

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

Dr. Michael J Passow  
Originally presented 25 Oct 2014

# Glaciers

Two basic types:

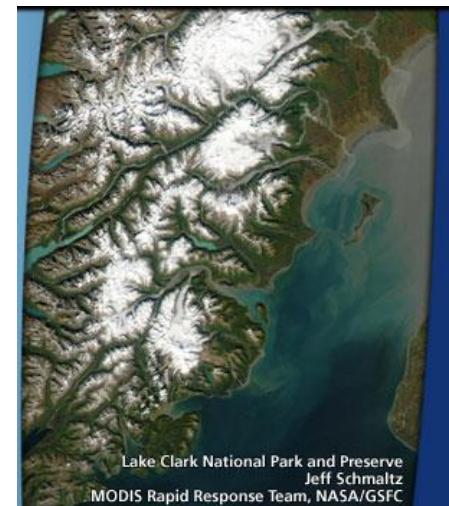
- Polar Ice Sheets—Antarctica and Greenland
  - Alpine/Mountain glaciers
- Found today in all continents except Australia



# Interesting Facts about Glaciers

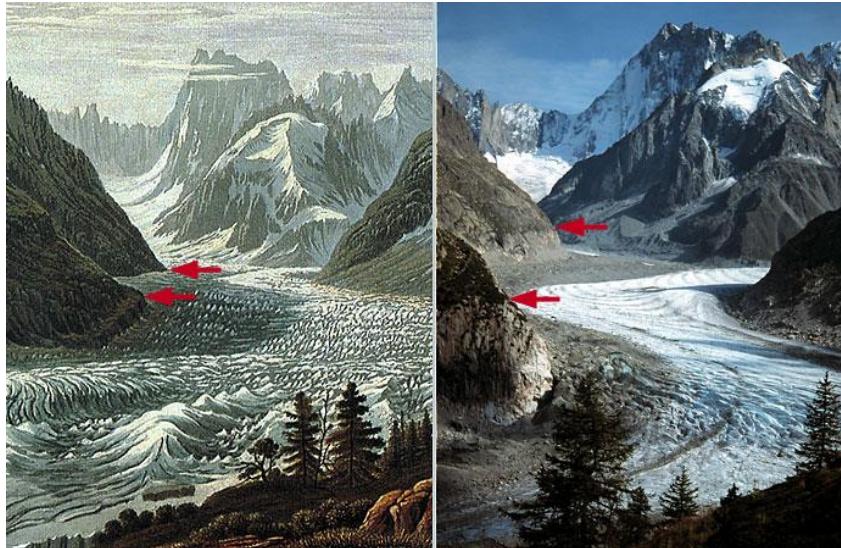
- Cover about 10% of Earth's surface
- Contain about 3% of world's water
- Influenced by precipitation, temperature, altitude, latitude, relief, and orientation to solar radiation
- Made of ice that accumulates over time on land, slowly moving

[http://pbs.panda-  
prod.cdn.s3.amazonaws.com/media/assets/wg  
bh/ess05/ess05\\_int\\_glaciers/index.htm](http://pbs.panda-prod.cdn.s3.amazonaws.com/media/assets/wgbh/ess05/ess05_int_glaciers/index.htm)

