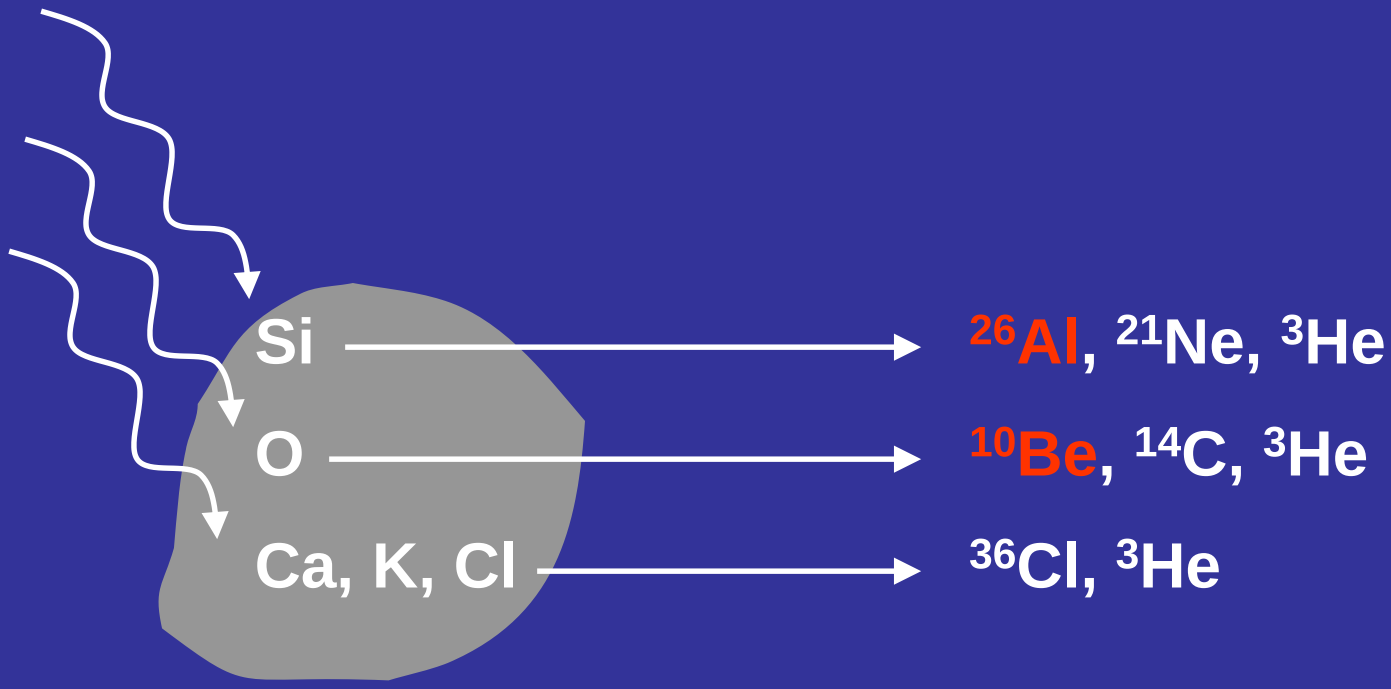
Conclusions of small-scale geomorphology

- Off road vehicles have lasting affects on desert environment
- Channels in walkway plots are bimodal and follow the orientation of rock alignments and the piedmont’s steepest gradient
- After 50 years the channels in walkway and road plots have not attained the characteristics of channels in control plots, mainly due to compaction and the rock alignments

Switch from human-induced rates to long-term rates of landscape change

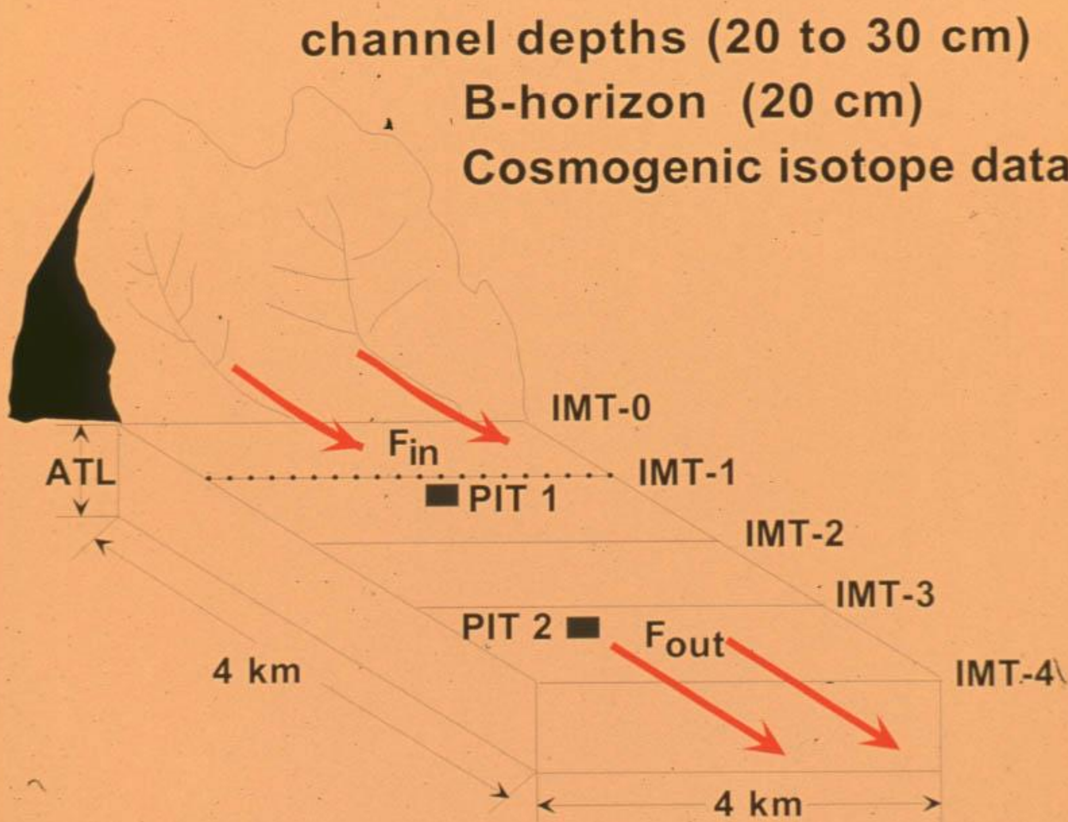
- Cosmogenic isotopes
- Tracers as sediment moves down piedmont
- Tracers at near surface to determine deposition rates

Cosmogenic Isotopes



The isotopes are like a suntan.

