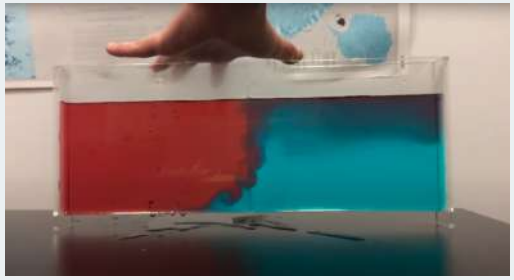
Navigate

Turn and Talk

We figured out that the temperature of solid rock in the Earth's mantle is *heterogeneous,* and the rock can flow like a liquid.

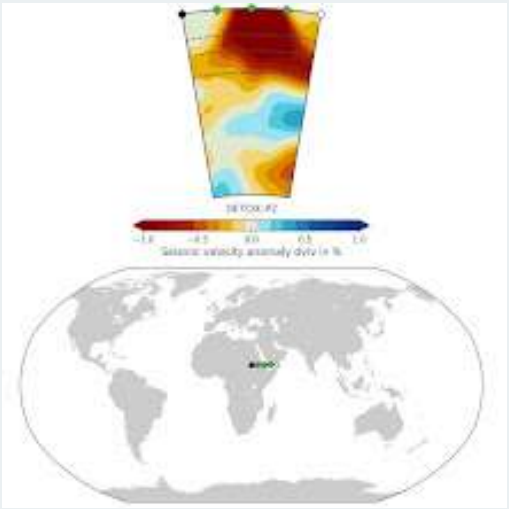


UCAR

What do we know about **how flowing matter of different temperatures interacts** that could explain how the mantle might change over time?

Navigate

With your class



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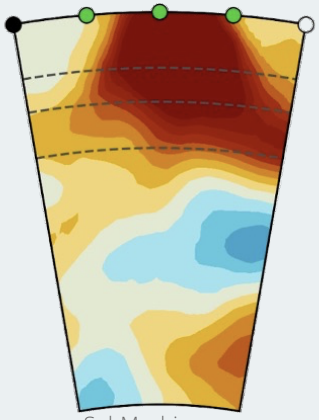
- When flowing matter is heated, what changes at the particle level?
- How do these changes at the particle level affect what we observe about matter at the macro scale?
- How might this affect how matter flows in Earth's mantle?

Develop Predictive Models

Last time, we looked at tomography data to get an idea of how what is happening in the mantle affects the surface.



On your own

Use your knowledge about the particle nature of matter at different temperatures to create a model for why the anomalies in the mantle move under the Afar region.

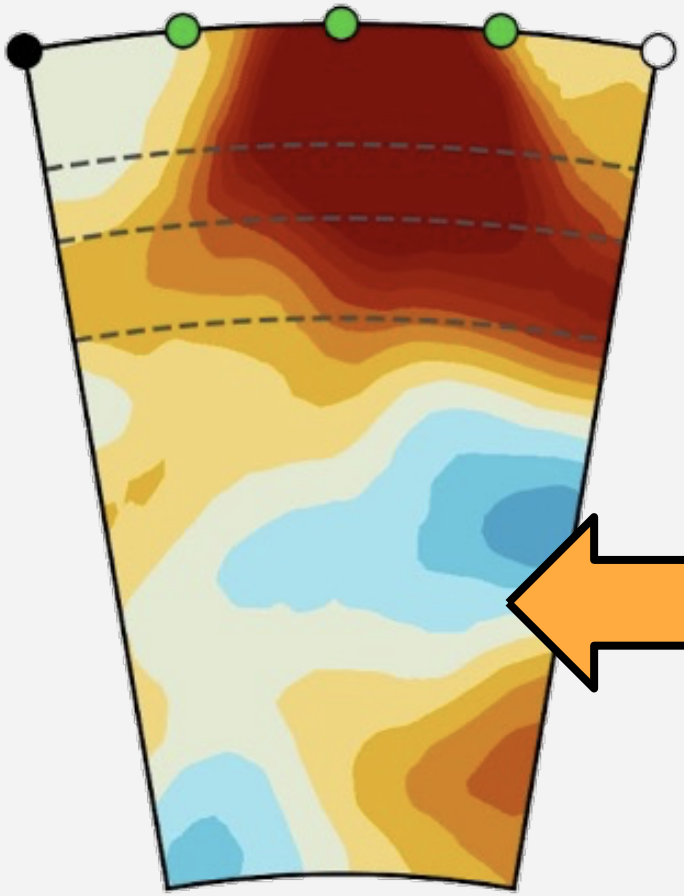
➔ Be ready to share your ideas with the class.

