

Practices to enable the geophysical research spectrum: from fundamentals to applications

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Collaboration in geophysics: SimPEG

Why?

- Want consistency between geophysical applications
- Want to work interactively and collaboratively
- Moving to large scale, integrated inversions
- Few well documented open source choices

How?

- Everything in Python
- Provide documentation, test everything
- Make everything modular and extensible
- Provide an extensible framework and a toolbox

What?

- Interactive finite volume simulation
- Forward and inversion frameworks
- Building applications: DC, IP, EM, MT, Flow, Seismic

Things!

- Unit testing, continuous integrations
- Version control, documentation
- Community

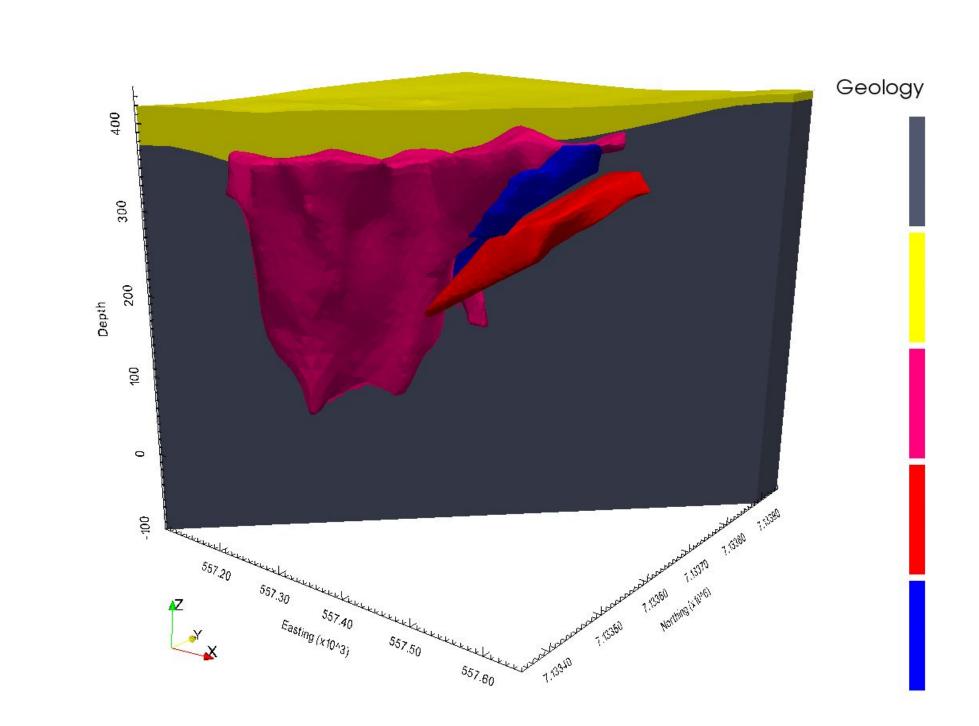




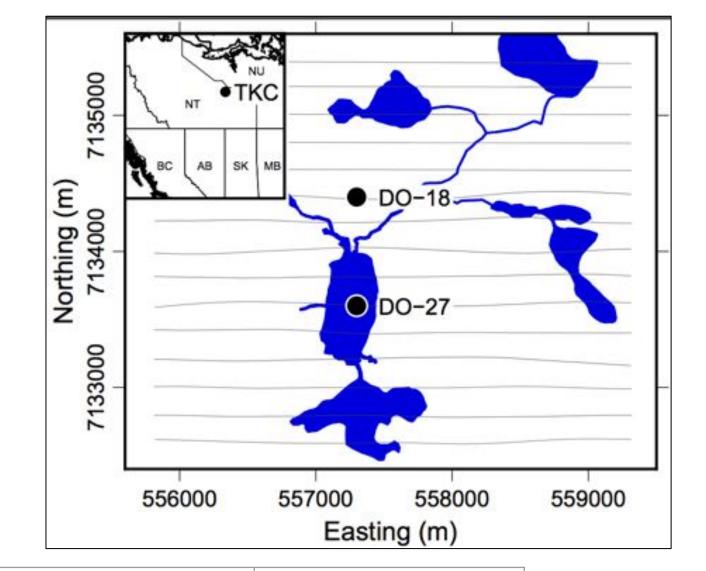


Synthetic Model

- Diamond bearing Kimberlite pipe
- Variable physical properties



 Synthetic model based on Tli Kwi Cho (TKC) complex in Northern Canada



UTM Northing (m)

