

Welcome!
PolarConnect Event
January 6, 2011

Glacial History in Antarctica

with
Lesley Urasky,
Science Teacher,
Rawlins, Wyoming





Team Members



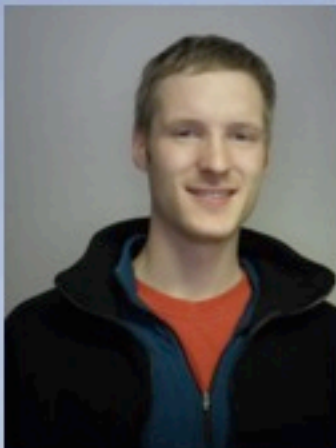
John Stone
Researcher
University of Washington



Howard Conway
Researcher
University of Washington



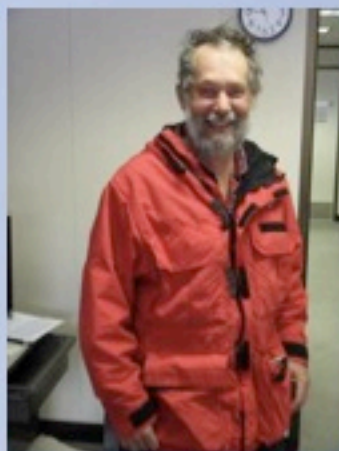
Brenda Hall
Researcher
University of Maine
Climate Change Institute



Gordon Bromley
Researcher
University of Maine &
Lamont-Doherty Earth Observatory



Perry Spector
Ph.D. Candidate
University of Washington



Maurice Conway
Mountaineer

How Did I Get Here?





Helicopter
Supported
Remote
Camps



Beardmore Glacier

McMurdo, Antarctica

Christchurch, N.Z.

Auckland, N.Z.

From
Los Angeles



Christchurch, New Zealand



First Eleven Days in Antarctica

- **McMurdo Station:**

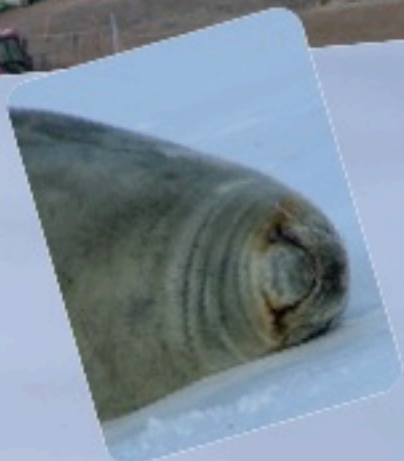
- One of three bases for all American research projects
- About 1,000-1,100 residents during austral summer
- Office in Crary Lab
- Galley
- Dorm 203a





Things to Do Around McMurdo

- Historic Locations: Discovery Hut
 - One of Sir Robert Falcon Scott's huts during expedition to be 1st to reach South Pole
- Observation (Ob) Hill:
 - Offers great views of Ross Island and McMurdo
 - Memorial cross for Scott's fatal expedition
- Tours:
 - Pressure Ridges





Pre-Field Training

- Snow Craft I class – AKA “Happy Camper”
 - Assess hazards & implement risk management
 - Learn snow survival skills
 - Camping – 3 types of shelters: Scott tents, mountain tents, snow trenches
 - Operation & troubleshooting of:
 - Radios – both VHF & HF
 - Stoves
 - Rescue in whiteout conditions
- Helicopter training



Where Have We Been?