Test Predictions with Large Timescales

With your class

What have we done in the past to increase or decrease the speed at which a phenomenon occurs?

Mantle Investigation



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Mantle Investigation

Turn and Talk

What purpose might each element of this model serve, and how can we use it to test our models?

Elements of the mantle tank:

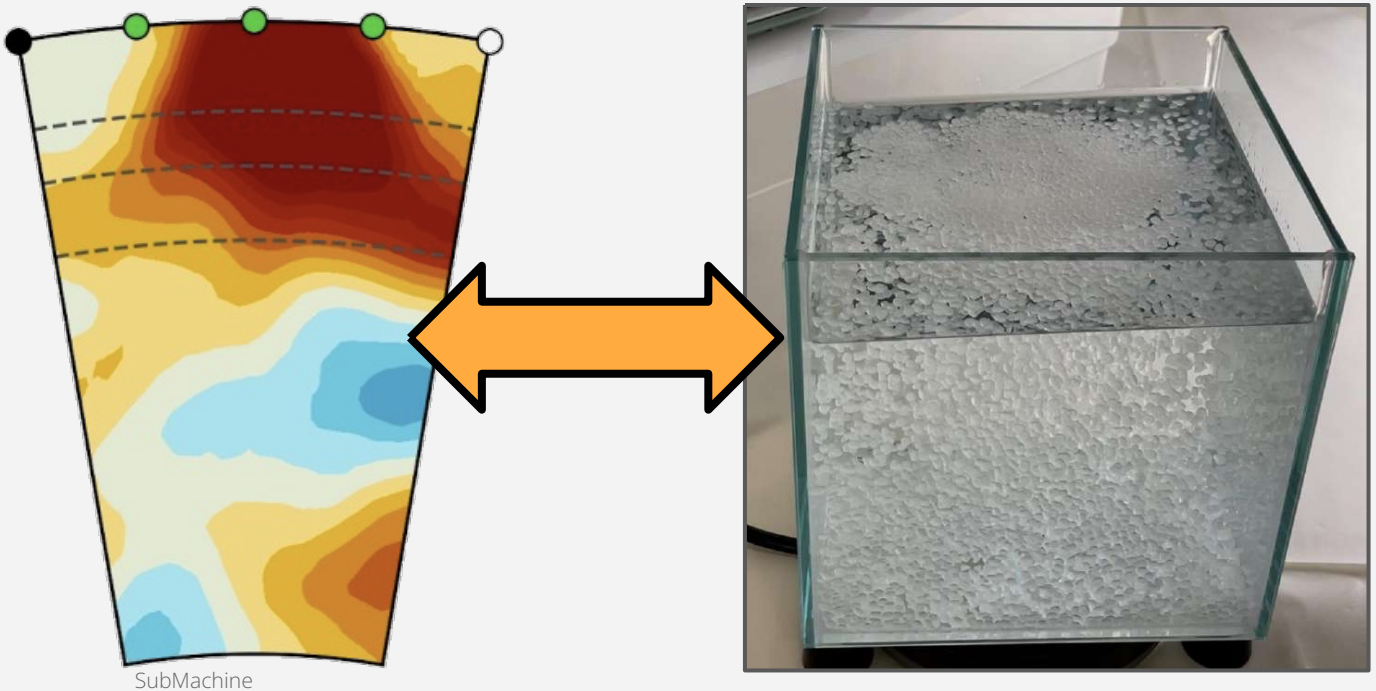
- 1-gallon clear tank
- liquid solution of water and rubbing alcohol
- plastic pellets with the same density as the liquid
- can be heated

➔ Be ready to share your ideas with the class.

Mantle Investigation

With your class

What advantages and limitations does this model have for testing our models?



