

Binary system

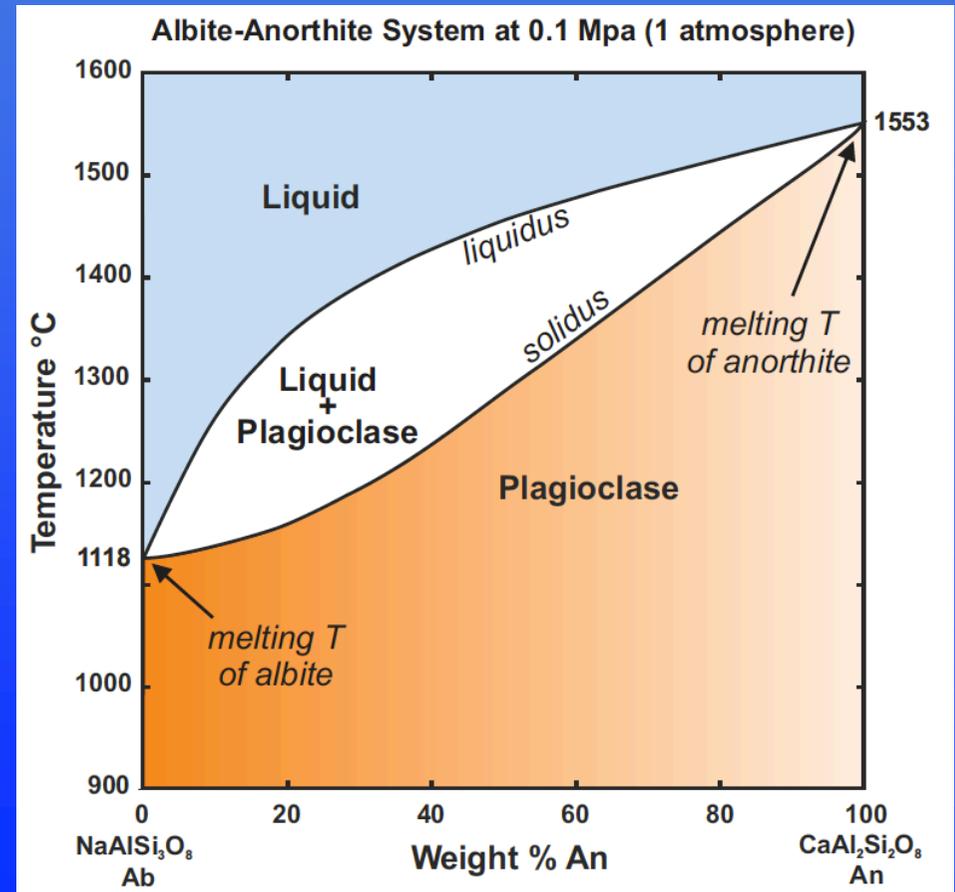
Binary systems with complete solid solution

Plagioclase series => $\text{NaAlSi}_3\text{O}_8$ – $\text{CaAl}_2\text{Si}_2\text{O}_8$
Albite

Anorthite

Isobaric T-X phase diagram at P_{atm} $\frac{\text{Ca}}{(\text{Na}+\text{Ca})}$
Intensive variables here are T and X ()
P is fixed

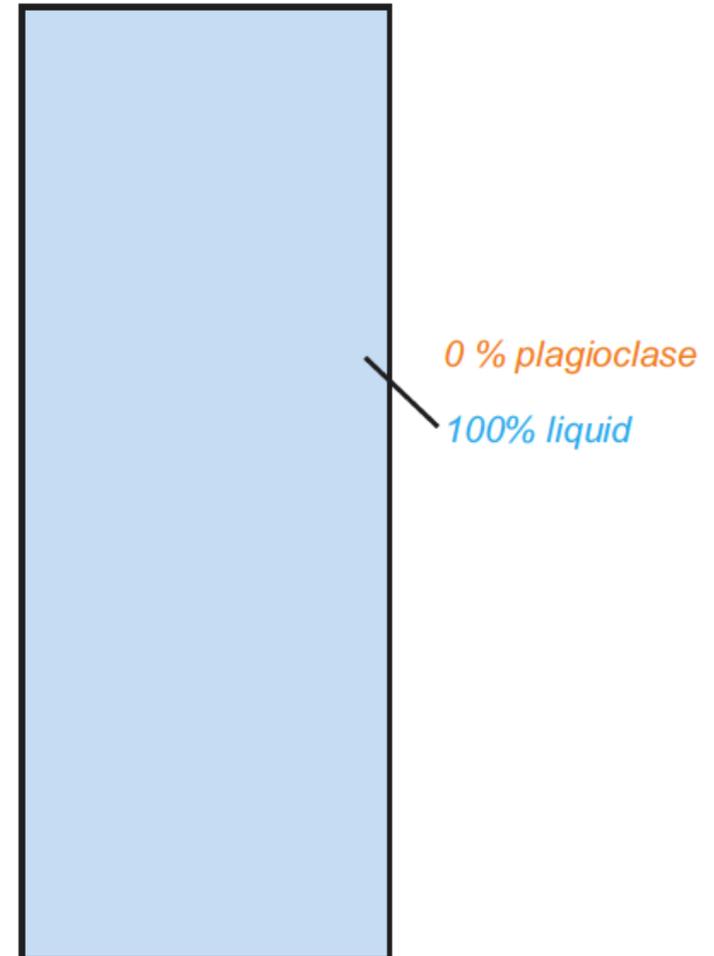
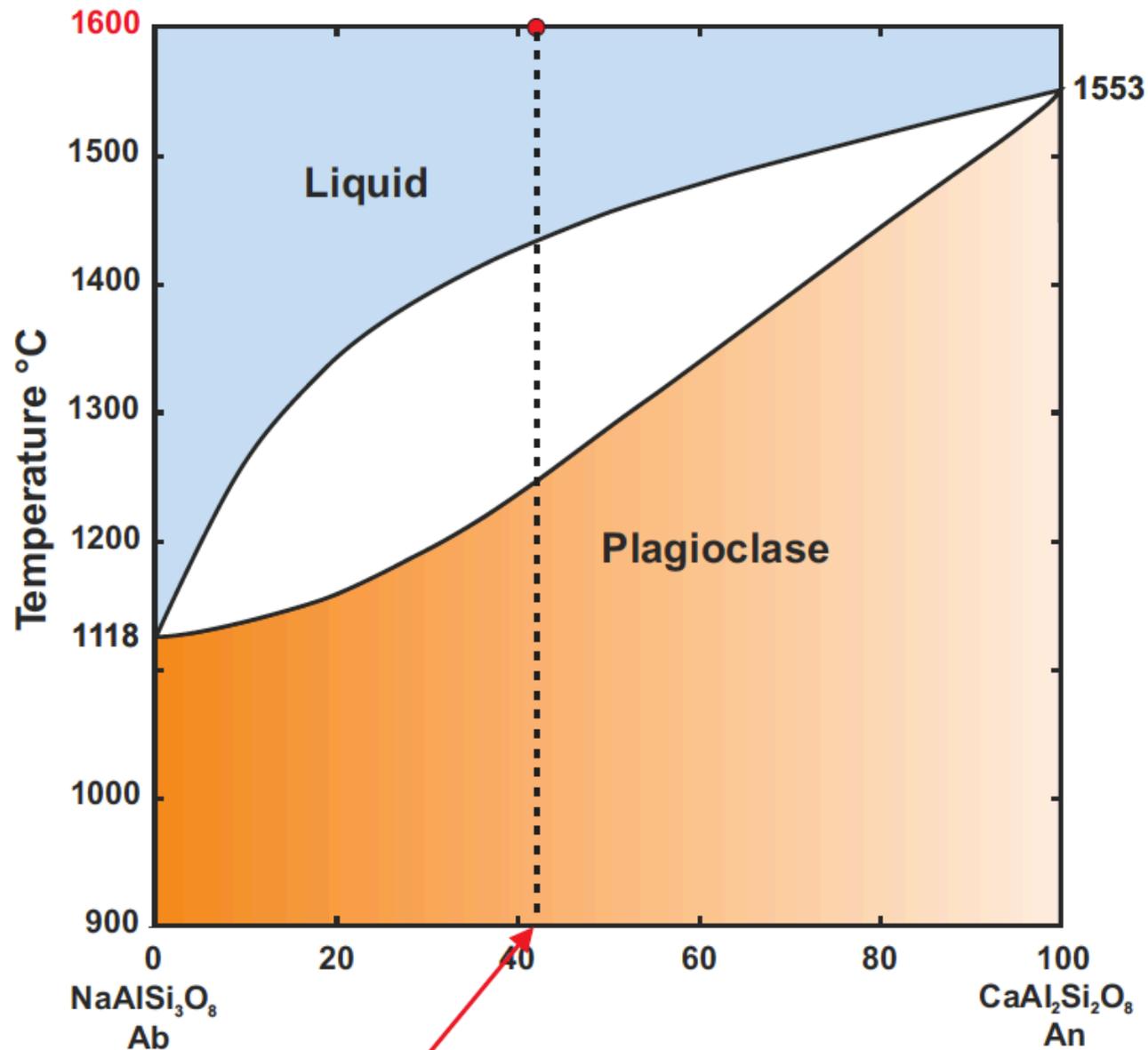
Crystallization at equilibrium



