

Nagurney et al. Supplemental Material Part III

**Part III: Comparison of Calculated ds5.5 Pseudosections to the Published Literature**

**Sikkim, Himalaya Sample 24-99:** The previously published pseudosection for sample 24-99 was calculated with Theriak-Domino and ds5.5 (Gaidies et al. 2015). Using the intersection of garnet core isopleths, Gaidies et al. (2015) determined that garnet in sample 24-99 nucleated at 518 °C and 4.5 kbar (their Figure 10B). This is in close agreement to the 526 °C and 5.0 kbar that garnet was calculated to nucleate at in this study (Figure 2). In both our calculation and the published literature, the field in which garnet is first stable also contains chlorite, feldspar, muscovite, ilmenite, garnet, and quartz. This mineral assemblage almost matches the observed mineral assemblage in the rock, however biotite is present in the rock matrix and not stable until greater *P-T* conditions than garnet-in in both our pseudosection and that calculated by Gaidies et al. (2015), but biotite is calculated to be stable in the peak field defined by Gaidies et al. (2015) in our calculation, so this distinction is not important. Our pseudosection calculation is very similar to that of Gaidies et al. (2015).

**Rappold Complex: Sample 35F03:** Previously published phase equilibria for 35F03 were calculated using Theriak-Domino and ds5.5 (Gaidies et al. 2008). Garnet core isopleth intersections suggested that garnet nucleation occurred at 533 °C and 5.2 kbar (Gaidies et al. 2008), in good agreement with an intersection at 531 °C and 4.4 kbar in our calculation (Figure 3). In both cases, garnet core isopleths intersect at garnet-in, suggesting no appreciable garnet overstepping. The calculated mineral assemblage at this point is similar in both cases, with both calculations containing chlorite, garnet, ilmenite, muscovite, quartz, and plagioclase, though biotite stable instead in our calculation and chloritoid is

stable in the calculation of Gaidies et al. (2008). Our calculation matches the mineral assemblage in the rock matrix (Gaidies et al. 2008).

**Eastern Tibet Sample W122:** Weller et al. (2013) used THERMOCALC and ds5.5 to calculate the pseudosection in their study (their Figure 7a). They do not determine the  $P$ - $T$  conditions of garnet nucleation in their study, thus we cannot compare our conditions (547°C and 4.9 kbar) or stable phases (chlorite, garnet, ilmenite, muscovite, plagioclase, quartz) to theirs (Supplemental Figure 1). However, the topologies of the two pseudosections look very similar. The rock matrix represents peak  $P$ - $T$  conditions and contains biotite, garnet, ilmenite, muscovite, plagioclase, quartz, and staurolite (Weller et al. 2013).

**Kootenay Arc Sample DM\_06\_128:** Moynihan & Pattison (2013) calculated their pseudosection using ds5.5 and Theriak-Domino (their Figure 7a). The garnet core isopleths in their calculation intersect at 500°C and 5.2 kbar (Moynihan and Pattison 2013), which is in good agreement with the 491°C and 5.1 kbar we calculated (Supplemental Figure 2). In both our calculation and that of Moynihan & Pattison (2013) chlorite, garnet, ilmenite, muscovite, quartz, and plagioclase are stable in the field of garnet nucleation. In the rock matrix, chlorite is not present, but staurolite is, which is a result of the peak  $P$ - $T$  conditions of the rock being greater than the  $P$ - $T$  stability field of garnet nucleation, and thus chlorite has reacted out of the rock in the sample. (Moynihan and Pattison 2013)

**Eastern Vermont Sample TM549A:** A previously published pseudosection for this sample was calculated using Gibbs (Spear et al. 2014) and the thermodynamic data of (Spear and Pyle 2010). Detailed phase equilibria with labeled mineral assemblage fields were not originally presented for this sample, so it is not possible to directly compare our

results. However, the rock matrix contains biotite, chlorite, epidote, garnet, ilmenite, muscovite, plagioclase, and quartz (Menard and Spear 1994). This is similar to our calculated mineral assemblage, with the exception that epidote is not stable in the field of garnet nucleation and we do not consider ilmenite in this calculation. The position of our calculated garnet-in reactions are at lower pressure and temperature than originally presented (Spear et al. 2014; their Figure 8B), consistent with previous comparisons of the SPaC and ds5.5 datasets (Pattison and DeBuhr 2015; Waters 2019). Spear et al. (2014) used multiple methods to calculate the  $P$ - $T$  conditions of garnet nucleation, noting that the intersection of garnet core isopleths would occur at 520 °C and 7.1 kbar, at lower  $P$ - $T$  than garnet-in in their calculation. In our calculation, garnet core isopleths intersect 540 °C and 5.8 kbar, within the garnet stability field (Figure 4).