- Central TransAntarctic Mountain (CTAM) camp
 - Centralized remote camp acting as a base or jumping off point for many science projects
 - Paleontologists, Paleobotanists, Seismologists



- Cloudmaker Peak:

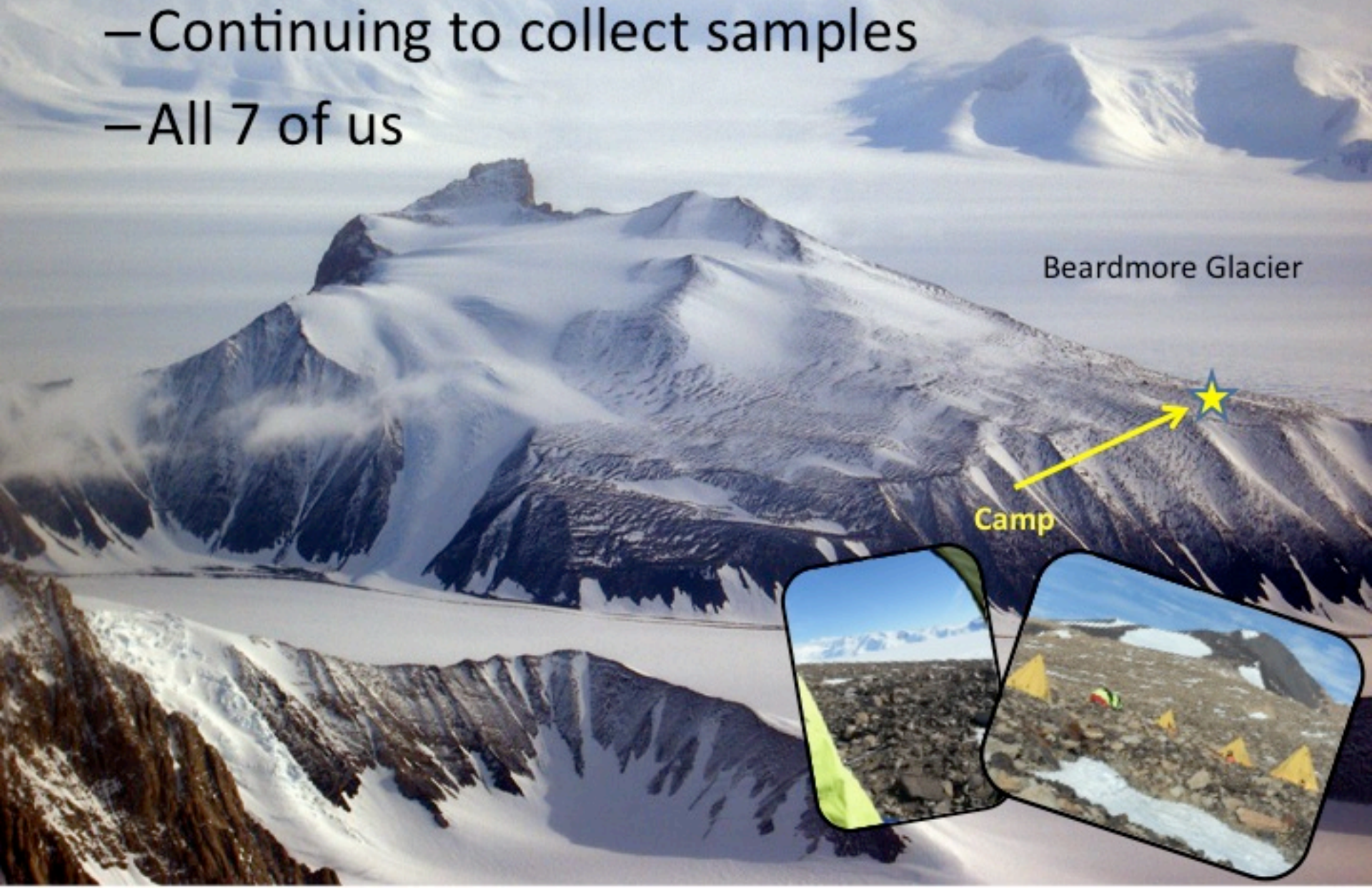
- Collecting samples for dating

- Determine edge of Beardmore Glacier during Last Glacial Maximum (LGM)

