THE DETERMINATION OF BACKGROUND EROSION RATES USING COSMOGENIC ANALYSIS OF $^{10}$Be IN THE SHENANDOAH NATIONAL PARK
Appalachian Mountains paradox

Determine erosion rates within the Park on a $10^3$ to $10^6$ year timescale

Testing erosion as a function of lithology

Test Hack’s (1960) model of dynamic equilibrium and steady state erosion

Relationship between grain size and $^{10}$Be concentration (Matmon et al. 2003)
Specific Goals for Investigation

- To determine how rapidly the basins of different lithologies of Blue Ridge in Shenandoah National Park are eroding
- To assess the relationships between erosion rate, lithology, slope and basin area
- To compare the relationships between $^{10}$Be based erosion rates, slope, lithology and grain size with those reported by Matmon et al. (2003a, 2003b), Reuter (2004), U-Th/He erosion rates of Spotila et al. (2004) and fission track erosion rates of Naeser et al. (2005)
Physical Setting

- Appalachian Mountains formed via three major orogenic events:
  - Taconic (Ordovician)
  - Acadian (Devonian)
  - Alleghenian (Pennsylvanian)
- Continental rifting and denudation in the Mesozoic
- Continued relief since cessation of orogenic events ~ 300 Mya
Shenandoah National Park

Virginia

Occ – Carbonates
Cch – Quartzites and siliciclastics
Zc – Basalt and granodiorite
Zyg – Granite
Principle Rock Types

Granites - Old Rag Granite and Pedlar Formation (Granodiorite)

Quartzite - Erwin and Swift Run formations

Basalt - Catoctin Formation

Siliciclastics - Weverton and Hampton formations
Fall 2005 Sample Collection

- Collected samples from four lithologies - basalt, quartzite, granite, siliciclastics
- Four grain sizes
  - 0.25 - 0.85 mm
  - 0.85 - 2 mm
  - 2 - 10 mm
  - > 10 mm
Experimental Design

- Erosion rate vs. slope
- Erosion rate vs. lithology
- Slope vs. lithologic resistance
“It is assumed that within a single erosional system all elements of the topography are mutually adjusted so that they are downwasting at the same rate.”
Grain Size Analysis

• Grain size
  Lithologies split into 4 grains sizes:
  0.25-0.85 mm, 0.85-2 mm, 2-10 mm, > 10 mm
• Comparison of my grain size analysis with that of

The first erosion rate data:

- 0.25 - 0.85 mm: 7 m/My ± 1.48
- 0.85 - 2 mm: 9 m/My ± 1.89
- 2 -10 mm: 10 m/My ± 2.19
Significance of the Results

Erosion rates in the context of other research:
- Matmon et al. (2003)
  25 - 30 m/My
- Reuter et al. (2004)
  4 - 54 m/My
- Spotila et al. (2004)
  10 - 20 m/My
- Naeser et al. (2005)
  20 m/My
- This study
  9 m/My