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The S ar of he Subsurface

Why do we care?

Surface temperatures affect our calculated subsurface temperatures

Today
In the past

Proper attention to surface temperatures marks you as a careful worker

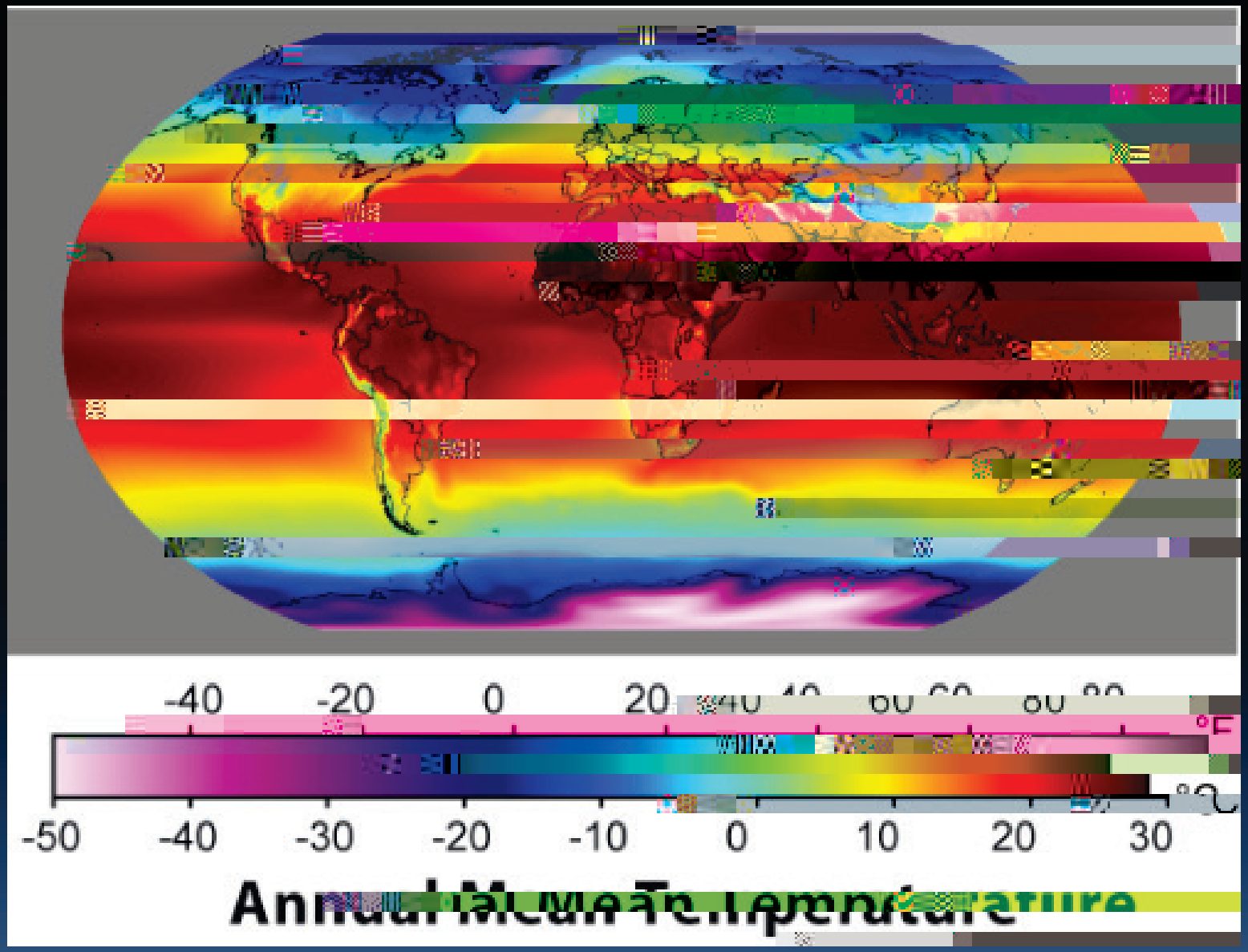
Present-day surface temperatures

Onshore
Offshore

Paleosurface temperatures

Onshore
Offshore

Present-day surface temperatures



Examples of air temperatures

Port Moresby, PNG (9.67^{o}S, elev. 47 m)

Tsurf = 27.6 – 0.4 – 0.6 – 0.3 = 26.3^{o}C [26.9^{o}C]

PNG Thrust and Fold Belt (5.5^{o}S, elev. 2700 m)

