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FIELD AREA

The field area is in northeastern Connecticut. It is located at the southern tip of the Acadian thermal high in New England.

The rock samples are from the Brimfield Schist. This rock unit forms part of the Merrimack synclinorium in the Acadian (Devonian) orogenic belt of the northeastern USA. The rocks are best exposed in a ~0.75 km by ~0.25 km quarry near the town of Willington; all samples are from this area unless otherwise noted. The rocks are cut by numerous shear zones, part of a system of west-northwest-dipping thrust faults that transect the synclinorium (Rodgers, 1981).

The geology of the region and sample locations are shown in Figure 1 of the main text.

FIELD-EMISSION GUN ELECTRON-PROBE MICROANALYSIS

Quantitative wavelength-dispersive spectrometer (WDS) analysis, energy-dispersive spectrometer analysis (EDS), and backscattered-electron (BSE) imaging was done using the JEOL-JXA 8530F field emission gun electron probe microanalyzer (FEG-EPMA) at Yale University. Quantitative analyses employed 10 or 15 kV accelerating voltage, natural and synthetic standards, 10-15 nA (amphibole, biotite, feldspar, garnet, pyroxenes) or 150 nA (oxides) beam currents, and off-peak background corrections. Trace elements in Ti±Fe oxides were counted for long times (100–200 s on peak) to optimize counting statistics; Zr counts were obtained with a high-reflectivity PETL crystal. 10 kV was used for analyzing the oxides, because of the significantly reduced activation volume relative to 15 kV. The 10 kV operation and highbrightness FEG facilitated quantitative analysis of crystals with minimum dimensions of ~800 nm. Typical analytical uncertainties are summarized in Ague and Eckert (2012).

DESCRIPTION OF TABLES

Mineral compositions for garnet, pyroxenes, feldspars, biotite, ilmenite and spinel, and rutile are provided in Tables DR 1 through DR 6. Pressure-temperature (*P-T*) estimates are given in Tables DR 3C (ternary feldspar thermometry), DR 6A (Zr-in-rutile thermometry), and DR 7.

TERNARY FELDSPAR THERMOMETRY

Ternary feldspar compositions were reintegrated to estimate minimum crystallization temperatures (e.g., Marschall et al., 2003). First, the compositions of host and exsolution features were measured separately by FEG-EPMA (Tables DR3A, 3B). Then, BSE images of feldspar were digitally processed using the ImageJ particle analysis software to estimate the proportions of exsolved and host phases (see <u>http://rsbweb.nih.gov/ij/index.html</u> for ImageJ information and download). Finally, the compositional and modal proportion data were reintegrated using the molar volumes of Holland and Powell (1998) for feldspar end members (Table DR3C). Volumes were assumed to mix ideally; any non-ideal contributions would be very small given the similar molar volumes of the three feldspar end members. Compositional reintegration was straightforward as there is little or no chemical zonation (Table DR 3C).

The reintegrated feldspar compositions are plotted on a ternary feldspar phase diagram in Figure DR 1 generated using the feldspar activity model of Benisek et al. (2004) together with the Therter program which is part of the Theriak Domino software package (de Capitani and Petrakakis, 2010; version 1.08.09, <u>http://titan.minpet.unibas.ch/minpet/theriak/theruser.html</u>). The diagram was drawn for 1 GPa; the results are only weakly pressure dependent, as shown in Table DR 3C.

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CONVENTIONAL MULTIPHASE THERMOBAROMETRY

Unless otherwise noted, the equilibria discussed in this section were computed with winTWQ version 2.34 (http://beta.geogratis.gc.ca/api/en/nrcan-rncan/ess-sst/259c8635-73bc-5fb2-8ced-6346bf9eb899.en_CA.xml; Berman, 1988; 1991), which incorporates recent updates to garnet, pyroxene, oxide, and biotite thermodynamic data and activity models (e.g., Berman and Aranovich, 1996; Aranovich and Berman, 1997; Berman et al., 2007). Ferric iron in Febearing minerals was estimated using winCMP version 2.32. The winTWQ software yields thermobarometry results that are closely comparable to THERMOCALC version 3.33 (Holland and Powell, 1998; 2003; http://www.metamorph.geo.uni-mainz.de/thermocalc/) (see comparisons in Vorhies and Ague, 2011).

