

Phase changes in the earth's crust

enough to saturate the melt at all times, the melting in the wet system will appear as in Fig. 4(b). If the vapour-pressure curve of the hydrate intersects the melting curve as shown in Fig. 4(b), then the system $A \cdot H_2O$ (no excess water) will melt as in Fig. 4(c). These curves, intermediate between the totally dry and wet curves, are those that are most likely to be significant if melting occurs near the base of the earth's crust.

Experiment shows that the first fractions of melt likely to be formed by this process have a composition similar to rhyolites which occur as surface volcanic rocks and granites which form huge intrusive bodies of igneous rocks invading various crustal levels. The accumulation of this liquid into huge drops which rise, is possibly related to the viscosity contrast between a partially molten zone and unmelted cooler crust. Small drops of light liquid can rise rather rapidly in

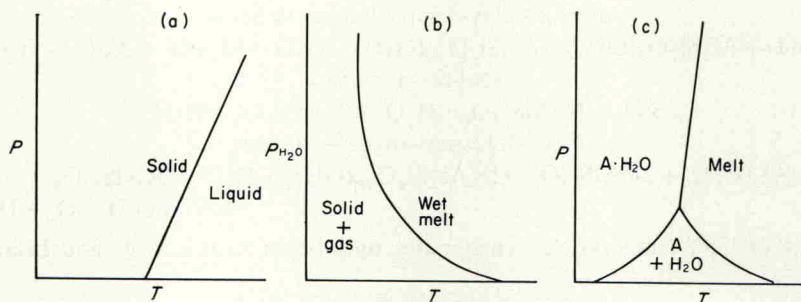
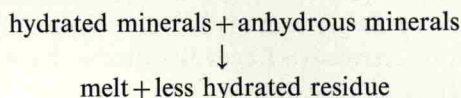


Fig. 4. Melting relations in a system A with and without water. (a) The dry system. (b) The system with excess water, $P = P_{H_2O}$. (c) The system when water is contained only in a hydrate $A \cdot H_2O$ where the vapour-pressure curve of the hydrate intersects the depression of freezing curve.

the hot zone but will slow down in the cool zone. If we apply Stoke's law to such a problem we see why only large drops can invade the viscous solid crust.

As soon as partial melting commences dehydration reactions now proceed via the general process:



The water of dehydration now rises to the surface as part of a fluid phase dominated by silicate liquid. While the condition

$$P_{\text{fluid}} \simeq P_{\text{Lithostatic}}$$

may still apply, it must be remembered that P_{H_2O} is only a part of P_{fluid} possibly a part as small as 10 per cent. Thus in the migmatite zones we must consider dehydration reactions where the solids are under greater pressure than the