CWEMF 2023

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Vertical Hydraulic Gradients

Applications in Groundwater Modeling

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In collaboration with Graham Fogg and Helen Dahlke

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HYDROLOGIC SCIENCES GRADUATE GROUP

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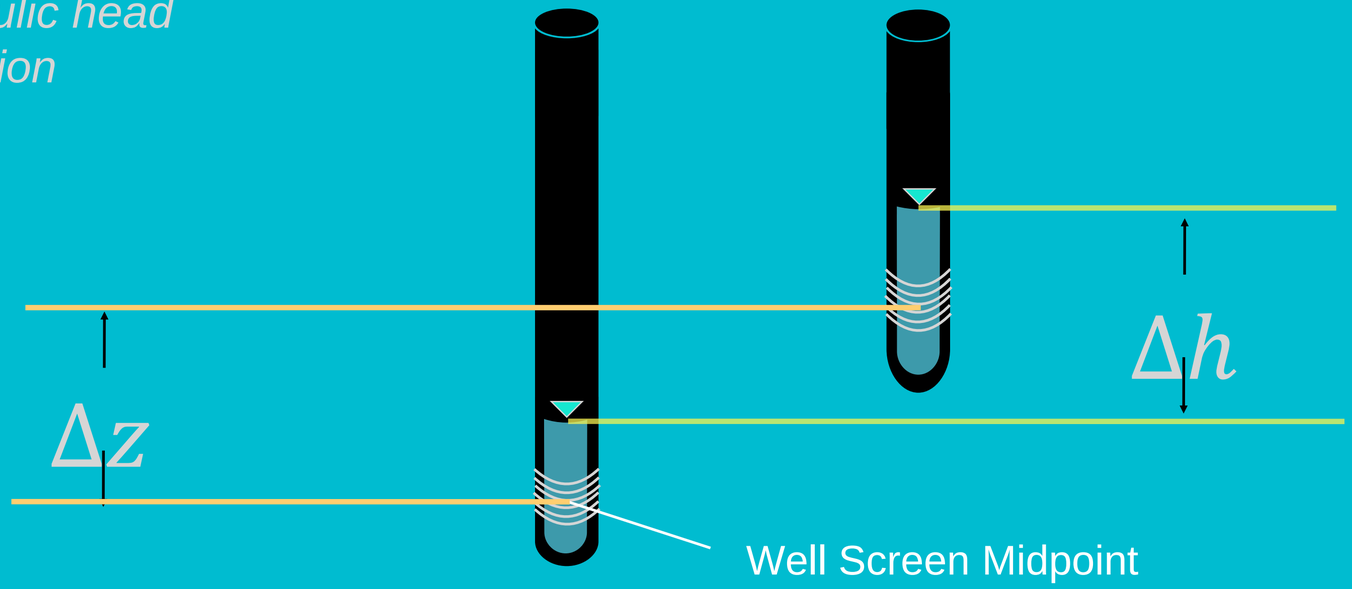
What are Vertical Head Gradients (VGs)?

$$VG = \frac{\Delta h}{\Delta z}$$

VG - vertical head gradient
h - hydraulic head
z - elevation



▽ = Water Level

Main Takeaway

Vertical hydraulic head gradients (VGs) can help identify highly-connected geologic features