Link from centimeter-scale to large-scale sediment dynamics is the Active Transport Layer (ATL) thickness. The ATL is the depth to which sediment is well-mixed. We use the ATL to help determine the sediment flux across the piedmont.

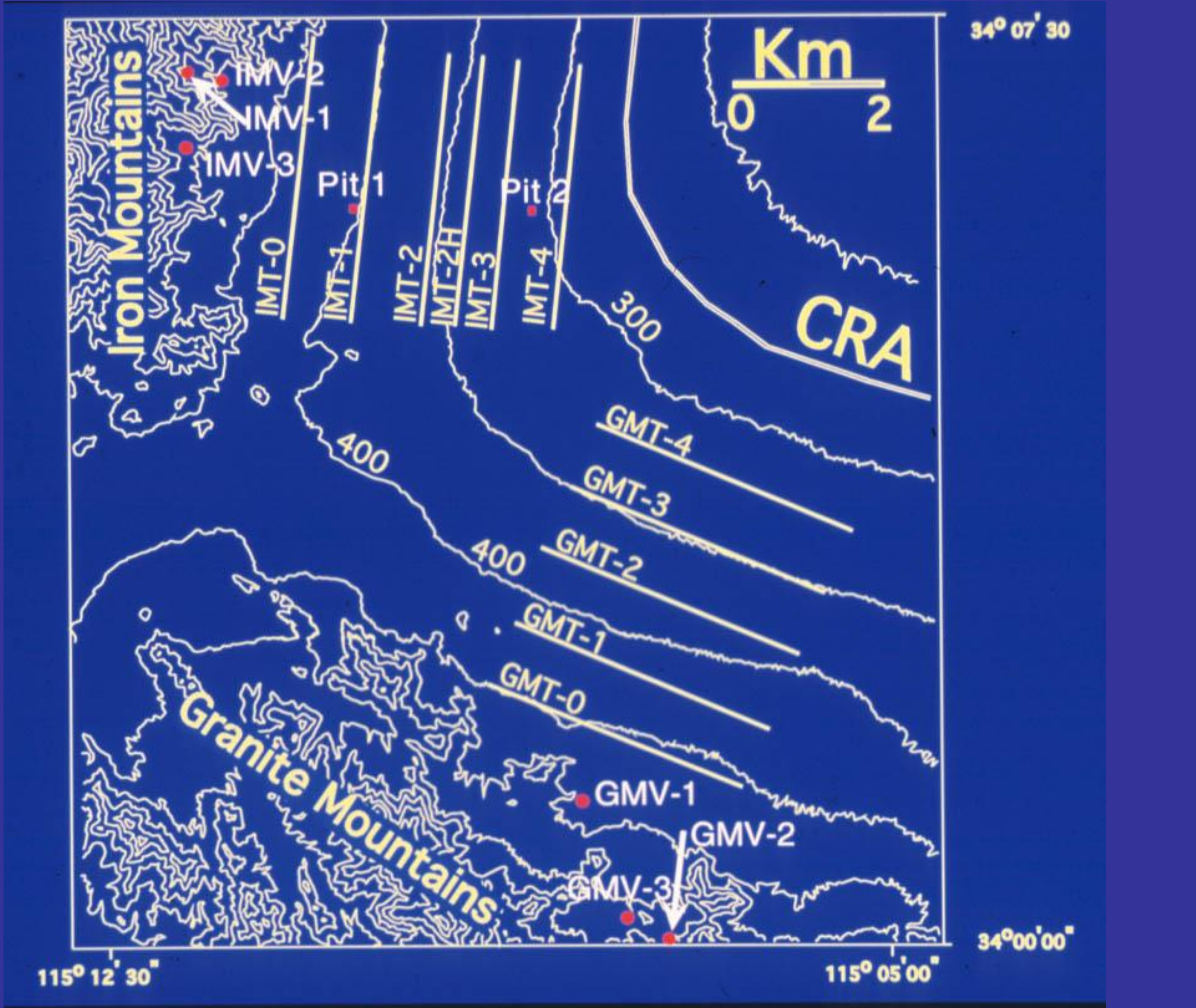


Objectives

1. Sediment residence time in low terraces
2. Depositional history of the piedmont
3. Sediment generation rates of source basins
4. Average sediment transport velocities

Three types of cosmogenic isotopes samples

- Integrated valley samples collected from streams that exit steep narrow basins of the Iron and Granite Mountains
- Integrated soil profiles from two pits on the Iron Mountain piedmont
- Integrated transect samples collected at 1 km intervals away from the Iron and Granite Mountain rangefronts



34° 07' 30
Km
0
2
Iron Mountains
IMV-2
IMV-1
IMV-3
Pit 1
Pit 2
IMT-0
IMT-1
IMT-2
IMT-2H
IMT-3
IMT-4
300
CRA
400
GMT-4
GMT-3
400
GMT-2
GMT-1
GMT-0
Granite Mountains
GMV-1
GMV-2
GMV-3
34°00'00"
115° 12' 30"
115° 05' 00"