Orthopyroxene-Clinopyroxene Thermometry

The partitioning of Fe and Mg between coexisting ortho- and clinopyroxene is temperature sensitive:

$$MgSiO_3 + CaFeSi_2O_6 = FeSiO_3 + CaMgSi_2O_6$$
 (DR 1)

Sample 105A is a ~1 cm-wide veinlet that contains large (0.25-0.75 cm) pyroxenes surrounded by complex intergrowths of hornblende, actinolite, spinel, anorthite, phlogopite, and ilmenite. The large pyroxenes are unzoned and are inferred to represent part of the original mineral assemblage stable at ultrahigh temperatures. *T* estimation yields 1000 °C at 1 GPa. This estimate is very insensitive to pressure; for example, it decreases slightly to 966 °C at 2 GPa. For comparison, THERMOCALC version 3.33 yields an almost identical estimate of 1002 °C at 1 GPa. Coexisting ortho- and clinopyroxene are also present in quartzofeldspathic gneiss sample 66a. The crystals are relatively fine-grained (<1 mm) and were thus likely to have exchanged Fe and Mg during cooling. Consequently, this sample preserves a lower *T* of ~810 °C.

Garnet-Orthopyroxene Thermobarometry

Garnet-orthopyroxene (Grt-OPX) thermobarometry was done on quartzofeldspathic gneisses and used the method of Aranovich and Berman (1997) based on the following three equilibria:

$$Fe_3Al_2Si_3O_{12} = 3 FeSiO_3 + Al_2O_3$$
(DR 2)

$$Fe_3Al_2Si_3O_{12} + 3 MgSiO_3 = 3 FeSiO_3 + Mg_3Al_2Si_3O_{12}$$
 (DR 3)

$$6 \text{ MgSiO}_3 + 3 \text{ CaAl}_2\text{Si}_2\text{O}_8 = \text{Ca}_3\text{Al}_2\text{Si}_3\text{O}_{12} + 2 \text{ Mg}_3\text{Al}_2\text{Si}_3\text{O}_{12} + 3 \text{ SiO}_2$$
(DR 4)

Here, Al_2O_3 refers to the Al_2O_3 component of orthopyroxene. Reaction (DR 3) was calibrated by Harley (1984), whereas reaction (DR 4) was studied by Eckert et al. (1991). Reactions (DR 2) and (DR 3) are strongly *T*-sensitive; reaction (DR 2) is considerably less sensitive to retrograde *T* resetting than (DR 3) (Aranovich and Berman, 1997). Reaction (DR 4) is well suited for barometry.

Following Aranovich and Berman (1997), the intersections of reactions (DR 2) and (DR 3) with reaction (DR 4) were used to estimate *P-T* conditions using winTWQ (Table DR 7). For comparison, *T* was also calculated with the Harley (1984) calibration of reaction (DR 3). Calculations are straightforward as there is negligible zoning in garnet and orthopyroxene. Reaction (DR 2) is the least sensitive to resetting and yields the highest average *T* of ~745 °C (T_2 in Table DR 7). However, all three methods of temperature estimation yield average results that overlap within error. The average pressure estimate is 0.57 GPa (±0.09 GPa 2 σ standard deviation; ±0.04 GPa 2 σ standard error). We conclude that the Grt-OPX thermometers and

barometers thoroughly re-equilibrated during retrograde cooling and do not record "peak" *P*-*T* conditions.

Kyanite-zone Overprint P-T Conditions

P-T estimates for vein mineral assemblages that grew during the kyanite zone overprint and that contain kyanite were recalculated from the mineral composition data presented in Ague (1995). These estimates are based on the possible equilibria between pyrope, almandine, grossular, muscovite, phlogopite, annite, kyanite, anorthite and quartz (Ghent, 1976; Ferry and Spear, 1978; Ghent and Stout, 1981; Berman, 1991).

Two additional samples contain hornblende but no kyanite (3-2, 26-1). Pressures for these were estimated following Ague (1995) using the average of the Fe- and Mg-end member amphibole-garnet-plagioclase-quartz barometer reactions of Kohn and Spear (1990). Temperatures were estimated using the amphibole-plagioclase thermometers of Holland and Blundy (1994); these supersede the original estimates in Ague (1995) made using the Graham and Powell (1984) thermometer.

