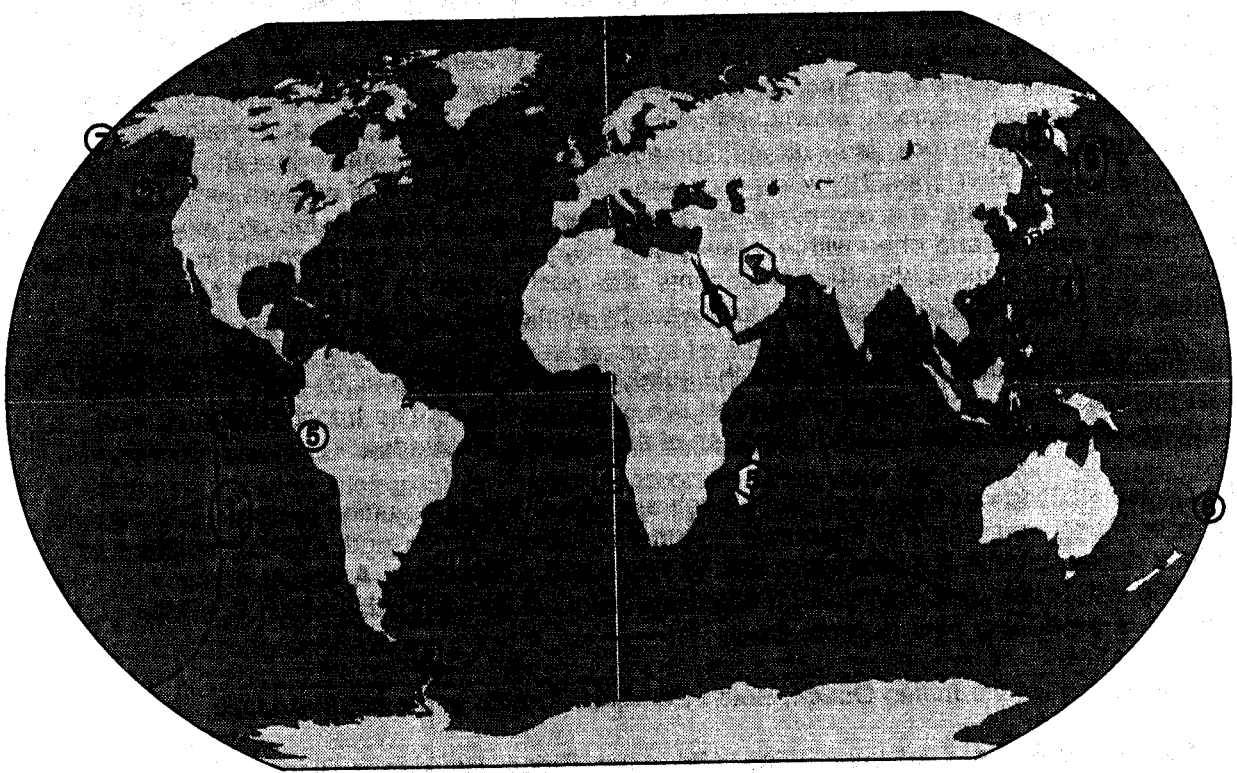
Exercise 4. Geography of the Oceans

This exercise acquaints students with major submarine geographic and topographic features. As with Exercise 3 (Sea-Floor Spreading and Plate Tectonics), it is useful to have large physiographic maps of the Atlantic, Pacific and Indian Ocean basins in the laboratory room.

1. See completed Figure 4–4 below.



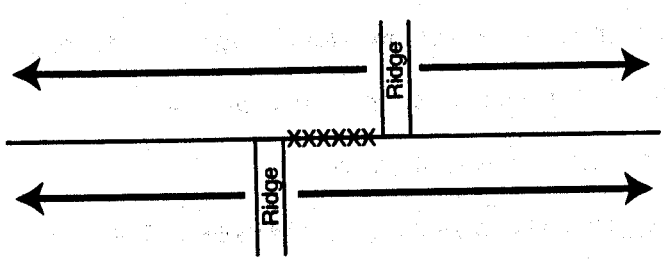
□ = Atlantic Ocean features

⬡ = Indian Ocean features

○ = Pacific Ocean features

Figure 4–4

2. Transform faults are represented by the Romanche and Eltanin fracture zones.



XXXX = Earthquake Epicenters

3. Major rivers flow into the Atlantic Ocean (depositing sediment across the ocean basin), whereas the Pacific Ocean is ringed by trenches that trap terrigenous sediments preventing them from being transported to abyssal plains. In addition, hot spots within the Pacific Ocean create high relief seamounts and guyots within the ocean basin.

4. The three ridges are continuous and part of the same midoceanic ridge system.

5. Guyots are flat-topped submerged volcanic mountains found along the seafloor. Dredge hauls from the tops often contain rounded cobbles of basalt, corals and other shallow marine fossils dating back millions of years. Therefore, the old volcanoes must have been at or above sea level at some past time, were eroded rapidly after the volcanic activity ceased and then the flat-topped seamount slowly settled into the ocean crust as the crust yielded to the weight of the volcanic rock (isostatic adjustment). The flat top suggests that they were eroded by wave action when they were near sea level. Observations of modern new volcanoes that reach the sea surface show that wave erosion rapidly cuts away the top of the volcano after activity ceases and often within a few years. Guyots are most often found in the Pacific Ocean and, like the more abundant seamounts, are most commonly formed near spreading centers and transported outward and downward by seafloor spreading.

6. The deepest spots in the oceans are in the subduction trenches (up to 10 km), where ocean crust plunges down at the contact between two colliding plates. The trench is formed over the downward moving plate, and at the base of the colliding plate edge.

7. The Carlsberg Ridge and the Red Sea Trough are part of the same rifting system. The ridge is a line of rifting and where it intersects continental plates (Africa and Arabia), splitting of the less dense, overlying continental plate has formed the Red Sea. A similar process is occurring where the Eastern Pacific rise enters the Gulf of California, which is another rifting area producing new oceanic crust.

8. a. Java Trench in the Indian Ocean, South Sandwich Trench in the south Atlantic.

   b. Mid-Atlantic Ridge, Carlsburg Ridge, Mid-Indian Ridge, Reykjanes Ridge.

   c. Chain Fracture Zone, Romache Fracture Zone.

   d. Divergent plate boundaries are marked by spreading centers, so any of the features in 8b above are examples of divergent plate boundaries.

   e. Convergent plate boundaries are marked by subduction zones, so any of the features in 8a above are examples of convergent plate boundaries.

   f. Western margin of South America, southwestern margin of Indonesia region.

   g. Eastern margin of North America, western margin of Africa

9. a. The seamount is a remnant volcanic structure.

   b. A deep submarine canyon cuts across the shelf at Monterey Bay.

   c. San Andreas Fault.

   d. There is no trench at the base of the shelf because the area is located within the Pacific plate (*i.e.* the plate boundary is located along the San Andreas Fault system to the east).