The plot above shows the temperatures of rocks at various depths at some location in the Earth (solid line). The solidus and liquidus lines are plotted for peridotite. Answer the following questions based on this graph.

1) Given this geothermal gradient, what temperature are rocks (in equilibrium) at 200 km depth?

~1,500 °C

2) Given this geothermal gradient, at what depth will peridotite (in equilibrium) begin to melt?

If it stays on this geothermal gradient (i.e. in equilibrium), it will not melt. This makes sense because if a typical geothermal gradient crossed the solidus line for peridotite, the mantle would be partially melted (i.e. a liquid). The mantle is NOT liquid, so this makes sense.

3) A mass of peridotite at 200 km depth (star A) gets caught in a convection cell and rises to the location marked by star B.

A. Give one possible reason why this rock does not follow the geothermal gradient?

Because rocks hold heat very well (i.e. they have a high specific heat), when moved by a convection cell, it may take considerable time for the rocks to reach equilibrium with the nearby rocks.

B. Once settling at location B, does the peridotite melt? If so, to what degree (partial or complete)?

Yes, the peridotite at location B will partially melt because it is past the solidus curve but not past the liquidus curve.

4) The hot mass of peridotite is now sitting at ~70 km depth (within the continental crust) and heats the surrounding felsic rocks to the point where they begin to melt. Which minerals will melt first?

A. Felsic    B. Intermediate    C. Mafic

5) In terms of compositional changes, what will this partial melting of the continental crust do to the peridotite melt?

A. The melt will become more felsic    B. The melt will become more mafic

6) What about the partially-melted continental rocks?

A. The remaining rock will become more felsic    B. The remaining rock will become more mafic