Starting liquid composition is An_{42}

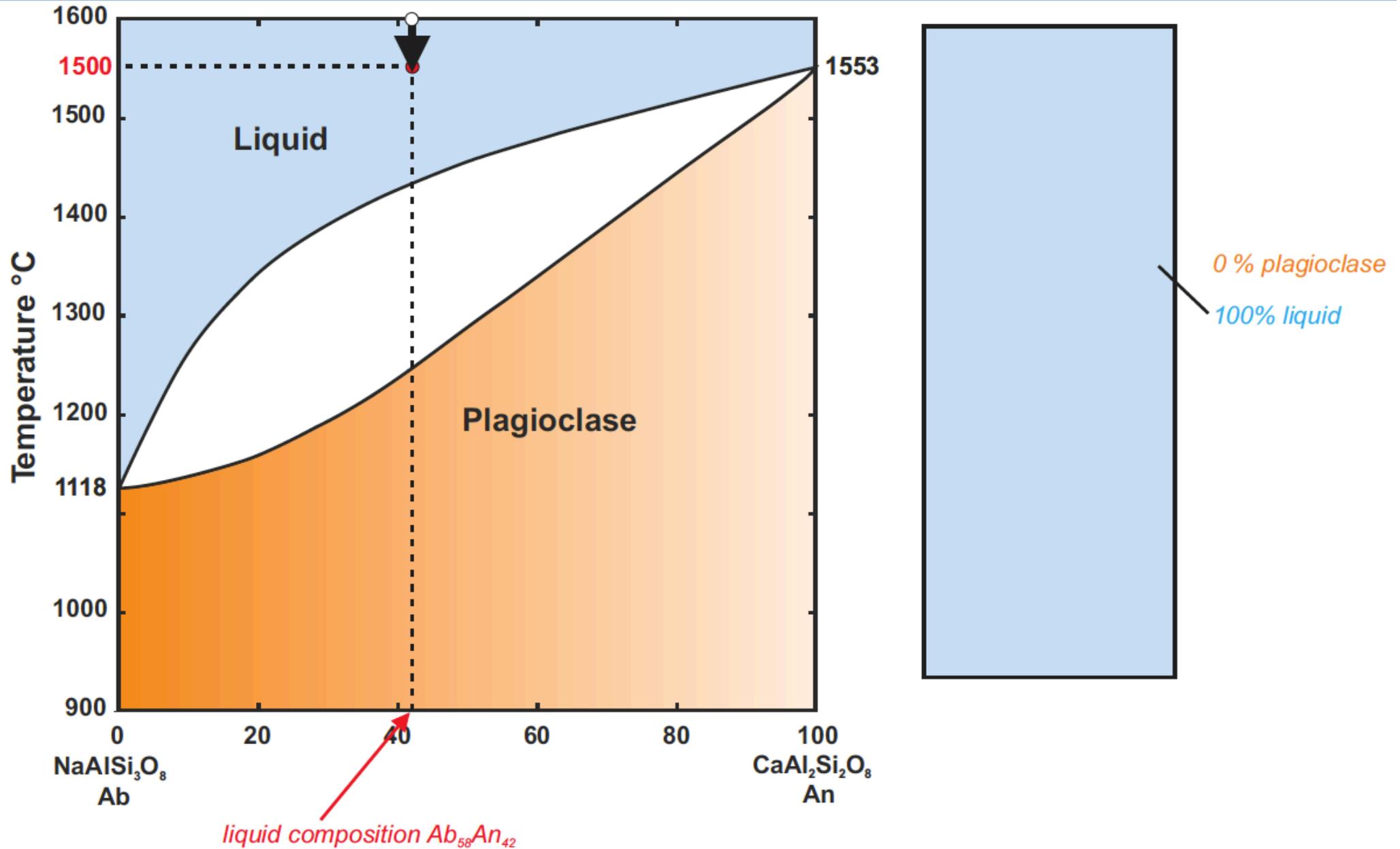
$\Rightarrow 42\% \text{ An} + 58\% \text{ Ab}$