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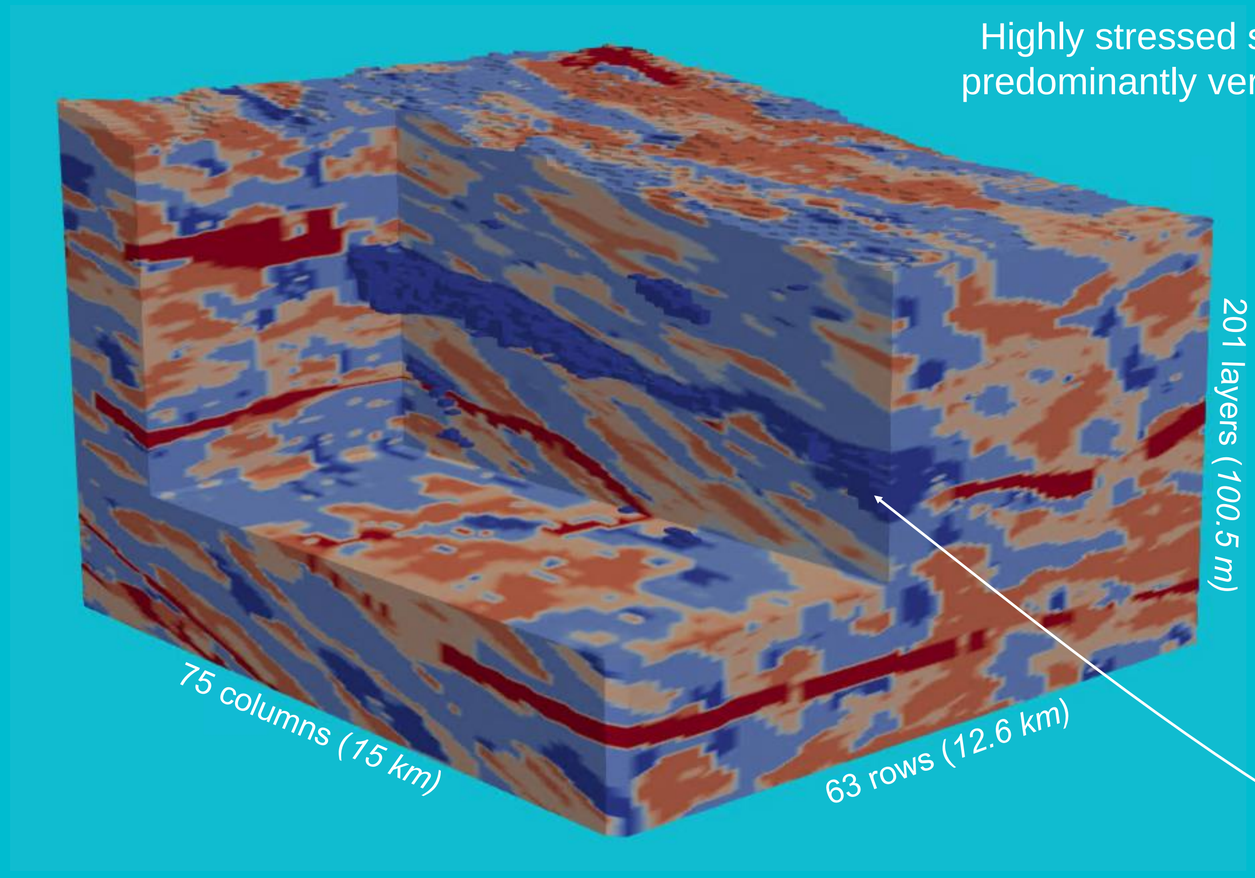
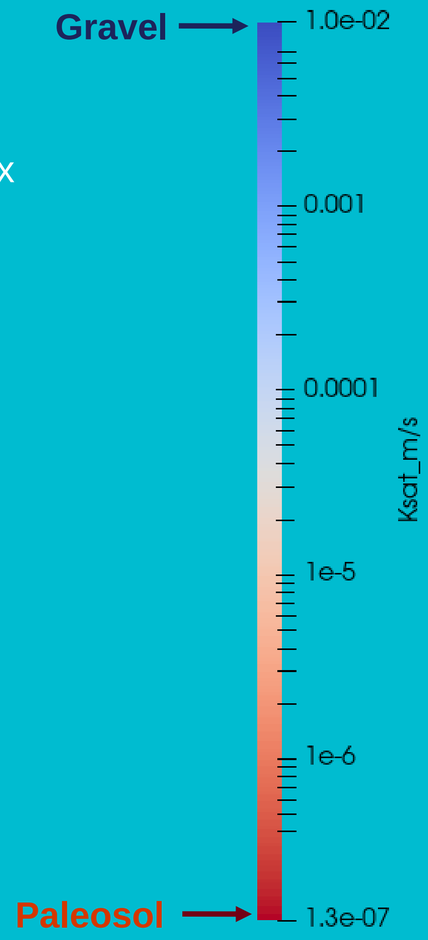
Incised valley fill deposit in California's Kings River Fan