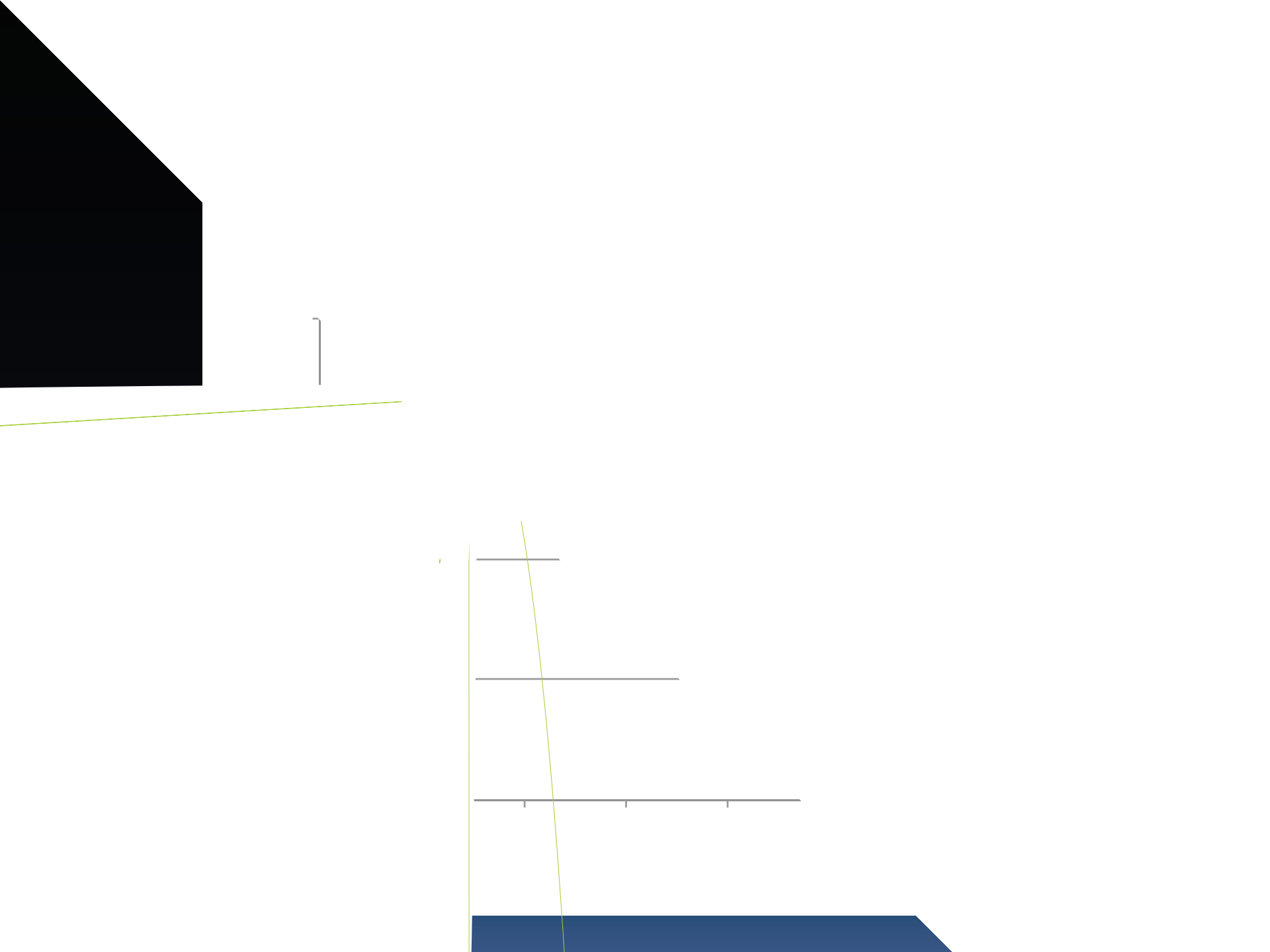
Tsurf = 27.6 – 0.2 – 0.2 – 17.3 = 9.9^{o}C

Confidence levels

Non-continental climates: ± 1.5^{o}C

Continental climates: ± 3.5^{o}C ??

