Amherst College
Department of Geology

MELTING AND CRYSTALLIZATION

Review your class notes and consider Figures 6.3 and 6.4 from your textbook (reproduced below).

Write a brief (one paragraph) explanation of why the mantle undergoes partial melting when it rises (decompresses) yet continental crust melts when it is buried (subjected to greater pressure). From this context, proceed with a brief (one paragraph) explanation of why granites and basalts are common but rhyolites and gabbros are rare.

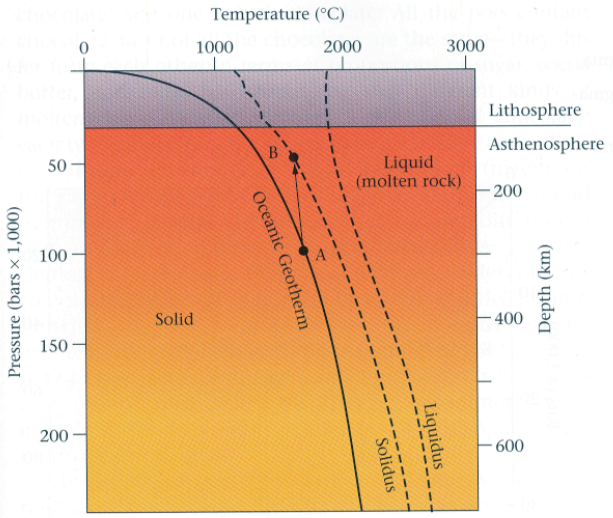

FIGURE 6.3 The graph plots the Earth's geotherm (solid line), which specifies the temperature at various depths below oceanic lithosphere, as well as the "liquidus" and "solidus" (dashed lines) for peridotite, the ultramafic rock that makes up the mantle. The "solidus" represents conditions of pressure 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.

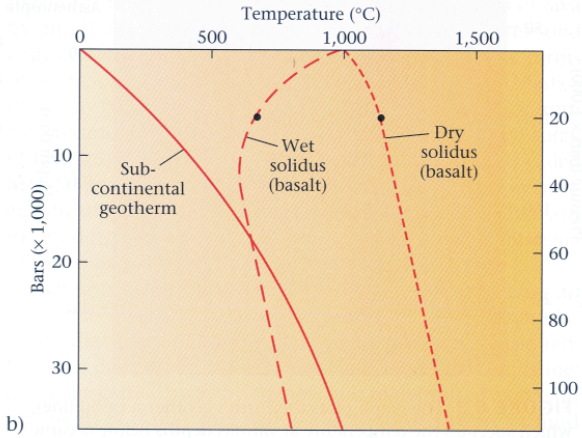

FIGURE 6.4b The addition of volatiles decreases the melting temperature. For example, at a depth of 20 km, the melting temperature of wet basalt (basalt that contains volatiles) is about 500°C lower than the melting temperature of dry basalt.