$$An_{xx} = 42 / (42 + 58) = 0.42$$

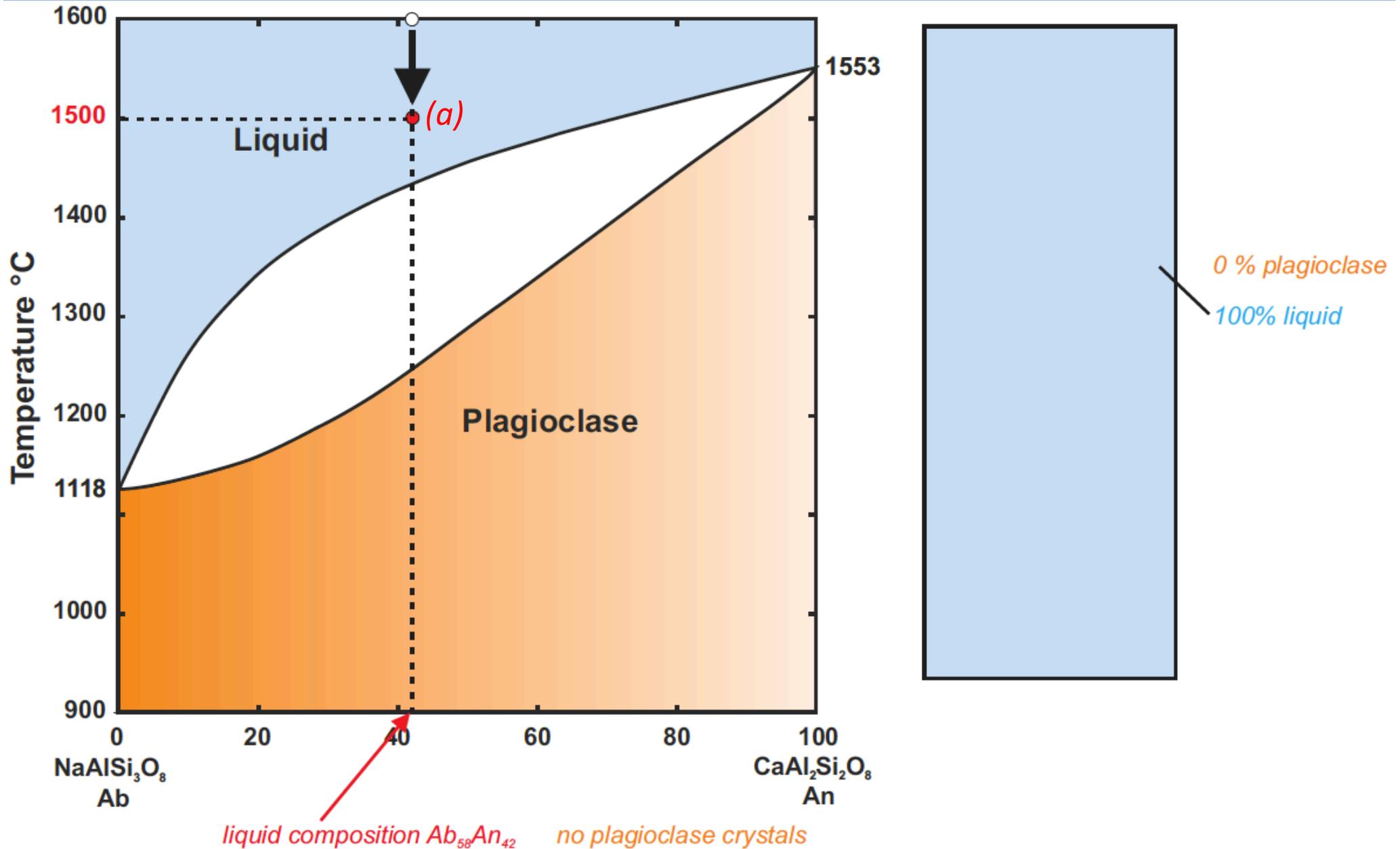


liquid composition $Ab_{58}An_{42}$ no plagioclase crystals

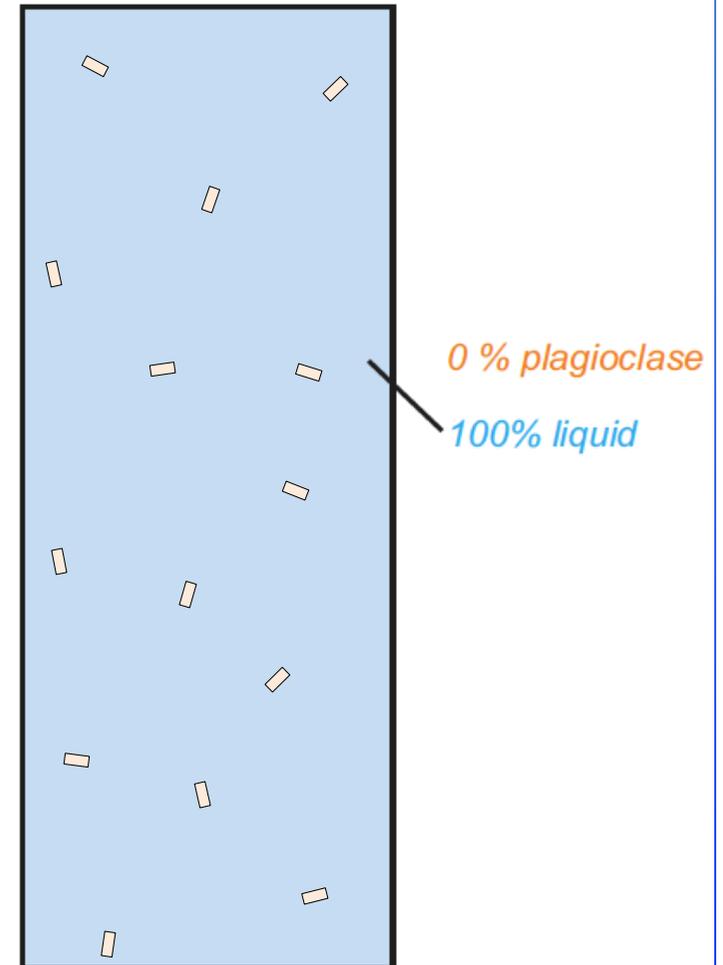
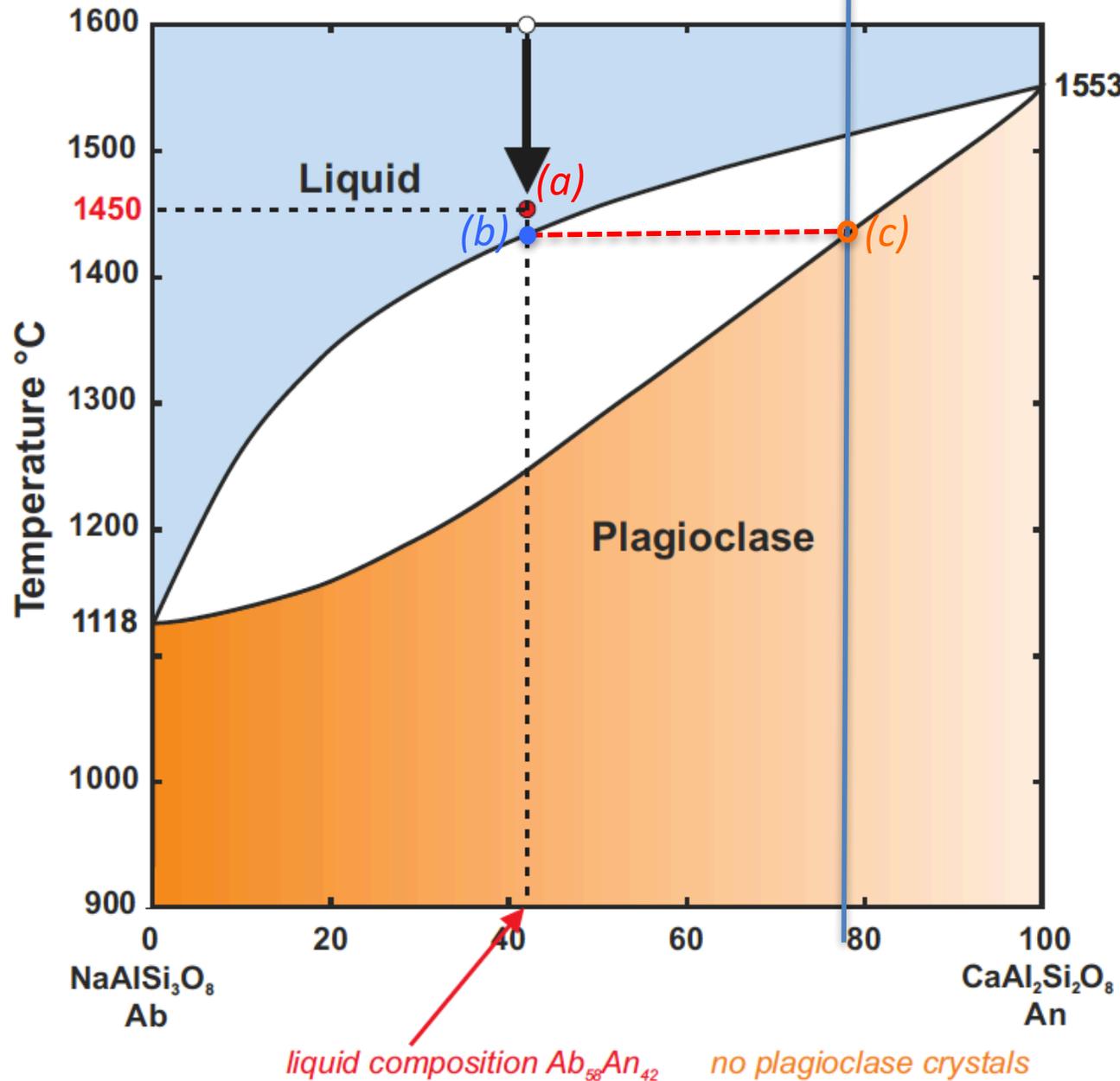
The liquid $\text{Ab}_{58}\text{An}_{42}$ is cooling from 1600°C to the liquidus



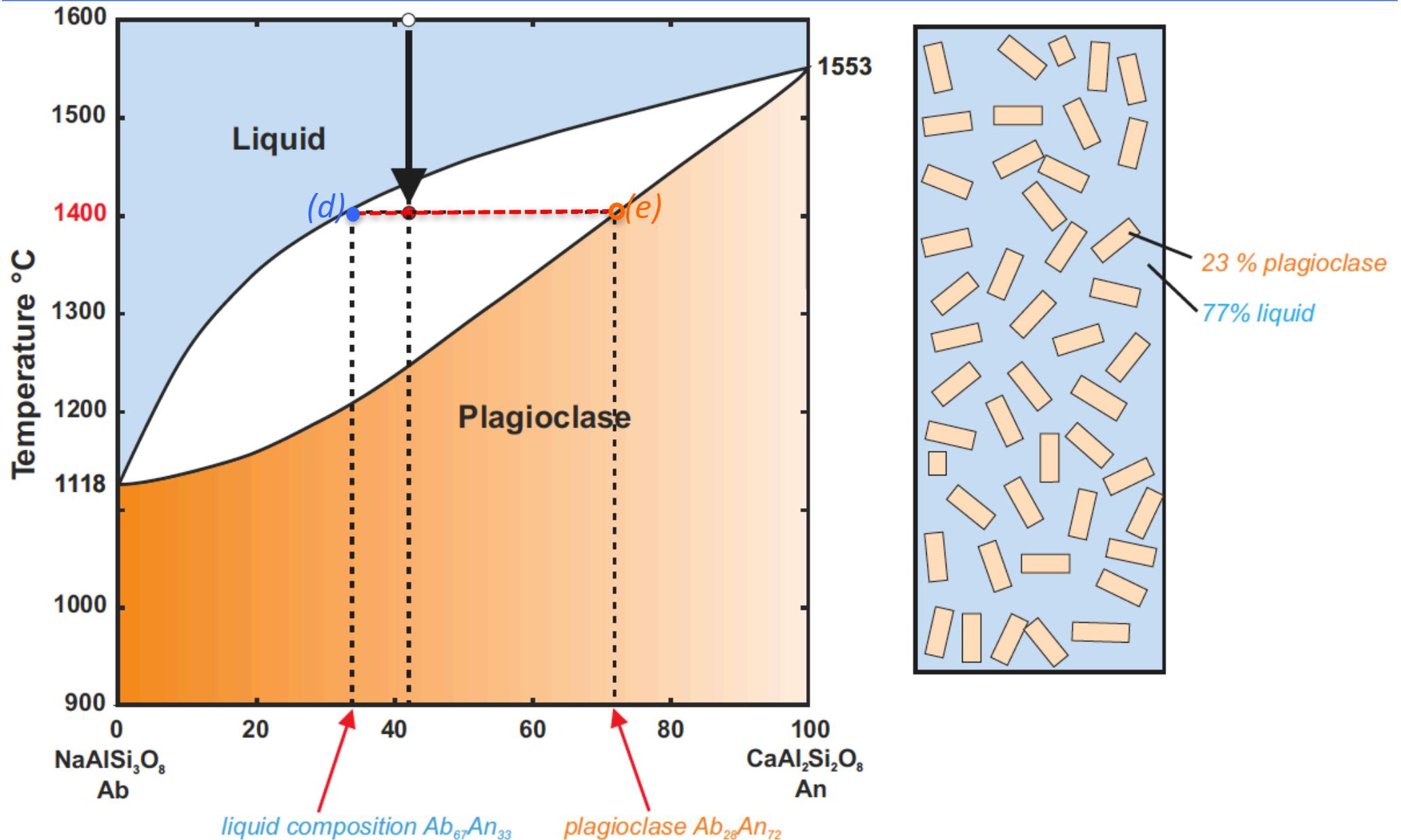
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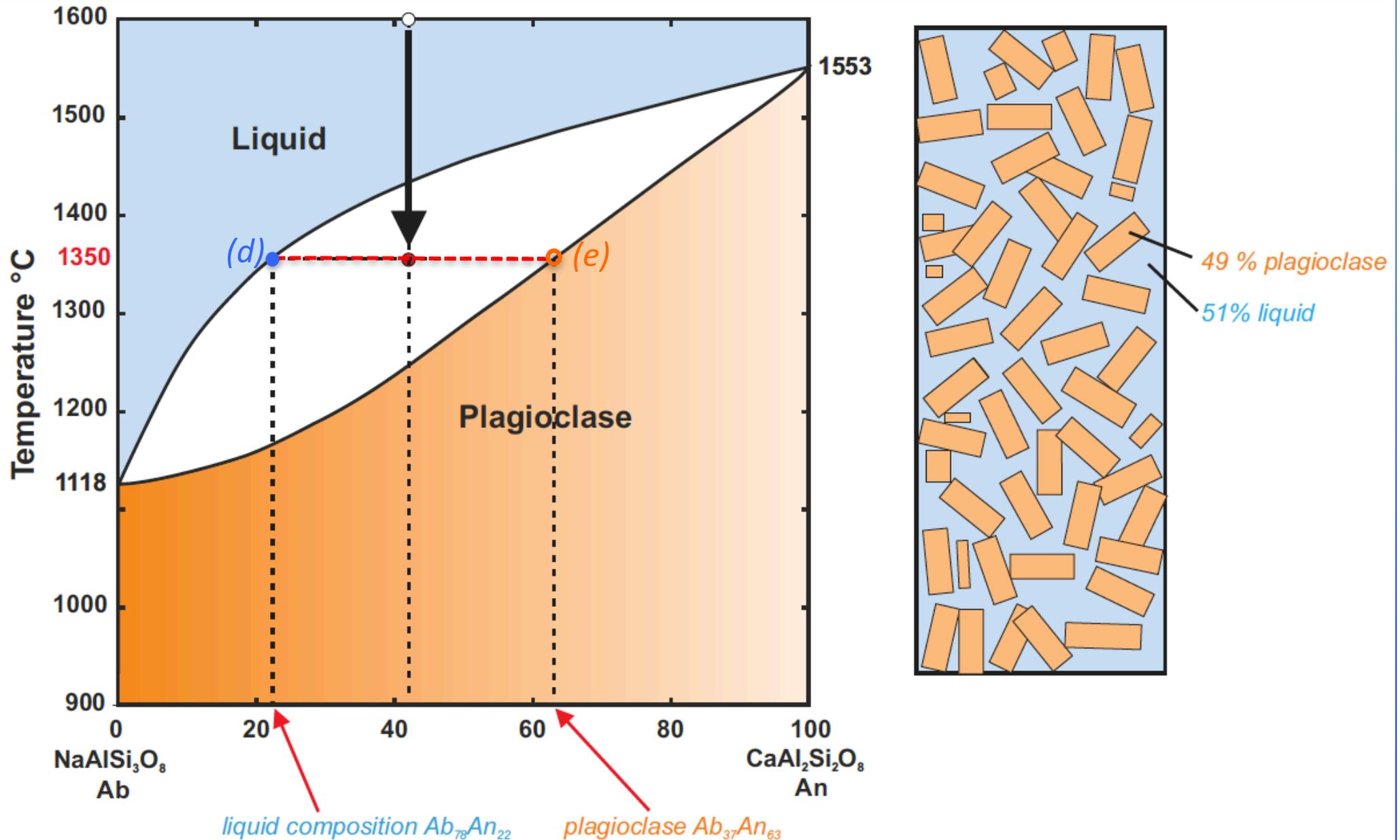
The liquid $\text{Ab}_{58}\text{An}_{42}$ is cooling from 1600°C to the liquidus
 At 1430°C , the liquidus is reached (b), 2 ϕ are present (liq + plag)
 The first crystal of plagioclase (c) is An_{77}