Accuracy can be improved using weather data to calibrate a local model

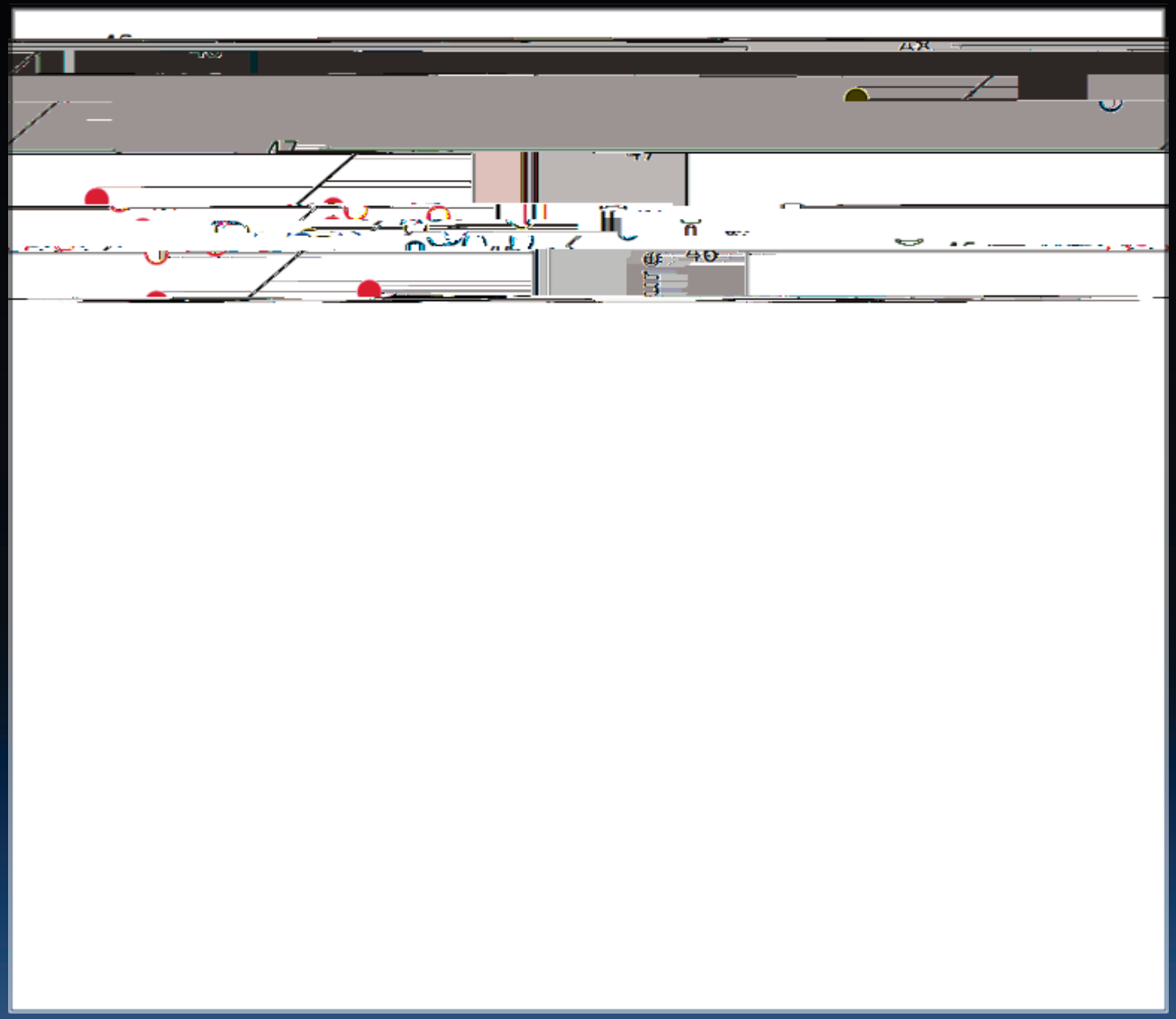


Sources of weather data

www.worldclimate.com

Gives mean annual air temperatures, elevations, latitude, and longitude

Powder River Basin: after calibration



Local calibration in PRB

Adjust constants in latitude equation

Adjust adiabatic lapse rate

Add dependence on longitude, since degree of continentality decreases westward into the mountains

In PRB 95% of calculated values are within 2.3^{o}F of measured values

Present-day offshore “surface” temperatures

Actually they are sea-floor temperatures,

not water or air temperatures

Depend on

Water depth

Latitude

Degree of isolation of water body

Nomograph of Beardsmore and Cull (2001)