Valley Sample

Transect Sample

Soil Pit Samples

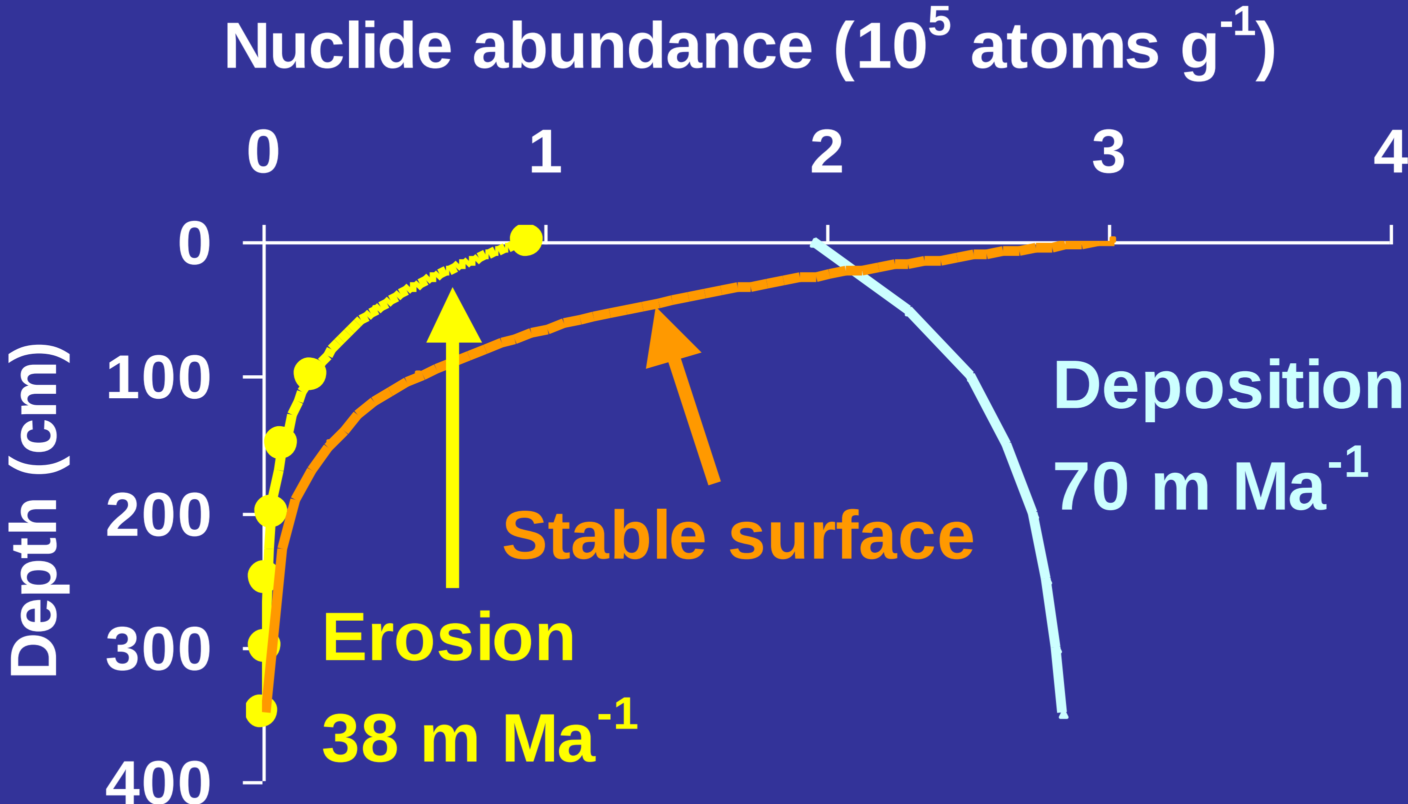
Sediment generation rates

valley data determine mountain mass erosion and sediment generation rates (Bierman and Steig, 1996):

$$m = \frac{\Lambda P}{C}$$

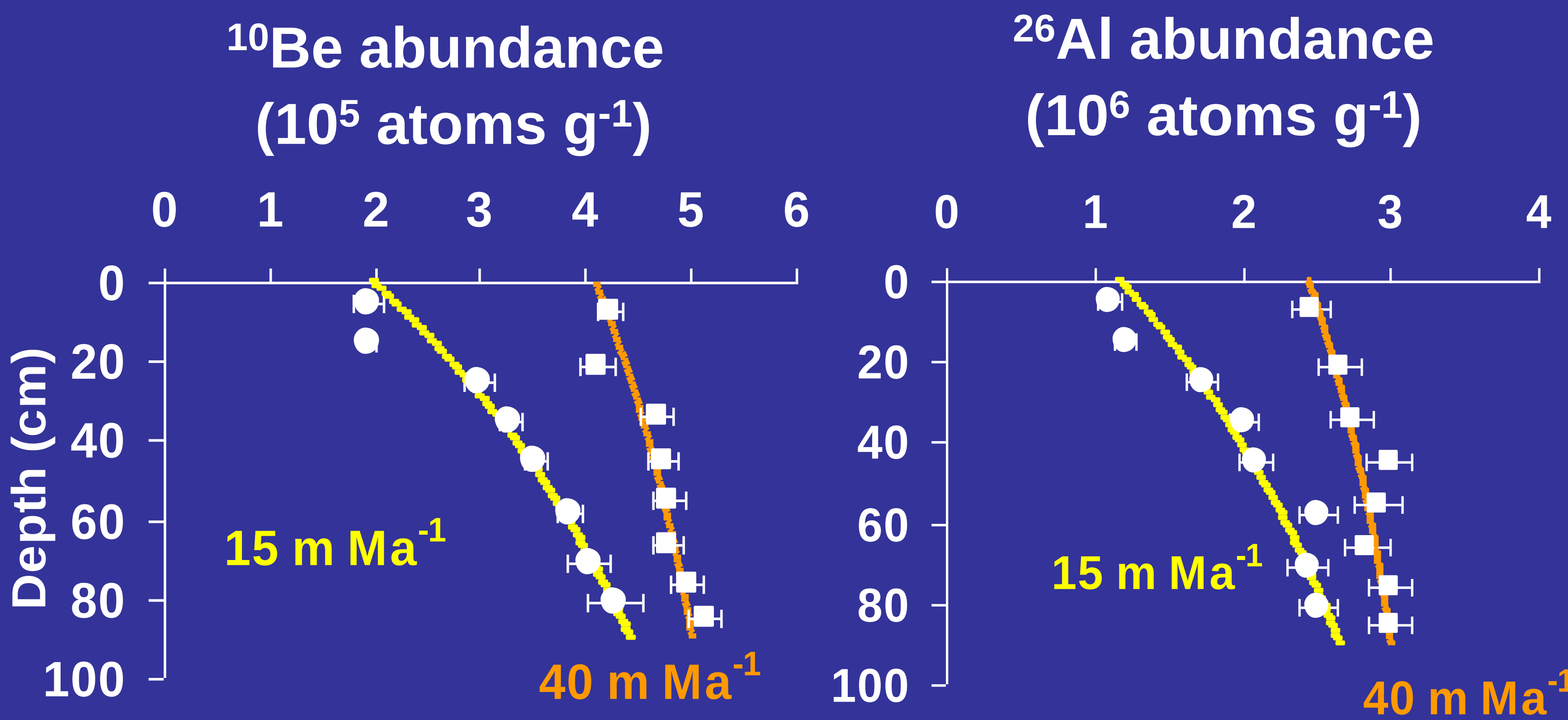
Average sediment generation rates are $0.127\ m^3\ y^{-1}\ m^{-1}$ for Iron Mountains and $0.098\ m^3\ y^{-1}\ m^{-1}$ for Granite Mountains.

