Evidence & Explanations

Guiding Question:

How can we use science to encourage students' wonder and curiosity in nature?

Inquiry Fever Quotes

"After we did my first NSI, I couldn't get my hiking group off the playing field to start our hike for a long time, because they were so excited about stuff they kept finding to investigate."

- Field Instructor after leading first NSI

"I've never seen anything like this before. I didn't know you could do this with kids!"

- Field Instructor observing Inquiry Fever

Dialogue from girls engaged in inquiry fever after NSI

Student 1: Man, I feel like a scientist today.

Student 2: I know, I've never done this before.

Student 1: Yeah, I've been to the woods before, but not discovering and stuff like this.

Student 2: It's really cool.

Student 1: *[after exploring for a bit]* I didn't even know I could do this.

Student 2: I'm gonna do this at the park near my house!

National Research Council *A Framework for K-12 Science Education* quote:

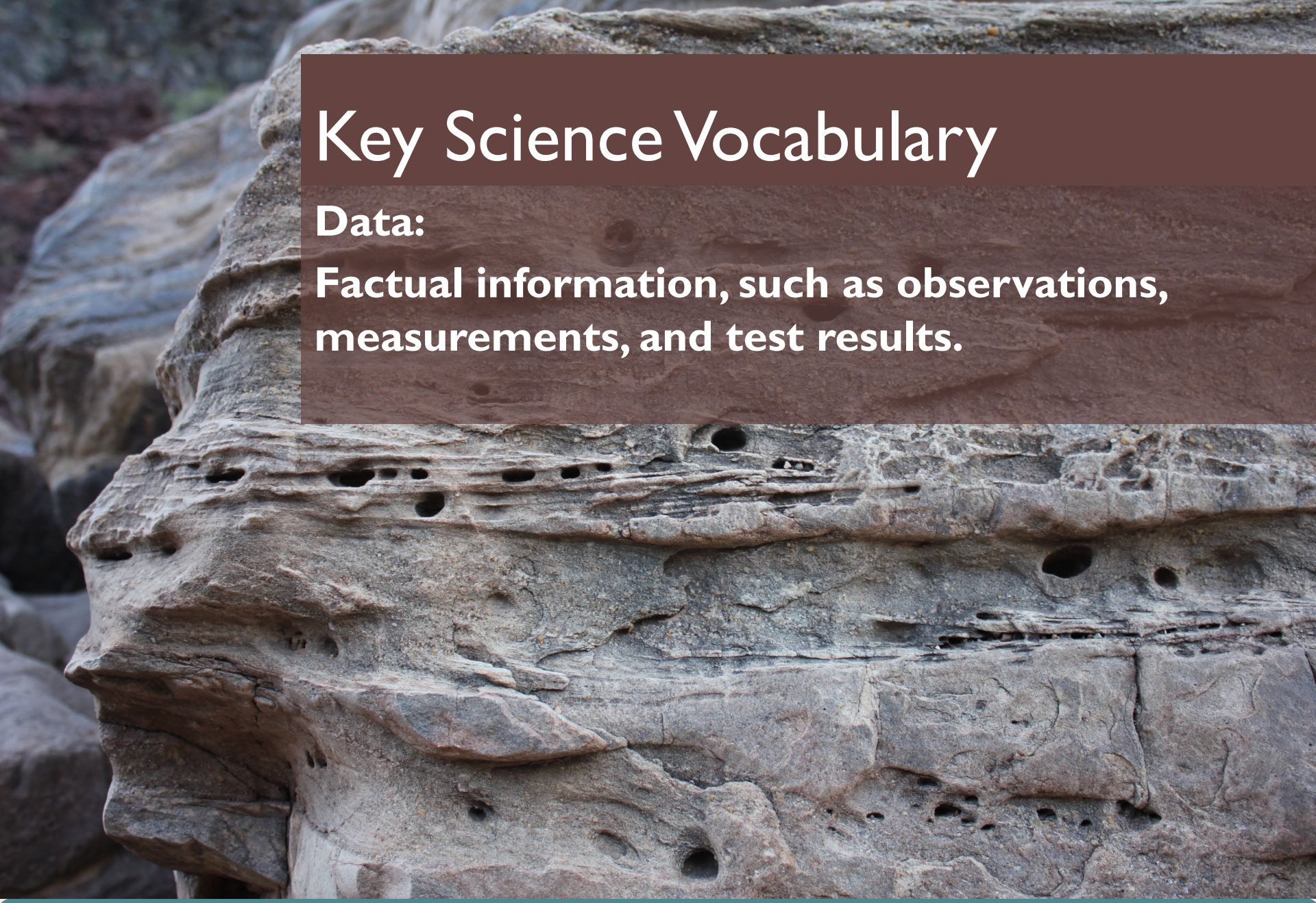
"Engaging in the practices of science helps students understand how scientific knowledge develops…It can also pique students' curiosity, capture their interest, and motivate their continued study…"

NGSS Science & Engineering Practices:

1. Ask questions and define problems
2. Develop and use models
3. Plan and carry out investigations
4. Analyze and interpret data
5. Use mathematics and computational thinking
6. Construct explanations and design solutions
7. Engage in argument from evidence
8. Obtain, evaluate, and communicate information

Common Core/NGSS overlapping practices for Science, English Language Arts & Math:

- Read, write, and speak grounded in evidence
- Construct viable arguments and critique reasoning of others
- Engage in argument from evidence



Key Science Vocabulary

Data:

Factual information, such as observations, measurements, and test results.