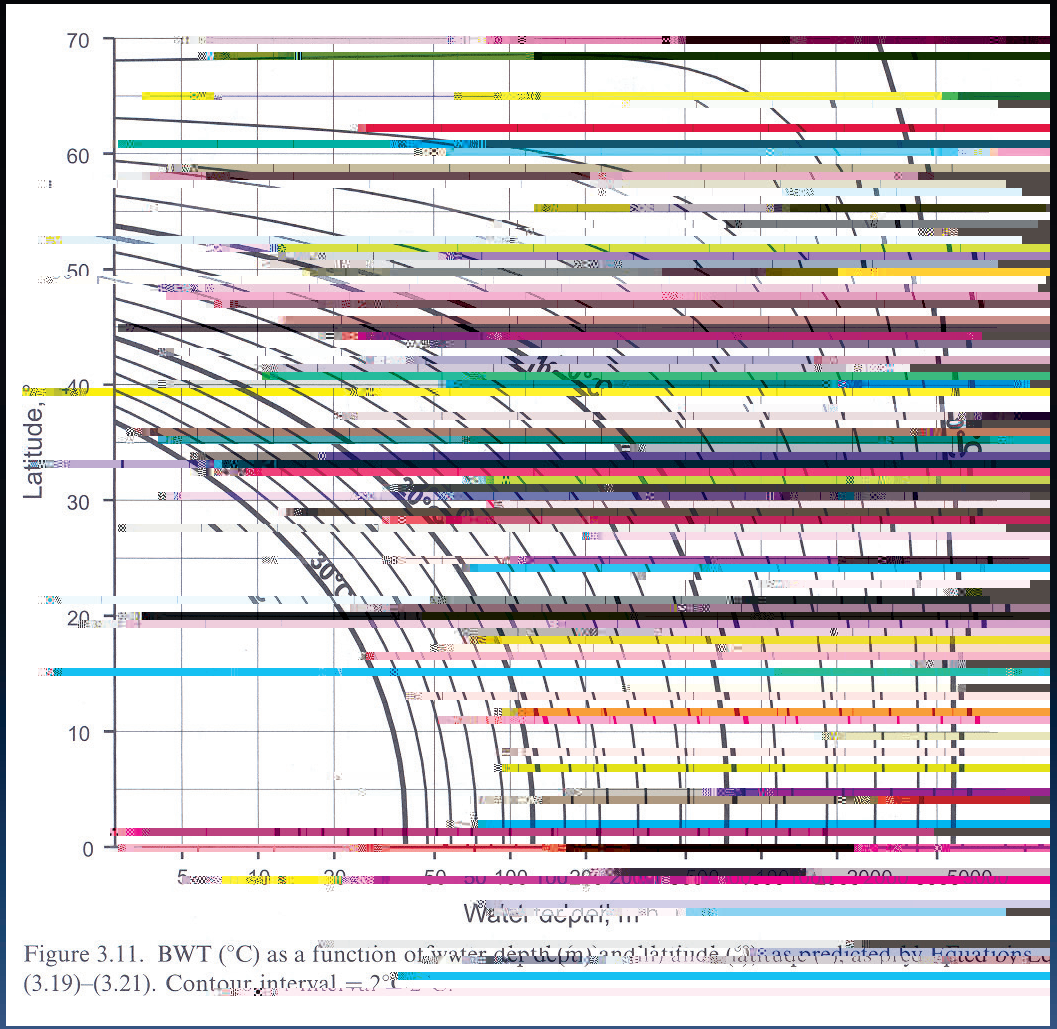
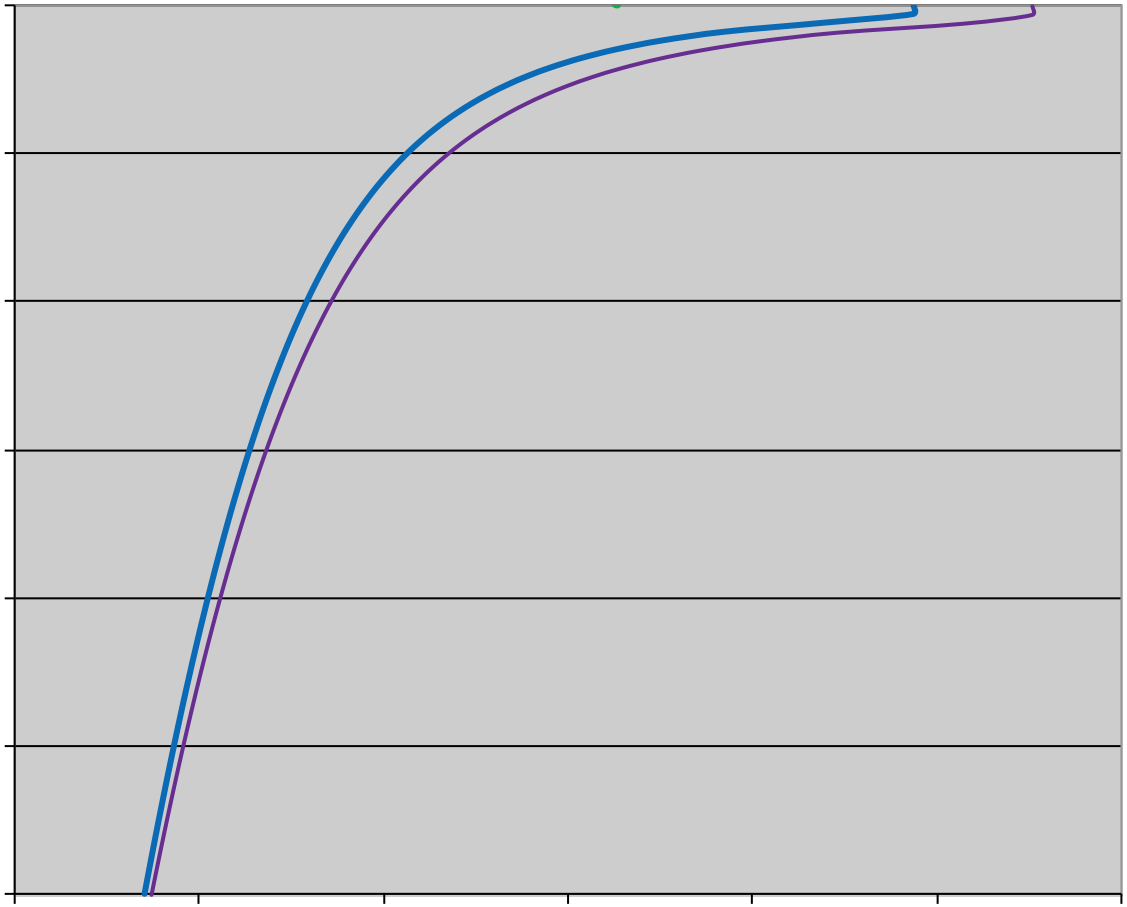