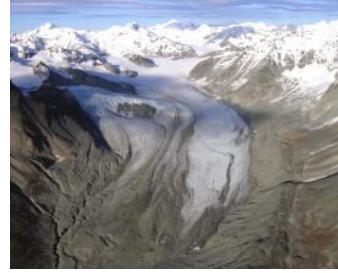
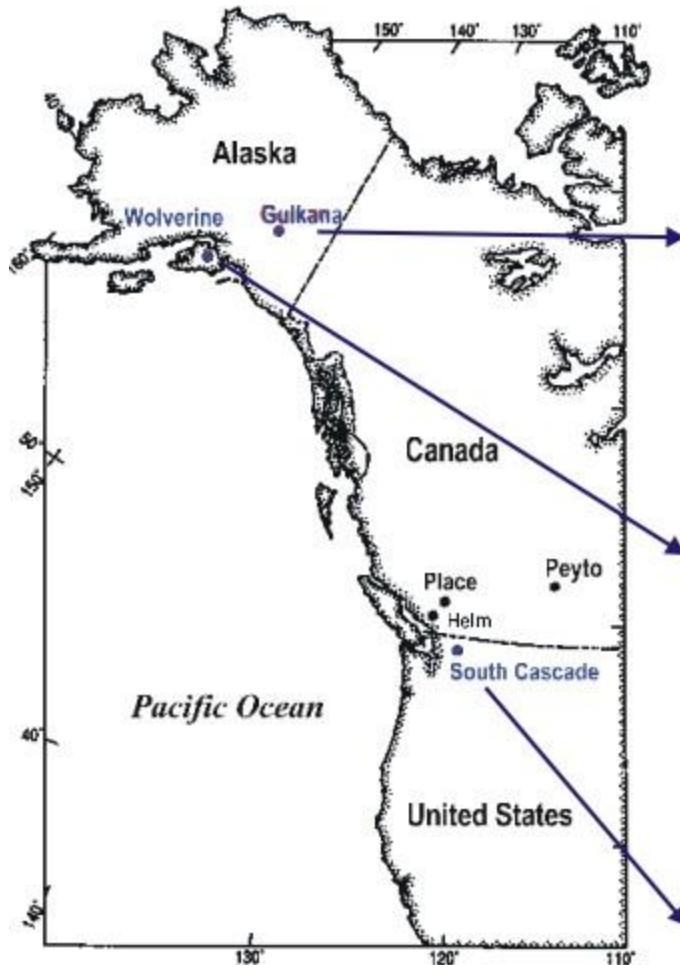


# Glaciers and Climate Change

- 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



# USGS “Benchmark Glacier” Program



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

# South America has glaciers, mainly concentrated in the south

Inbox (19) - michael@earthlink.net    24 Earth to Class - Lamont-Doherty    Edit Post < Earth2Class —    DLESE Find a Resource >    BBC NEWS | Americas | M    Map of Glaciers in South America

www.touristlink.com/south-america/cat/glaciers/map.html

Where are you going? Glaciers (32)

Napa's Premier Food Tour  
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1 Perito Moreno Glacier  
2 Serrano Glacier  
3 Polish Glacier  
4 Marinelli Glacier  
5 Grey Glacier  
6 Viedma Glacier  
7 San Rafael Glacier  
8 Italia Glacier  
9 San Quintin Glacier  
10 Alemania Glacier  
11 Romanche Glacier  
12 Tyndall Glacier  
13 Mocho-Choshuenco  
14 Pastoruri Glacier  
15 Upsala Glacier  
16 Amalia Glacier

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<http://www.touristlink.com/south-america/cat/glaciers/map.html>