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Data that help answer a question, form an explanation, or disprove an explanation.

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Data that help answer a question, form an explanation, or disprove an explanation.

Explanation:

A non-fiction evidence-based story about how or why something in the natural world appears or happens. A scientific explanation must connect data or phenomena with accepted scientific knowledge.

Supporting All Students

"When supported appropriately, [English language learners, students with disabilities that involve language processing, students with limited literacy development, and students who are speakers of social or regional varieties of English] are capable of learning science through their emerging language and comprehending and carrying out sophisticated language functions (e.g., arguing from evidence, providing explanations, developing models) using less-than-perfect English."

NRC *Framework*, 2012

Supporting English Language Learners

- Opportunity to practice language skills with their own discoveries.
- Allowing students to talk in their most comfortable language.
- Providing sentence starters:
  - I wonder…
  - I notice…
  - I've heard…
  - An explanation might be…

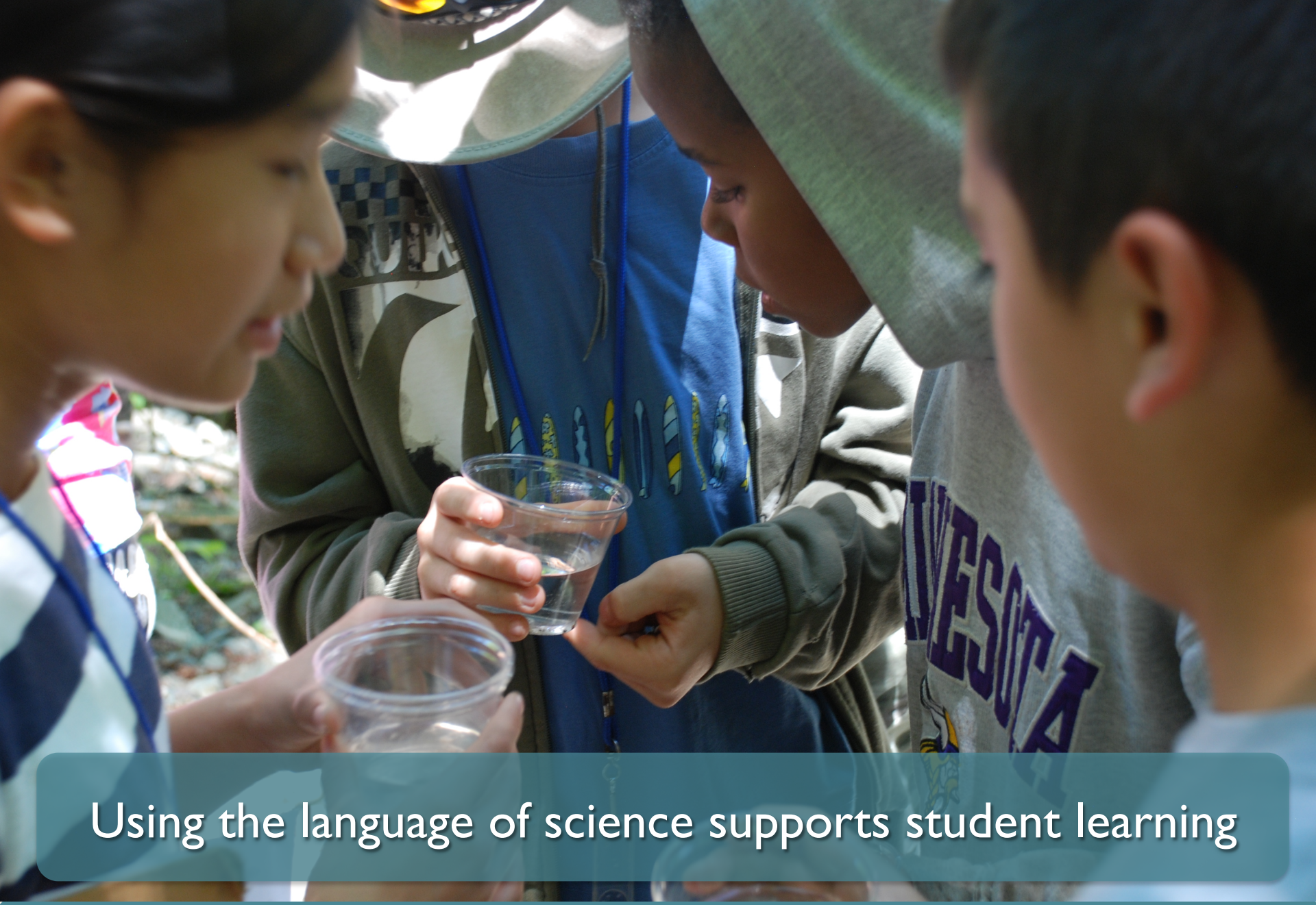
Supporting Reluctant-to-speak Students

- Asking "safe" questions about direct observations:
  - What's the color, shape?
- Asking questions that relate to something another student has just said:
  - Do you agree with what Angelo just said?