Predicted depth profiles for *stable*, *erosional*, and *depositional* surfaces



$$P_x = P_o e^{-(x\rho/\Lambda)}$$

Pit 1 Pit 2

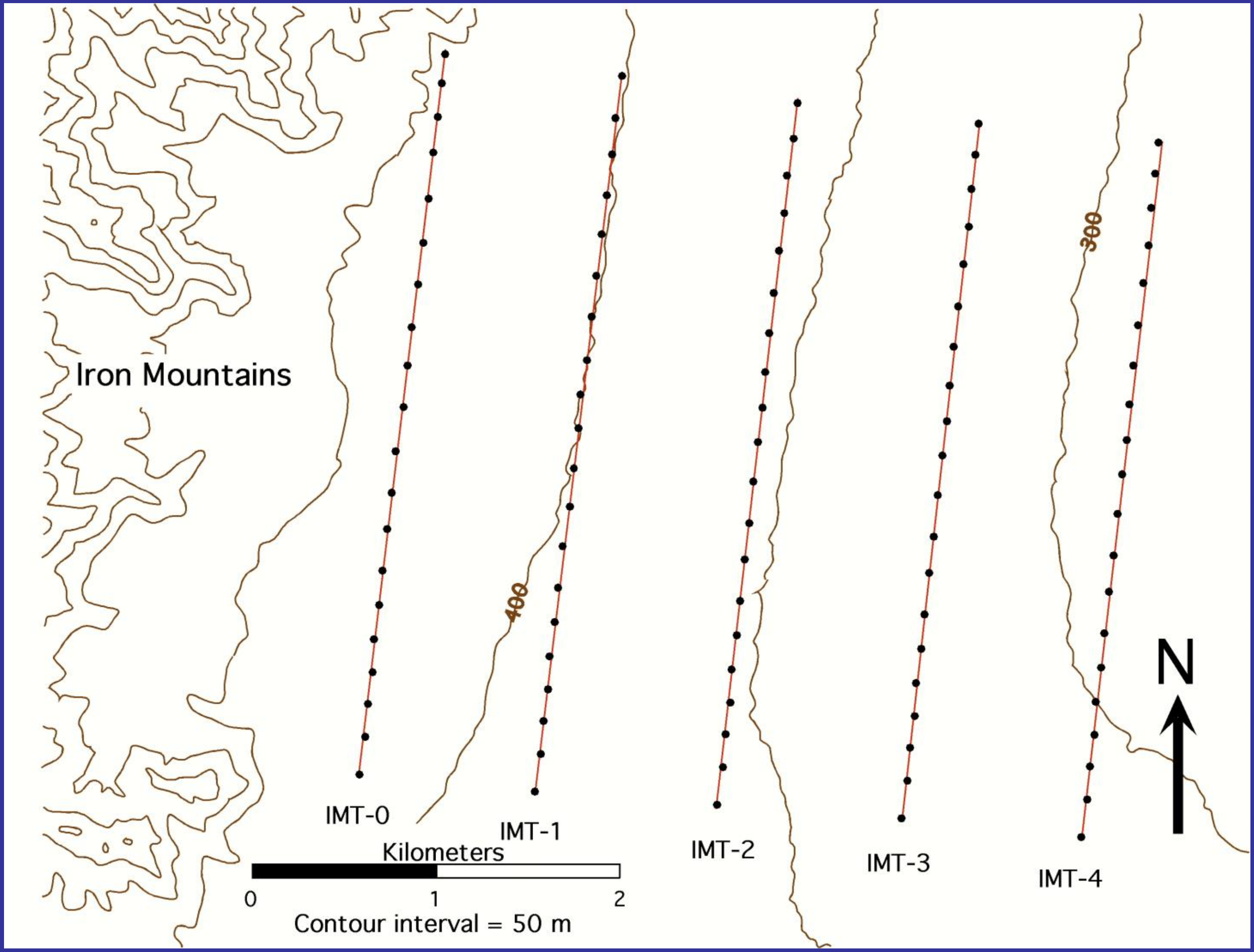


$$N = C_i + \frac{1}{s}\int_0^h P_0 e^{(-z\rho/\Lambda)}\,dz$$

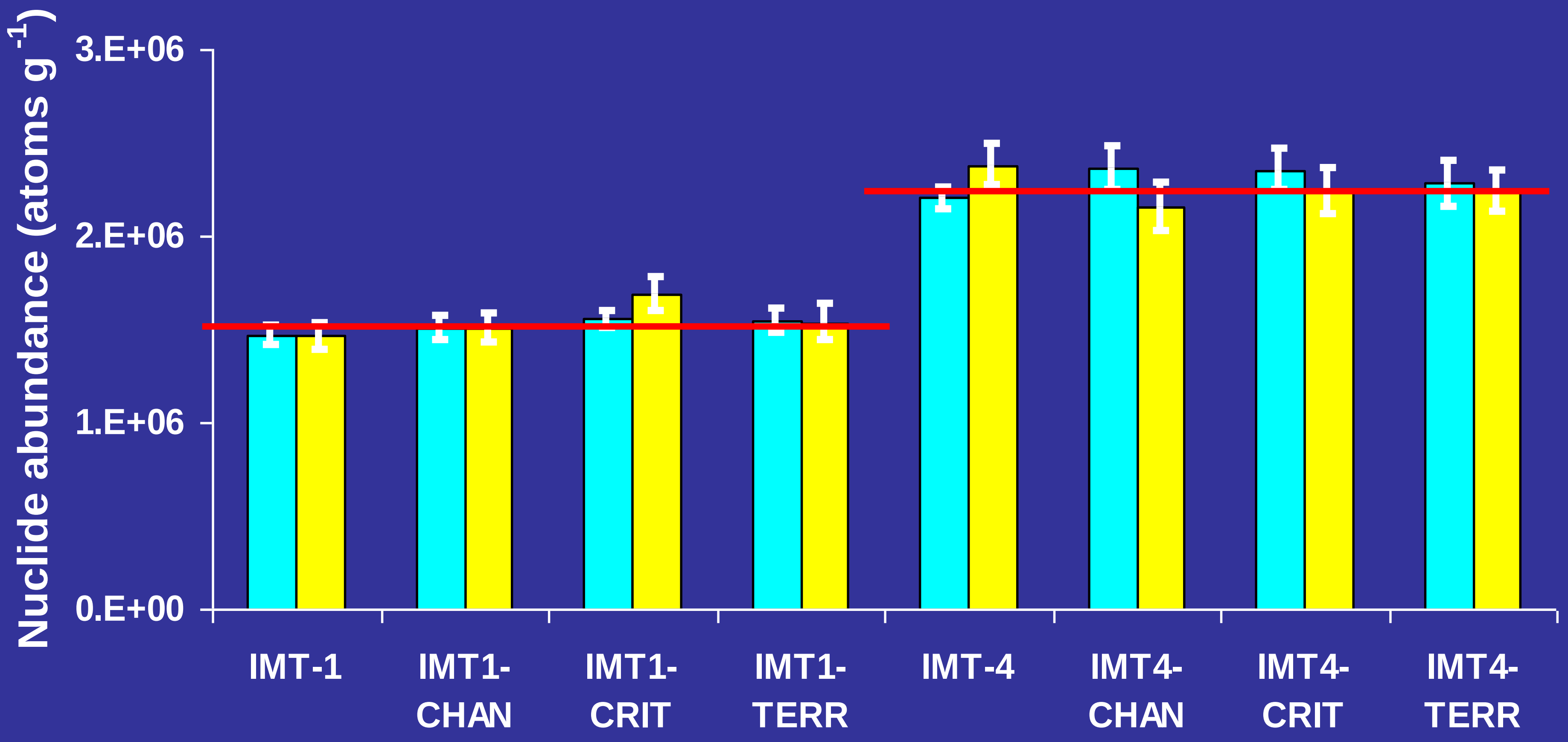
Unconformity

- Lower nuclide abundances = less dosed sediment
- Nuclide difference represents a period of time
- Soil pit 1 ^{10}Be difference represents ~15 ka and ^{26}Al difference represents ~6 ka