Geostatistical facies model (Weissmann *et al.* 1999)

MODFLOW numerical groundwater flow model (Pauloo *et al.* 2021)

Highly stressed system: predominantly vertical flux

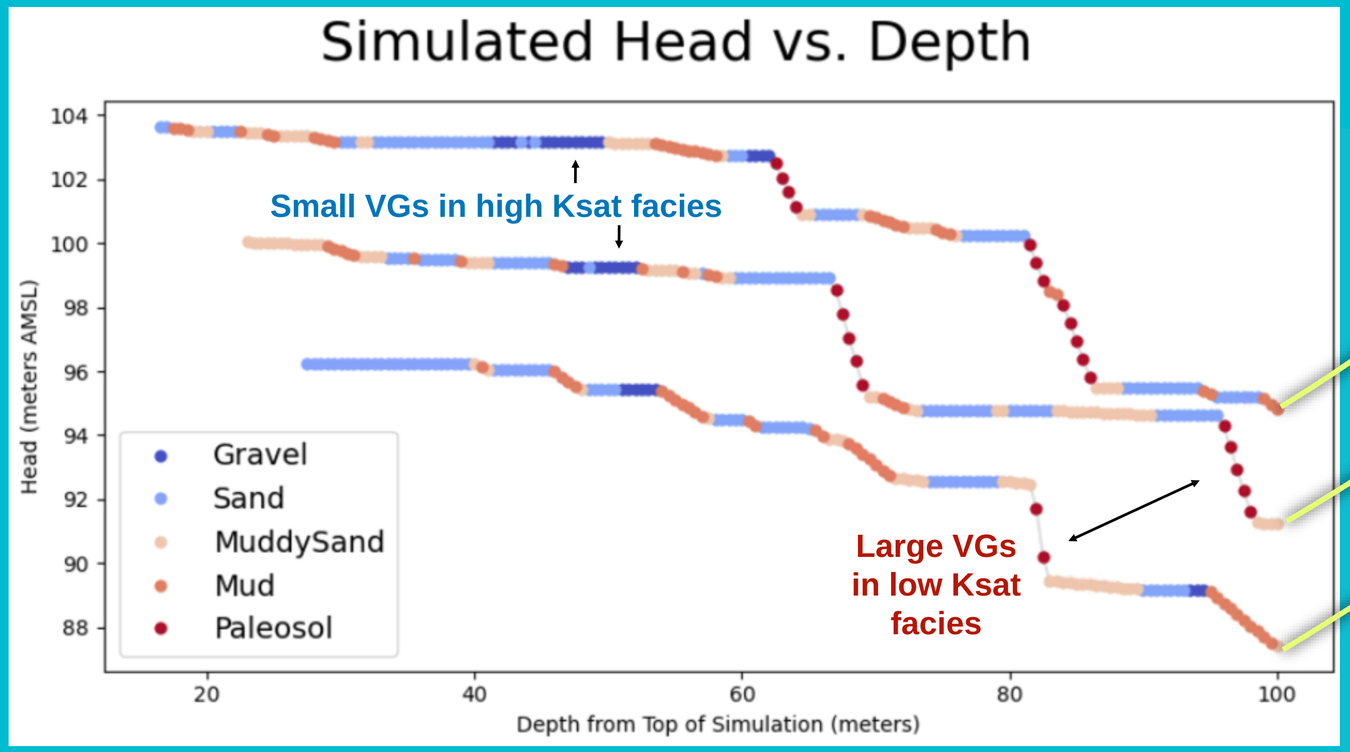


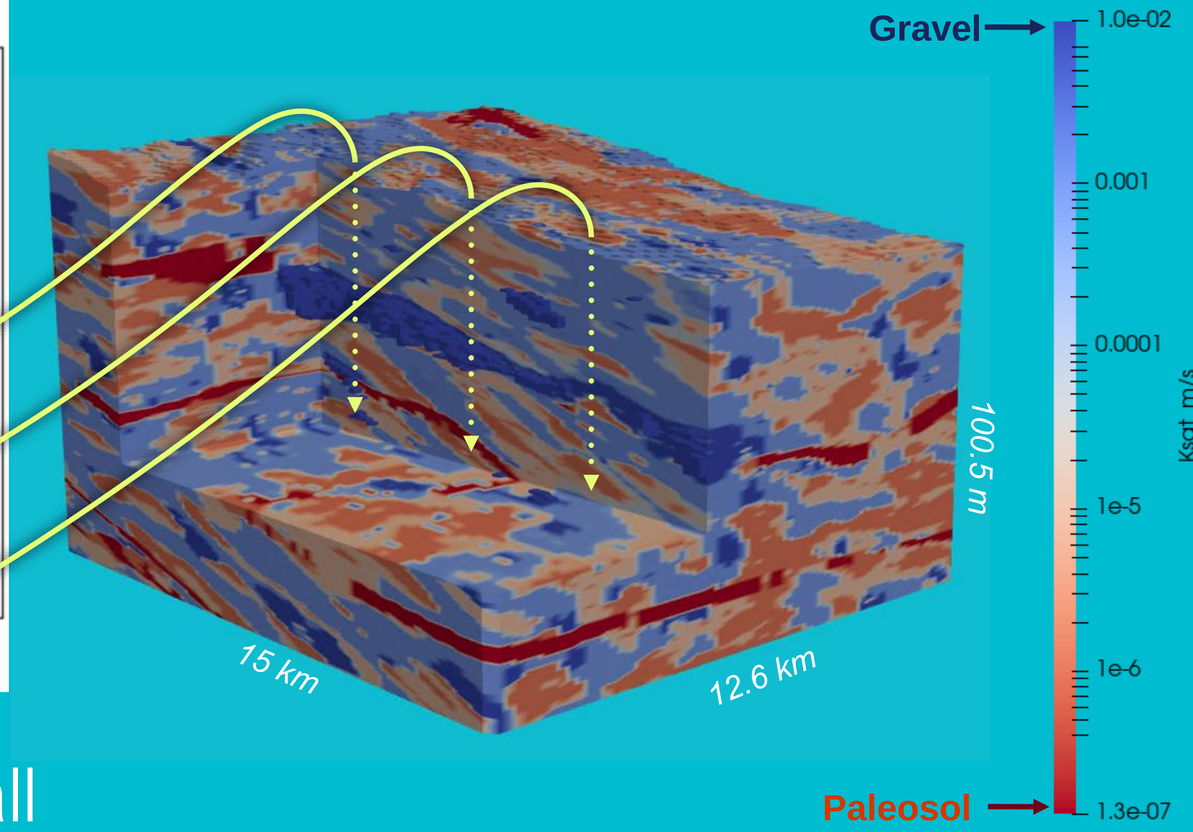


Well-connected coarse-grained channel between laterally extensive paleosol layers