Figure 3.11. BWT (°C) as a function of water depth (m) and latitude (°) as predicted by Equations (3.19)–(3.21). Contour interval = 2°C.



Use of measured bottom-water temperatures

Correction for depth?

Geographic relevance?

Changes in water circulation?

Paleosurface temperatures

Onshore and offshore

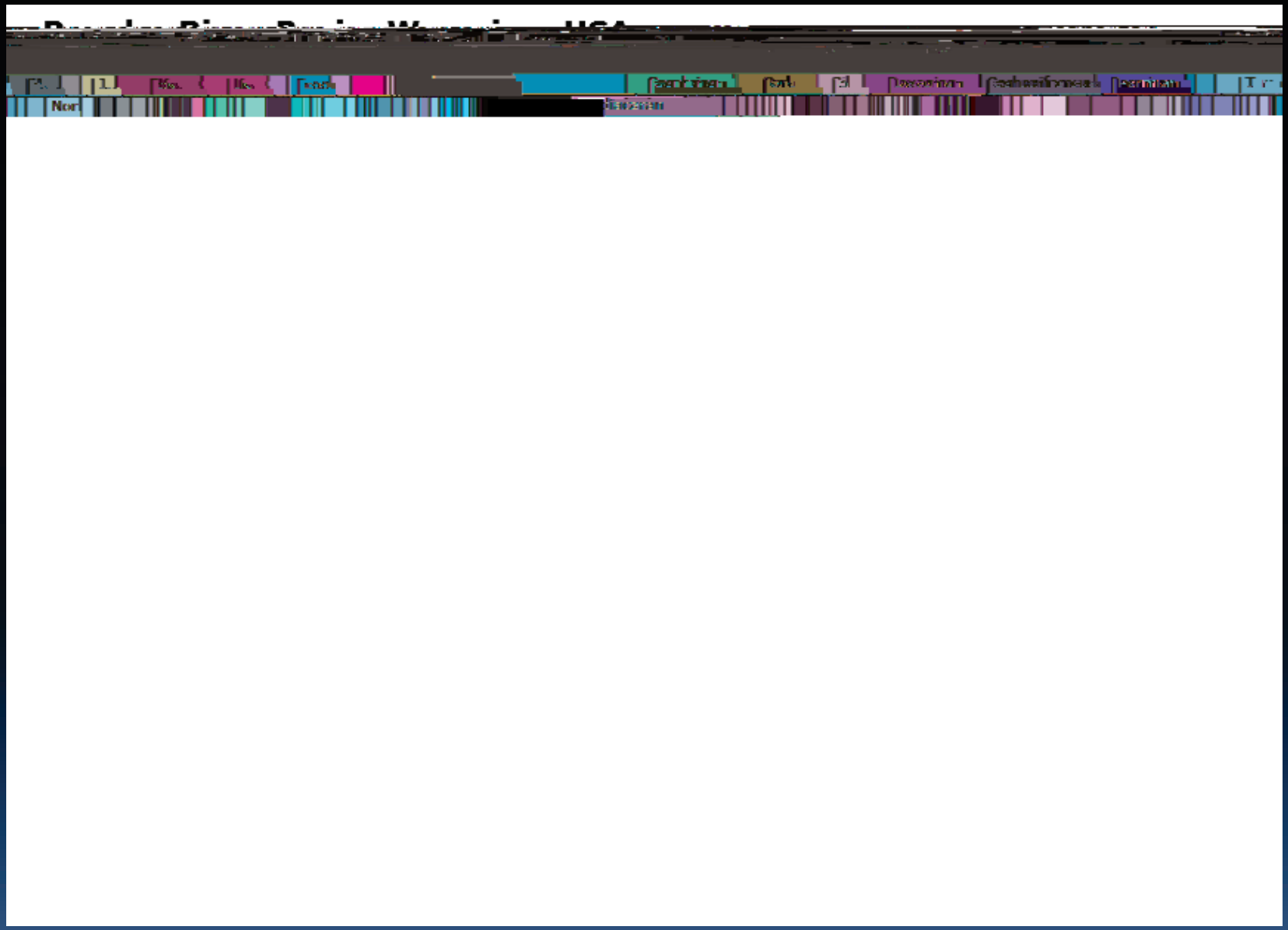
Paleolatitude

Paleoclimate

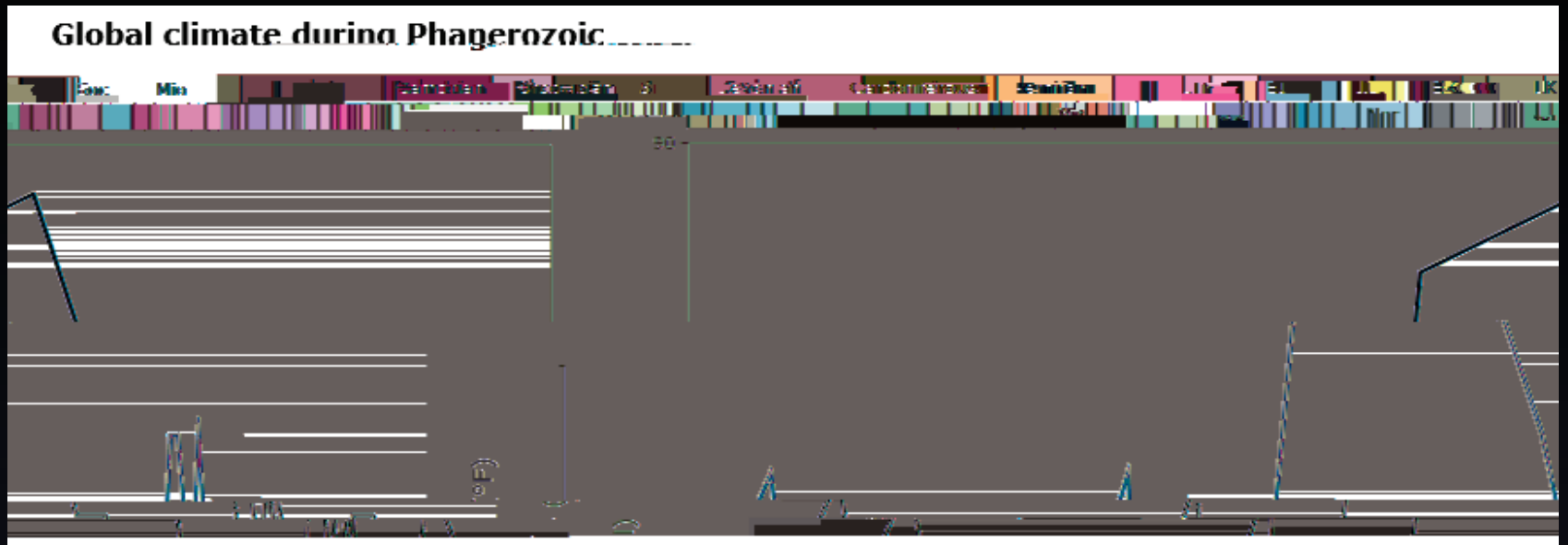
Paleoelevation

Paleobathymetry