Zr-IN-RUTILE THERMOMETRY

Thermometer Calibration and Thermodynamic Considerations

The Zr-in-rutile thermometer calibration of Tomkins et al. (2007) was used to estimate temperatures because it can be used over a range of pressures. The Zr content of rutile coexisting with zircon and quartz increases with temperature according to the reaction:

$$ZrSiO_4 = ZrO_2 + SiO_2, \tag{DR 5}$$

in which ZrO_2 is the ZrO_2 component in rutile. As discussed in detail by Ferry and Watson (2007), the equilibrium Zr content of rutile depends on the activities of $ZrSiO_4$ and SiO_2 in the system. These will be ~1 if quartz is saturated and zircon is essentially pure.

Assuming Henry's law behavior for ZrO_2 in rutile, the law of mass action for equation (DR 5) can be recast as:

$$\ln(X_{ZrO_{2}}^{Rt}) = -\ln(h_{ZrO_{2}}^{Rt}) - \frac{\Delta G^{*}}{RT(K)} - \ln(a_{SiO_{2}}) + \ln(a_{ZrSiO_{4}}^{Zrn}), \qquad (DR 6)$$

where *X* denotes mole fraction, *a* is activity, *h* is the activity coefficient, ΔG^* is the standard state free energy change for reaction, *R* is the gas constant, *T*(K) is temperature in Kelvin, and Rt and Zrn stand for rutile and zircon, respectively. For a pressure of ~ 1 GPa, Ferry and Watson (2007) give the calibration:

$$\log(\text{Zr ppm in Rt}) = 7.420 - \frac{4530}{T(\text{K})} - \log(a_{\text{SiO}_2}) + \log(a_{\text{ZrSiO}_4}^{\text{Zrn}}), \quad (\text{DR 7})$$

in which the logarithms are base 10. This equation clearly illustrates the dependence of rutile Zr content on silica and zircon activities.

The source for Zr in the rutile inclusions was almost certainly small zircon inclusions in garnet (a few µm to tens of µm across) and/or Zr dissolved in the garnet structure. Zircon is normally fairly pure but it can contain impurities such as U, Th, and Hf which reduce its thermodynamic activity. We have not analyzed zircons in this study, but point out that reduced zircon activity leads to *T* underestimation. As a consequence, our conclusion that the rocks record UHT temperatures is unaffected even if $a_{ZrSiO_4}^{Zrn} < 1$. Similar arguments apply if Zr in rutile was obtained from a Zr-poor garnet which was internally undersaturated in zircon; again, $a_{ZrSiO_4}^{Zrn}$ would be < 1 and *T* would be underestimated. Given the abundance of zircons in the rocks, however, we conclude that zircon activity must have been near unity during oxide precipitation.

If silica activity was < 1, then temperatures would be overestimated to some degree. All the rocks contain quartz, and quartz inclusions are widespread in garnet (Ague and Eckert,

2012). Rutile Zr content does not vary in any systematic way with distance from quartz. For example, at locality 5, UHT grain analyses #5-3 (0.944 wt% ZrO₂) and #6-3 (0.921 wt% ZrO₂) in 5-3 are in direct contact with a quartz inclusion, whereas UHT analyses #1-2 (0.730 wt% ZrO₂) in 5-1 and #1 (0.645 wt% ZrO₂) in 5-3 are not (although quartz inclusions are present in the garnets) (Table DR 6A). The high ZrO₂ contents in excess of 0.9 wt% for rutile in direct contact with quartz yield *T* estimates of ~950–980 °C at 0.6–1.0 GPa which are unequivocally UHT.

We also investigated the potential effects of silica undersaturation using the equilibrium:

$$Al_2SiO_5 = Al_2O_3 + SiO_2, \tag{DR 8}$$

calculated using the Berman (1988) thermodynamic dataset and Domino. The rocks are highly aluminous, and sillimanite is nearly ubiquitous. As noted in the text, sillimanite pseudomorphs after kyanite also occur, indicating Al₂SiO₅ saturation during earlier stages of the metamorphic evolution. For sillimanite and corundum at representative conditions of 950 °C and 0.6–1.0 GPa, the equivalent β -quartz activity for Al₂SiO₅ breakdown and corundum saturation is ~0.9 (Fig. DR 2; the activity is even larger at higher *P*). We emphasize that this must be an *absolute minimum* value, as no silica-undersaturated phases like corundum or nepheline have been observed anywhere in the field area.