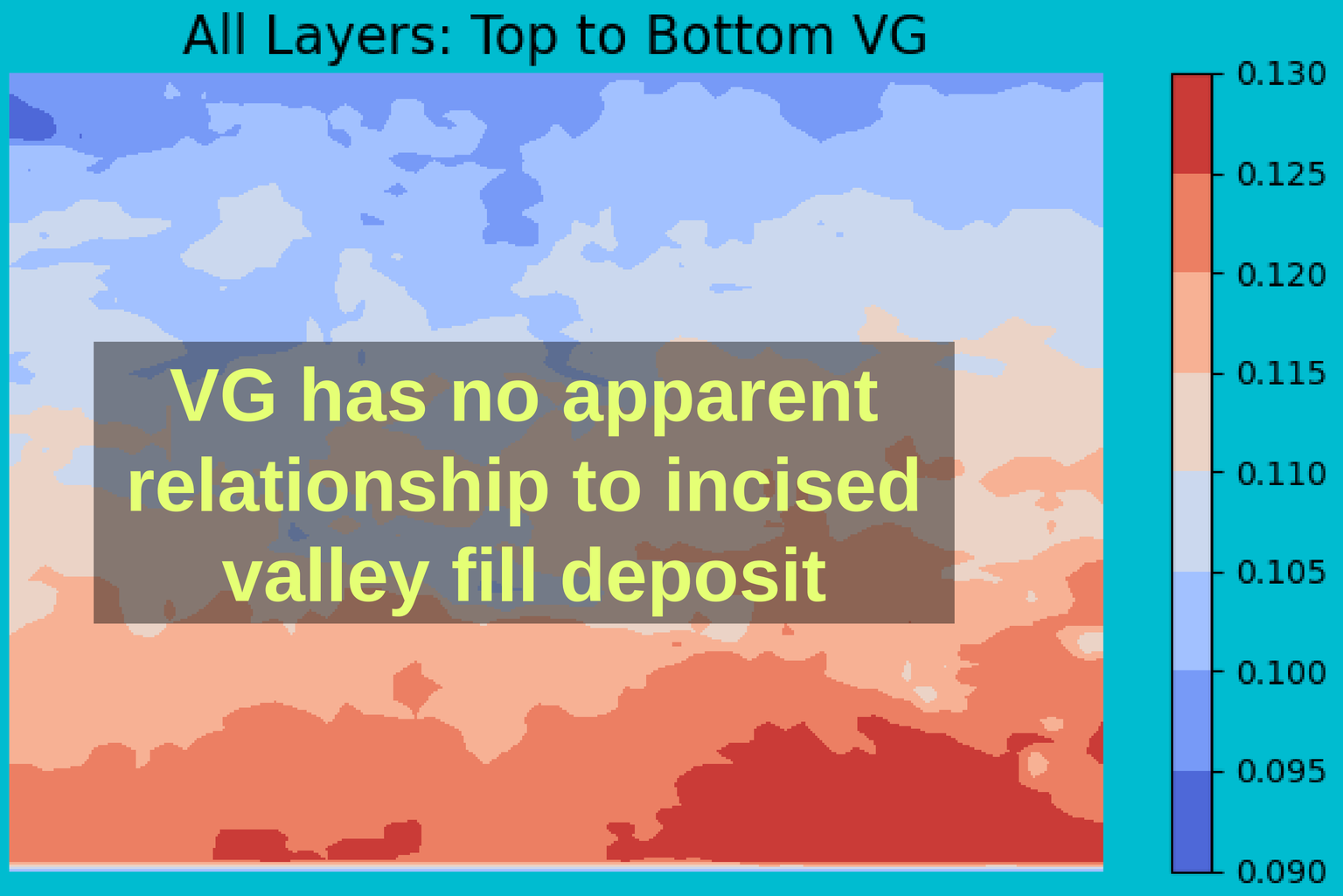
Vertical exaggeration: 100x

How does head change with depth?