Framework Language Learning Quote:

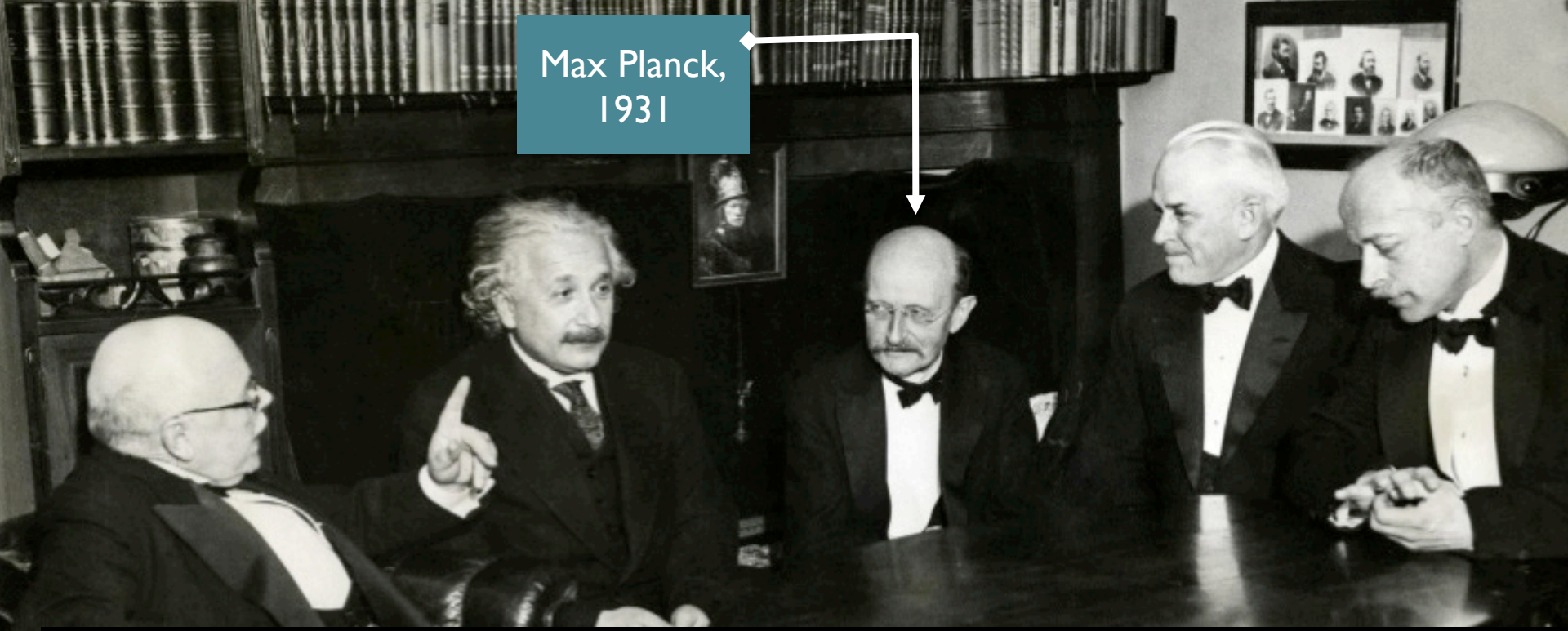
"The practices offer rich opportunities and demands for language learning while advancing science learning for all students."

NRC *Framework*, 2012



Using the language of science supports student learning

The language of science is open-minded, tentative & humble!



"Science progresses funeral by funeral…A new scientific truth does not triumph by convincing opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it."

