FROM NEOPROTEROZOIC ‘PRE-CURSOR’ CLAMS TO THE KLAMATHS: DOCUMENTING THE PALEOGEOGRAPHIC EVOLUTION OF THE EASTERN KLAMATH TERRANES, AN EDUCATION OUTREACH MODEL

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Session No. 184

T76. Geocorps™ America and Mosaics in Science Programs: Successful Partnerships Promoting Individual Professional Development and Application of Geoscience and Related Fields to Management of America’s Public Lands

Tuesday, 3 November 2015: 8:00 AM- 12:00 PM.
GeoCorps Project 2014-2015
Public Education Outreach: Geologic History of the park and surrounding region
Field Experience
Oregon Caves National Monument receives ~75,000 visitors annually.
Outreach goal: **describe the geologic history** in a text **accessible to a public audience**

Why are mountains here?

What’s with the cave?
Current park materials: 250 Ma - present

New additions: 640 Ma - 250 Ma
Research, Text and Graphics

GeoCorps assignment Fall 2014-Spring 2015
Oregon Caves National Monument
Where is Oregon Caves located?
The Klamaths a microcosm for understanding the geologic history of the entire Western Cordillera.
Range in ages of terranes in the Klamaths.

- 144-60 Ma
- 200-144 Ma
- 250-160 Ma
- 400-360 Ma
- 640-180 Ma
Ediacaran Fossils of the Antelope Mountain Quartzite. Neoproterozoic (Pre-Cambrian) Cyclomedusoid fossils 460-575 million years old preserved in sedimentary sandstone of the Yreka terrane in Northern California.

collected by John Griffin, 1970. Identified as fossils 20 years later; published in 2006.

The Klamaths contain the oldest fossils (to date) of accreted terranes in the Western Cordillera.
What tools can be used to communicate this complex geologic history?

What is a terrane?
Problem: the earth looked (and behaved) very differently in the deep past.

(It is a dangerous case of unfamiliarity…

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600 Million Years

The oldest rock unit in the Klamath terranes, the Antelope Mountain Quartzite, begins to form from the sandy debris eroding from nearby continental pieces between 640 and 575 million years ago (Griffin 2008). This material accumulates on the shallow parts of oceans around continental edges. These sedimentary rocks preserve the fossilized impressions of pre-Cambrian aged cyclomedusoids.

Quartz-rich sands and muds washed off from the former pieces of the supercontinent form the oldest rocks in the Klamaths between 640 and 575 million years ago (Griffin 2008). The Antelope Mountain Quartzite is so named because of pressure and heating during burial metamorphose the silica-rich sandstone into quartzite.

Work at Oregon Caves: Illustrations by Audrey Ledford, text by John Roth, illustration consultation and text by Gina Roberti.

Fossils were first discovered by John Griffin in the 1970s though not described as Proterozoic fauna and published until 2006.
Geologists studying the jumbled bedrock of the west coast of North America needed a theory to explain how so many diverse sets of unrelated rocks existed all together.

This led to the development of ‘the terrane concept’, an idea key to understanding how continents form from plate tectonic processes.

A terrane describes a fragment of crust formed on, or broken off from, one tectonic plate and accreted or sutured to another plate.

Small pieces of land are carried towards a continent by sinking seafloor plate. Seafloor plates are dense and heavy and thus sink beneath continental plates.

Miles beneath the surface, rocks of the seafloor plate change into even denser forms, sometimes causing the seafloor plate to tear.

Terranes are ‘glued’ onto the continent with magma that can rise through these openings.

We call large bodies of magma that cool underground ‘plutons,’ after Pluto, the Roman god of the Underworld.

In geology, terrane names a group of rocks which share a similar history: It is distinct in meaning from the similar sounding (and more commonly used) word ‘terrain’.

The word ‘terrain’ refers to the lay of the land, elevation, slope, and orientation of features.

‘Terrane’ describes a history in four dimensions: up and down and sideways, through time.

Both terrane and terrain contain the root terra (‘earth’). The second e of terrane reflects the eons over which these processes occur.

Created by Gina Roberti, 2015, gina@monolarker.com

With thanks to the National Park Service and Geologic Society of America.

Timeline and Legend

Each color represents rocks of different types and ages.

- North American Craton (oldest part of the continent)
- The Western Cordillera (material added onto the continent before and during the time of the dinosaurs)
- Deformed continental rocks
- Coastal plain sedimentary rocks (the youngest ‘land’ to form)

For example, in the Klamath Mountains of north-western California, 600 million-year-old cyclostominid fossils give clues that rocks made their journey distances over the course of geologic time before they were detached, or accreted, to North America.
To ‘ERR’ on the side of effective science communication:

1. Engaging
2. Exciting
3. Relevant
START: a complex 4D problem.
Fig. 1. Palaeozoic to early Mesozoic terranes of the North American Cordillera. Terranes are grouped according to faunal affinity and/or source region in early Palaeozoic time. Terrane and geological abbreviations: KB, Kilbuck; QN, Queenella; RT, Richardson trough; SM, Slide Mountain; ST, Stikinia; YSB, Yukon Stable Block; YT, Yukon–Tanana terrane in the Coast Mountains; WR, Wrangelia. Inset shows location of the Cordilleran orogen in western North America with respect to Chukotka and Wrangel Island (WI), Pearya in the Arctic Islands, the Greenland Caledonides (Cal.) and the Appalachians along the east coast.
Using analogies.

Like a collapsed tower, geologists work with the jumbled pieces of tectonic processes that have already played out their story.

It is only through imagination and diligent detective work that we can imagine how the pieces once fit together.
Using jargon as a teaching tool.

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Simplifying concepts with a combination of visuals and text.

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With many thanks to the support of John Roth, Audrey Ledford, GeoCorps America, and the staff and resources of Oregon Caves National Monument.
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Primary Literature:

Blakey, Ron. 2011. Paleogeographic reconstructions. Web source: [http://www2.nau.edu/rcb7/](http://www2.nau.edu/rcb7/)


Secondary Sources:


Individual citations for photographs and images used in this presentation listed on slides.