- 5 of us: John, Brenda, Gordon, Perry, & myself



- Camp on Mt. Kyffin
 - Continuing to collect samples
 - All 7 of us



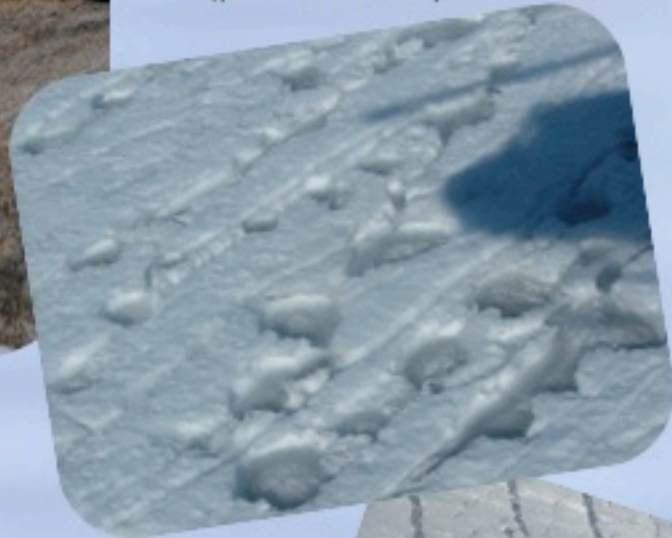
Beardmore Glacier

Camp




On Mt. Hope
Looking Toward
Mt. Kyffin

(note rock sample in foreground)
(photo courtesy John Stone 2007)



- Camp on Mt. Hope
 - Continuing to collect samples
 - 4 of us: John, Perry, Maurice, & myself

An aerial photograph taken from the perspective of someone inside an aircraft, looking out over a vast, snow-covered mountain range. The aircraft's wing and landing gear are visible in the upper portion of the frame. The terrain below is a rugged, snow-dusted ridge with patches of brownish rock or vegetation. The sky is clear and blue.

North Ridge,
Mt. Hope

(photo courtesy John Stone 2007)



Why is This Research Important?

- Helps scientists better understand current changes in the West Antarctic Ice Sheet
- Past & current changes can be used as indicators of future climate change
 - If West Antarctic Ice Sheet were to melt, global sea level would rise around 4-6 m

The Effect of a 6m (~18 ft.) Sea Level Change on the Southeastern United States & the Gulf of Mexico