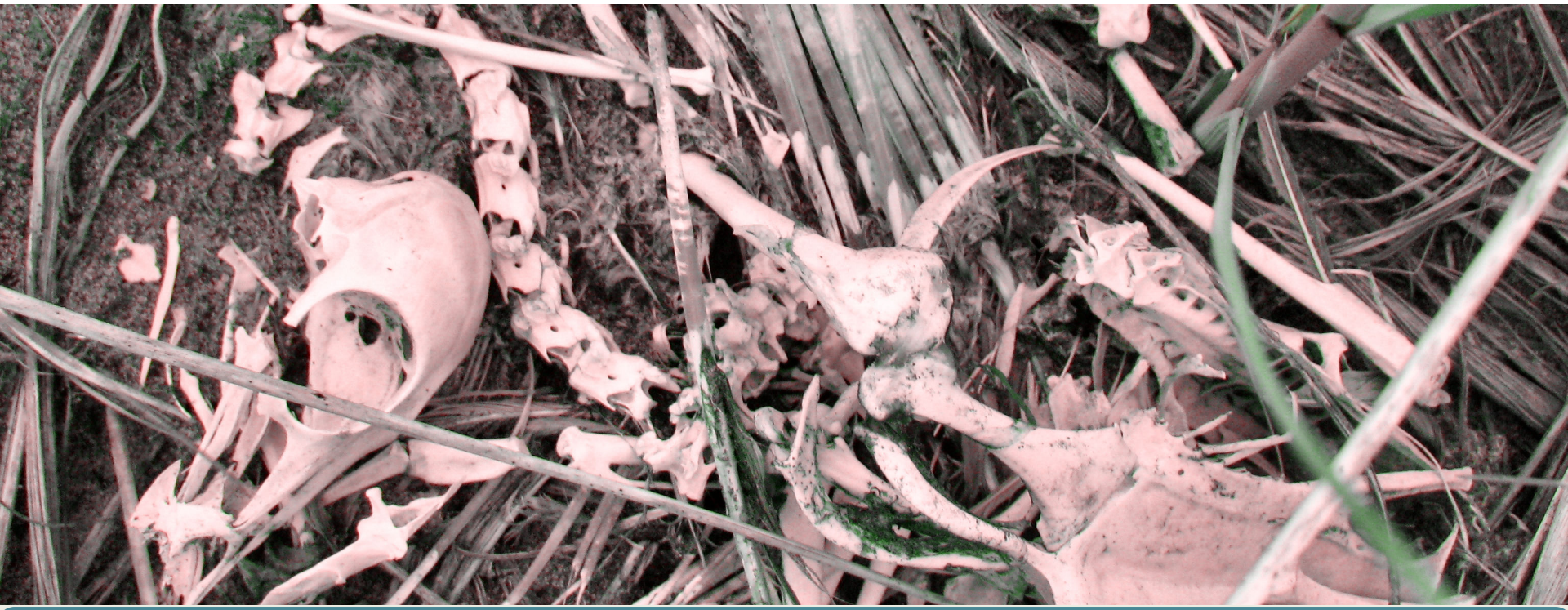
— Max Planck

Criteria for Evaluating the **STRENGTH** of Evidence

- ❑ Quantity of evidence
- ❑ Size of assumption
- ❑ Quality of source

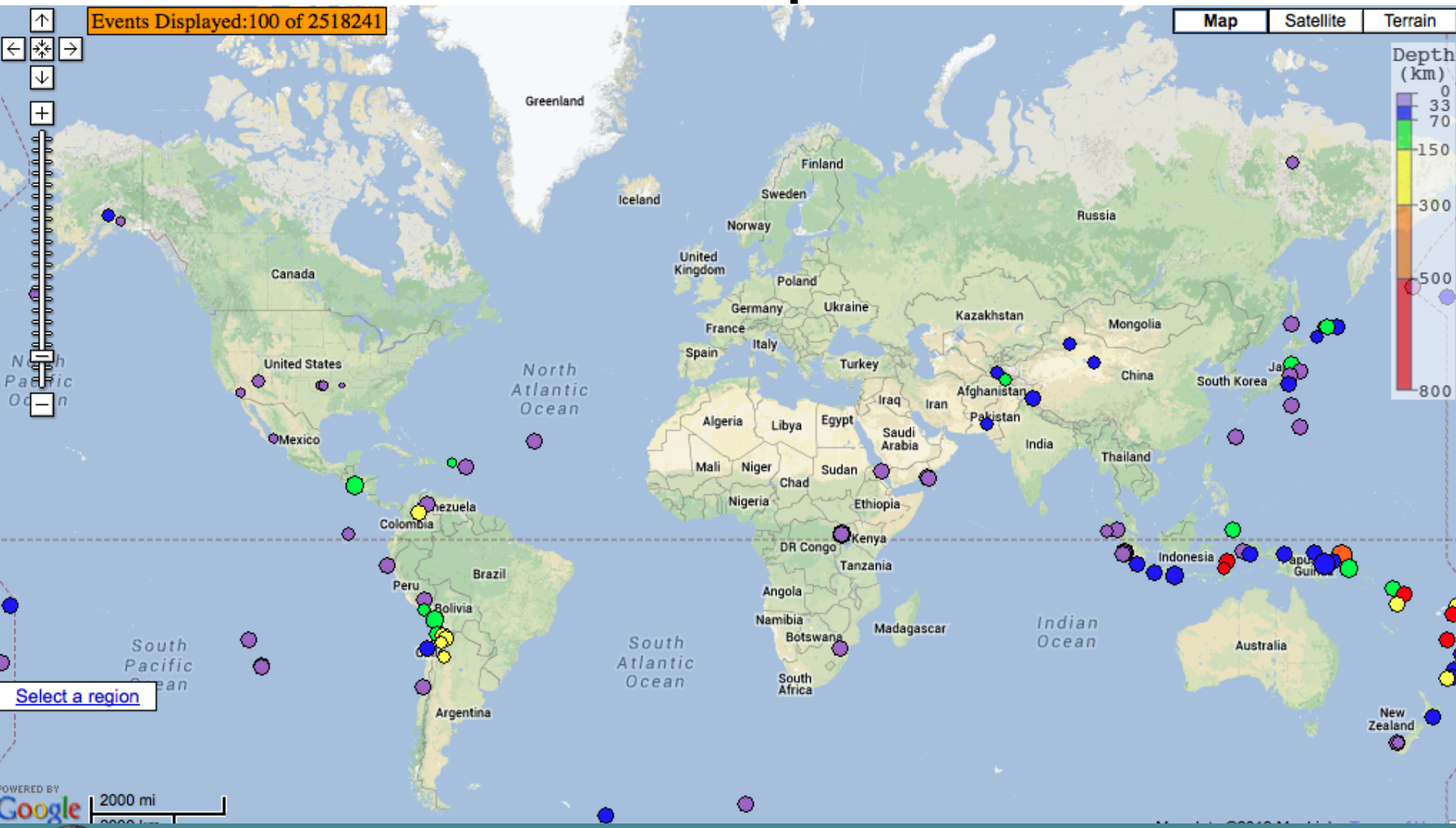
Useful Criteria: Quantity of Evidence

How much evidence has been collected that supports the explanation?



