

## GLACIERS

**GEOLOGY IN THE NEWS: New predictions made for a large earthquake along San Andreas Fault; former Clemson geology major on the research team.**

### I. EFFECTS OF GLACIERS

- Sea level change (melting glaciers → rising oceans)
- Melt all glaciers → sea level rise of ~65 m (200+ ft)
- Glaciers trap huge amounts of water, sea level has risen ~120 m since last ice age
- **Isostatic depression**- glaciers causing crust to sink
  - East Antarctic ice sheet = up to 2.5 km of isostatic depression
- **Isostatic rebound**- crust trying to come back up
- Thermohaline circulation- melting glaciers cause circulation of ocean currents to slow down
- Drinking water & irrigation- Washington gets ~470 bil gallons a year from glaciers

### II. GLACIER BASICS

- **Glacier**- chunk of ice that is in motion
- Ice on Earth
  - Currently cover 9-10% of Earth's land area
    - Antarctica: 85%
    - Greenland: 10%
  - Ice on Antarctica exceeds 4200 m (2.5 mi) in max thickness
- Forming a glacier
  - **Granular snow**- slightly more compact form of snow
  - **Firn**- denser snow, like pellets of ice
  - **Glacial ice**- even denser snow, like chunks of dense ice
  - Requires time, cold, & precipitation
- Types of glaciers

- o **Valley glaciers**- form in valleys & basically fill them up (aka **mountain glaciers**, **alpine glaciers**)
  - Make up a lot of small glaciers all over the world
    - Ex: Mt. Kilimanjaro (elevation ~20,000 ft)
- o **Continental glaciers**- cover significant portions of a continent (aka **ice sheets**)
- Glacial advance & retreat
  - o **Accumulation**- phase where glaciers are building up more ice, this allows it to creep forward, uphill end
  - o **Ablation**- glacier end that is melting, downhill end
  - o **Firn line** (aka equilibrium line)- glacier not getting bigger or smaller
    - If most of glacier is accumulating, it is moving forward
    - If most of glacier is ablating, it is getting smaller
- Glacial movement
  - o Speed varies within one glacier due to differences in friction
  - o Some move meters per day, some just creep
- Types of movement
  - o **Plastic flow** (>50 m thick)- ice is compacted at bottom of glacier, moves downhill crystal by crystal (slow)
  - o **Basal slip**- at bottom of glacier, layers of liquid water remain on ground, water reduces friction & allow glacier to move much more rapidly
    - Like slip & slides or ice skating
- **Crevasses**- low pressure at glacial surface, so ice reacts in a brittle fashion, on top of plastic flow

### III. **GLACIAL EROSION**

- **Abrasion**- ice dragging across & breaking off bedrock
  - o More like a dump truck than a bulldozer
  - o Rock pieces stuck in the glacier
- **Plucking**- glaciers pick up HUGE pieces of rock, happens when glacier moves over a hill, alters shape of the hill

- Erosive features
  - o **Striations**- area where straight grooves have been etched into the solid rock
  - o **U-shaped valleys**- due to valley glaciers
  - o **Hanging valleys**- also due to valley glaciers, U-shaped valleys connecting to other valleys, glaciers merge together, sometimes marked by waterfalls
  - o **Cirque**- bowl-shaped valleys very high up in the mountains, where the glacier started
  - o **Tarn**- lake or pond filling up a cirque
  - o **Horn**- very sharp & pointy mountain peak, multiple glaciers on different sides carved the mountain into this pointy shape
    - Ex: Matterhorn
  - o **Arête**- thin ridges dividing valleys between glaciers
  - o **Roche moutonnée**- big solid bodies of rock with a very asymmetrical shape, a lot of plucking, glacier moved towards steeper slope

#### IV. GLACIAL SEDIMENT DEPOSITS

- **Till**- extremely poor rounding & sorting, form when glacier melts & sediment is dumped in the place of melting
- **Outwash**- better rounding & sorting, stuff getting washed out of glacier when glaciers melt
- **Erratics**- solitary, huge sediment particles in an area with no mountains or hills nearby, glacier dropped big chunk
- **Loess**- really fine-grained particles that wind picks up & moves after a glacier drops them, can be extremely good for agricultural areas (nutrient-rich, water supply)
- Depositional features
  - o **Moraines**- ridge of tills along edges of glacier
    - **Terminal moraine**- farthest advance of glacier
    - **End moraines**- ends of glacier, form as it retreats
    - **Lateral moraines**- sides of glacier
    - **Medial moraines**- middle of glacier