# 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](http://en.wikipedia.org/wiki/Glacial_erratic)

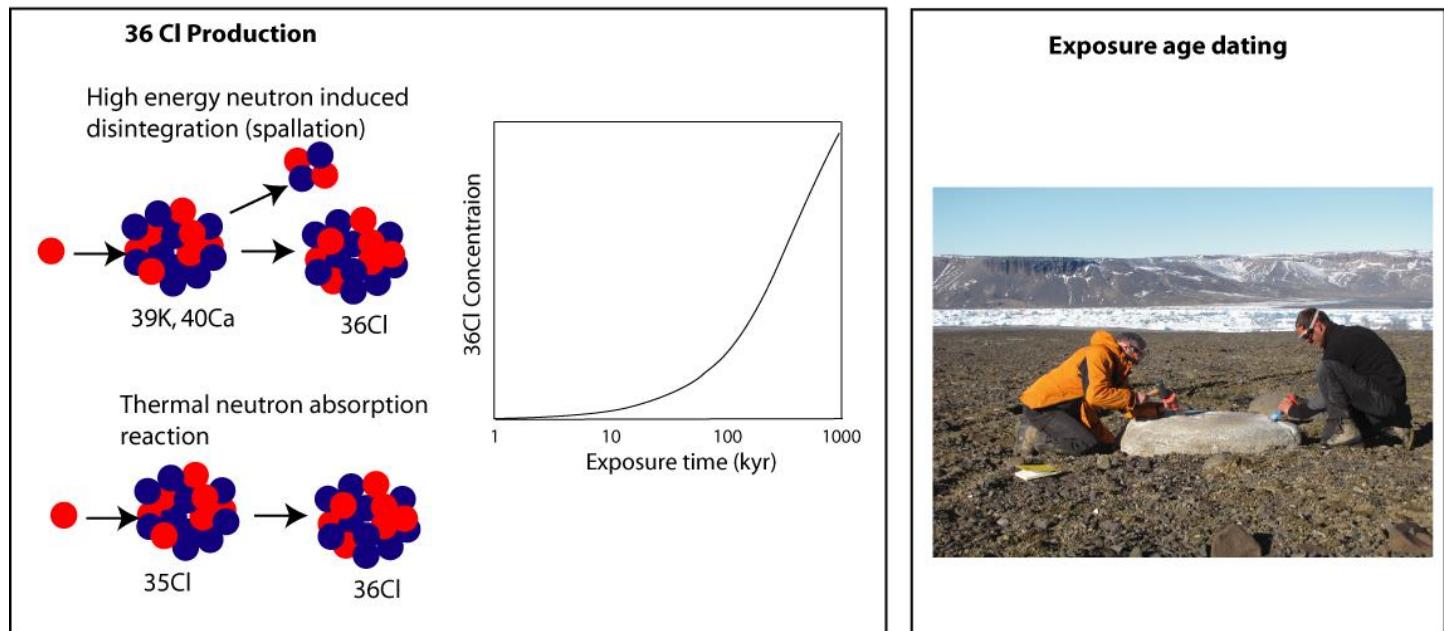
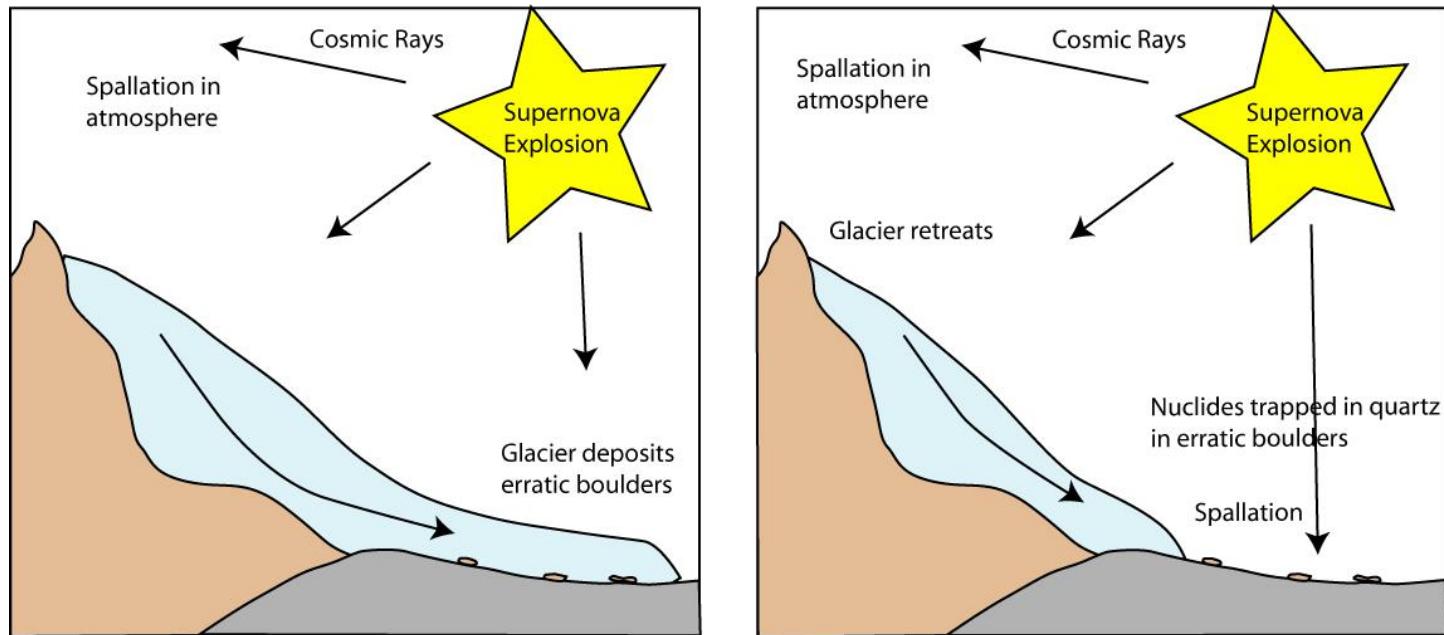
# Cosmogenic Nuclide Dating

- 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 from 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
  - $\beta$ -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