A silica activity of 0.9 leads to only trivial *T* overestimation. For example, for a hypothetical rutile equilibrated at 950 °C and 1 GPa at a silica activity = 0.9 and a zircon activity = 0.99, equation (DR 7) yields a *T* estimate of 964 °C—an overestimation of only 14 °C.

As noted in the text, baddeleyite has been found in rare association with HT rutile. We suggest that this baddeleyite may have exsolved from original UHT rutile as T dropped and rutile lost Zr in an attempt to equilibrate. At equilibrium, the presence of baddeleyite instead of zircon requires lowered SiO₂ activity below quartz saturation. This could result in overestimation of T

for a few HT rutiles, although we note that the HT group *T* estimates agree well with independent thermometers (Fig. 3 in main text).

Chemical Analysis of Small Rutile Inclusions

As the rutile inclusions can be very small, overlap of the FEG-EPMA beam onto adjacent garnet during rutile analysis is a concern. We use only those analyses with $SiO_2+Al_2O_3+MgO \le 0.4$ wt%, the maximum value observed for large rutiles for which beam overlap is not a problem (over 95% of the analyses have sums < 0.4 wt%). Even so, there may still be some overlap signal in the analyses of the smallest grains. However, the 0.4 wt% cutoff ensures that it will be minor. The main concern would be if Zr in garnet was artificially added to the rutile analyses. Critically, the maximum ZrO₂ content of garnet is only ~0.015 wt%, so any such additions would be insignificant (Ague and Eckert, 2012). Moreover, there is no correlation between rutile inclusion size and measured Zr content, so any secondary fluorescence effects are insignificant.

Concentrations of Other Elements in Rutile

Rutile is relatively pure; most crystals contain between 95 and 98 wt% TiO₂ (Table DR 6A). The concentrations of impurities in rutile from the HT and UHT groups show little or no correlation with Zr content, perhaps because they are not highly *T* or *P* sensitive at these conditions. Another possibility is that their concentrations were reset during retrograde cooling. This may be particularly relevant for elements such as Mg, Fe, and Mn, which can diffuse relatively rapidly through garnet at high temperatures (e.g., Carlson, 2006). The rates of diffusion for these elements through rutile, however, remain to be determined. An additional factor is that the concentrations of minor and trace elements such as V, Nb, Cr, and Ta will be largely controlled by rock bulk composition. For example, V-poor phases will crystallize in a rock that has little bulk V to begin with, and *vice versa*. Interestingly, impurity concentrations in most of

the LT rutiles are lower than in the HT or UHT examples; this probably reflects reduced solubilities at lower temperatures.

Rutile Zr Content from Core to Rim in Garnet

Systematic variations in rutile Zr content from core to rim in garnet can be present; garnet in sample 114A-1 is an example (Fig. DR 3). Rutile Zr content decreases strongly from the core of the garnet outward. The highest values in the center of the grain yield UHT *T* estimates, whereas the others yield estimates that are mostly in the HT range. As discussed in the text, this pattern may reflect rutile precipitation at successively later times (and lower temperatures) from the core outward. Another possibility is that Zr was lost to the matrix by diffusion through garnet during cooling. The core rutile would have lost the least Zr, whereas the grains closer to the rim would have lost the most. Zr diffusion coefficients in garnet are required to test this hypothesis but are unknown; however, we consider such diffusion to be extremely unlikely given the relative immobility of Zr in silicate structures. It is important to emphasize that none of the above scenarios would give rise to *T* overestimation, so the conclusion that the rocks underwent UHT metamorphism is unaffected.

Pressure for Zr-in-rutile T estimates

Zr-in-rutile *T* estimates for the UHT rutile crystals were made at 1.0 GPa based on the approximate minimum *P* obtained from the pseudosection. As discussed in the text, varying *P* by \pm 0.4 GPa changes the mean UHT estimate by only \pm 26 °C. The HT Zr-in-rutile *T* estimates were done at 0.6 GPa corresponding to the HT *P* conditions. The LT kyanite zone overprint occurred over a range of pressures from ~0.4 to ~0.9 GPa. As we don't know the pressure of equilibration for each sample, we used an intermediate value of 0.6 GPa. Varying *P* by \pm 0.3 GPa changes the mean LT estimate by only \pm 13 °C.