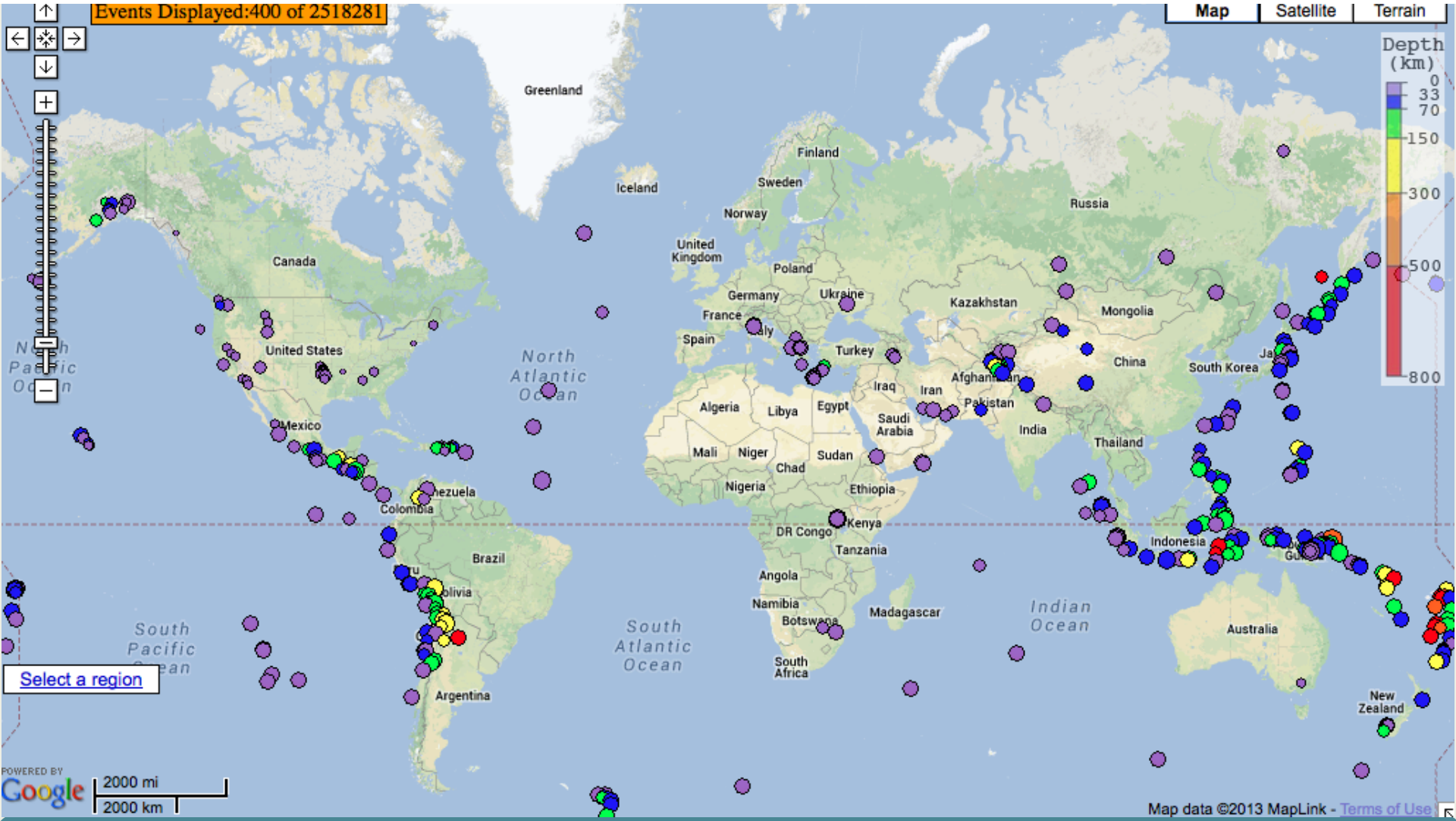
Where do earthquakes usually occur?

