

FIGURE 6.6 Bowen's reaction series. Minerals that crystallize at higher temperatures are at the top of the series. On the left is the discontinuous reaction series, consisting of a succession of different minerals. On the right is the continuous reaction series, consisting of progressively changing plagioclase compositions. Rocks formed from minerals at the top of the series are mafic, while rocks made from minerals at the bottom of the series are felsic. The short arrows indicate reactions.

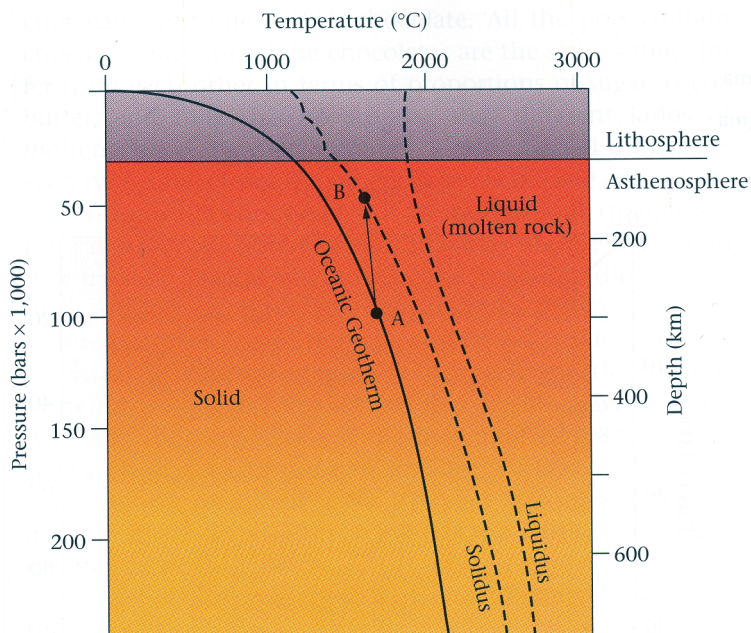
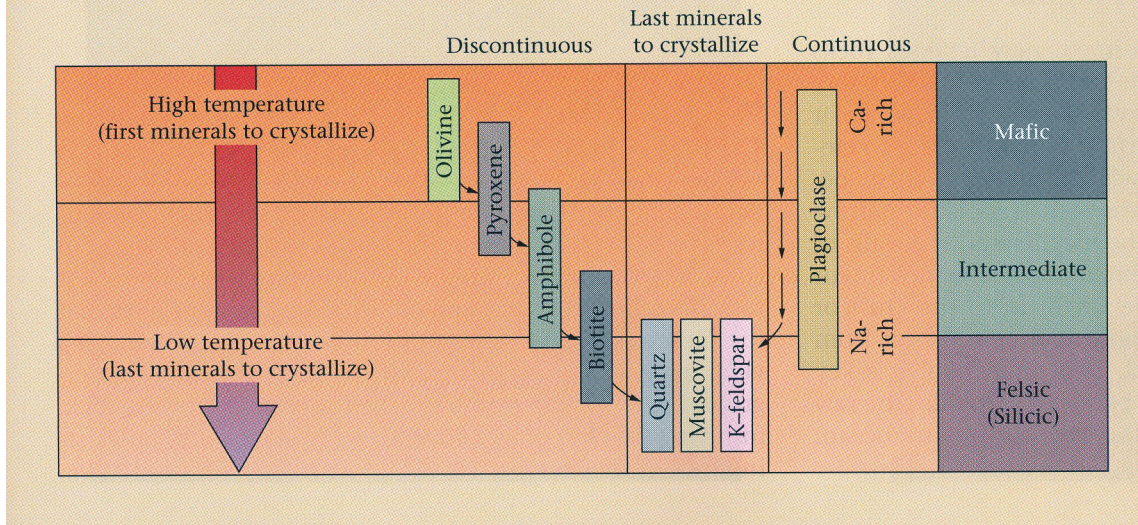


FIGURE 6.3 The graph plots the Earth's geotherm (solid line), which specifies the temperature at various depths below oceanic lithosphere, as well as the "liquidus" and "solidus" (dashed lines) for peridotite, the ultramafic rock that makes up the mantle. The "solidus" represents conditions of pressure and temperature at which a rock *begins to melt*, whereas the "liquidus" represents the conditions of pressure and temperature at which the *last solid disappears*. The region of the graph between the liquidus and solidus represents conditions under which there can be a mixture of solid and melt. Note that the geothermal gradient (the rate of change in temperature) decreases with greater depths; if it were constant, the geotherm would be a straight line. A rock that starts at pressure and temperature conditions indicated by point A, and then rises to point B, undergoes a significant decrease in pressure without much change in temperature. When it reaches the conditions indicated by point B, it begins to melt. This process is called decompression melting. Note that asthenosphere cools only slightly as it rises, because rock is such a good insulator.

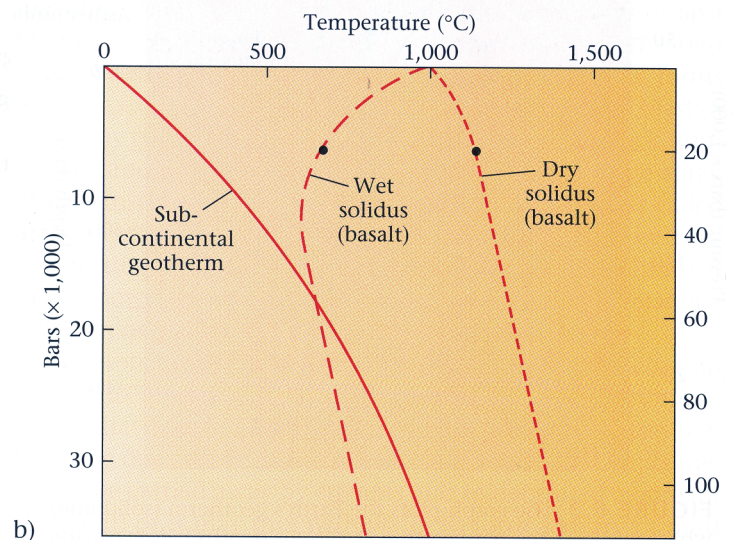


FIGURE 6.4b The addition of volatiles decreases the melting temperature. For example, at a depth of 20 km, the melting temperature of wet basalt (basalt that contains volatiles) is about 500°C lower than the melting temperature of dry basalt.