4.2.1 Examples: Errors in binary phase diagrams

To see how rigorous the Gibbs phase rule is we will discuss the artificial binary phase diagram shown in Fig. 4.1. Since we have a binary phase diagram $C = 2$. The shown $x - T$ diagram implies $p = const.$, i.e. $P + F = C + 1 = 3$ or $F = 2 + 1 - P$, thus the maximum number of coexisting phases is 3, i.e. $F = 0$ which marks a point or horizontal line in the phase diagram. $F = 1$ marks a sloped line or heterogeneous field. $F = 2$ marks a homogeneous field. With this input we now check the lines highlighted in Fig. 4.1.

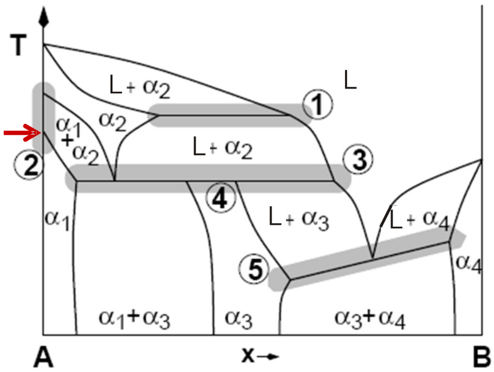

Figure 4.1: Binary phase diagram with obvious errors according to the Gibbs phase rule.

1. The horizontal line implies $F = 0$, however we only have two phases (L and α_2), i.e. $P = 2$ but $P = 3$ needed! No phase boundary can exist between two identical fields (L and α_2).
2. This vertical line holds for pure A, i.e. $C = 1$. Thus having two phases $F = 0$ is a must, however T can be varied. Such errors can be induced experimentally by overlooking impurities, i.e. not pure A exists.
3. A) Neighboring closed areas can not contain more than ± 1 different phases in contradiction to two neighboring phases $(L + \alpha_2)$:(α_3), B) The max. number of coexisting phases is three in contradiction to two neighboring phases $(L + \alpha_2)$:$(\alpha_1 + \alpha_3)$.
4. Since $P = 3$ $(L,\ \alpha_2)$ α_3 we expected $F = 0$, however x can be varied.
5. Three phases (e.g. L, α_3, α_4) can only coexist at constant T and x, i.e. $F = 0$. Thus a horizontal line with $T = const.$ must exist and no slope is allowed.