100 data points



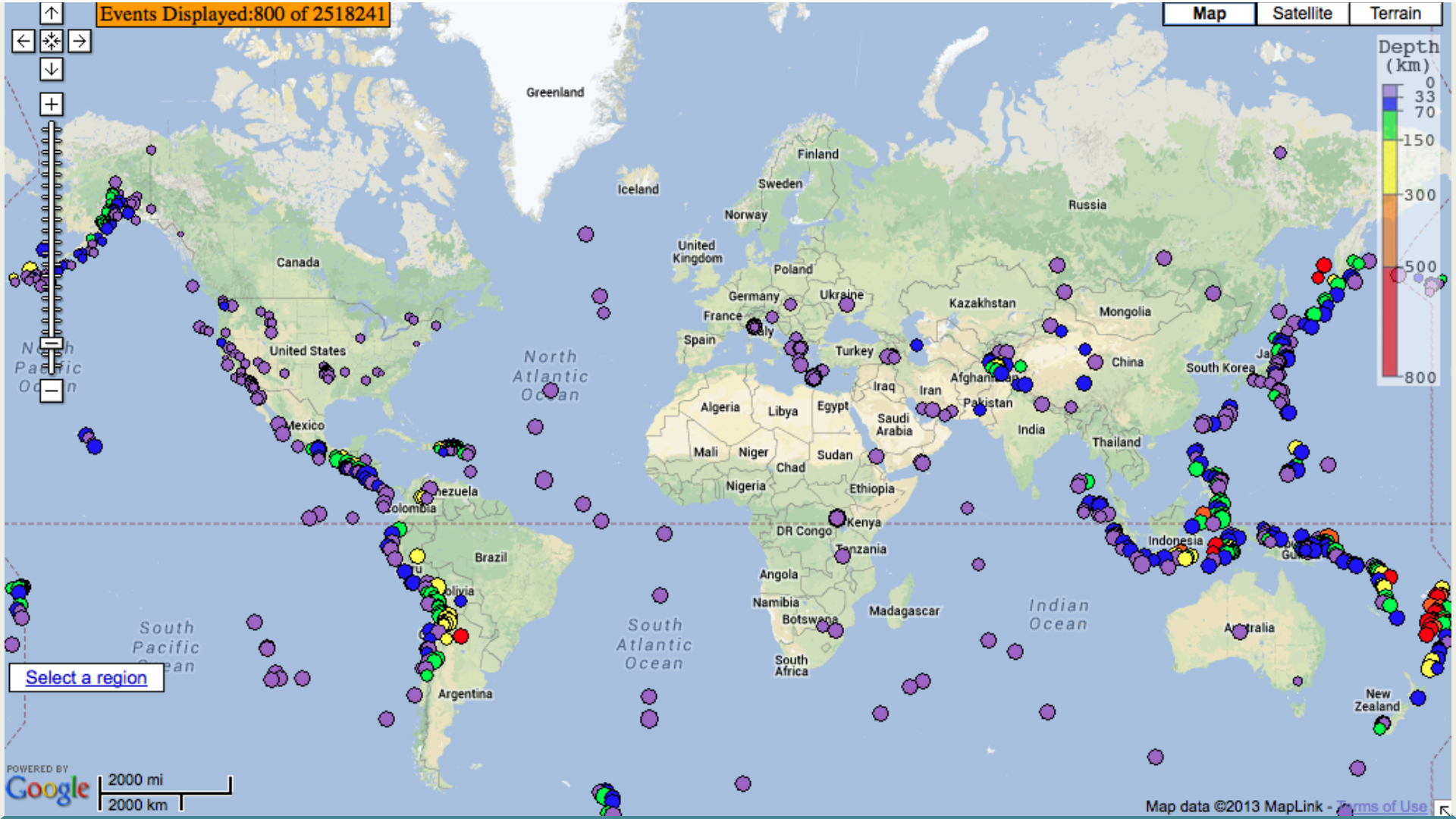
Where do earthquakes usually occur?

400 data points



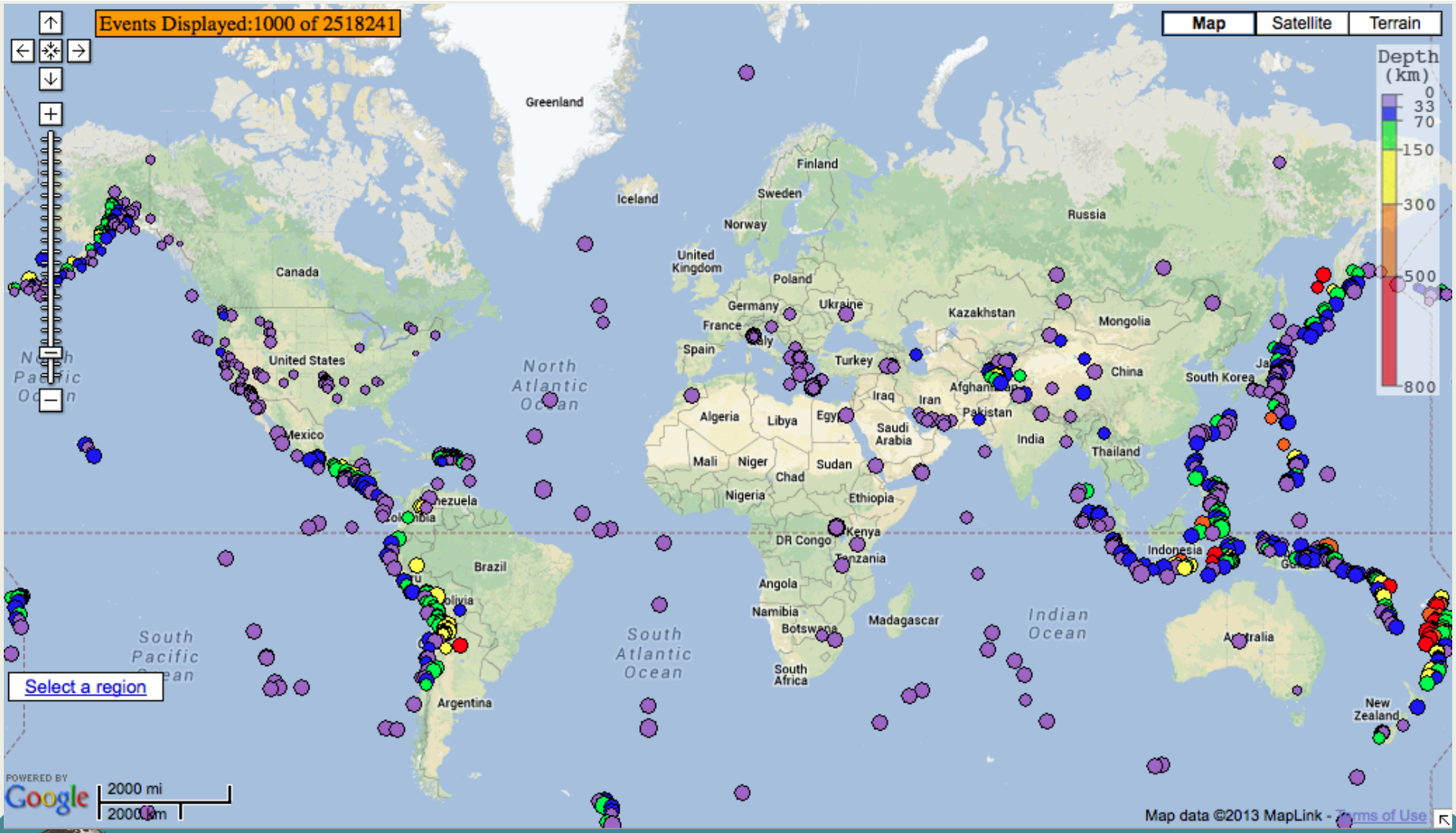
Where do earthquakes usually occur?