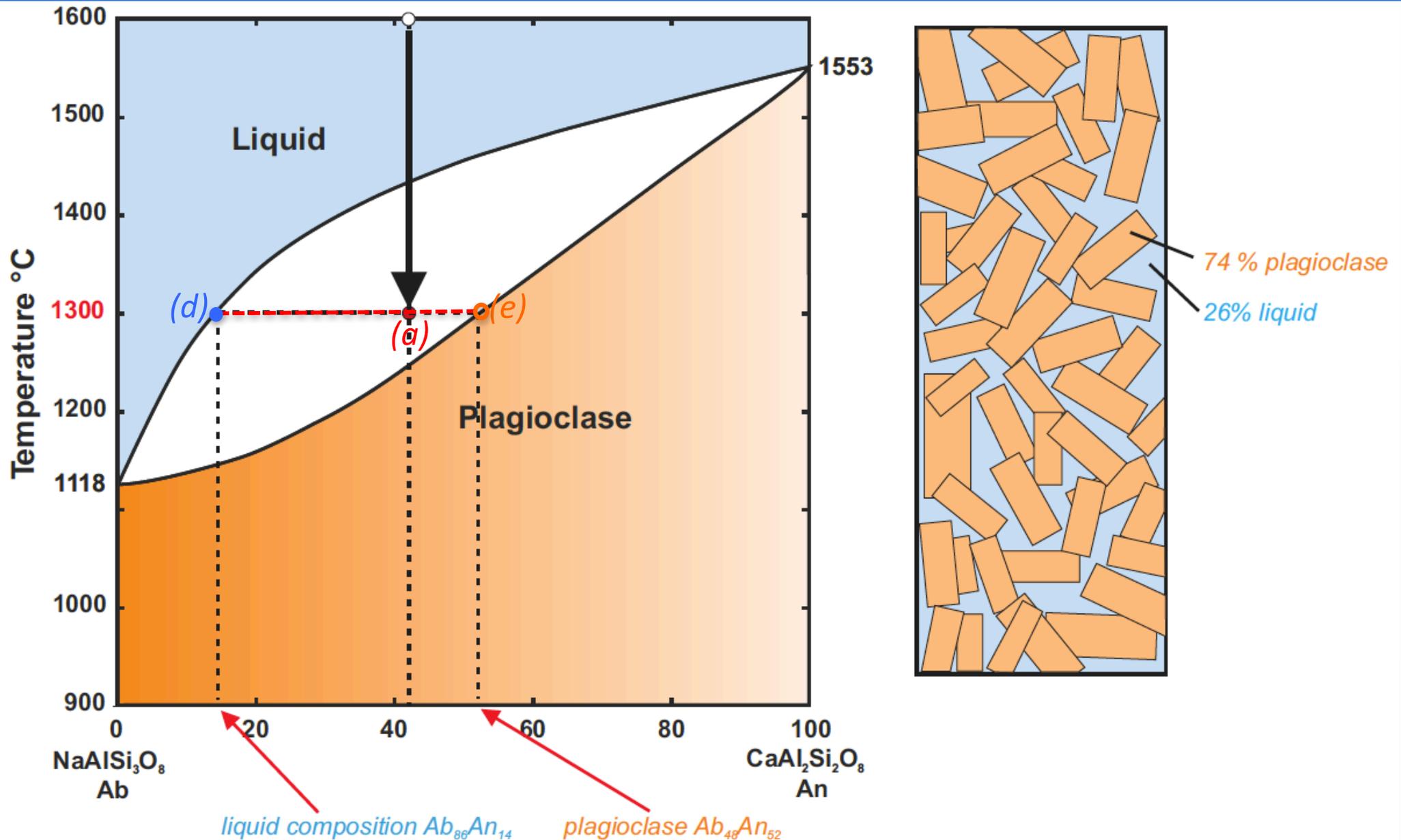
As it cools, the liquid evolves towards sodic (An_{33}) compositions
 Plagioclase crystals evolves to An_{72}
 The continuous reaction is $Liq_b + Plag_c \Rightarrow Liq_d + Plag_e$



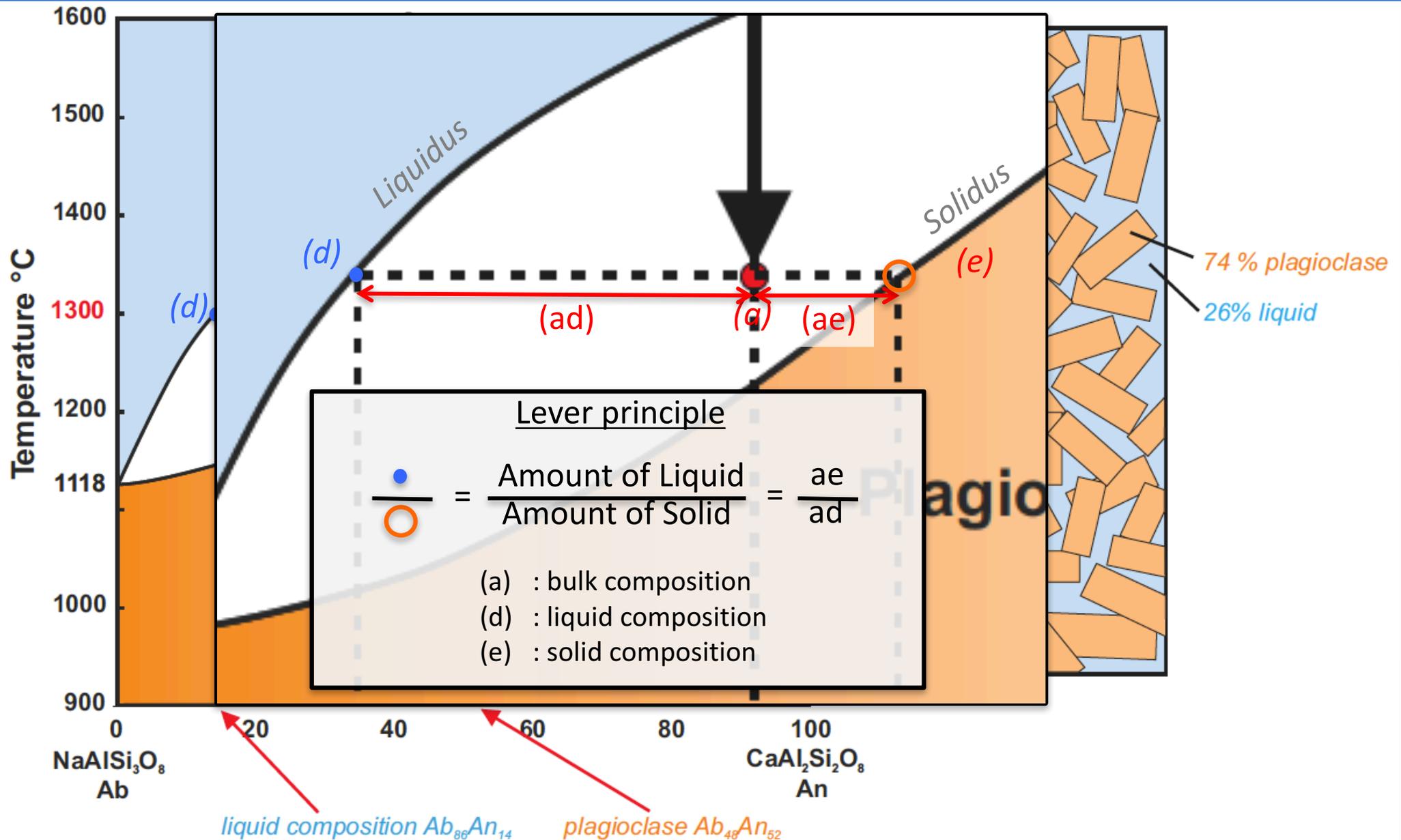
As it cools, the liquid evolves towards sodic (An_{22}) compositions
Plagioclase crystals formed at this stage are An_{63}



