24. Ocean Basins

Background

The majority of the planet is covered by ocean- about _____%. So the majority of the Earth’s crust is ____________________.

This crust is hidden from view beneath the water so it is not as easily studied as continental crust. It is also not as variable as continental crust, which contains a mix of sedimentary, igneous and metamorphic rocks.

Oceanic crust is predominantly made of __________________ and _____________.

This makes the oceanic crust denser than continental crust. It is also thinner, so because of isostacy the continents stand higher than the oceanic crust, which forms deep basins filled with water.

The four major ocean basins are the Pacific, Atlantic, Arctic, and Indian Oceans.

The largest is the __________ Ocean, which contains ___% of all the water on Earth.

Smaller bodies of water called seas may be connected to the oceans, or may be unconnected. Some bodies of water on the continents called seas are actually large lakes because they do not have oceanic crust beneath them (e.g., ________________).

The Ocean Floor

For much of human history, it was assumed that the ocean floor was a vast, featureless plain. This assumption mostly resulted from the fact that the ocean floor couldn’t be observed directly.

   Is the seafloor really featureless?  YES or NO ?

We can now image the ocean floor using modern techniques such as:

_____________________ and ____________________.

The ocean floor contains numerous linear features that attest to the tectonic events that formed the oceanic crust. Much of the sea floor is also covered by sediments that have either been eroded off of the continents, or formed from the precipitation of __________ from sea water, or from shells of marine organisms.

The three main components seen along a transect of a typical ocean basin from one continent across the ocean to the next continent are as follows:

1) ___________________________ (closest to the continents)
2) ___________________________ (further away from the continents)
3) ___________________________ (furthest from the continents)
Continental Margins

The edges of the sea floor are actually marked by submerged parts of continental crust, where it turns into oceanic crust. These regions are called continental margins.

What are the three components of continental margins (moving away from the shoreline)?

1) ____________________________ (very slight slope towards the open ocean)
2) ____________________________ (slight increase in the slope)
3) ____________________________ (decreased slope towards the deep ocean)

Where does the change from continental crust to oceanic crust usually occur?

_____________________________________________________

The continental shelf can vary from __________________________ in width, although the depth of the water at their edges, where they turn into a continental slope, is pretty consistent at about __________ water depth.

Off the east coast of the United States, the continental shelf is ______________ wide, but off the west coast, it is ______________ wide. So the water gets very deep much quicker off the west coast.

Sometimes, the continental slope and shelf may be cut into by deep submarine canyons. These are often off the coast at the mouths of big rivers.

What is the average angle of the continental slope? ________

How steep can the continental slope get? ______________

The continental rise may or may not be present- off the east coast of the U.S. there is one, but off the west coast, the continental slope continues straight down into a deep ocean trench.

More than ____% of all sediments on the sea floor are on the __________________, and may be mostly land-derived sediment that rushed down the continental slope in the form of submarine landslides called ________________________________.

What are the two types of continental margins?

1) ____________________________ and 2) ____________________________

An active continental margin essentially represents a tectonic plate boundary right off the coastline.

Example: ____________________________ (a subduction zone)
Which plates?: ____________________________ and ____________________________

Active continental margins are very geologically active, with phenomena such as:

________________________ and __________________________.
Passive continental margins are far from tectonic plate boundaries.

Example: ____________________________________

Passive continental margins have wide continental slopes and rises, and are rarely associated with earthquake activity.

**Deep Ocean Basins**

What is the average depth of the ocean? ________________

Sunlight can only penetrate to a depth of about ___________ so the majority of the ocean is very dark and cold- only slightly warmer than freezing. The pressure in the ocean can reach as high as 1000 times atmospheric pressure. So we can only explore the ocean depths in highly advanced submersibles.

What are the three main components of deep ocean basins?

1) ____________________________
2) ____________________________
3) ____________________________

1) The abyssal plains are found beyond the continental slope and rise of a continental margin. They are the flattest places on Earth because the ruggedness of the sea floor has been buried by sediments deposited on the ocean bottom, mostly by turbidity currents.

Sediment also forms by settling out of ocean water far from land. This type of sediment is called _________________.

There are two types pelagic sediment:

_________________________________ and ________________________

2) The ocean trenches are the deepest parts of the oceans, but only make up about _____% of the total ocean floor.

They represent the locations along active continental margins where oceanic crust is subducted beneath an adjacent tectonic plate. They are most common around the margins of the Pacific Ocean basin but also occur in the Caribbean, southern Atlantic, and Indonesia.

Trenches are usually a few hundreds of kilometers wide, thousands of kilometers long, and are often very linear.

Where is the deepest point in the ocean? ____________________________

How deep is it? ______________________

The steepest continental slopes are adjacent to trenches, sloping at about 25°.
3) The **mid-ocean ridges** are submarine volcanic mountain chains that rise up to 2.5 km above the surrounding plains.

   Example: ____________________________

Most mid-ocean ridges are connected to the others and extend a total of 43,000 miles around the Earth, making them the longest mountain chain on the planet.

The mid-Atlantic ridge is more than 2000 km wide. Like all ocean ridges, it is composed of basalt and gabbro.

Most ocean ridges are completely submerged, but in some places they protrude above sea level. Where does this happen? ________________________

What actually happens at ocean ridges? ________________________________

___________________________________________________________

Ocean ridges are sites of active volcanism, where new lava is constantly being extruded onto the sea floor, often forming bulbous or pod-like features in the lava called: 

_________________________

These pillow lavas erupt out of fissures, indicating that magma moves upwards from the magma chamber to the ocean floor along dikes. As a result of this consistent process at mid-ocean ridges, ocean crust has a characteristic form that can be broken down into a number of layers as follows:

   Top layer: __________________________
   Layer 2: __________________________
   Layer 3: __________________________
   Layer 4: __________________________
   Underlying mantle: _________________

Mid-ocean ridges do not all spread apart at the same rates. We typically differentiate slow spreading ridges like the Mid-Atlantic Ridge from fast spreading ridges like the East Pacific Rise. What is the dominant difference between these two types?

   Slow spreading ridge: __________________________
   Fast spreading ridge: __________________________

Because ocean ridges represent locations where two tectonic plates are moving apart from each other, there are tensional stresses present, and this often results in the development of ________________ (which cause earthquakes) and deep valleys called submarine rift valleys. They are up to 2 km deep and several kilometers wide.

If we look at the map of the ocean floor, we can also see many **fractures** in the sea floor that cut across the trends of the ocean ridges. These fractures cause offsets along the ocean ridges, and form because different parts of the ocean ridges pull apart at different rates.
Blocks of ocean crust slide past each other along these fractures. This makes them types of strike-slip faults that are called _______________________.

**Origin and Evolution of an Ocean Basin**

New seafloor along a mid-ocean spreading ridge must begin with the breakup of a continent through the process of continental rifting.

Example of where this has recently begun: ________________________________

Eventually the rift valley fills with water and the new ocean basin widens through time through the process of ______________________ along the submerged rift zone.

Ocean crust that spreads away from the mid-ocean ridge eventually gets consumed along a subduction zone. The angle of subduction may be shallow or steep depending on how dense the subducting ocean crust is. Ultimately, an entire ocean plate may get swallowed up along a subduction zone.

What ocean plate used to exist off the west coast of N. America? ________________

What do we call the remnants of this plate off the coast of the Pacific Northwest?

____________________________

**FINAL QUESTION:**

Because of this recycling of ocean plates, how young is the oldest ocean crust today?

____________________________