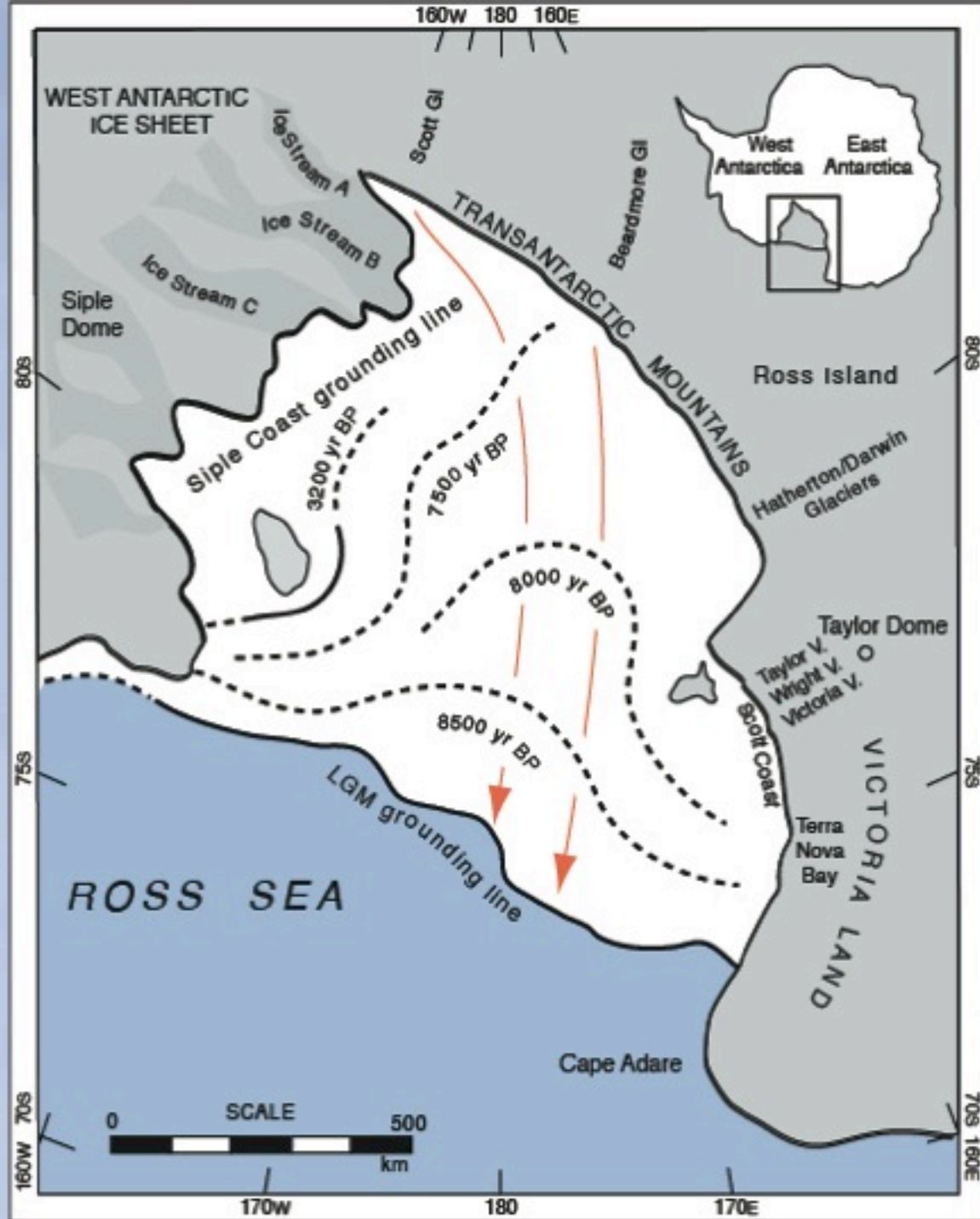
Field Work

- Searching for exposed, glacially transported rocks, deposited during & since last ice age
 - Collection of samples (~1 kg each):
 - From areas around the glacier and
 - Right up to its edges
- Collected samples will be boxed and shipped to the University of Washington for analysis

Why Are These Rocks Important?

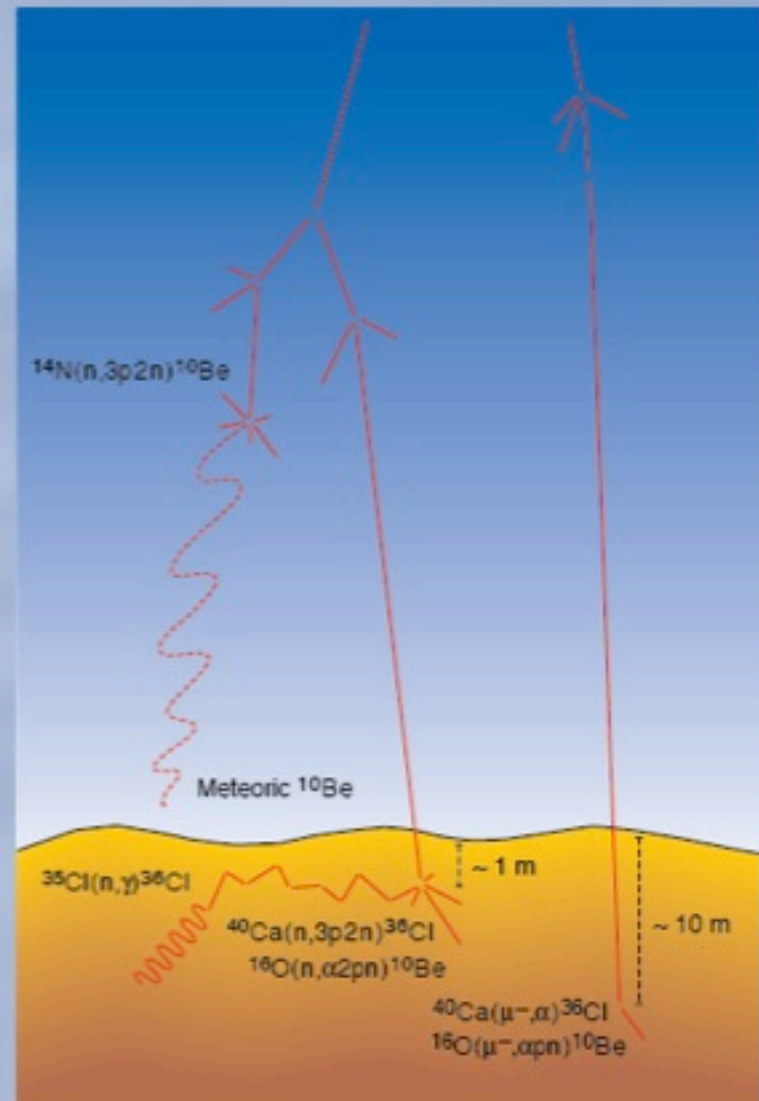
- They can serve as indicators of:
 - When the West Antarctic Ice Sheet receded after the last ice age
 - 10,000-20,000 years ago
 - How rapidly it retreated