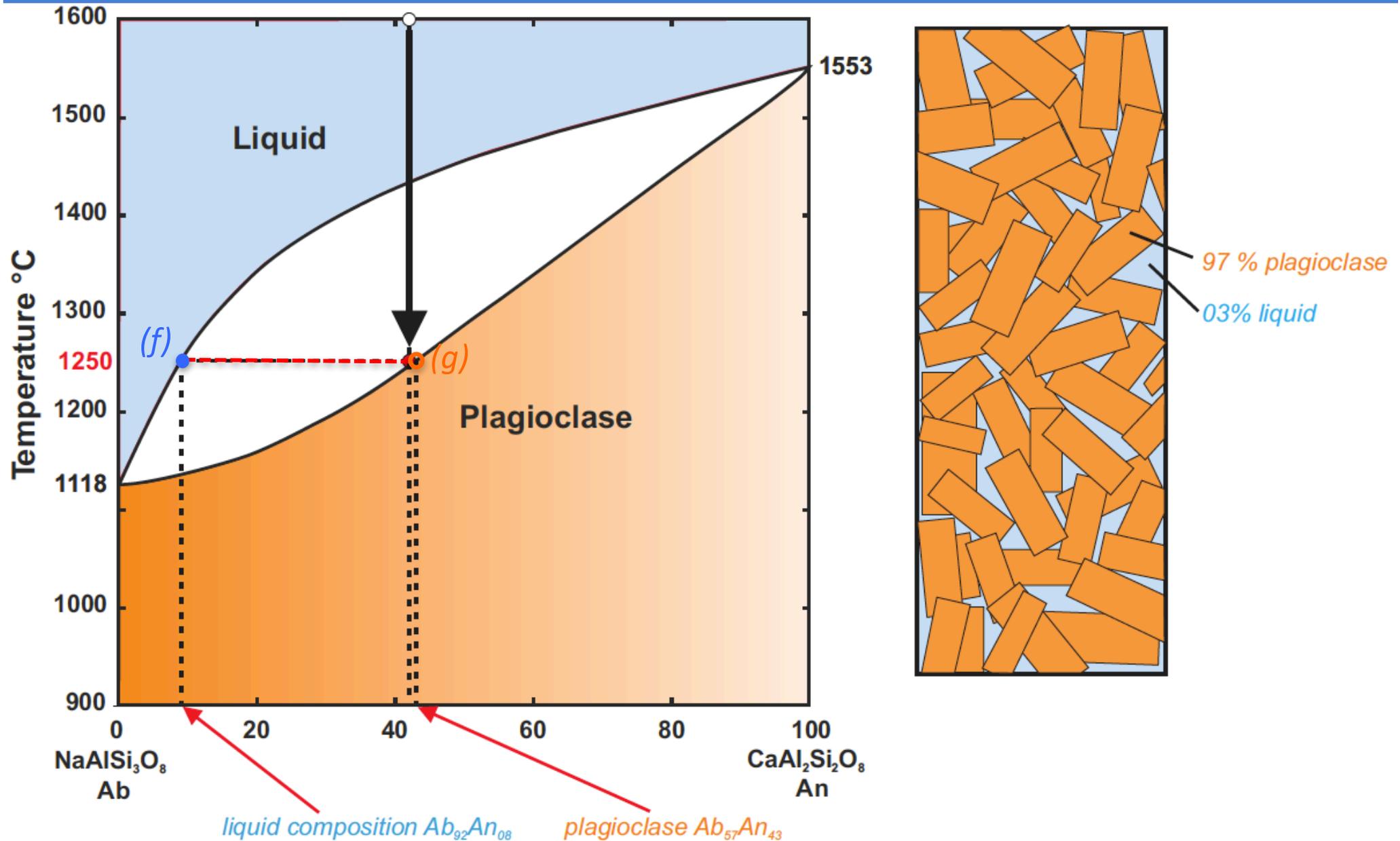
As it cools, the liquid evolves towards sodic (An_{14}) compositions
 Plagioclase crystals formed at this stage are An_{52}
 The mass of crystal-liquid formed is determined by the lever rule



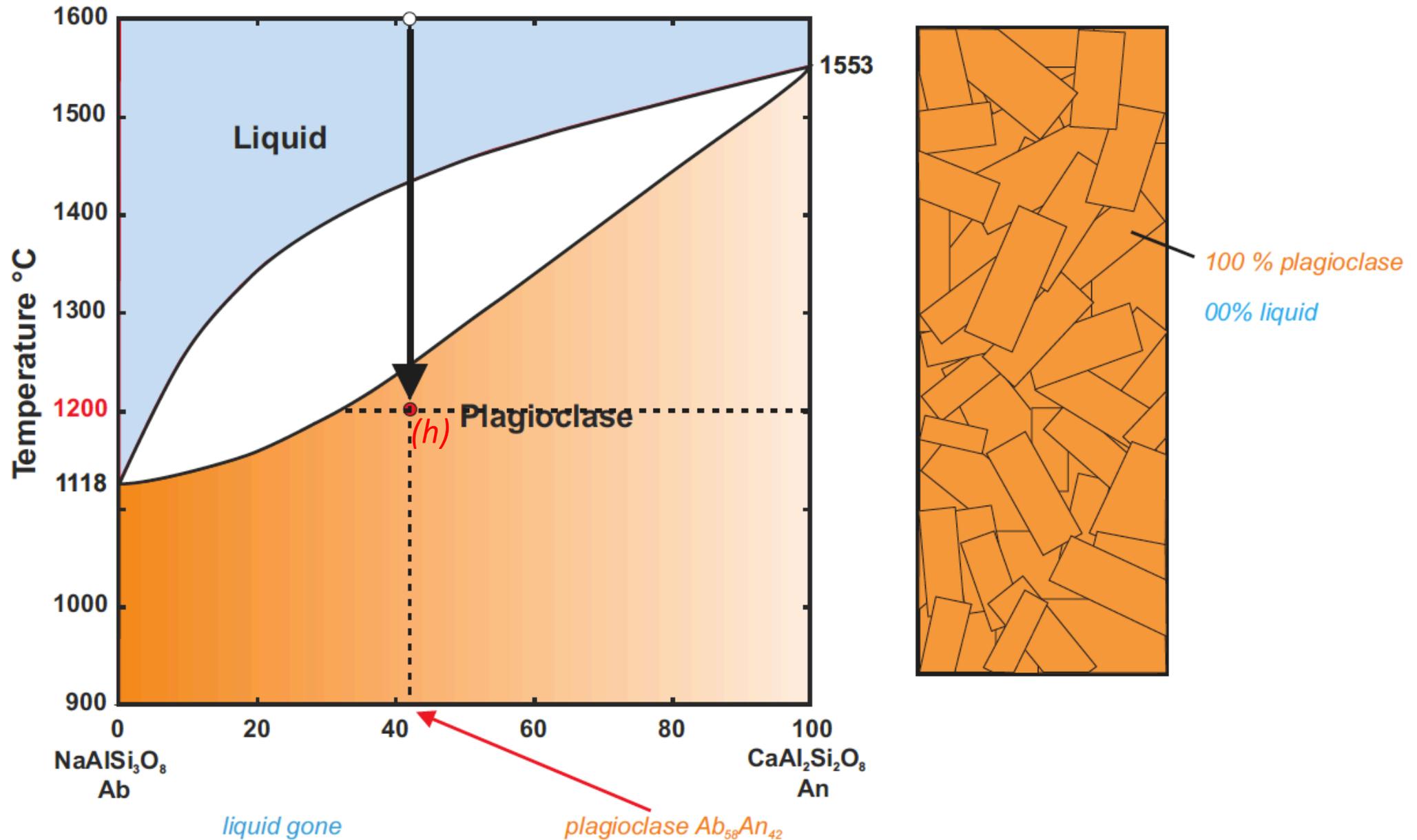
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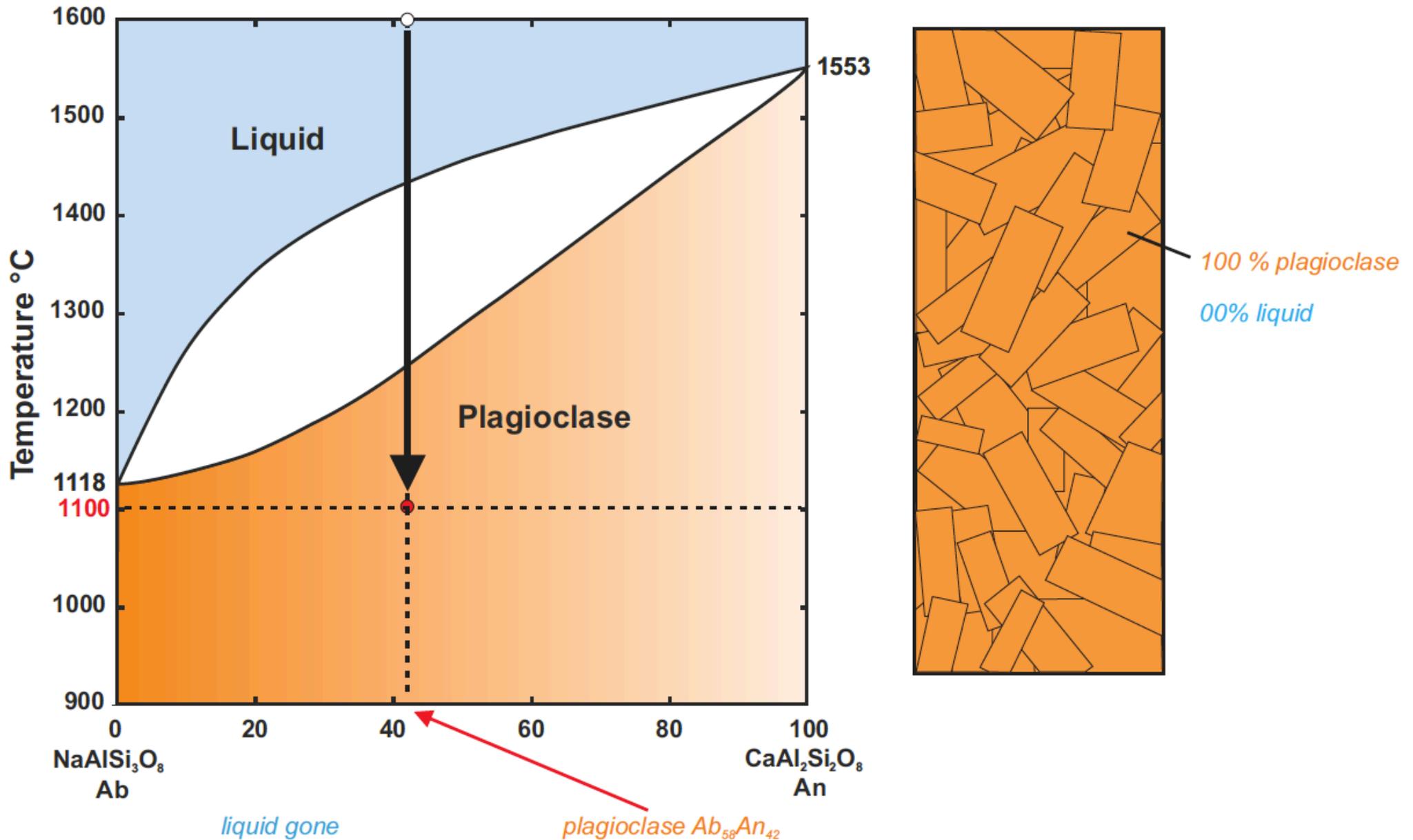
When the solidus is reached, the last drop of liquid (An_8) crystallizes
Plagioclase crystals formed at this stage are An_{43}