PSEUDOSECTION

The pseudosection was constructed for sample 80A to constrain minimum *P* by solving non-linear equations in a MATLAB code set with the algorithms proposed by Powell et al. (1998) and an internally-consistent thermodynamic database (Fig. DR 4; Holland and Powell, 1998). This sample hosts fresh perthitic feldspar and is inferred to be little retrograded. Minor amounts of biotite are present. It is mostly interstitial to other grains or fills cracks, and is interpreted to reflect small quantities of residual melt that crystallized during cooling (e.g., Moraes et al., 2002). Some of the rutile is rimmed or pseudomorphed by clearly retrograde ilmenite.

We adopt the most recent available activity-composition models and a bulk composition in the model system NCKFMASHT. The bulk-rock composition (moles) is:

SiO ₂	TiO ₂	Al_2O_3	FeO	MgO	CaO	Na ₂ O	K ₂ O	H ₂ O
48.81	2.409	21.27	14.74	8.552	0.905	0.244	1.290	1.773

The diagram was computed on an Mn-free basis using the compositions of the phases, their modal proportions, and the molar volume data of Holland and Powell (1998), projected through apatite and pyrrhotite. In terms of wt% oxides, the composition is:

SiO ₂	TiO ₂	Al_2O_3	FeO	MgO	CaO	Na ₂ O	K ₂ O	H ₂ O
42.40	2.78	31.35	15.31	4.98	0.73	0.22	1.76	0.46

This composition is extremely residual, and is characterized by low Si, Na, Ca, and K, and high Ti and Al. Sapphirine and osumilite are absent from the pseudosection, largely because of the rock's relatively low Mg/Fe. The low K content may have also hindered osumilite stability.

The Fe_2O_3 contents of garnet, biotite, ilmenite, spinel, and pyroxene influence their stabilities. Garnet has little Fe_2O_3 , and the UHT *P-T* field of this study lies well outside the likely

stability limits of biotite and orthopyroxene. Consequently, neglect of Fe_2O_3 in these phases is unlikely to affect our interpretations significantly. Structural formula calculations for representative ilmenite and spinel analyses detect no Fe_2O_3 (Table DR 5). The presence of Fe_2O_3 in ilmenite would expand ilmenite stability and, thus, push the critical ilmenite-out boundary to higher pressures (dashed red line on Fig. DR 4). Our calculations indicate that this boundary is also insensitive to water content or melt proportion. These relationships are consistent with our conclusion that the minimum UHT *P* was roughly 1.0 GPa.

Quartz is present in the rock but textural relations are ambiguous so it is unclear if it was present as a solid phase (as opposed to SiO_2 being a component in melt) at peak UHT conditions. If quartz was present, the minimum pressure for the assemblage garnet+K-

feldspar+Al₂SiO₅+quartz+rutile+melt would be about 1.4 GPa.

The activity-composition models used for the pseudosection are as follows, together with the mineral abbreviations used in Figure DR 4:

Phase	Abbreviation	Reference
Garnet	g	White et al., 2007
Biotite	bi	White et al., 2007
Cordierite	cd	Holland and Powell, 1998
Plagioclase	pl	Holland and Powell, 2003
Spinel	sp	White et al., 2002
Ilmenite	ilm	Ghiorso and Evans, 2008
K-feldspar	ksp	Holland and Powell, 2003
Orthopyroxene	Opx	White et al., 2002
Silicate melt	melt	White et al., 2007

We implemented the activity-composition model for ilmenite of Ghiorso and Evans (2008) as follows. The distributions of cations on sites *A* and *B* are given by:

$$\left(Fe_{\frac{1+Q}{2}x}^{2+}Mg_{\frac{1+Q}{2}(1-x)}^{2+}Ti_{\frac{1-Q}{2}}^{4+}\right)^{A}\left(Fe_{\frac{1-Q}{2}x}^{2+}Mg_{\frac{1-Q}{2}(1-x)}^{2+}Ti_{\frac{1+Q}{2}}^{4+}\right)^{B}O_{3}$$