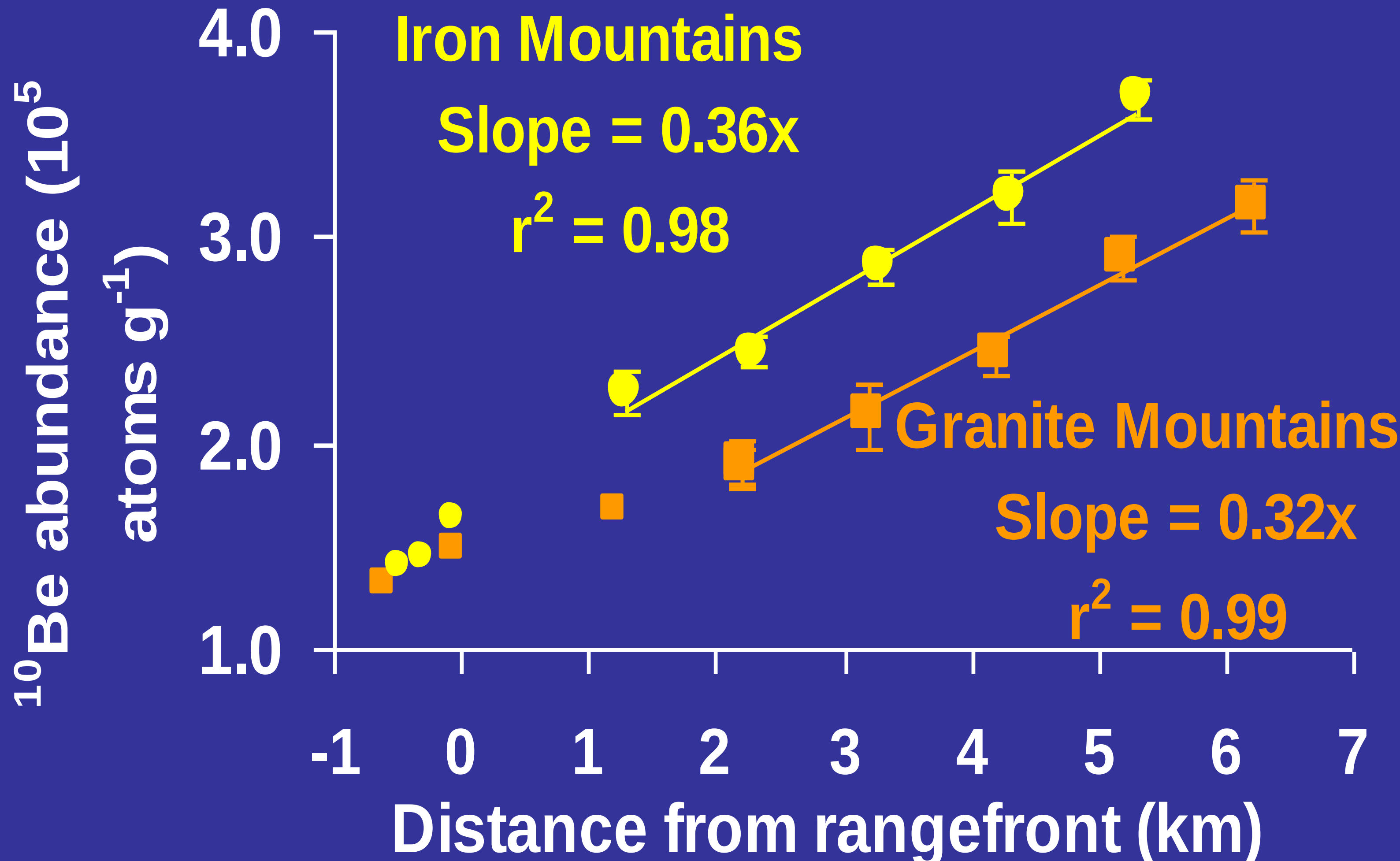
Iron Mountain transect samples



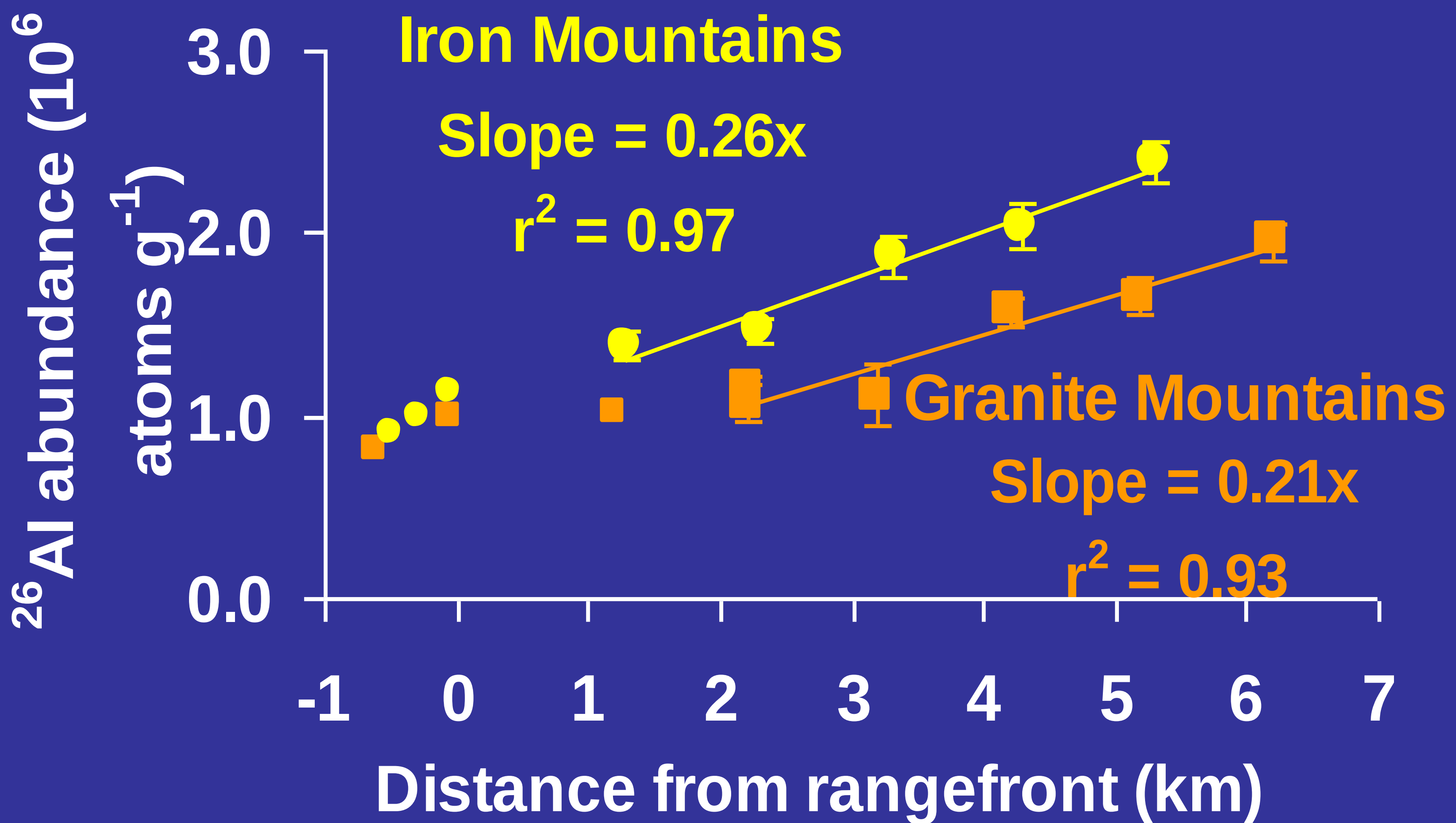
Channels “firehose” across the surface



Incredible Linearity



More linear trendlines!