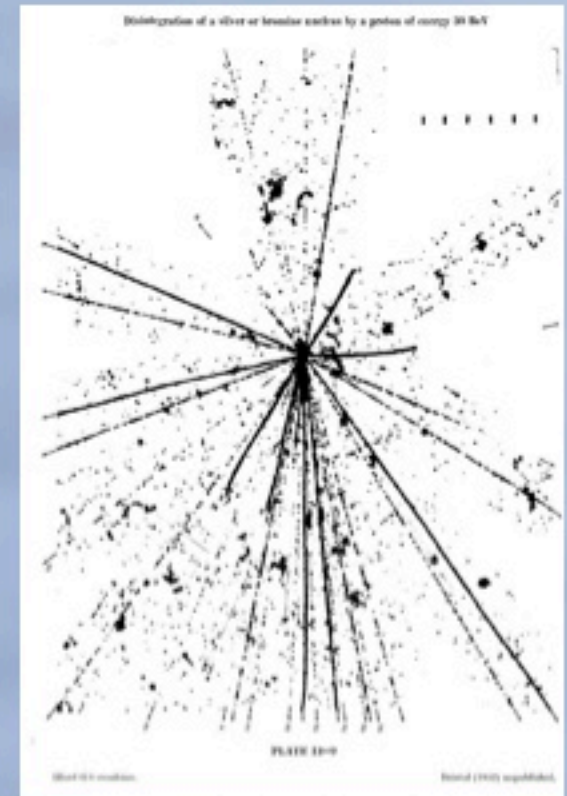


How Do Cosmic Ray Produced Nuclides Tell Us the Age of Rocks?

- Rocks on Earth's surface are constantly bombarded by cosmic rays
 - They penetrate solid materials to a depth of a few meters



- What are they?
 - Energetic particles originating in outer space
 - Causes subatomic particles to be dislodged
 - Turning the atom into:
 - » Rare isotopes of different elements



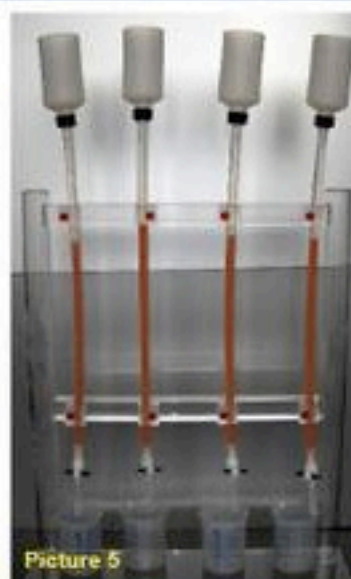


How are Cosmogenic Nuclides Measured?