The proportions of end members are:

 $p_{oilm} = xQ$

$$p_{dilm} = x(1-Q)$$
$$p_{gk} = 1-x$$

where *oilm* is ordered ilmenite, *dilm* is disordered ilmenite, and *gk* is geikielite. The activity terms are then:

$$RT \ln a_{oilm}^{ideal} = RT \left[\ln \left(\frac{1+Q}{2} x \right) + \ln \left(\frac{1+Q}{2} \right) \right] + \frac{1}{2} \left[p_{gk}^2 + p_{gk} (1-p_{oilm}) Q \right] (W_{il-gk} + W_{(il-gk)^T}) + \frac{1}{4} \left[\left(p_{dilm}^2 + 2p_{dilm} p_{gk} \right) - p_{gk}^2 (1-Q^2) \right] W_{il-il} + \frac{1}{4} \left[p_{oilm} p_{dilm} (6p_{oilm} + 2p_{dilm} - 6p_{oilm}^2 - 3p_{oilm} p_{dilm}) - 3p_{gk}^4 Q^2 (1-Q^2) \right] \Delta^2 W_{il-il}$$

$$RT \ln a_{dilm}^{ideal} = RT \left[\frac{1}{2} \ln \left(\frac{1+Q}{2} x \right) + \frac{1}{2} \ln \left(\frac{1-Q}{2} x \right) + \frac{1}{2} \ln \left(\frac{1+Q}{2} \right) + \frac{1}{2} \ln \left(\frac{1-Q}{2} \right) + \ln 4 \right] + \frac{1}{2} \left[p_{gk}^2 - p_{oilm} p_{gk} Q \right] \left[W_{il-gk} + W_{(il-gk)^T} \right] + \frac{1}{4} \left[\left(p_{dilm}^2 + 2p_{dilm} p_{gk} + 2p_{oilm} \right) - p_{gk}^2 \left(1-Q^2 \right) \right] W_{il-il} + \frac{1}{4} \left[p_{oilm}^2 \left(2p_{oilm} + 2p_{dilm} - 3p_{dilm}^2 - 6p_{oilm} p_{dilm} \right) - 3p_{gk}^4 Q^2 (1-Q^2) \right] \Delta^2 W_{il-il}$$

$$RT \ln a_{gk}^{ideal} = RT \left[\ln(1-x) + (1-Q) \ln 4 + (1-Q) \ln \left(\frac{1-Q}{2}\right) + (1+Q) \ln \left(\frac{1+Q}{2}\right) \right] + \frac{1}{2} \left[(1-p_{gk})^2 + p_{oilm} (1-p_{gk}) Q \right] \left[W_{il-gk} + W_{(il-gk)^T} \right] + \frac{1}{4} \left[(-p_{dilm}^2 - 2p_{oilm} p_{dilm}) - p_{gk} (2-p_{gk}) (1-Q^2) \right] W_{il-il} + \frac{1}{4} \left[(-3p_{oilm}^2 p_{dilm} (2p_{oilm} + p_{dilm}) - p_{gk}^3 (4-3p_{gk}) Q^2 (1-Q^2) \right] \Delta^2 W_{il-il}$$

 $W_{il-il} = 69.908 \text{ kJ/mol}$

 $\Delta^2 W_{il-il} = 12.756 \text{ kJ/mol}$ $W_{il-gk} = 2.6 \text{ kJ/mol}$ $W_{(il-gk)^T} = 88.1 \text{ kJ/mol}$

At ultrahigh-temperature conditions, the ilmenite and geikielite activities are close to ideal for the rock bulk composition studied here.

OXIDE PRECIPITATES IN ORTHOPYROXENE AND QUARTZ

Ti \pm Fe oxide needles are also found in quartz, plagioclase, alkali feldspar, and orthopyroxene. Quartz may contain tiny rounded hercynite-rich spinel inclusions several micrometers in diameter as well (Fig. DR 5A). These spinels have little zinc and no Fe³⁺ detectable with structural formula calculations (Table DR 5). Oriented needles in Opx are exclusively rutile (Fig. DR 5B). Reports of oriented rutile needles in orthopyroxene are fairly uncommon; they have been described from several settings including UHT gneisses (Moraes et al., 2002) and ultramafic rocks (Moore, 1968).