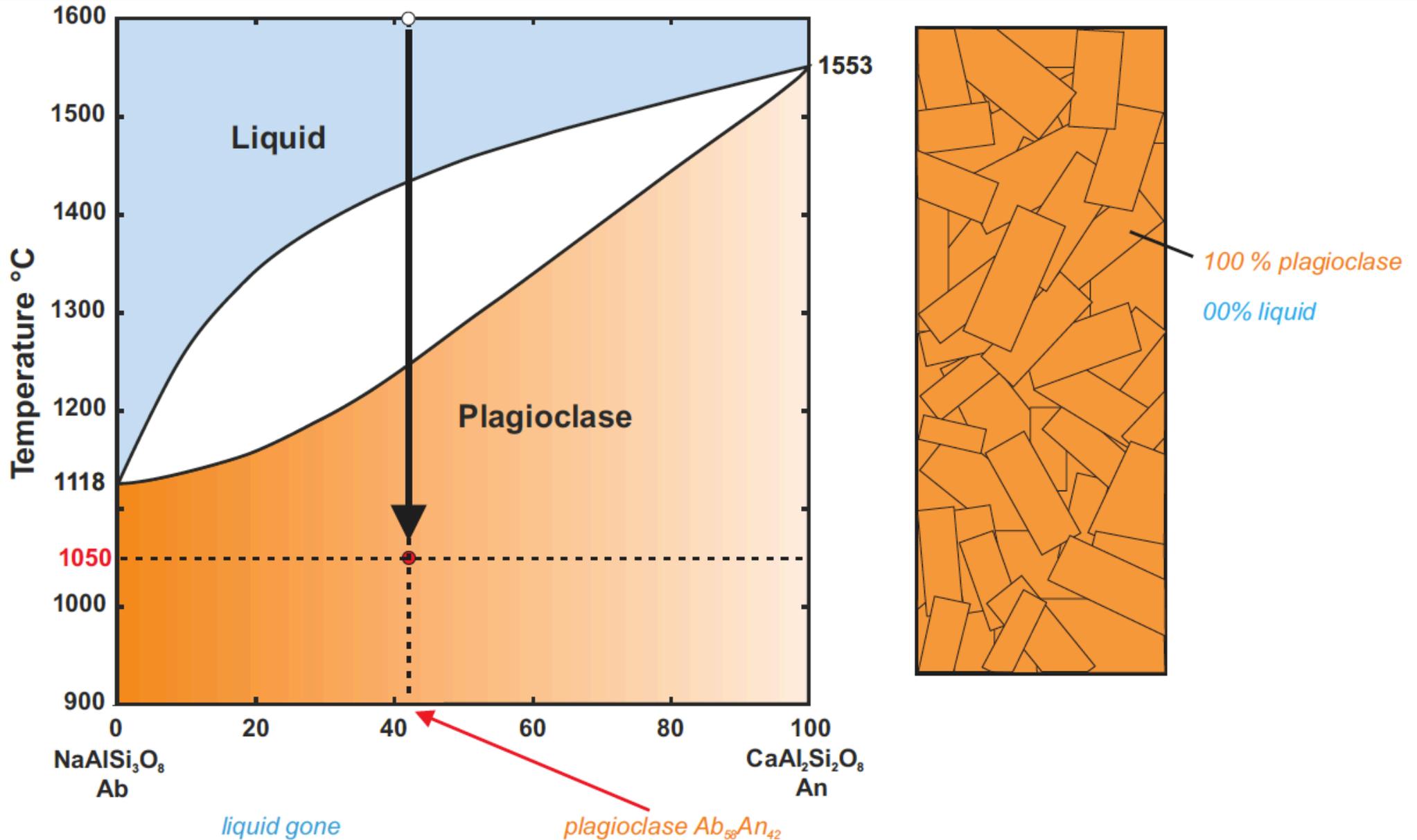
Below the solidus, the system is fully crystallized
Plagioclase has average final composition An_{42}