	Conductivity	Susceptibility	Density	Velocity
Host	V. Low	Low	V. Low	Mod
Till	Mod	High	Mod	L. Mod
PK	High	Low	Low	L. Mod
HK	Mod	None	Low	V. Low
VK	Mod	None	High	High

Fundamentals: Physics

• Electrostatic Maxwell's equations:

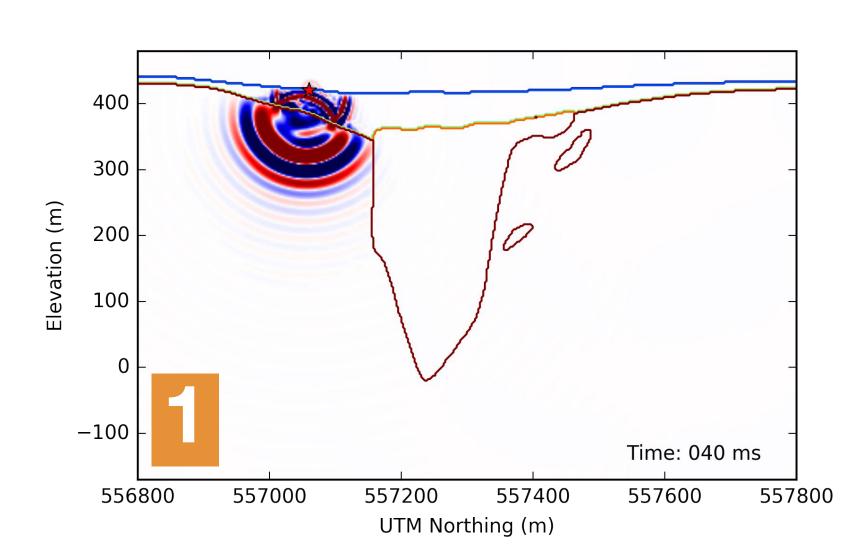
$$ec{j} = \sigma \vec{e}$$
 $ec{e} = -\nabla \phi$
 $\nabla \cdot \vec{j} = -\vec{j}_s$

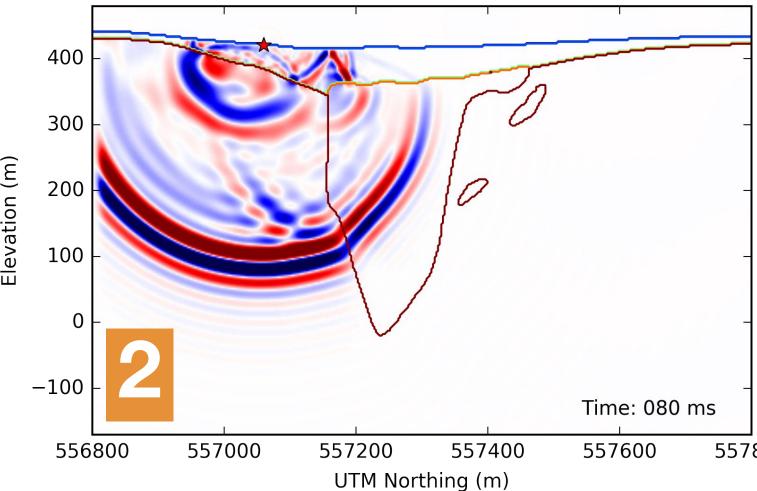
 \vec{i} : Current density (A/m²) \vec{e} : Electric field (V/m)

