Geodynamics

Climatic, geomorphic and geodynamic processes
Lecture 13.6 - Tectonic response to erosion

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Goals of this lecture

- Present some examples of how tectonic models respond to erosion
Tectonic response to erosion

MODEL 1:
- one layer crust
- strong coupling
- mantle subducted
- no denudation

Convergence 1.5h

b) Velocity and Strain Rate

Pro ——— Step-up shear zones ——— Retro

0°C 325°C

325°C

0°C

S

S

c) Deformation and Temperature

Pro-wedge ——— Plug ——— Retro-wedge

0°C 325°C

325°C

S

S

d) Strain

Distributed Thrust Belt ——— Crustal Scale Shear Zone ——— Foredeep

4.5h

Flexural Subsidence

Beaumont et al., 2000
Tectonic response to erosion

MODEL 1:
- one layer crust
- strong coupling
- mantle subducted
- no denudation

\[ a) 0^\circ C \quad 2 \text{ cm/yr} \quad 325^\circ C \]

Convergence 1.5h

b) Velocity and Strain Rate

\[ \text{Pro} \quad \text{Step-up shear zones} \quad \text{Retro} \]

c) Deformation and Temperature

\[ \text{Pro-wedge} \quad \text{Plug} \quad \text{Retro-wedge} \]

\[ 0^\circ C \quad 325^\circ C \quad 325^\circ C \]

d) Strain

\[ \text{Foredeep} \quad \text{Distributed Thrust Belt} \]

\[ \text{Crustal Scale Shear Zone} \quad \text{Foredeep} \]

\[ \text{Flexural Subsidence} \]

Beaumont et al., 2000

MODEL 2:
- one layer crust
- strong coupling
- mantle subducted
- total denudation

\[ a) 0^\circ C \quad 2 \text{ cm/yr} \quad 325^\circ C \]

Convergence 1.5h

b) Velocity and Strain Rate

\[ \text{Pro-} \quad \text{Step-up Shear Zones} \quad \text{Retro-} \]

c) Deformation and Temperature

\[ \text{Denudation} \quad \text{Antiform} \]

\[ \text{Exhumed lower crust} \]

\[ 0^\circ C \quad 325^\circ C \quad 325^\circ C \]

d) Strain

\[ \text{Distributed Shear} \quad \text{Focussed Shear} \]

\[ \text{No flexure or Foreland Basins} \]

Beaumont et al., 2000
Tectonic and erosional response to climate

The prevailing wind direction determines how precipitation is distributed.

The resulting changes in erosion shifts the topographic high with respect to the ‘S-point’ and alters the distribution of strain.

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Beaumont et al., 2000
Tectonic and erosional response to climate

- The prevailing wind direction determines how precipitation is distributed.

- The resulting changes in erosion shifts the topographic high with respect to the ‘S-point’ and alters the distribution of strain.

What types of rocks would be exhumed and where in these scenarios?
Where can we test this hypothesis and how?

- So, we have a working hypothesis that climate can affect tectonics through erosion

- Where might we be able to test this theory?
- What data could we collect?
- What are the biggest challenges?

Tectonics

Climate

Topography

Erosion

There is much we still don't know about these processes and their interaction, and many opportunities for future research!
Where can we test this hypothesis and how?

• So, we have a working hypothesis that climate can affect tectonics through erosion

• Where might we be able to test this theory?

• What data could we collect?

• What are the biggest challenges?

• There is much we still don’t know about these processes and their interaction, and many opportunities for future research!
Let’s see what you’ve learned…

• If you’re watching this lecture in Moodle, you will now be automatically directed to the quiz!

• Reference(s):