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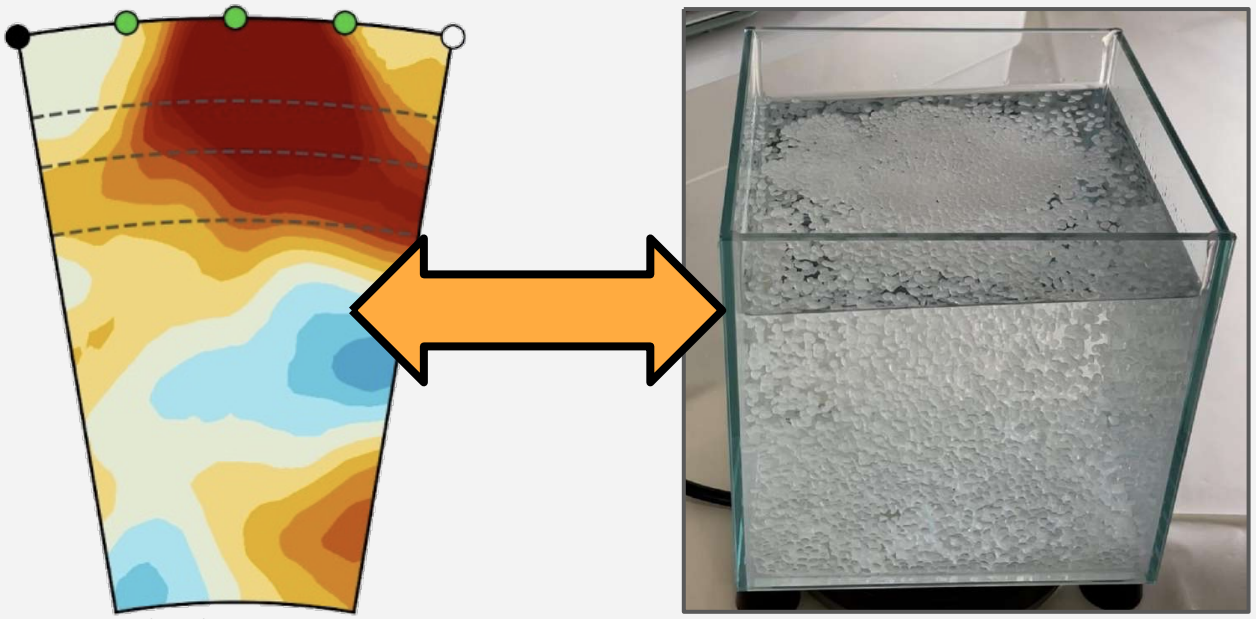
Mantle Investigation

With your class

How can this mantle tank be used to test the reliability of our drawn models of the mantle under Afar?



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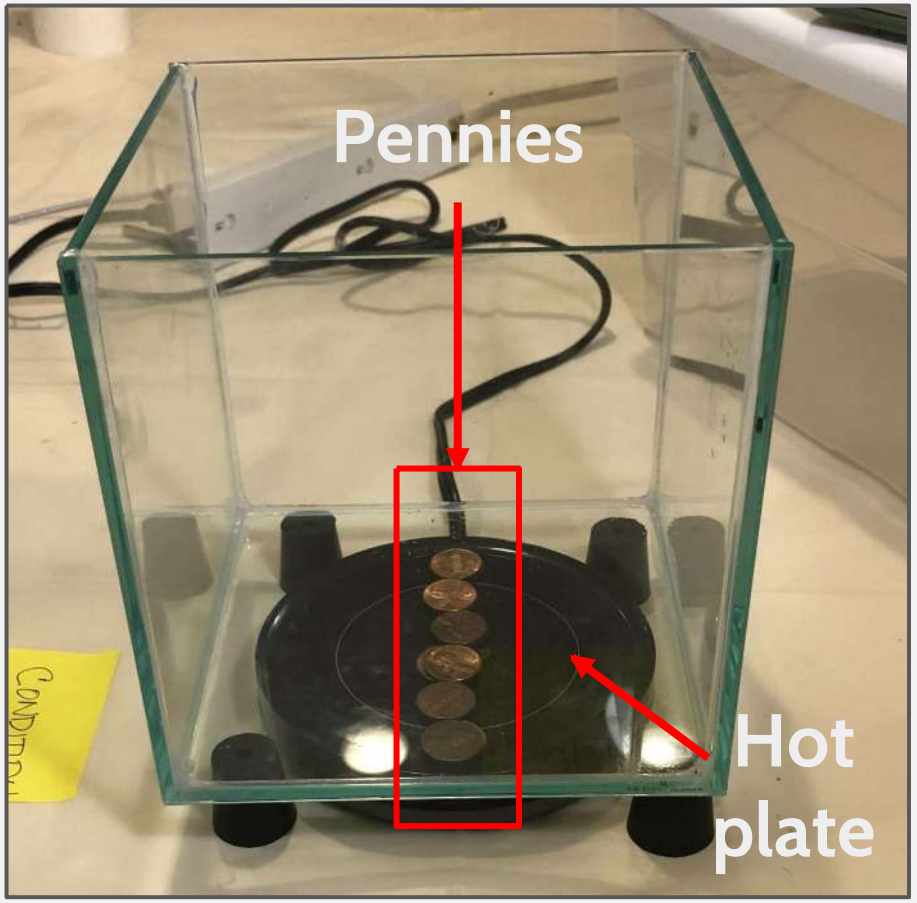
Mantle Tank

With your class

The stacks of pennies transfer heat from the hot plate to the tank.

Why do the pennies only make contact with the middle of the tank?