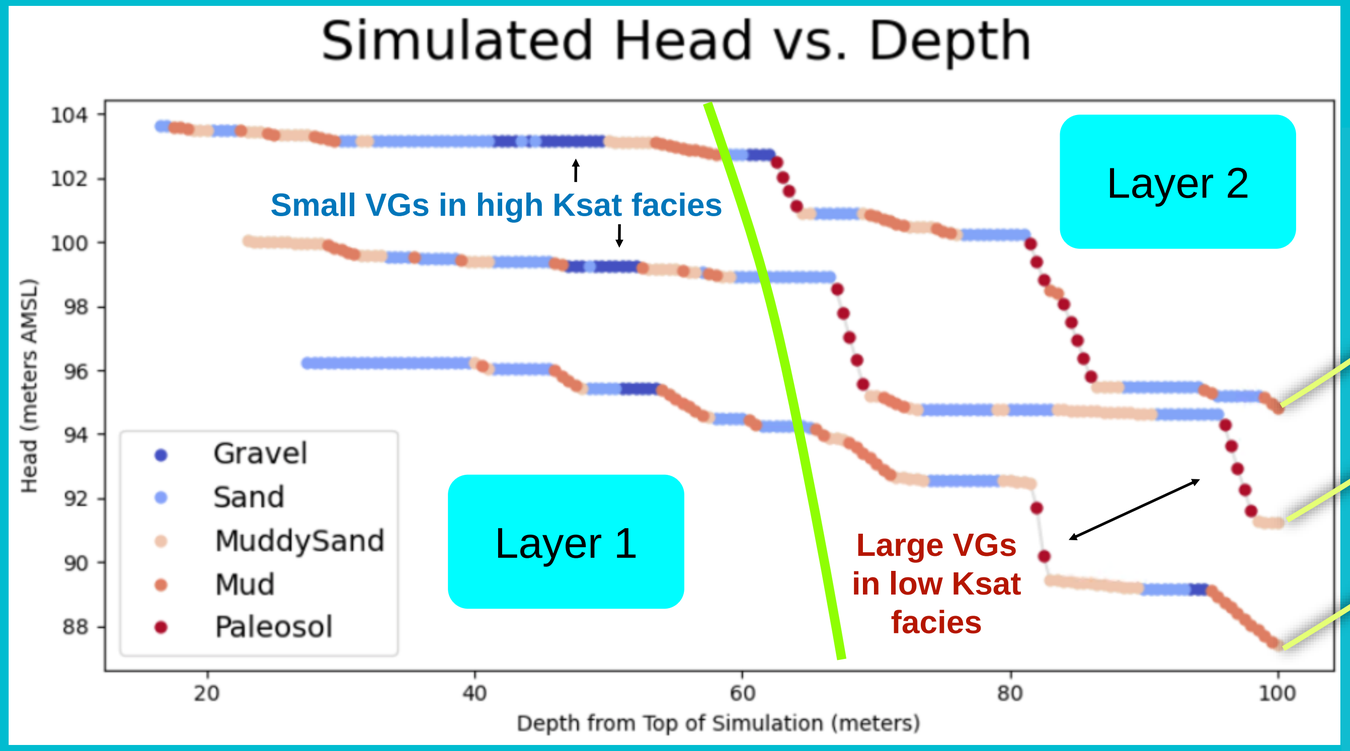


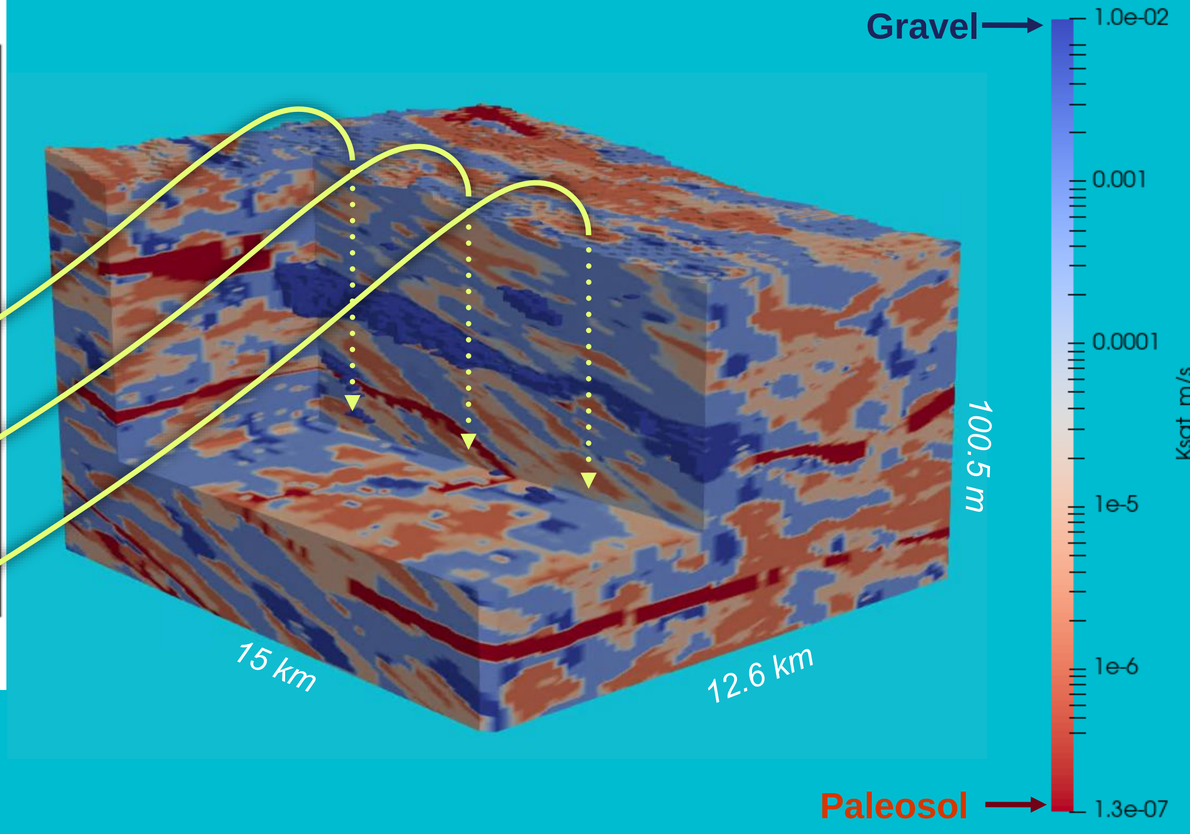
Does the relationship between small VGs and high Ksat scale up?