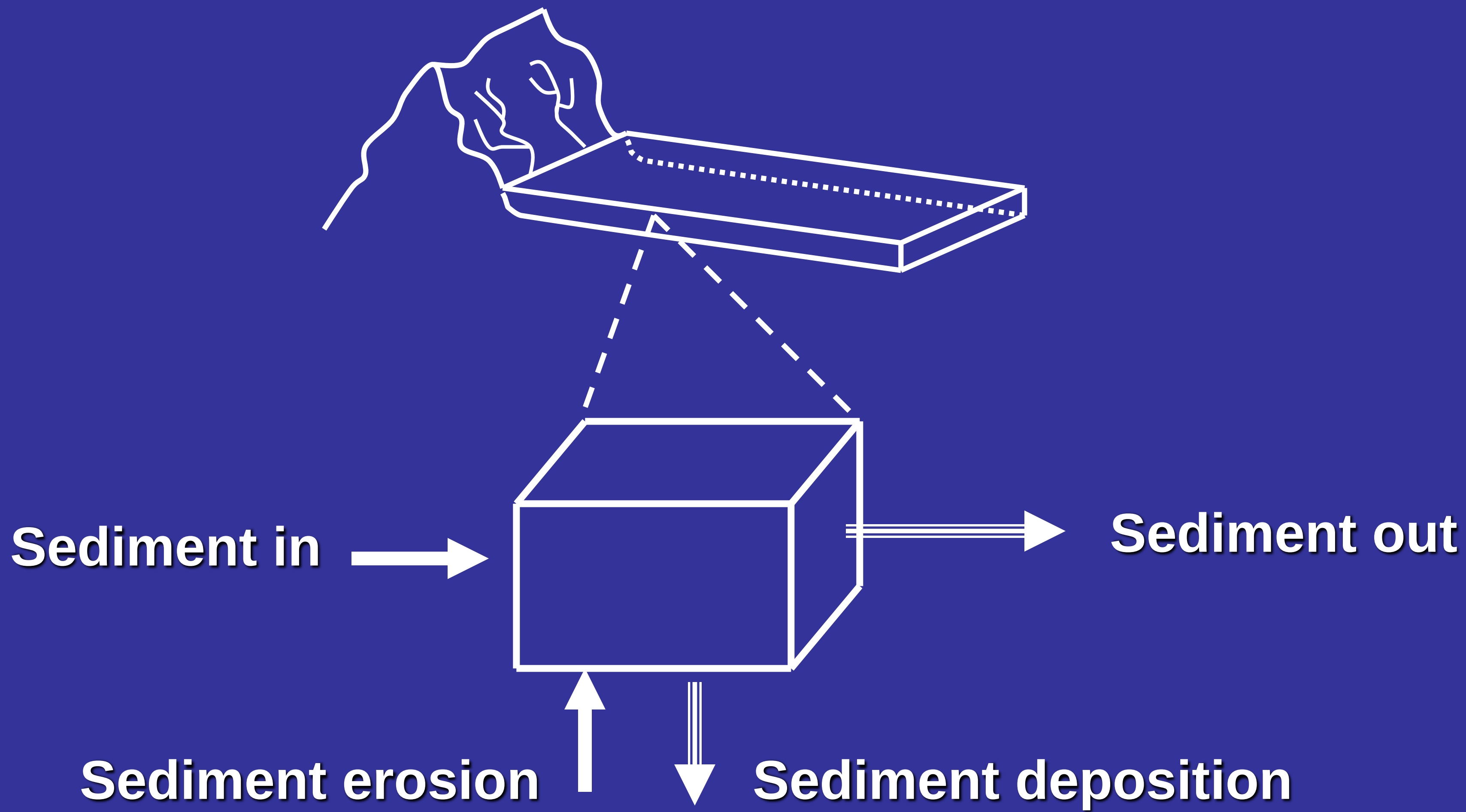
Three endmember processes

1. Depositional surface

2. Surface of transport

3. Erosional surface

Model Equation

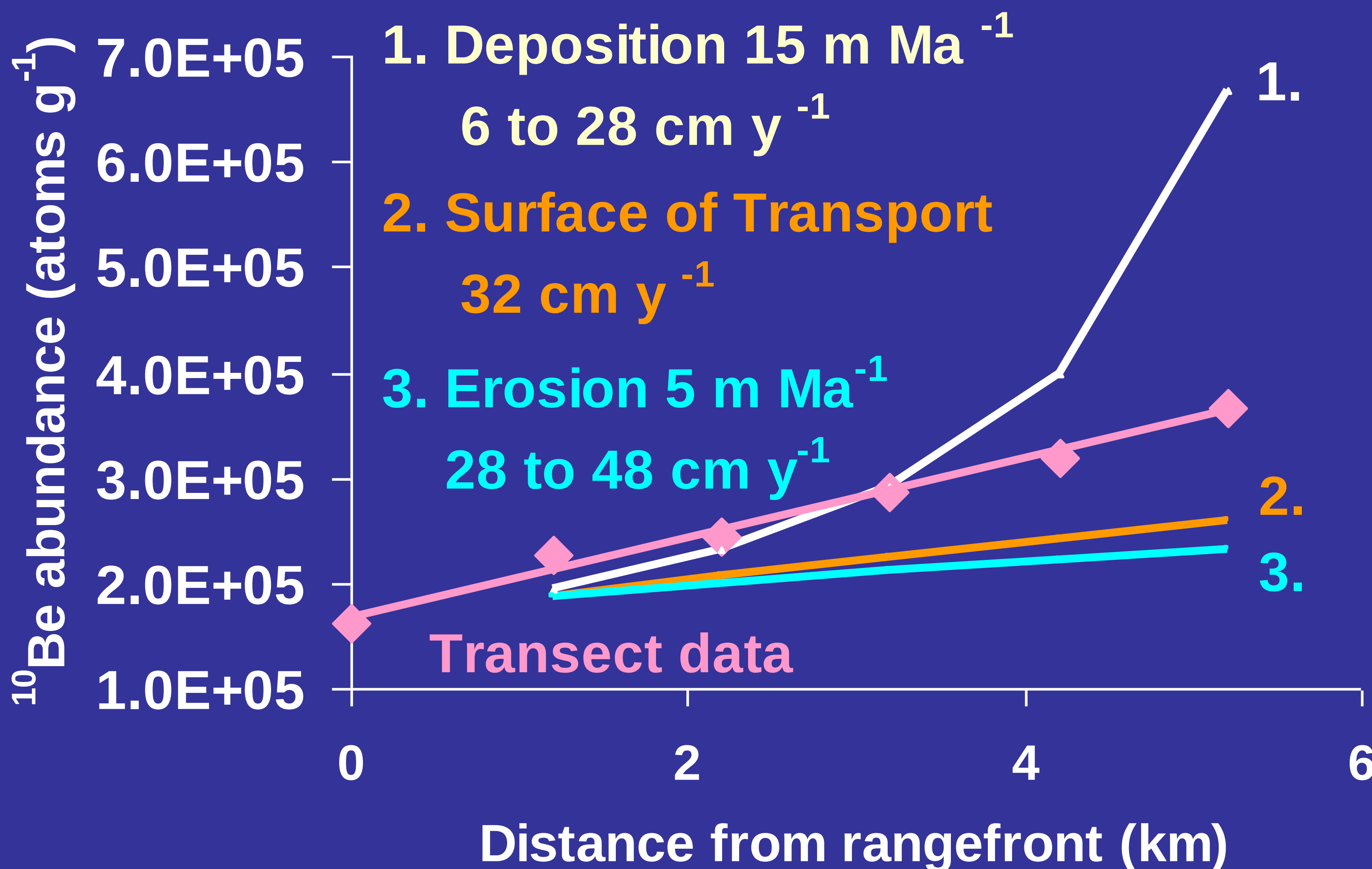


Constraints on piedmont deposition and active layer

- Deposition rates are not uniform across piedmont (15 m Ma^{-1} to 40 m Ma^{-1})
- Deposition rates are not uniform through time (unconformity from ~5 to ~15 ka at soil pit 1)
- Active layer is well-mixed and thickness (20 to 30 cm) is spatially uniform

