Surface currents are deflected by the Coriolis effect. In the northern hemisphere, the cause a clockwise rotation.

If the ocean current is regarded as layered, then each deeper layer moves more slowly than the overlying layer.

Layers that move slower will be acted on more strongly than those that moved faster. Therefore, the lowest layers are rotated 90 degrees and more to the surface layer.
Coriolis Force Action

- Surface currents are deflected by the Coriolis effect. In the northern hemisphere, the causes a clockwise rotation.
- If the ocean current is regarded as layered, then each deeper layer moves more slowly than the overlying layer.
Rotation of Current

- Layers that move slower will be acted on more strongly than those that moved faster. Therefore, the lowest layers are rotated 90 degrees and more to the surface layer.
Ekman forces along the shoreline

- The water column effected by the Ekman spiral has a net motion 90 degrees clockwise from the wind direction in the northern hemisphere.
- As wind moves from south to the north along the shoreline of the west coast of South America, the surface layer is forced to move away from the shore.
Average Flow

- The water column effected by the Ekman spiral has a net motion 90 degrees clockwise from the wind direction in the northern hemisphere.

- As wind moves from south to north along the shoreline of the west coast of South America, the surface layer is forced to move away from the shore.
Coastal Upwelling

- W represents wind blowing from south to north along the coast in the northern hemisphere.
- Black errors represent Ekman transport.
- Up stands for upwelling.
Upwelling

- If the upper 100 meters is forced to move away from the shore (wind to north to south, clockwise 90 degrees), deep water must move upward to replenish the shoreline water.

- Conversely, if the wind is to the north then surface water is pushed onto the shore where it downwells.
Coastal Upwelling - Peru

- The situation is the reverse in the southern hemisphere but this also leads to coastal upwelling.
Southern Hemisphere

- Gyres in the southern hemisphere rotate counterclockwise.
- As a consequence, the Peru current moves northward along the western edge of the continent. This forces surface water offshore and creates upwelling.
- Upwelling represents only 1% of ocean surface but supports >50% of the fish population.
Stream Transport

- **Saltation**: sand particle motion that consists of bouncing along river bed.
- **Suspension**: particle load that stays in suspension due to in part to turbulence.
- **Rolling**: motion caused by hydrostatic shear.

Illustration: Hamblin and Christiansen, Earth’s dynamic systems, fig. 12.5
Stream velocity

Stream velocity is greatest about 2/3 up from base. Erosion due to directional impact and rotation of current.