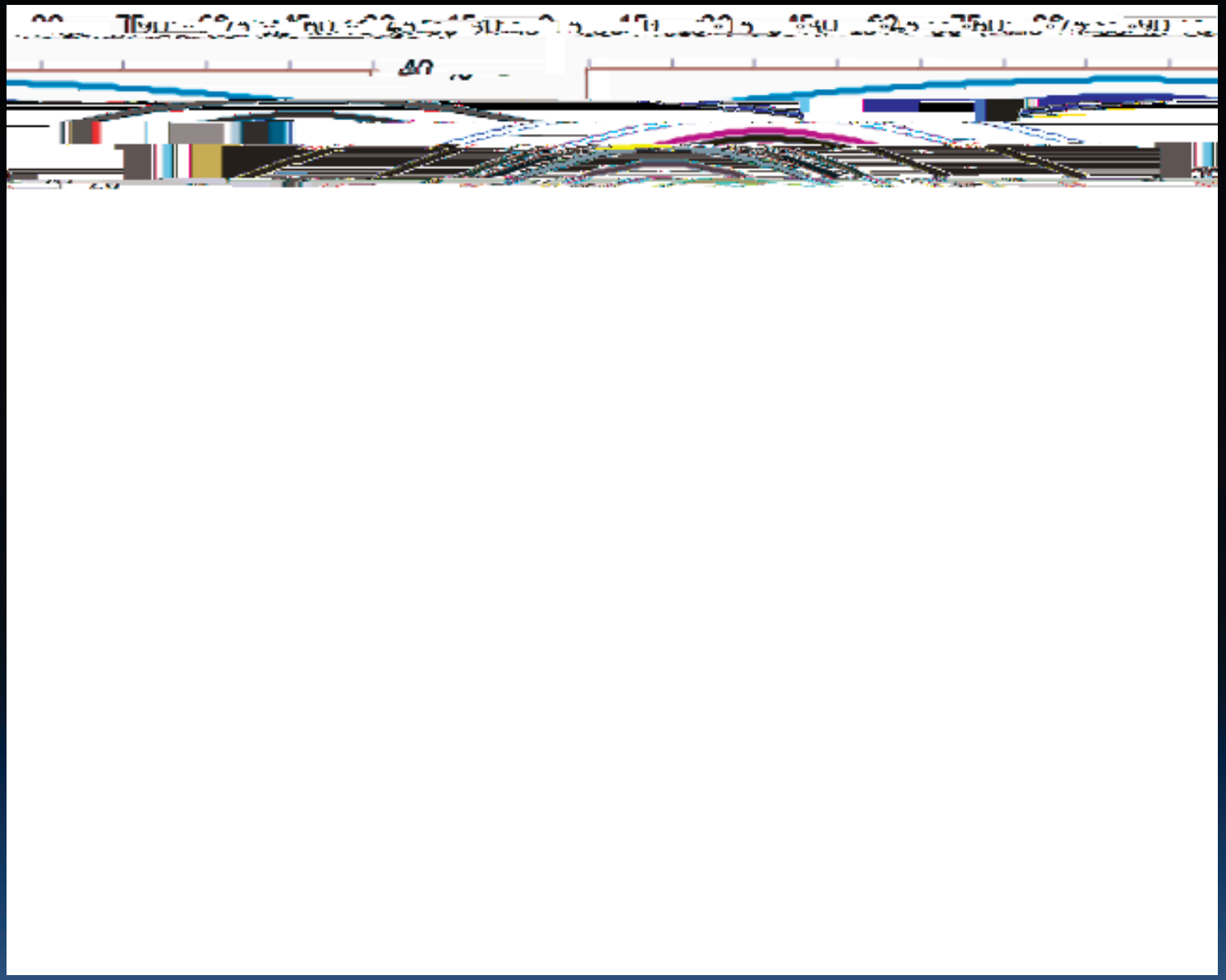
Paleolatitude



Paleoclimate



Latitudinal dependence of effects of paleoclimate



Paleoelevation

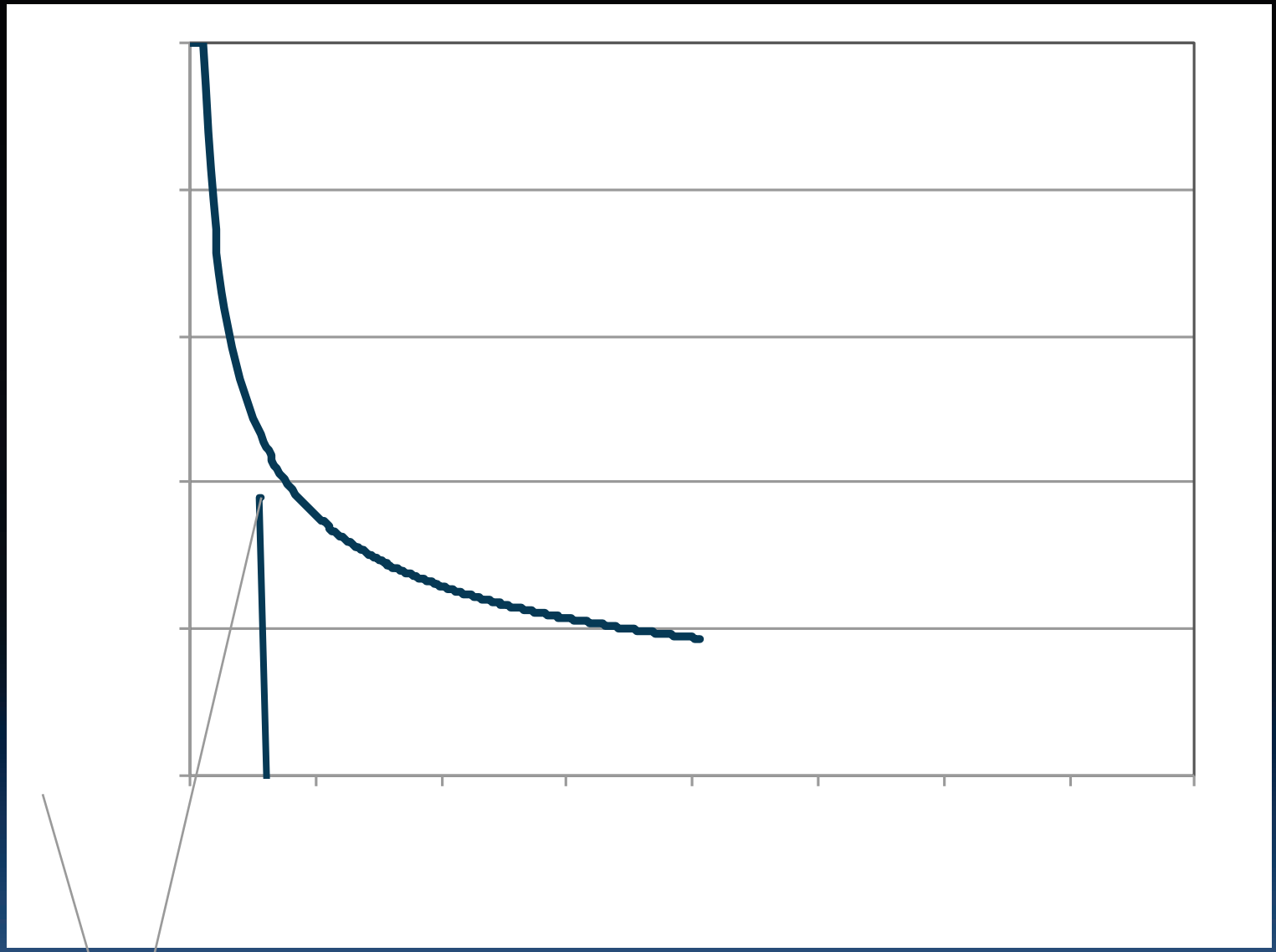
Adiabatic lapse rate assumed to be the same as today’s