Simulated VG from water table to bottom of model domain

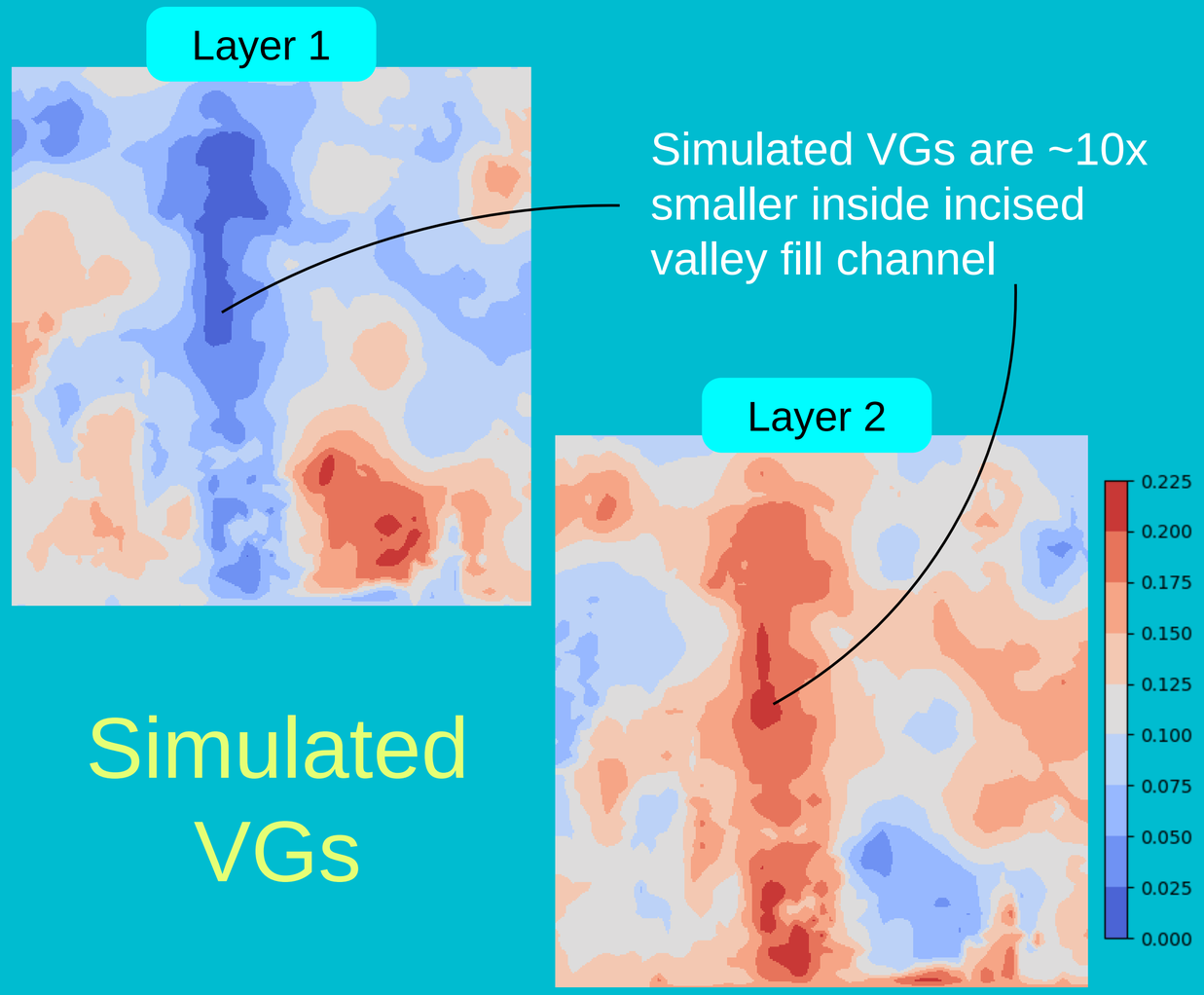
How does head change with depth?