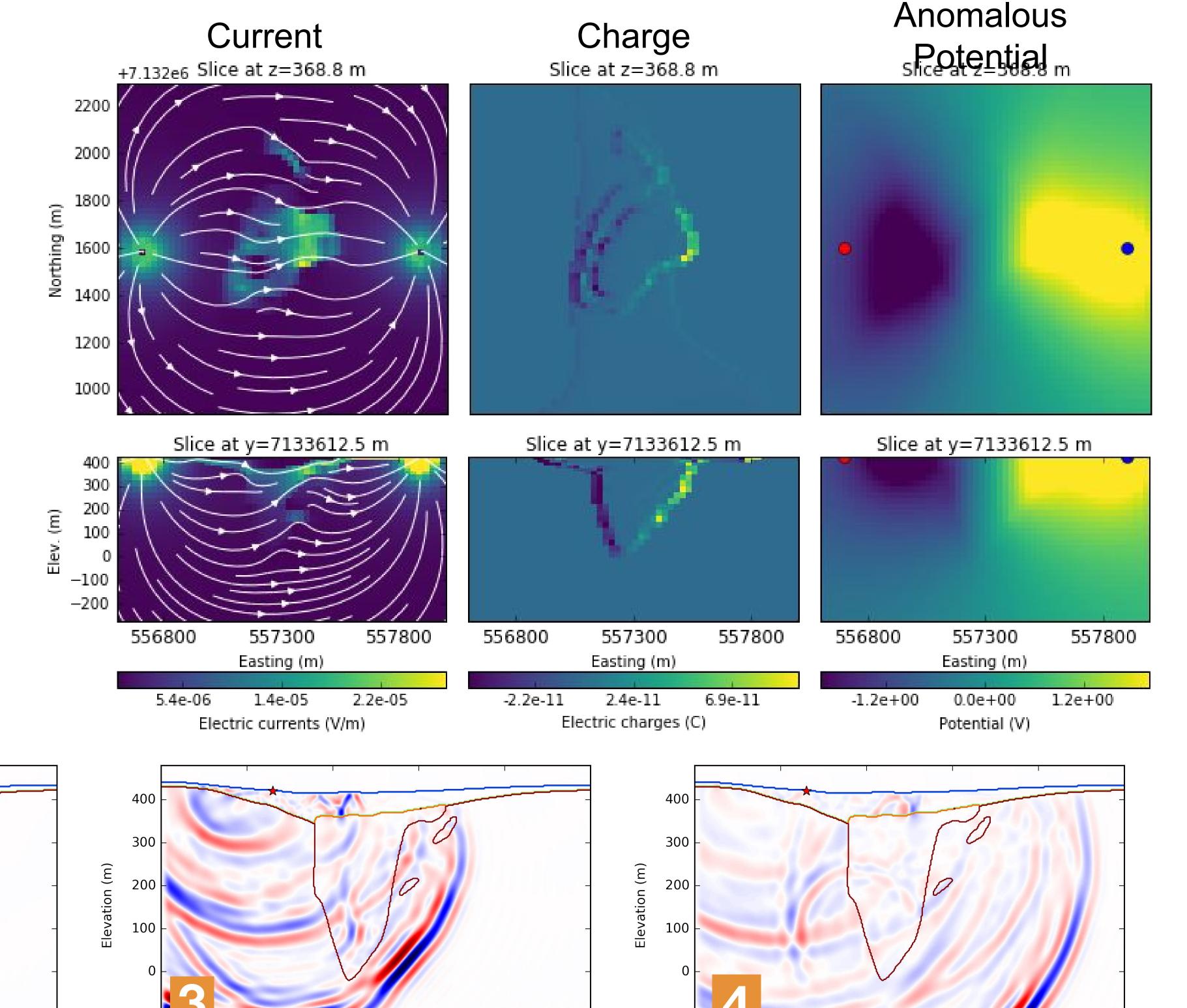
 \tilde{i}_s : current source (A/m²) σ : Conductivity (S/m)

Acoustic wave equation:

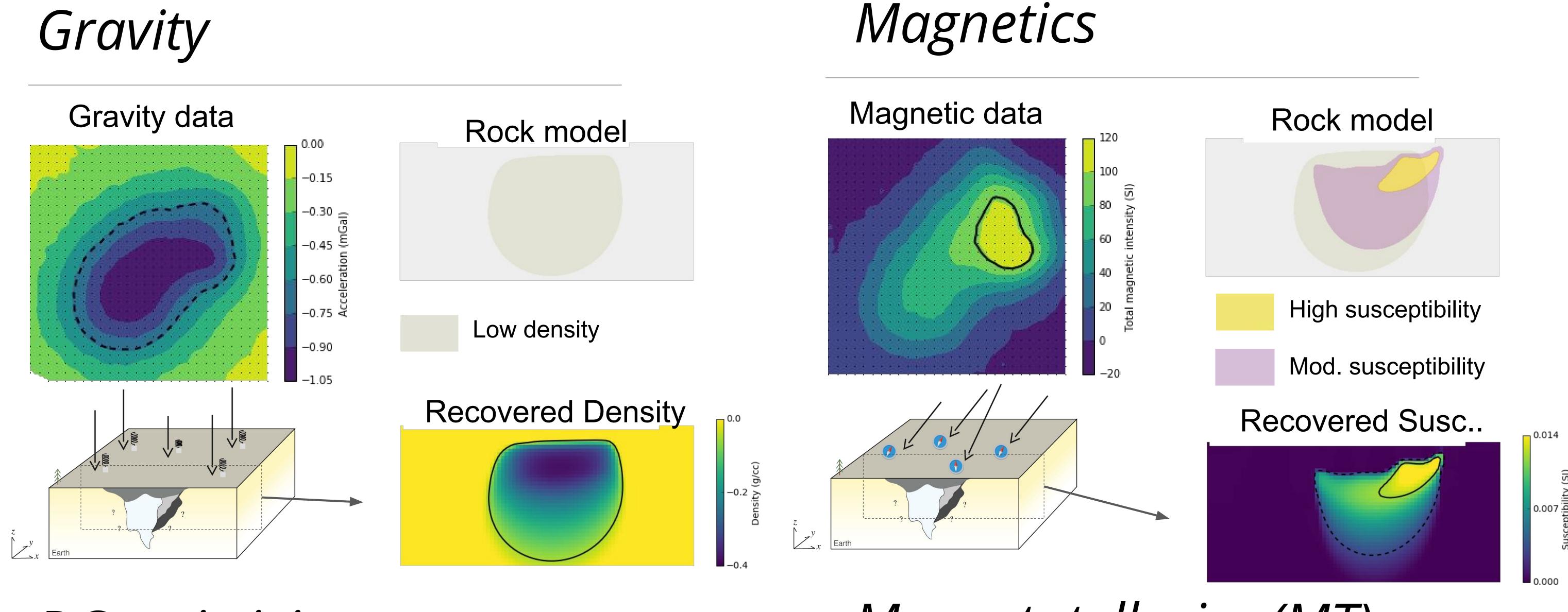
$$\left(\nabla \cdot \frac{1}{\rho} \nabla + \frac{\omega^2}{c^2 \rho}\right) \mathbf{u} = -\mathbf{s}$$