Paleobathymetry

Based on Beardsmore/Cull algorithm using paleolatitude and paleobathymetry

Adjustment for climate change

Effect of paleoclimate on seafloor temperatures0

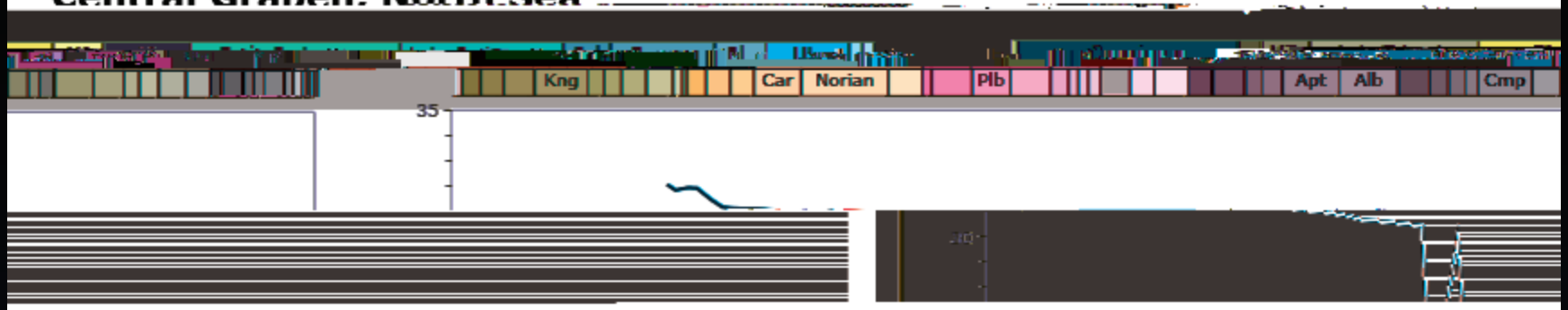


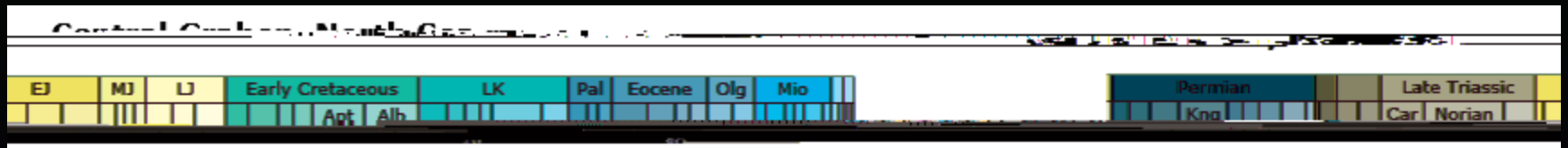
Powder River Basin

Powder River Basin

Powder River Basin

Central Graben, North Sea




EJ
MJ
LJ
Early Cretaceous
Apt
Alb
LK
Pal
Eocene
Olg
Mio
Permian
Kng
Late Triassic
Car
Norian

Central Graben, North Sea

Summary

“Surface” temperatures depend on many factors

Past, present

Concepts are simple but application is complex

Enabled by appropriate software

Of direct and indirect benefit