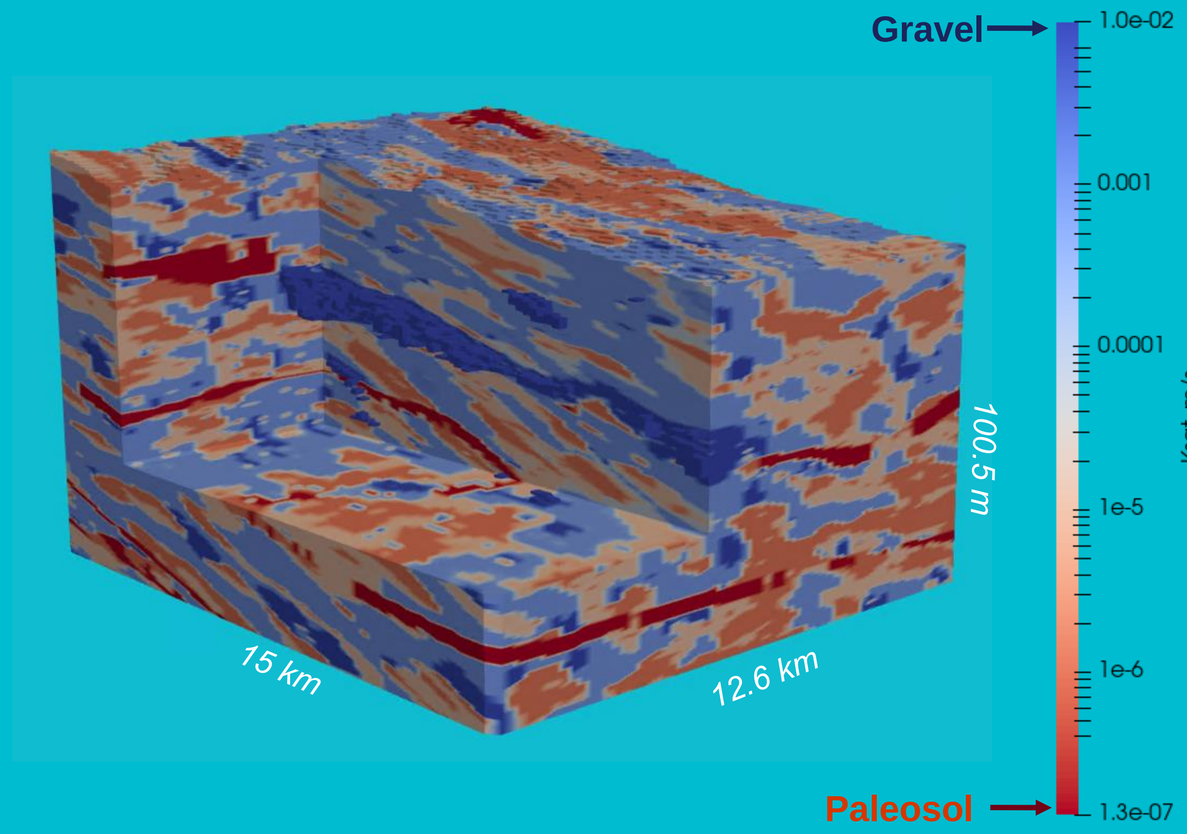


Upscale to 2 layers

Incised valley fill deposit in California's Kings River Fan



Simulated VGs



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Conclusion

VGs can help identify highly-connected geologic features

- Small VGs indicate good connectivity
- Relationship is scale-dependent

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Further Research

- Regional-scale changes in VGs
- VGs as calibration targets in Ksat parameterization

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Thank you for your time!

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