Mantle Video Analysis

On your own

We will watch the video together, pausing it at specific points to share our observations and ideas. Take notes on your model handout about:

- what you notice
- new ideas and/or questions that the video elicits

➔ Be ready to share your ideas with the class.

Develop a Model

On your own

Use the evidence from the mantle tank video to create a model to describe and explain why the matter in the tank is moving in the way we observed.

Choose at least 1 of the following perspectives to develop in your model:

- matter (particle-level interactions)
- energy
- forces

➔ Be ready to share your ideas with the class.

Compare Models: Same Perspective

With a partner

Look for a person who used **the same perspective** that you did to explain the motion of matter in the mantle tank. Each person will have 1 minute to explain their model. After each partner has shared, look for:

- similarities between models
- differences between models
- areas of uncertainty
- areas of disagreement

Compare Models: Different Perspectives

With a partner

Look for a person who used **a different perspective** to explain the motion of matter in the mantle tank. Each person will have 1 minute to explain their model. After each partner has shared, look for:

- how both models combined help to explain the movement of matter
- areas of uncertainty
- areas of disagreement

Reflect on Our Community Agreements

Scientists Circle

Which of our Community Agreements will help us as we work together to develop a consensus model?

Develop a Model Using an M-E-F Perspective

Scientists Circle

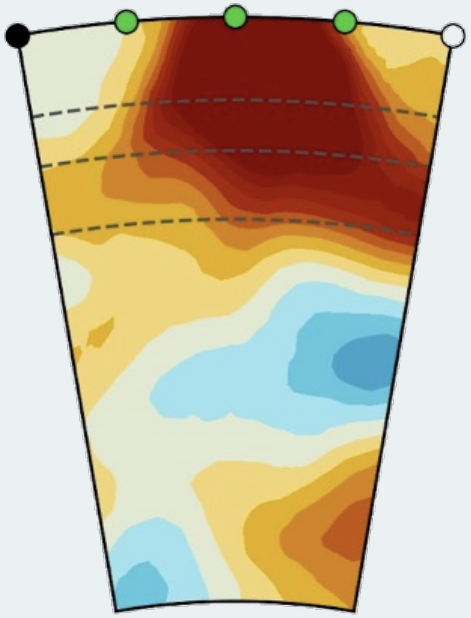
Develop a consensus model to explain the motion in the mantle tank from energy, matter, and forces perspectives.

- What did we observe in the mantle tank?
- What do these observations tell us about matter, energy, or forces?
- How are things different in different parts of the tank?

Compare with Afar

With your class

What are the differences between what we saw in the mantle tank and the Afar tomography data?



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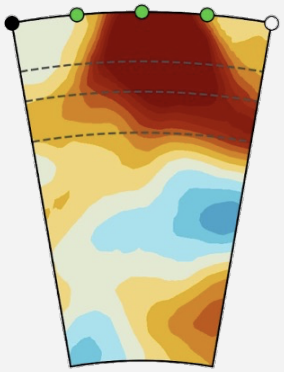
Compare Convection Models

With your class

- What similarities do we see between the lava lamp video and the mantle tank video?
- What differences do we see?
- How might these differences help explain the different mantle parcels we see in our tomography data?



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Test/Revise Our Afar Mantle Models

On your own

- Using our consensus model for the mantle tank, revise your model of the mantle movement under Afar on your handout.
- Make note of any lingering questions or uncertainties.

➔ Be ready to share your ideas with the class.

Update Our Driving Question Board

With your class

Revisit the Driving Question Board:

- Can we answer any new questions?
- What new questions do we want to add to the Driving Question Board?

Update Progress Tracker

On your own

Update your Progress Tracker in your science notebook.

Lesson #	What did you figure out?	Which of these lenses did you use to figure this out?	How did using these lenses help you figure this out?
6		❑ Stability over time ❑ Change over time ❑ Thinking at/across different scales	

Additional Image Credits

Submachine images were created using the following data and platforms:

Kasra Hosseini, Karin Sigloch, Maria Tsekhmistrenko, Afsaneh Zaheri, Tarje Nissen-Meyer, Heiner Igel, Global mantle structure from multifrequency tomography using P, PP and P-diffracted waves, Geophysical Journal International, Volume 220, Issue 1, January 2020, Pages 96–141, https://doi.org/10.1093/gji/ggz394

Hosseini, K. , Matthews, K. J., Sigloch, K. , Shephard, G. E., Domeier, M. and Tsekhmistrenko, M. (2018), SubMachine: Web-Based tools for exploring seismic tomography and other models of Earth's deep interior. Geochemistry, Geophysics, Geosystems, 19. doi:10.1029/2018GC007431

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