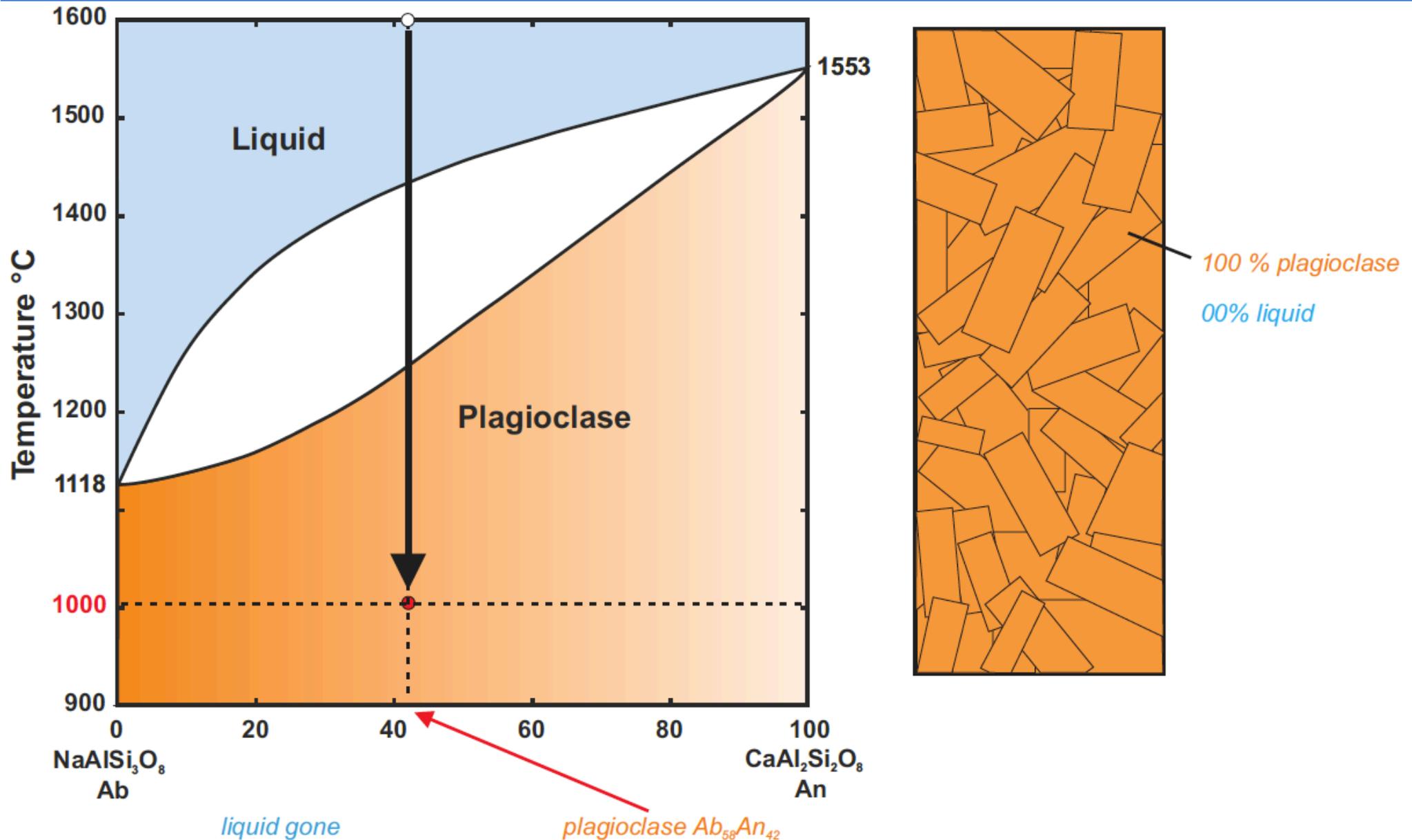
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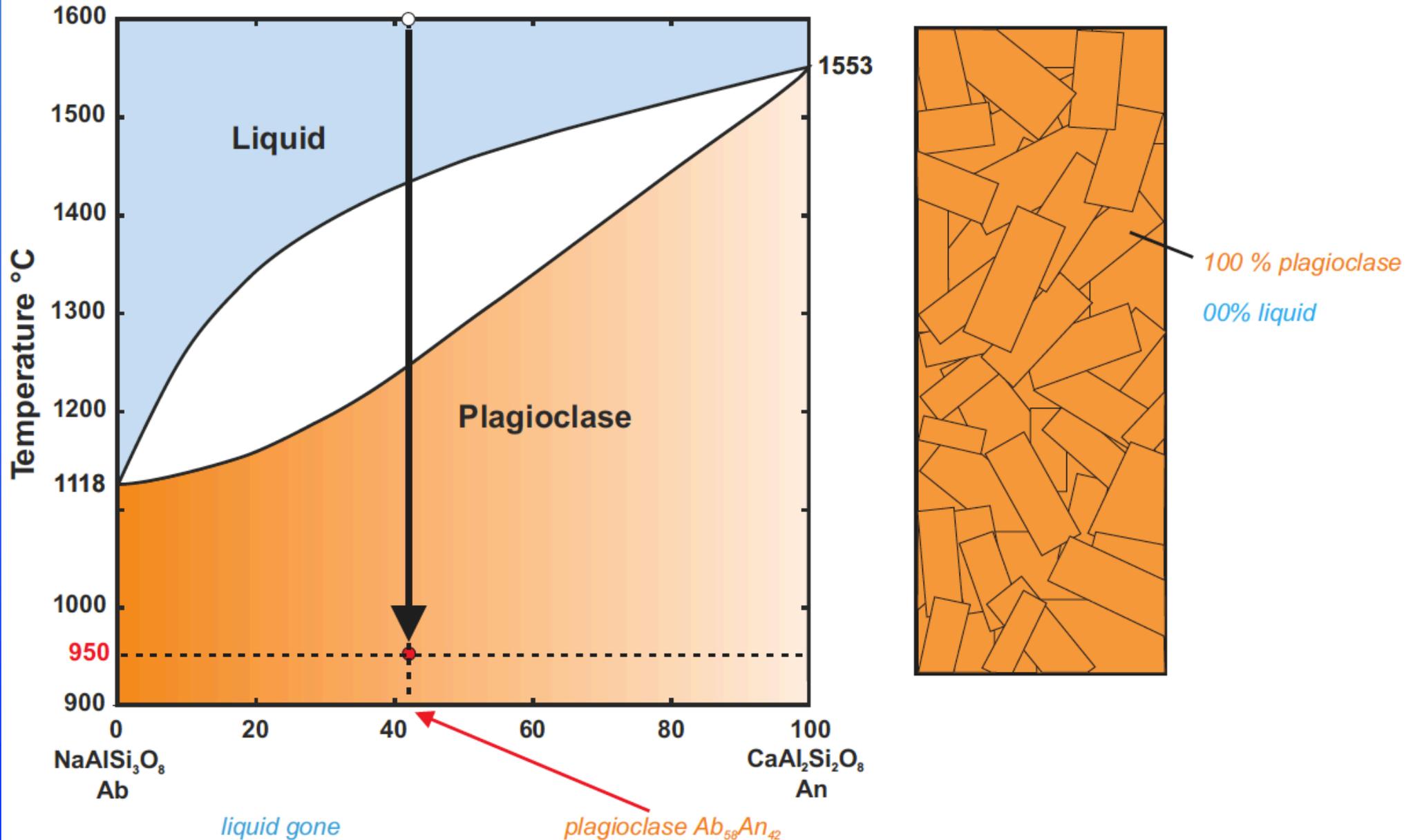
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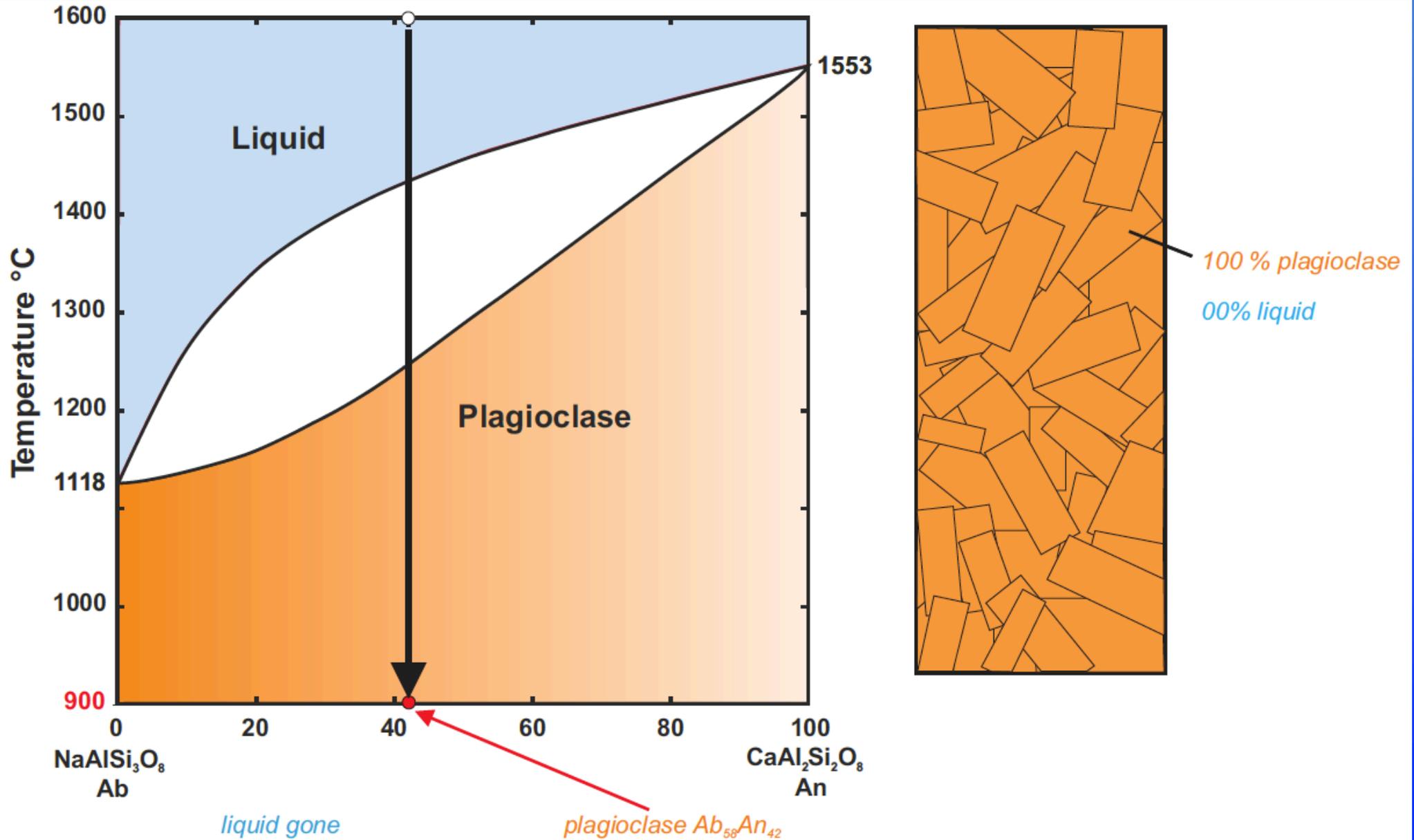
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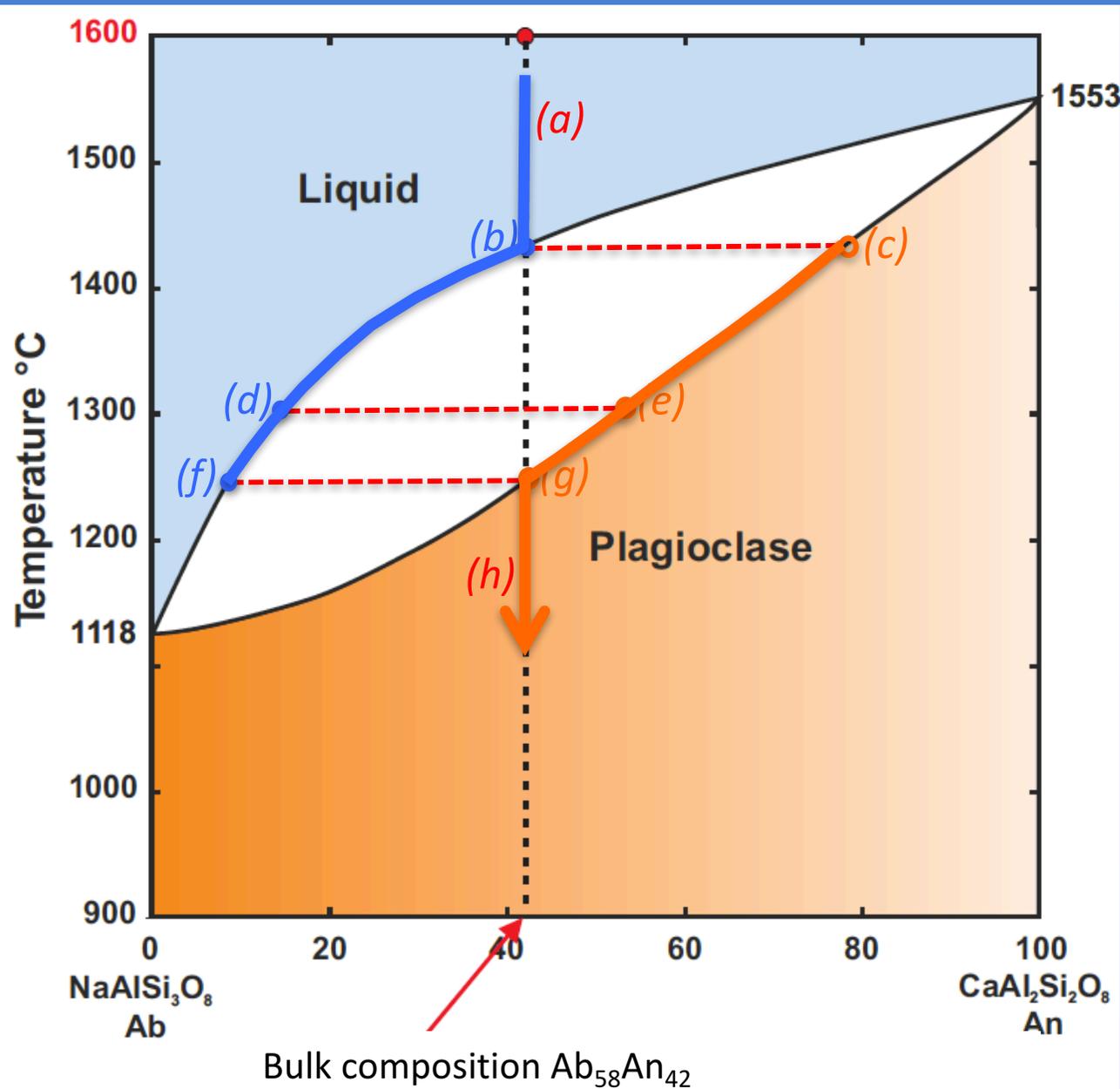


