“How Have Glaciers Behaved in Patagonia in the Past?”
with Dr. Michael Kaplan

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Originally presented 25 Oct 2014
Glaciers

Two basic types:

• Polar Ice Sheets—Antarctica and Greenland
• Alpine/Mountain glaciers

Found today in all continents except Australia

http://www.pbslearningmedia.org/resource/ess05.sci.ess.earthsys.glaciers/glaciers/
Interesting Facts about Glaciers

• Cover about 10% of Earth’s surface
• Contain about 3% of world’s water
• Influenced by precipitation, temperature, altitude, latitude, relief, and orientation to solar radiation
• Made of ice that accumulates over time on land, slowly moving

http://pbs.panda-prod.cdn.s3.amazonaws.com/media/assets/wgbh/ess05/ess05_int_glaciers/index.htm
Glaciers and Climate Change

• Much study wrt changing climate
• Polar ice sheet melt will raise sea level
• Ice core chemistry reveals past climatic shifts
• Extent reveals local climatic changes—“Little Ice Age” in Swiss Alps, Rockies

http://www.swisseduc.ch/glaciers/glossary/icons/little-ice-age-two.jpg
USGS “Benchmark Glacier” Program

Long-term study of 3 widely-spaced glaciers to monitor climate, stream runoff, and other factors

http://ak.water.usgs.gov/glaciology/index.html
South America has glaciers, mainly concentrated in the south

Concerns about SA and other glaciers’ retreat

• Important for tourism, water supply, culture
  “Melting glaciers threaten Peru”
  “Melting Himalayas may doom towns”
  Potential flooding of cities and towns

• Monitoring by satellites provide most detailed images to date
  JPL Snow/Ice/Glacier images
Landscape features left behind by glaciers

Glaciers move rocks and other solid materials of all sizes, and deposit them as they melt

- Erratics, moraines, eskers, till, etc.
- Outwash plains, kettle lakes, kames, etc.

http://en.wikipedia.org/wiki/Glacial_erratic
Cosmogenic Nuclide Dating

• Based on interactions between cosmic rays and nuclides in glacial boulders
• Effective over time scales from 100 – 1,000,000+ years, depending on which isotopes
• Sample from upper few cm of rock
Basics of Cosmogenic Dating

• Rare nuclides form in surface rocks by bombardment form cosmic rays originating in supernova explosions

• **Spallation reactions** fragment target nuclei

• Ratio of such isotopes to other isotopes calculates how long they have been exposed

• Do not penetrate deeply

• Excellent tool for glacial geologists because little organic matter present (can’t use C-14)

• Useful for determining maximum extents and rates of recession

• Sampling strategies key to accuracy

LDEO Cosmogenic Dating Group in Chile, Argentina, and Antarctica

• Goal: Understand how glaciers and climate have changed over time in the Andes
• Better understanding of Southern and Northern Hemisphere climate shifts
• May help predict future changes

• Primary isotope: Be-10

Methods of extraction

4 protons, 6 neutrons

β-decay to B-10

Half-life $1.39 \times 10^6$ yr

http://en.wikipedia.org/wiki/Beryllium-10
Dr. Kaplan’s Research

• Field-based and lab-based
• Multidisciplinary—geology, chemistry, physics
• Operating on various time scales, short and long
• Important implications for predicting changes in regions that often lack extensive scientific resources