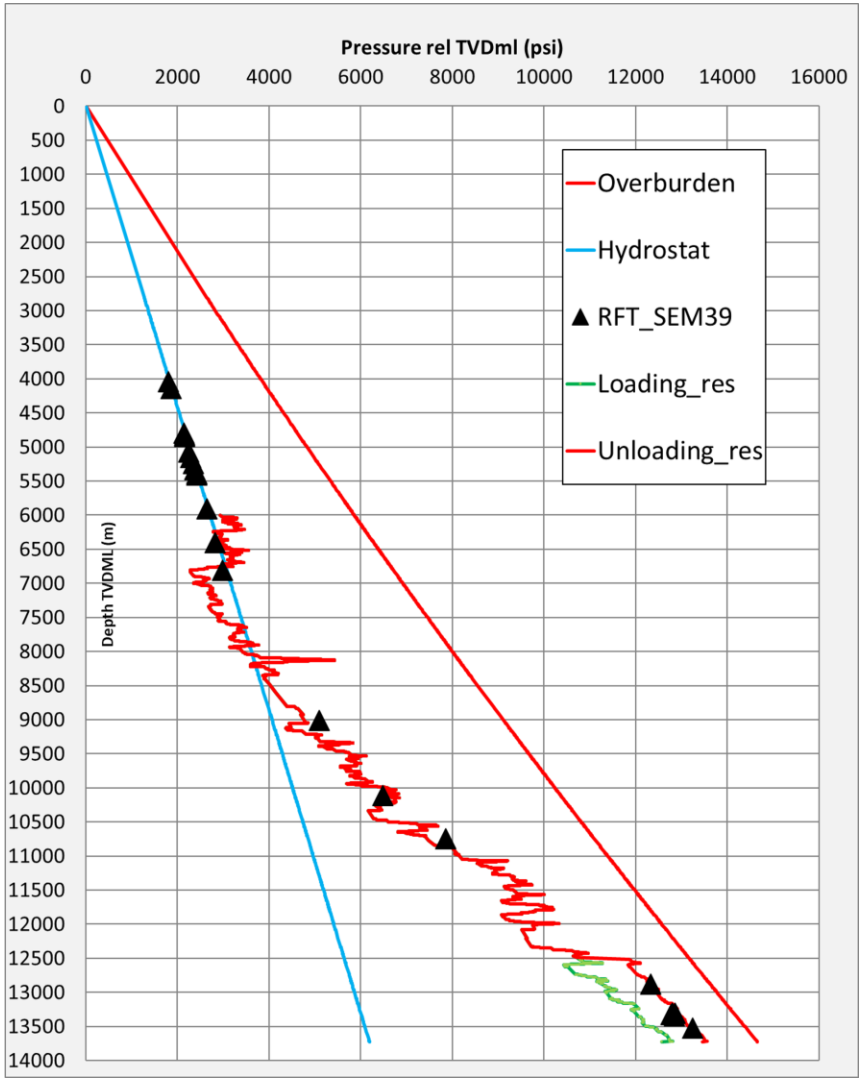
RES-VES Relationship



B-11 and SEM-39 Wells Res





Summary

- Unloading is observed in the Lower Kutei Basin,
- The sonic log is the primary tool to quantify this unloaded pore pressure
- The resistivity log has now been shown to be a useful tool for the same
- The resistivity log needs more borehole correction that the sonic tool
- The resistivity tool seems to be less sensitive than the sonic at low effective stress
- Fresh water encroachment maybe negate its use so its application is more likely to be successful in pro-delta shales
- In the Lower Kutei Basin, where sonic logs are often missing, or of limited extend, using the resistivity tool could be a useful new addition to the pore pressure toolbox.
- A larger dataset is needed to move this work forward.