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FIGURE CAPTIONS

Figure DR 1. Reintegrated ternary feldspar compositions (filled squares) and solvus *T* contours (°C). Reintegrated compositions give minimum *T* for feldspar homogenization and are thus minimum *T* estimates. Compositions of host and exsolved phases denoted by open symbols. Ab = albite, An = anorthite, Kfs = K-feldspar.

Figure DR 2. Temperature versus base 10 log of β -quartz activity for reaction (DR 8) between corundum (Co) and sillimanite (Sil) at 0.6, 0.8, and 1.0 GPa.

Figure DR 3. ZrO₂ wt% in rutile versus distance from center of garnet for garnet core in sample 114A-1.

Figure DR 4. Pseudosection for sample 80A. Abbreviations: als=Al₂SiO₅; bi=biotite; cd=cordierite; g=garnet; ilm=ilmenite; ksp=K-feldspar; opx=orthopyroxene; pl=plagioclase; q=quartz; ru=rutile; sp=spinel. Upper *P* stability limits of ilmenite denoted by dashed red line.

Figure DR 5. A: Rutile needles and small, rounded hercynitic spinel inclusions (arrows) in quartz [sample 114A-1]; plane-polarized light. B. Oriented rutile needles in orthopyroxene [sample 62A]; plane-polarized light.











TABLE DR 1A. GARNET ANALYSES (WT%)

SiO ₂	TiO ₂	Al_2O_3	FeO	MgO	MnO	CaO	Total
38.66 38.60	0.02	21.68	28.95 29.85	8.06	1.52	1.42	100.31
38.36	0.03	21.00	29.83	8.05	2.50	1.51	100.33
38.00	0.03	21.19	31.77	5.20	1.73	2.52	100.44
37.95	0.02	21.15	32.02	5.06	1.65	2.62	100.47
39.25	0.03	22.00	26.10	8.94	1.53	2.64	100.49
	SiO ₂ 38.66 38.60 38.36 38.00 37.95 39.25	SiO2 TiO2 38.66 0.02 38.60 0.03 38.36 0.01 38.00 0.03 37.95 0.02 39.25 0.03	SiO2 TiO2 Al2O3 38.66 0.02 21.68 38.60 0.03 21.60 38.36 0.01 21.57 38.00 0.03 21.19 37.95 0.02 21.15 39.25 0.03 22.00	SiO2 TiO2 Al2O3 FeO 38.66 0.02 21.68 28.95 38.60 0.03 21.60 29.85 38.36 0.01 21.57 28.33 38.00 0.03 21.19 31.77 37.95 0.02 21.15 32.02 39.25 0.03 22.00 26.10	SiO2 TiO2 Al2O3 FeO MgO 38.66 0.02 21.68 28.95 8.06 38.66 0.03 21.60 29.85 7.05 38.36 0.01 21.57 28.33 8.05 38.00 0.03 21.19 31.77 5.20 37.95 0.02 21.15 32.02 5.06 39.25 0.03 22.00 26.10 8.94	SiO2TiO2Al2O3FeOMgOMnO38.660.0221.6828.958.061.5238.600.0321.6029.857.051.1338.360.0121.5728.338.052.5038.000.0321.1931.775.201.7337.950.0221.1532.025.061.6539.250.0322.0026.108.941.53	SiO2TiO2Al2O3FeOMgOMnOCaO38.660.0221.6828.958.061.521.4238.600.0321.6029.857.051.132.4338.360.0121.5728.338.052.501.5138.000.0321.1931.775.201.732.5237.950.0221.1532.025.061.652.6239.250.0322.0026.108.941.532.64

Notes: Fe as FeO.

*MP = metapelitic gneiss; QF=quartzofeldspathic gneiss.