1. Rocks are broken into very small fragments
2. Pieces treated to separate mineral types using dense liquids and flotation
 - Minerals used:
 - Quartz for Be-10
 - Feldspar for Cl-36

4. Undergoes further complex purification techniques

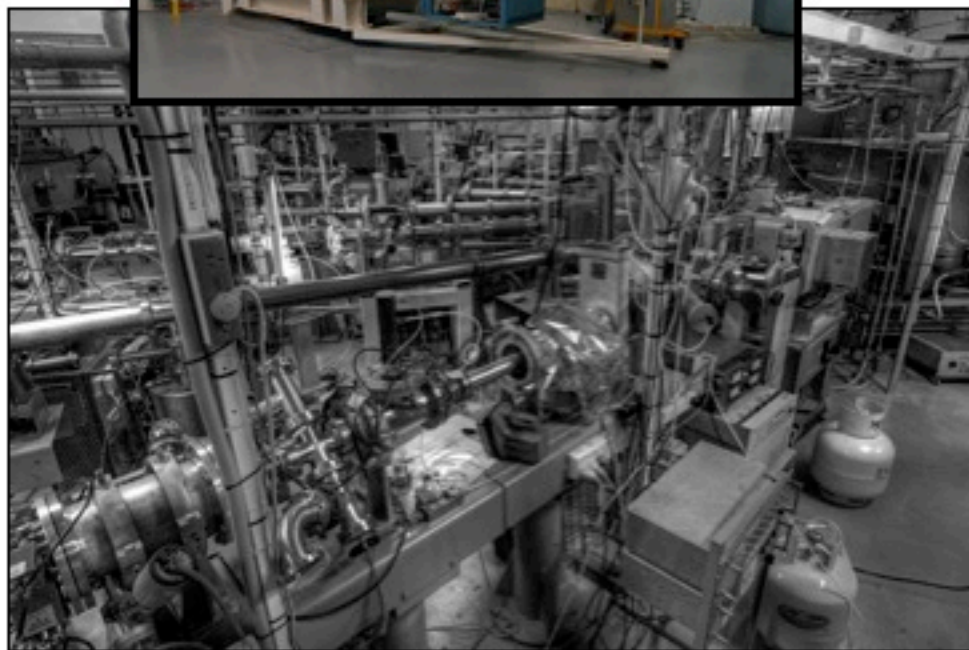
- Purified elements make up a **very** small portion of the entire rock sample
 - Few hundred micrograms of which may be less than 1 part per trillion of isotope for dating



5. Measure the ratio of rare isotope (Be-10) to common isotope (Be-9)
 - Uses Accelerator Mass Spectrometry (AMS)
 - Nuclear physics technique
 - Beam of accelerated Be ions can be separated into different Be isotopes
 - Uses magnetic and electrostatic deflection