800 data points



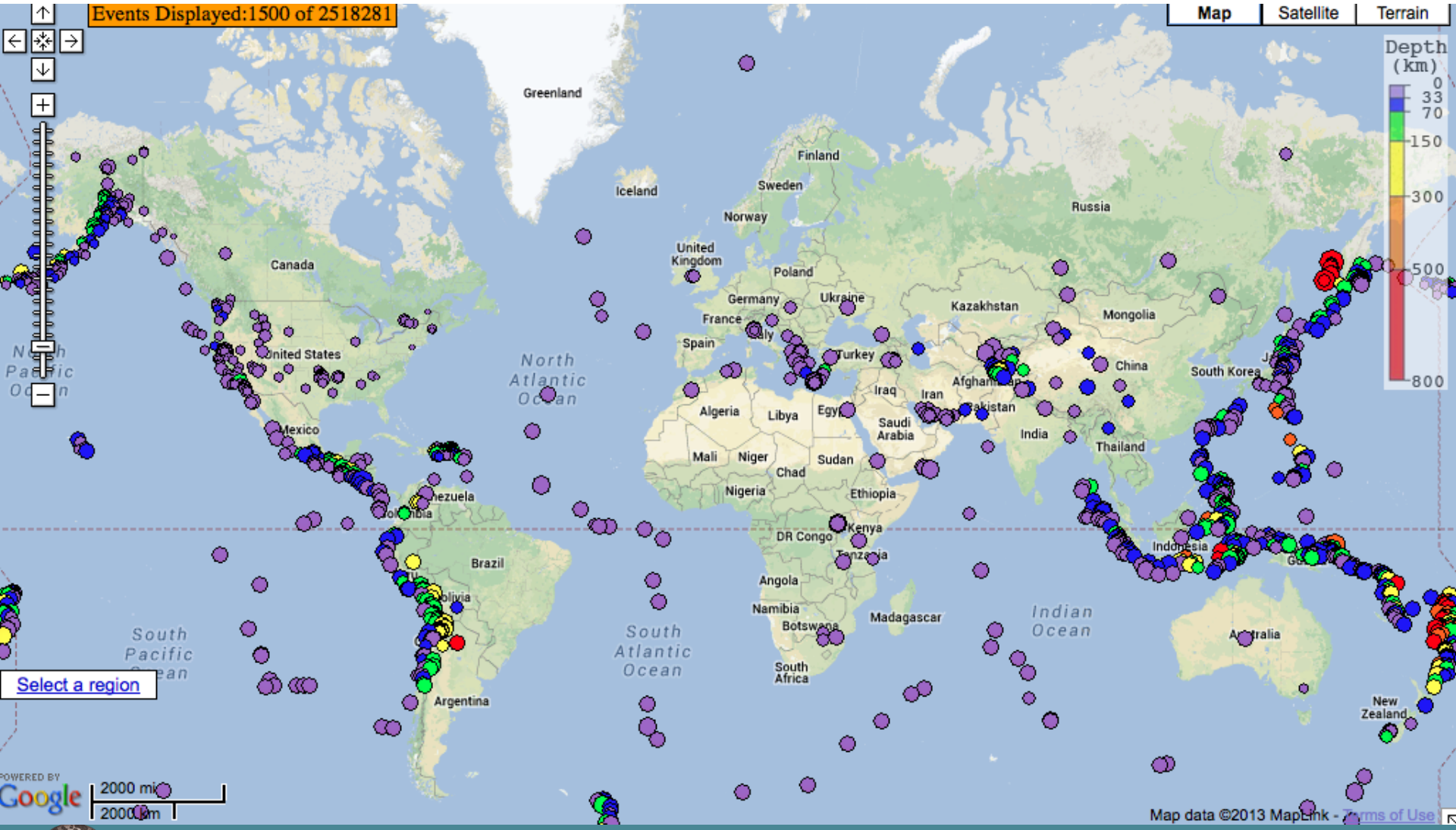
Where do earthquakes usually occur?