Mixed layer or active layer is uniform thickness (20 to 30 cm) as determined from

- measurement of B-horizon depth
- measurements of maximum channel depths



1. Deposition 15 m Ma -1
6 to 28 cm y -1
2. Surface of Transport
32 cm y -1
3. Erosion 5 m Ma-1
28 to 48 cm y-1
Transect data
1.
2.
3.
10Be abundance (atoms g-1)
7.0E+05
6.0E+05
5.0E+05
4.0E+05
3.0E+05
2.0E+05
1.0E+05
0
2
4
6
Distance from rangefront (km)

Mixed model assumes

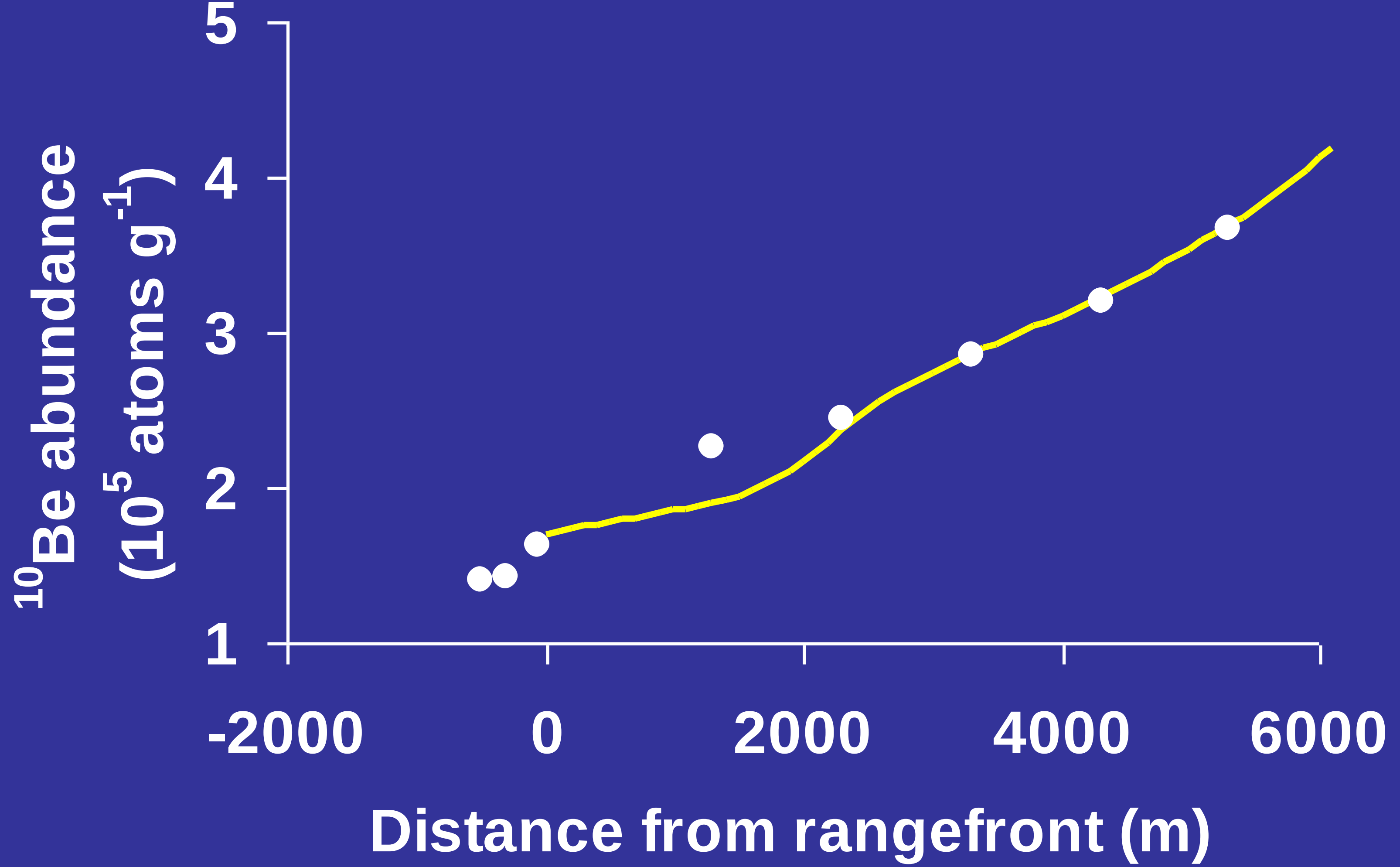
Pre-unconformity

- 40 cm ATL
- 25 m Ma^{-1} erosion rates
- deposition of 15 m Ma^{-1}
- deposition of 40 m Ma^{-1}

Post-unconformity

- 30 cm ATL
- 38 m Ma^{-1} erosion rates
- surface of transport
- deposition of 40 m Ma^{-1}

Mixed Model



Velocities are 35 ± 10 cm y^{-1}

Remember

First estimates of:

- Consistent average sediment transport rates
- Sediment velocities (35 cm y^{-1})
- Sediment residence times in low terraces (< 1000 years)

Big picture using ^{10}Be and ^{26}Al:

- Sediment generation rates and flux of sediment across piedmonts
- Constrain complex surface histories of piedmonts

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