

Nagurney et al. Supplemental Material Part IV

Part IV: Results for Examples Not Included in the Main Text

Examples with Minimal Overstepping

Eastern Tibet Sample W122: Along the P - T path, garnet is stable at 547 °C and 4.9 kbar, which is coincident with the P - T that the garnet core isopleths intersect, and thus garnet is not overstepped in this sample (Supplemental Figure 1A). At garnet-in in the TEC μ_{MnO} , μ_{MgO} , μ_{CaO} , and μ_{FeO} all immediately diverge from zero, with $\mu_{\text{Al}_2\text{O}_3}$ diverging at 2 °C greater than garnet-in, which is effectively at garnet-in (Supplemental Figure 1C). Thus, there is a trend where all chemical potentials experience a difference between the TEC and MSC at garnet-in.

Kootenay Arc Sample DM_06_128: Garnet is stable at 487 °C and 4.8 kbar and the garnet core isopleths intersect at 491 °C and 5.0 kbar, which equates to 4 °C and 0.2 kbar of overstep, but which is nearly coincident with garnet-in (Supplemental Figure 2A). Immediately up temperature of garnet-in $\Delta\mu_{\text{MgO}}$ is positive and $\Delta\mu_{\text{MnO}}$, $\Delta\mu_{\text{CaO}}$, and $\Delta\mu_{\text{FeO}}$ are negative. $\Delta\mu_{\text{Al}_2\text{O}_3}$ becomes negative at 492 °C and 5.1 kbar, which is nearly coincident with garnet-in and the P - T conditions where the garnet core isopleths intersect (Supplemental Figure 2C).

Examples with Apparent Overstepping

Southeastern Ontario Sample 12TM16: Garnet is stable at 496 °C and 3.4 kbar and the garnet core isopleths intersect at 530 °C and 4.4 kbar (Supplemental Figure 3A). This equates to 34 °C and 1.0 kbar of overstep. At 496 °C and 3.4 kbar, $\Delta\mu_{\text{MnO}}$ is negative and $\Delta\mu_{\text{MgO}}$ is positive. $\Delta\mu_{\text{FeO}}$ becomes negative at 505 °C and 3.6 kbar and $\Delta\mu_{\text{CaO}}$ becomes

positive at 511 °C and 3.8 kbar. $\Delta\mu_{\text{Al}_2\text{O}_3}$ is the final component to experience a deviation between the TEC and MSC, at 513 °C and 3.8 kbar (Supplemental Figure 3C).

Southwest Turkey Sample ED34: Along the prograde P - T path, garnet is stable at 524 °C and 5.1 kbar and the garnet core isopleths intersect at 550 °C and 6.3 kbar, which amounts to 26 °C and 1.2 kbar of overstepping (Supplemental Figure 4A). At 524 °C and 5.1 kbar $\Delta\mu_{\text{MnO}}$ and $\Delta\mu_{\text{FeO}}$ are immediately negative and $\Delta\mu_{\text{MgO}}$ is positive. $\Delta\mu_{\text{CaO}}$ and $\Delta\mu_{\text{Al}_2\text{O}_3}$ are initially zero, becoming negative at 532 °C and 5.5 kbar (Supplemental Figure 4C).

Central Himalaya Sample D13-75: Garnet is stable at 508 °C and 4.4 kbar along the prograde P - T path and the garnet core isopleths intersect at 530 °C and 5.4 kbar, which results in 22 °C and 1.0 kbar of overstep (Supplemental Figure 5A). At all P - T conditions above where garnet is stable in the TEC, $\Delta\mu_{\text{MnO}}$, $\Delta\mu_{\text{FeO}}$, and $\Delta\mu_{\text{CaO}}$ are negative and $\Delta\mu_{\text{MgO}}$ is positive (Supplemental Figure 5C). $\Delta\mu_{\text{Al}_2\text{O}_3}$ is initially zero and becomes negative at 532 °C and 5.5 kbar, which is effectively the P - T conditions at which the garnet core isopleths intersect.

Albion Mountains Sample TH203B: Along the prograde P - T path, garnet is stable at 507 °C and 4.4 kbar (Supplemental Figure 6A). The garnet core isopleths intersect at 550 °C and 6.3 kbar, which equates to 43 °C and 1.9 kbar of overstepping. After garnet is stable in the TEC, but suppressed in the MSC $\Delta\mu_{\text{MnO}}$ and $\Delta\mu_{\text{CaO}}$ are immediately negative and $\Delta\mu_{\text{MgO}}$ is positive. $\Delta\mu_{\text{Al}_2\text{O}_3}$ is the final component to experience a different between the TEC and MSC, becoming negative at 532 °C and 5.5 kbar (Supplemental Figure 6C).

Funeral Mountains Sample SSFM307-7G: Along the prograde P - T path garnet is stable at 518 °C and 5.4 kbar and the garnet core isopleths intersect at 552 °C and 7.1

kbar, so garnet is overstepped by 34 °C and 1.7 kbar (Supplemental Figure 7A). At the P - T where garnet is stable in the TEC $\Delta\mu_{\text{MnO}}$ is immediately negative and $\Delta\mu_{\text{MgO}}$ is immediately positive, $\Delta\mu_{\text{FeO}}$ and $\Delta\mu_{\text{CaO}}$ become negative at 520 °C and 5.5 kbar. $\Delta\mu_{\text{Al}_2\text{O}_3}$ is the final component to experience a difference between the TEC and MSC at 551 °C and 7.0 kbar, which is nearly coincident with the P - T conditions where the garnet core isopleths intersect (Supplemental Figure 7C).