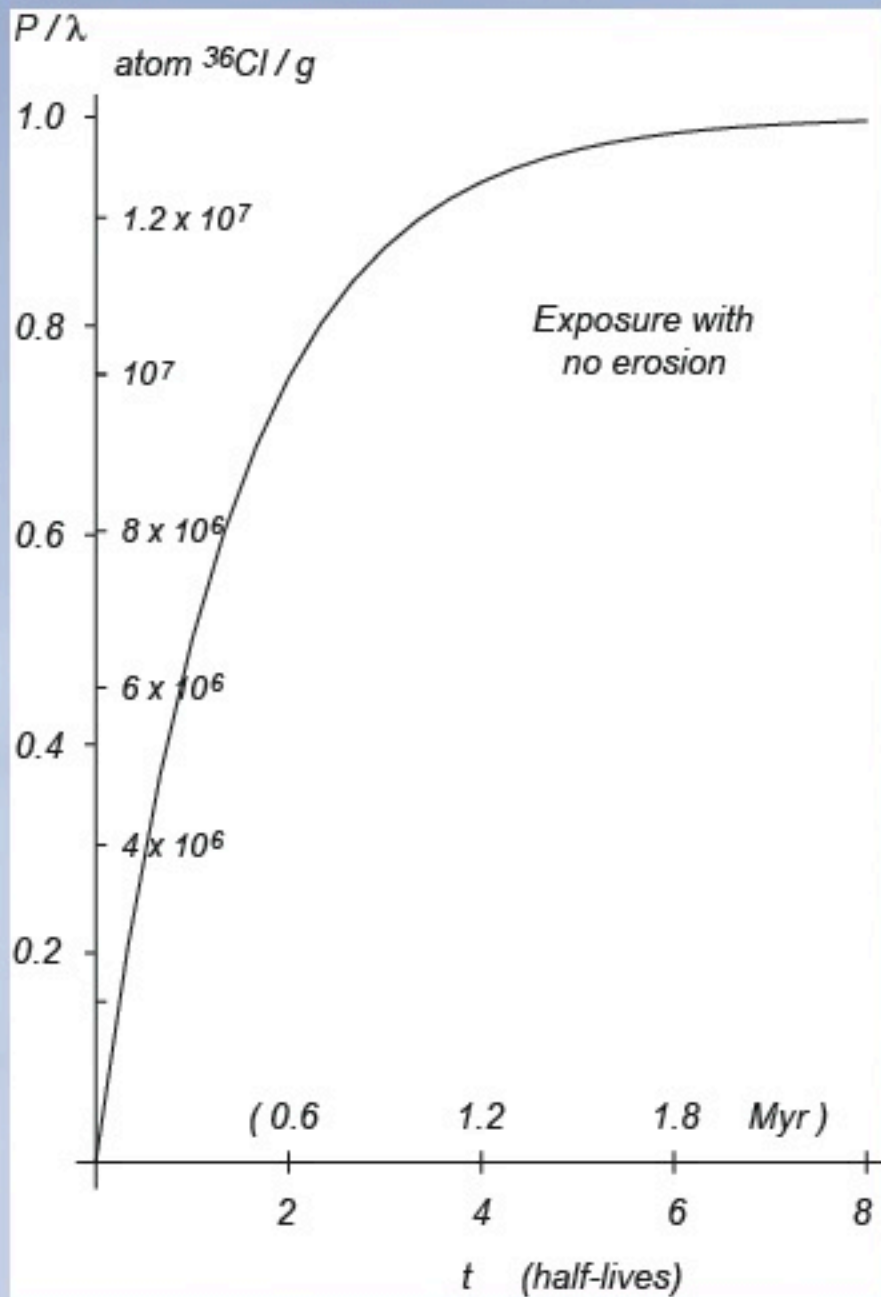


Accelerator Mass Spectrometer at the Australian National University in Canberra



6. Known Be-10 concentration can be used to estimate exposure age if production rate is known
- Higher concentrations = longer exposure time
 - Complex calculations because cosmic rays are affected by:
 - Latitude (Earth's magnetic field shields against cosmic radiation)
 - Altitude (shielding by atmosphere)





Cosmic-ray-produced nuclides accumulate in a freshly exposed surface

Assumptions:

- Steady production
- Continuous exposure
- No erosion



Accuracy of Exposure Dating

- Most accurate for samples:
 - With long exposure times
 - From high altitude
- Young (few 100 years) samples have accuracy of $\pm 5-10\%$
 - For example, if a sample is dated to be 350 years old, in reality, it could be anywhere from (315-385 years old)

- Old or high altitude samples with nearby calibration site may have an accuracy of $\pm 1-2\%$
 - If a sample is dated to be 16,000 years old, in reality, it could be anywhere from (15,680-16,320 years old)



Questions?

- Be sure to “raise” your hand
- If using VOIP, hold down “TALK” button entire time you are asking question
- State your name before you ask your question
- Speak clearly and slowly