1,000 data points



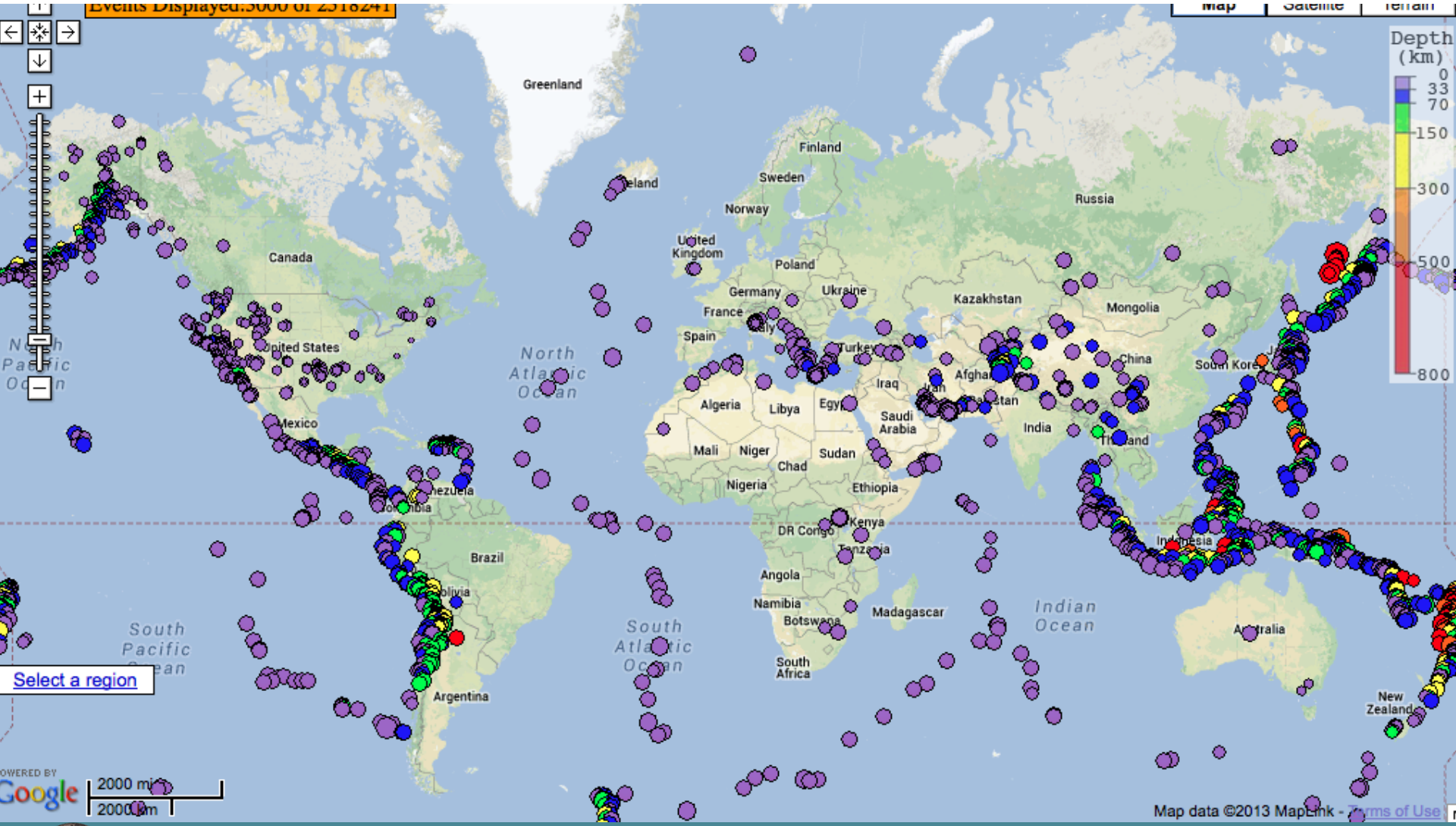
Where do earthquakes usually occur?

1,500 data points



Where do earthquakes usually occur?

3,000 data points



Criteria for Evaluating the **STRENGTH** of Evidence

- ✓ Quantity of evidence
- ❑ Size of assumption
- ❑ Quality of source

Useful Criteria: Size of Assumption

How much of a conceptual leap does it take to connect the evidence to the possible explanation?

???

Sort the cards in order of size of the assumption needed to support this explanation:

Cheetahs are predators of wildebeest.

Criteria for Evaluating the **STRENGTH** of Evidence

- ✓ Quantity of evidence
- ✓ Size of assumption
- ❑ Quality of source

Useful Criteria: Quality of Source

Where did the evidence come from and how reliable is it?

Sort the cards in order of highest to lowest quality of source.

Criteria for Evaluating the **STRENGTH** of Evidence

- ✓Quantity of evidence
- ✓Size of assumption
- ✓Quality of source

Model Language of Science & Inquiry Habits

- Give students a chance to observe, and wonder about their own explanations before sharing yours.
- When you share explanations, include *your* evidence.
- Cite *your* sources of information.
- Use language with an appropriate level of uncertainty.

Science instruction can sometimes discourage wonder & curiosity:

"I do science during our labs back at camp. I don't do science on my hikes, because the science takes away from kids being able to appreciate nature."

-Field Instructor

How can science lessons unintentionally discourage students' curiosity and wonder?

Guiding Question:

Discuss, then write in journal:

How can we use science to encourage students' wonder and curiosity in nature?

Photo Credits

Slide 1: Jedda Foreman

Slide 2: Craig Strang

Slide 3: Jedda Foreman

Slide 4: Kevin Beals

Slides 5-8: n/a

Slide 8-10: Kevin Beals

Slide 11: n/a

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