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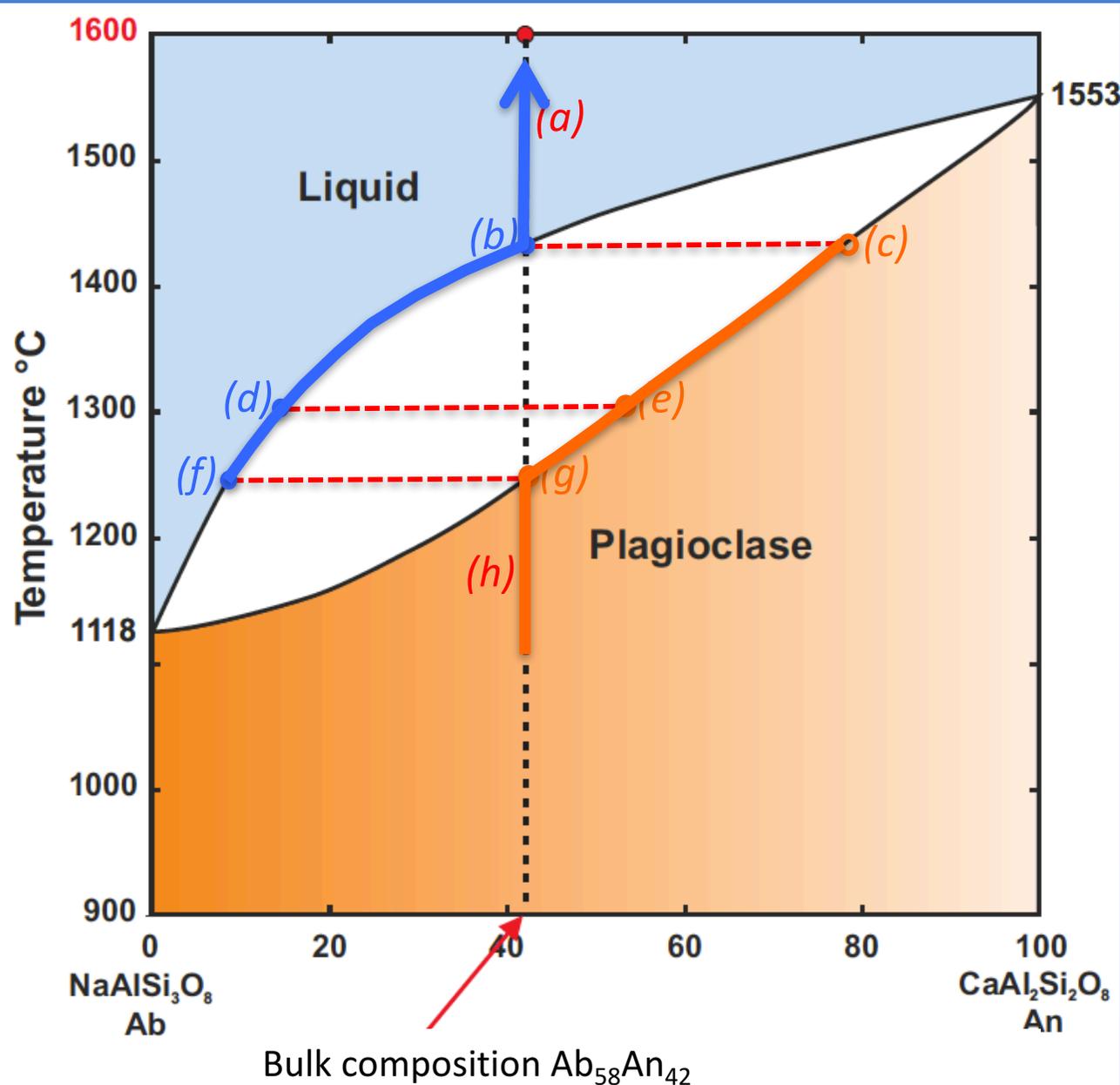
Crystallization at equilibrium

- In this binary system, for this composition, the melt crystallized over 175°C
- The composition of the liquid changed from (b) to (f)
- The composition of the solid changed from (c) to (h)



Equilibrium (batch) melting

- Heat a plagioclase An_{42} and the first melt is (f) at (An_8) at 1255°C
- Melt and plagioclase change composition with additional melting
- Last plagioclase crystal in melt is (c) at 1430°C



Binary system

Binary systems with complete solid solution

Olivine series => Mg_2SiO_4 – Fe_2SiO_4
Forsterite

Fayalite

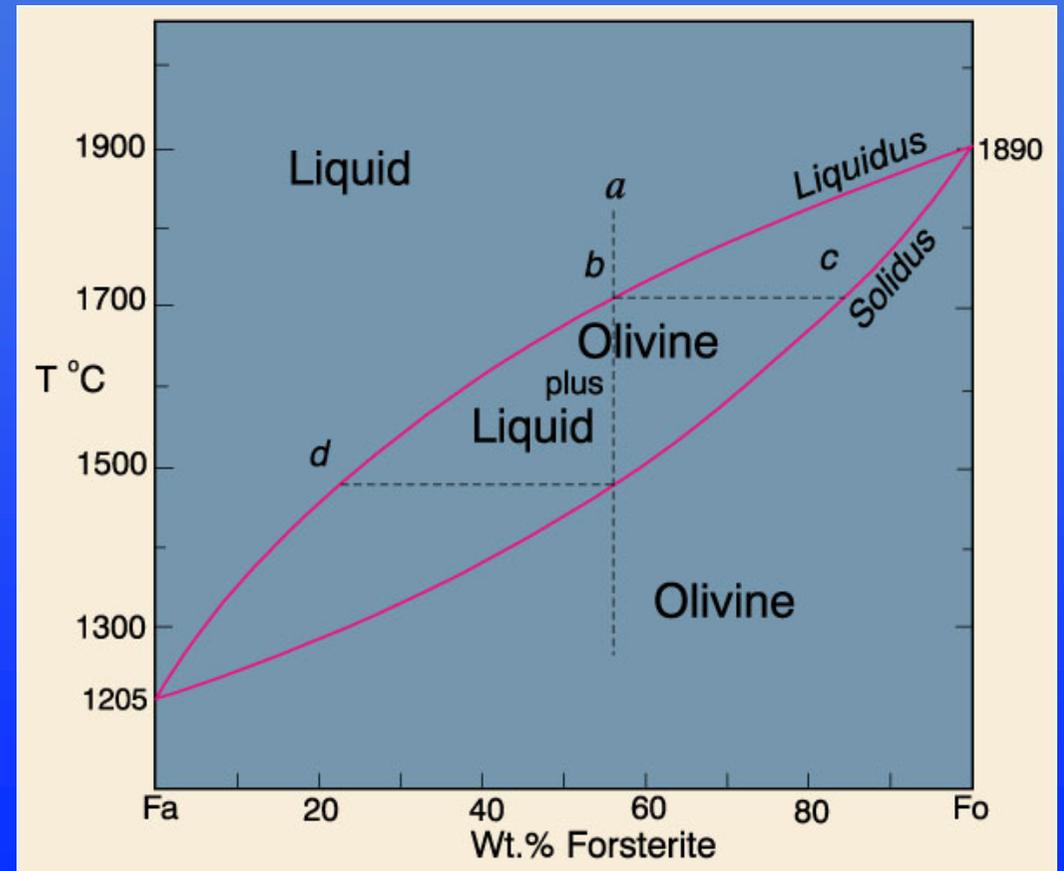
Clinopyroxene series

Orthopyroxene series

Clinoamphibole series

Orthoamphiboles series

Plagioclases



Bowen & Shairer (1932)