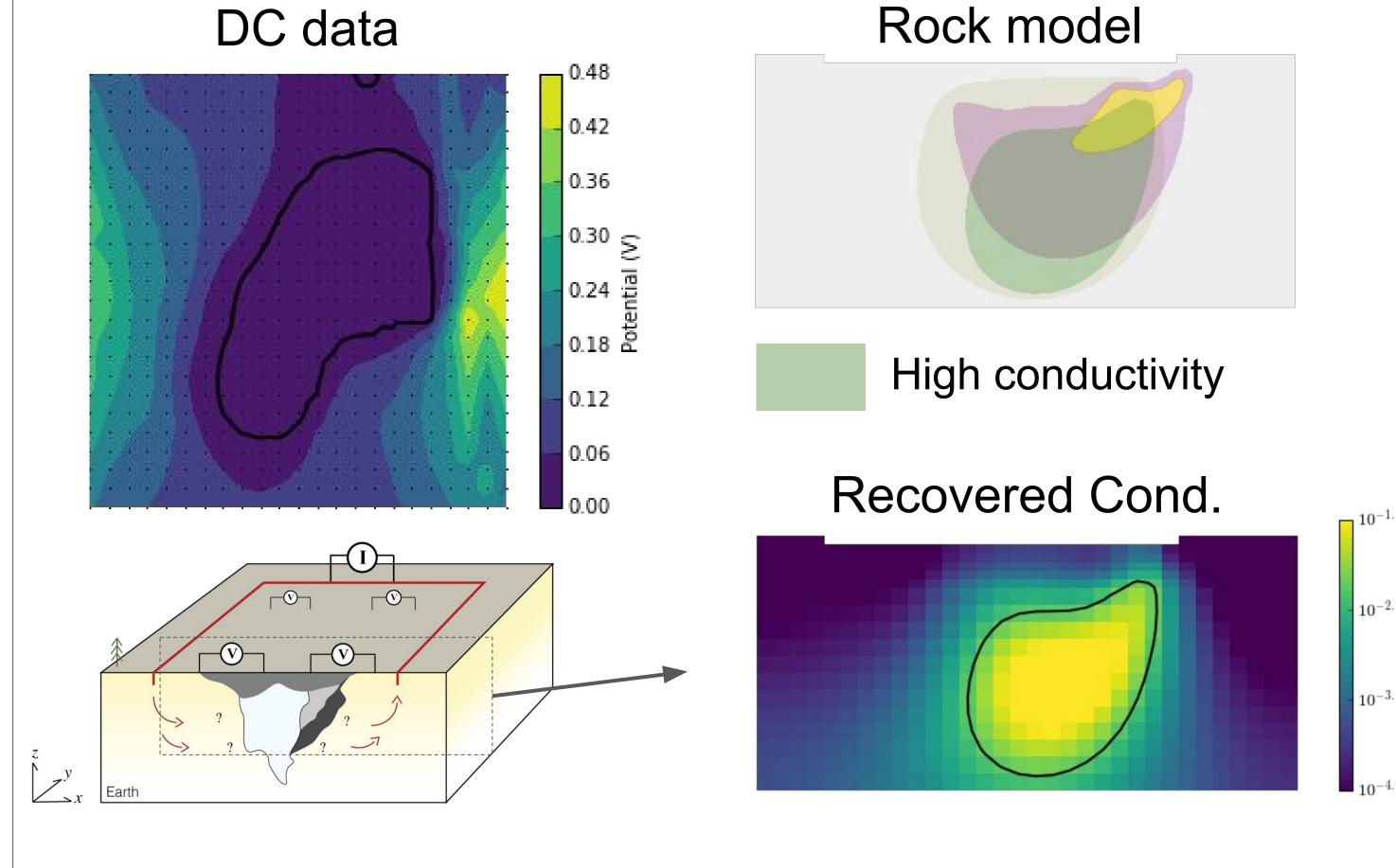




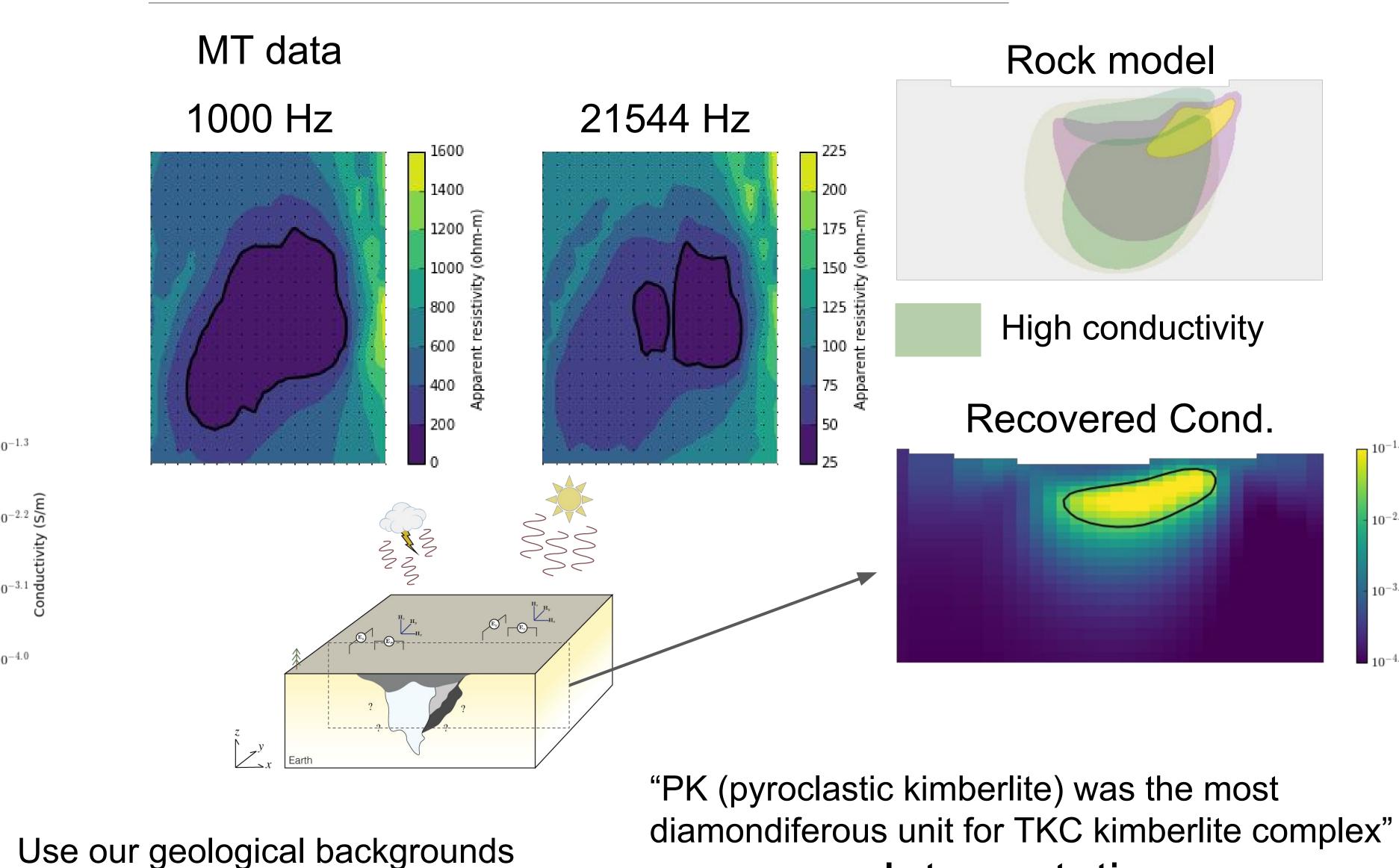
Multiple geophysical methods



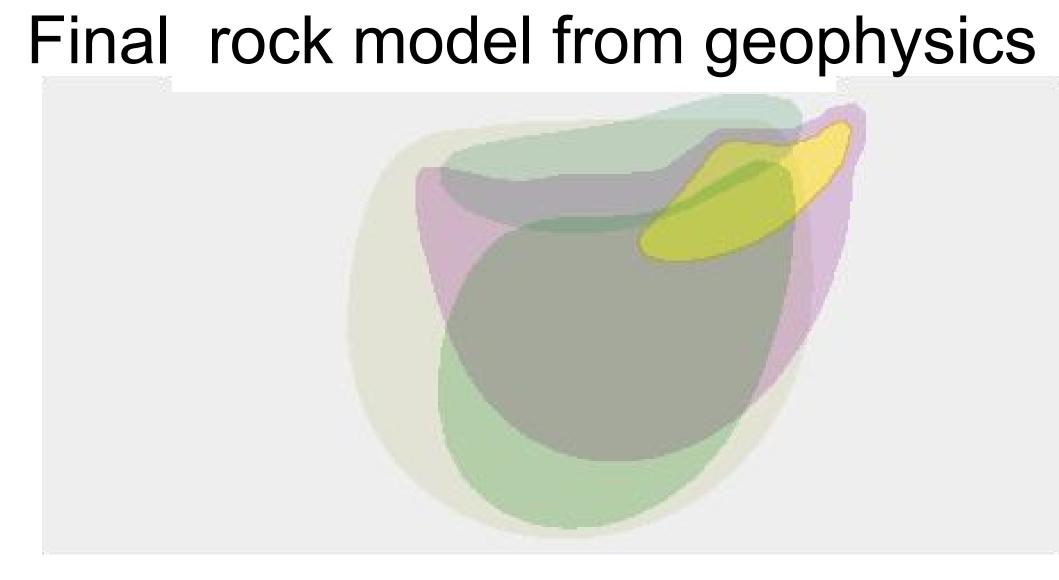
