Answer Key

Answers to the Study Questions

1. No. Episodes of erosion and uplift may occur several times throughout the history of a mountain range. A newer range in a temporary erosional state may be lower than an older range in a temporary state of uplift.

2. The evolution of a mountain range can be dated by determining the radioactive ages of its rocks. The Appalachians are older than the West Coast mountains.

3. A Precambrian shield is a complex of Precambrian metamorphic and plutonic rocks exposed over a large area. These rocks represent the roots of very old mountain ranges.

4. Sedimentary rocks in cratons are relatively thin, and they are undeformed or only gently warped into basins and domes. In mountain belts, sediment is thick and characterized by intensive deformation.

5. Sedimentary rocks on the volcanically active part of a mountain belt contain much volcanically-derived rock; sedimentary rock on the craton side consists of rocks similar to those of the craton-limestones, shales, and sandstones.

6. Folds and faults indicate tremendous compressive stresses.

7. Most of the metamorphic rocks found in mountain belts were originally sedimentary and volcanic rocks that had been deeply buried and subjected to intense stress and high temperature.

8. The presence of granite batholiths suggests that large volumes of magma may have accumulated from partial melting of the lower crust and then welled upward.

9. Cross-cutting relationships and the necessity for uplift or tensional stress to create normal faults suggests that normal faulting took place after intense deformation.

10. Other geophysical information about mountain belts and continental crust:
    - The composition of the continental crust is approximately the same as that of granite.
    - The rocks of mountains are less dense than those of the oceans.
    - Crust is much thicker under mountains than under cratons.
    - Crust is thicker under younger mountains than under older ones.

11. A *mountain range* is an elongate series of mountains belonging to a single geologic unit. An elongate unit consisting of many mountain ranges, regardless of the degree of similarity of the ranges in form or age, is referred to in this course as a *mountain belt*. The American Cordillera is a mountain belt made up of several separate ranges.

12. You could have chosen any of the following fold-and-thrust ranges: the Appalachians, the Alps, the Canadian Rockies, the Urals, the Himalayas, and the Carpathians.

    Fold-and-thrust mountain ranges
    - develop from thick piles of sedimentary strata (predominantly marine strata).
    - are characterized by strata that have been compressed, faulted, folded, and crumpled.
    - always demonstrate metamorphism and igneous activity.

13. Four types of volcanic mountain ranges are
    - submerged seafloor mountains, such as the Mid-Atlantic Ridge.
    - partially submerged seafloor mountains, such as the chain of volcanoes that forms the Hawaiian Islands.
    - oceanic island arcs, such as the arc formed by the islands of Sumatra.
    - continental volcanic arcs, such as the Andes or the Cascade range.

14. Fault-block mountain ranges are separated from the intervening lowland areas by normal faults of great displacement; they may "replace" either former volcanic mountains or former fold-and-thrust mountains that once occupied the same sites, but that were worn down by erosion before the block faults were formed.

15. Continental crust underlies the continental shelf.

16. The continental shelf consists of relatively young sediment derived from land; sand is characteristic of the near shore zone, and fine-grained mud occurs farther offshore. Subsidence results in thick sequences of sandstone and shale, and in tropical climates, limestone.

17. Sediments deposited at converging plate boundaries are characterized by a large proportion of volcanic rock fragments derived from adjacent volcanic arcs. Volcanic rock fragments are rare in sediments deposited in opening ocean basins.

18. An *orogeny* is an episode of intense deformation of the rocks in a region.

19. As an island arc approaches a continent, it cannot be subducted because it is too buoyant. Continued convergence causes the sea floor seaward of the arc to break away from the arc and to begin subducting. A new trench is formed seaward of the former trench, and the direction of subduction is opposite to the original direction of subduction.

20. If the Atlantic Ocean ceased to spread and began to close,
    - a new subduction zone would develop at one of the continental margins;
    - a magmatic arc would develop near the seaward edge of the thick sequence of continental shelf and slope sediments;
    - sequences of sediments from both sides of the closing ocean would collide,
    - sediments would be compressed into folds and faults;
    - very limited subduction of continental crust would occur, until its buoyancy prevented further downward movement; and
    - the continents would be sutured together into a single, massive continent.

21. The Appalachians formed during closing of the predecessor of the Atlantic Ocean during the Paleozoic Period.

22. After an orogeny, uplift of the newly thickened continental crust occurs as it adjusts isostatically. As erosion occurs, uplift continues until the crust beneath the mountain belt is the same thickness as that of the ocean. Eventually the mountain belt is eroded to a plain.

23. The Basin and Range Province may have formed after compressive forces ceased, by simple isostatic uplift along normal faults. Extension in the Basin and Range is probably caused by hotter mantle rising beneath the Earth's crust.

24. *Tectonostratigraphic terrane* is a region within which there is geologic continuity. The geology in one terrane is markedly different from that of a neighbouring terrane.

25. An *exotic terrane* is one that did not form at its present site on a continent. It drifted into the continent of which it is now a part. An *accretion terrane* is one that developed in situ, as a result of orogeny and accretion along the continental margin.

26. A *suspect terrane* has rock types and ages different from those of adjoining terranes. Geologists study the paleomagnetic poles of the terrane's rocks to determine whether a terrane is exotic.