**Pomfret Dome, Vermont Sample AV26A:** Bell et al. (2013) calculated a pseudosection for AV26A using THERMOCALC. They inferred garnet nucleation based on the intersection of garnet core isopleths at 550 °C and 8.0 kbar (their Figure 6F). Isopleths intersect at 540°C and 7.4 kbar in our diagram (Figure 5). In both cases, biotite, chlorite, garnet, muscovite, plagioclase, and quartz are stable in the field of garnet nucleation, but since there is no discussion of the minerals present in the rock sample (Bell et al. 2013), it is not possible to compare our pseudosection calculations to that of the rock sample.

**Nelson Aureole, British Columbia Sample 93-CW-4:** A pseudosection for 93-CW-4 was originally calculated using Theriak-Domino ds5.5 (Gaidies et al. 2011). Gaidies et al. (2011) calculated garnet nucleation based on the maximum driving force for garnet nucleation at 545 °C and 3.5 kbar. Garnet core isopleths do not tightly intersect in either our calculation (Figure 6A) or that of Gaidies et al. (2011) (their Figure 6). The topologies

of our pseudosection is similar to that of Gaidies et al. (2011), which was originally calculated by Pattison & Tinkham (2009). Our pseudosection calculation matches the mineral assemblage in the rock, with the exception that chlorite is stable in our pseudosection but it reacted out of the rock matrix by the final stage of garnet growth (Pattison and Tinkham 2009). However, chlorite was likely present during the nucleation of garnet so this is not an important difference.

**Southeastern Ontario Sample 12TM16:** McCarron et al. (2014) used ds5.5 and Theriak-Domino in their pseudosection calculation. Based on the intersection of garnet core isopleths, they determined that garnet nucleated at 512°C and 4.0 kbar (their Figure 6a), which is slightly less than the 530°C and 4.4 kbar we calculated (Supplemental Figure 3). In both the pseudosection calculated by McCarron et al. (2014) and the one calculated in this study, biotite, chlorite, garnet, ilmenite, muscovite, plagioclase, and quartz are stable in the field of garnet nucleation. This is identical to the minerals preserved in the rock matrix (McCarron et al. 2014).

**Southwest Turkey Sample ED34:** Etzel et al. (2019) used Theriak-Domino and an updated version (through 2010) of ds5.5 in their pseudosection calculation (their Figure 7e). They calculated (based on the intersection of garnet core isopleths) garnet nucleation at 565°C and 6.0 kbar, which agrees with the 550°C and 6.3 kbar determined in our recalculation of Sample ED34 (Supplemental Figure 4). In both our recalculation and the original biotite, chlorite, garnet, ilmenite, muscovite, plagioclase and quartz are stable in the field of garnet nucleation. There is not a description of the mineral assemblages in the rock matrix (Etzel et al. 2019), so it is not possible to compare the mineral assemblages calculated in our study to that in the rock matrix.

**Central Himalaya Sample D13-75:** Iaccarino et al. (2017) used *Perple\_X* and the 2002 update of *ds55*. In their pseudosection, Iaccarino et al. (2017) calculated garnet to nucleate at 520°C and 5.5 kbar based on the intersection of garnet core isopleths (their Figure 8b), which is in good agreement with the 530°C and 5.4 kbar calculated in our pseudosection (Supplemental Figure 5). In both calculations, biotite, chlorite, garnet, ilmenite, muscovite, plagioclase, and quartz are stable in the field of garnet nucleation, which matches the mineral assemblage in the rock sample (Iaccarino et al. 2017).

**Albion Mountains Sample TH203B:** Kelly et al. (2015) calculated their pseudosection using an updated (through 2010) version of *ds5.5* and *Theriak-Domino*. Based on the intersection of garnet core isopleths, they determined garnet nucleated at 550°C and 5.1 kbar, which is at the same *T*, but lower *P* than our recalculation, which found that the garnet core isopleths intersected at 550°C and 6.3 kbar (Supplemental Figure 6). In both cases, biotite, chlorite, garnet, ilmenite muscovite, plagioclase, and quartz are stable in the field of garnet nucleation, which matches the rock sample with the exception of chlorite, which reacted out of the rock by the final stage of garnet growth, so it is not preserved in the rock sample (Kelly et al. 2015).

**Funeral Mountains Sample SSFM307-7G:** The previously calculated pseudosection used *Theriak Domino* and *ds5.5* with a modified muscovite activity model (Craddock Affinati et al. 2020). In their pseudosection (their Figure 7d), garnet is calculated to nucleate, based on the intersection of garnet core isopleths, at 550°C and 6.1 kbar, which is at a similar *T*, but lower *P* than our recalculation, where garnet nucleates at 552°C and 7.1 kbar (Supplemental Figure 7). The pseudosection by Craddock Affinati et al. (2020) has garnet-in at lower *P-T* conditions than 500°C and 4.0 kbar, which is in contrast to our

recalculation (Supplemental Figure 7). In both our study and that of Craddock Affinati et al. (2020) biotite, chlorite, garnet, muscovite, plagioclase, and quartz are stable in the field of garnet nucleation. In our study ilmenite is stable, but ilmenite is not considered in the pseudosection in the source literature. However, this difference is minor.

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