DC resistivity

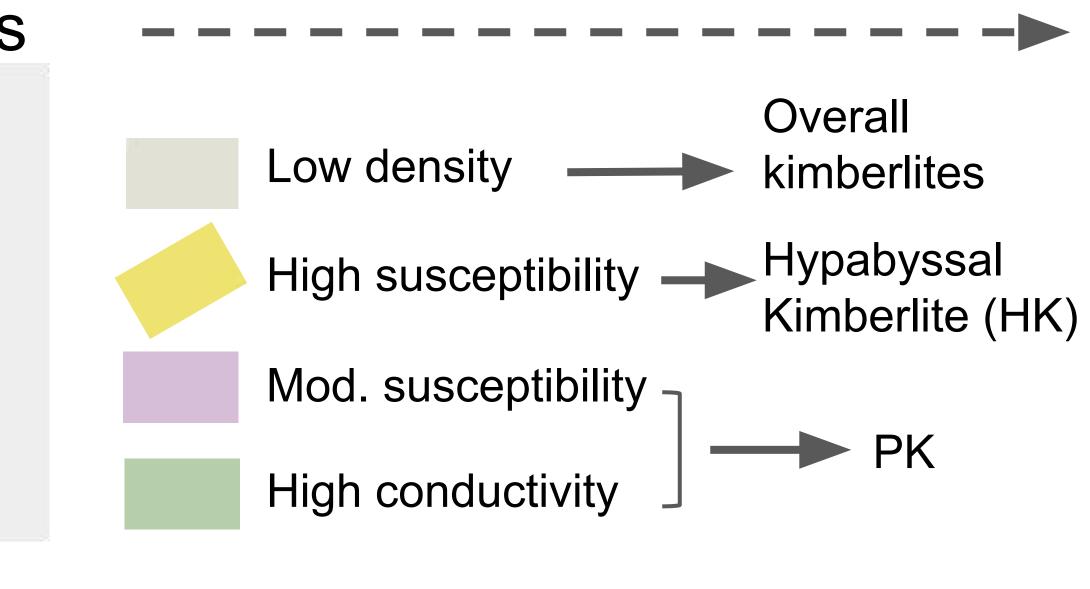


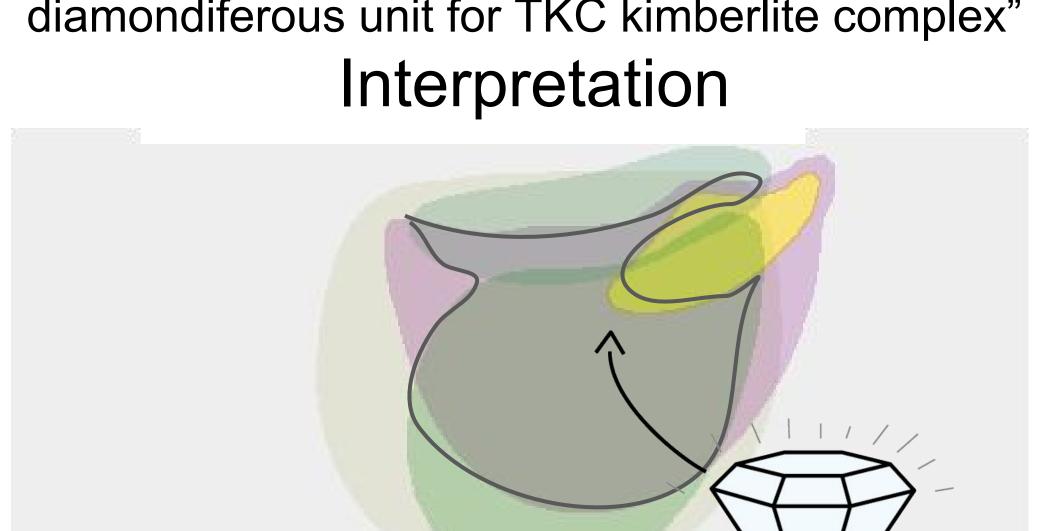
Magnetotellurics (MT)



Interpretation







Summary

Identify and build robust, modular pieces Define a consistent, extensible framework Work with people from other disciplines