TABLE DR 1B. GARNET STRUCTURAL FORMULAS (12 O)

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	Rock	Si	Ti	Al	Fe	Mg	Mn	Ca	X _{Alm}	$X_{Py}$	X _{Grs}	$X_{Sps}$
69A	QF	2.999	0.001	1.982	1.878	0.932	0.100	0.118	0.620	0.308	0.039	0.033
79A	QF	2.999	0.002	1.978	1.939	0.817	0.074	0.202	0.640	0.270	0.067	0.024
80A	MP	2.984	0.001	1.977	1.842	0.933	0.165	0.126	0.601	0.304	0.041	0.054
81A	QF	3.000	0.002	1.972	2.098	0.612	0.116	0.213	0.690	0.201	0.070	0.038
82A	QF	2.999	0.001	1.970	2.116	0.596	0.110	0.222	0.695	0.196	0.073	0.036
87A	QF	3.006	0.002	1.985	1.671	1.021	0.099	0.217	0.556	0.339	0.072	0.033
Notes: F	Fe as Fe ²⁻	•										

TABLE DR 2A. PYROXENE ANALYSES (WT%)

								,		
	Rock*	SiO ₂	TiO ₂	$Al_2O_3$	FeO	MgO	MnO	CaO	Na ₂ O	Total
66A OPX	QF	52.70	0.06	0.77	25.92	20.03	0.67	0.53	0.01	100.69
66A CPX		53.15	0.18	1.18	8.98	13.64	0.27	22.63	0.29	100.32
69A OPX	QF	50.95	0.11	3.20	26.03	19.42	0.46	0.13	0.02	100.32
79A OPX	QF	51.38	0.08	2.16	27.61	18.21	0.41	0.26	0.02	100.13
81A OPX	QF	50.61	0.09	1.34	32.87	14.93	0.60	0.28	0.02	100.74
82A OPX	QF	50.06	0.16	1.59	31.63	15.55	0.48	0.27	0.01	99.75
87A OPX	QF	51.51	0.08	3.04	24.78	20.21	0.57	0.15	0.01	100.35
105A OPX	V	54.72	0.08	1.17	16.12	27.08	0.41	0.57	0.01	100.16
105A CPX	"	53.76	0.18	1.18	5.38	15.87	0.14	23.39	0.13	100.03
Notas: Fo as	FeO OP	X-orthon	vrovene.	CPX-cli	nonvrove	ne				

*Notes:* Fe as FeO. OPX=orthopyroxene; CPX=clinopyroxene. *QF=quartzofeldspathic gneiss; V=cross-cutting vein.

Table DR 2B. PYROXENE STRUCTURAL FORMULAS (6 O)

						-		()		
	Rock	Si	Ti	Al	Fe	Mg	Mn	Ca	Na	Mg#
66A OPX	QF	1.982	0.002	0.034	0.815	1.123	0.021	0.021	0.001	0.580
66A CPX	"	1.978	0.005	0.052	0.279	0.757	0.009	0.902	0.021	0.731
69A OPX	QF	1.923	0.003	0.142	0.821	1.093	0.015	0.005	0.002	0.571
79A OPX	QF	1.956	0.002	0.097	0.879	1.034	0.013	0.011	0.002	0.541
81A OPX	QF	1.968	0.003	0.061	1.069	0.866	0.020	0.012	0.002	0.448
82A OPX	QF	1.957	0.005	0.073	1.034	0.906	0.016	0.011	0.001	0.467
87A OPX	QF	1.931	0.002	0.134	0.777	1.130	0.018	0.006	0.001	0.593
105A OPX	V	1.973	0.002	0.050	0.486	1.455	0.013	0.022	0.001	0.750
105A CPX	"	1.975	0.005	0.051	0.165	0.869	0.004	0.921	0.009	0.840
Notes: Fe as F	$e^{2+}$ .									

TABLE DR 3A. FELDSPAR ANALYSES (WT%)

	Rock*	SiO ₂	$Al_2O_3$	FeO	CaO	BaO	Na ₂ O	K ₂ O	Total
38A-5 Kfs	MP	65.30	18.70	0.03	0.06	0.37	1.03	15.13	100.62
38A-5 Pl	"	58.16	26.75	0.03	8.52	0.01	6.74	0.19	100.40
60A-3 Kfs	MP	64.53	18.44	0.01	0.06	0.32	0.87	16.71	100.94
60A-3 Pl	"	57.59	26.60	0.02	8.71	b.d.	6.54	0.27	99.73
66A Kfs	QF	64.04	18.52	b.d.	0.03	1.27	1.02	15.96	100.84
66A Pl	"	61.00	24.17	0.05	6.12	0.03	8.17	0.29	99.83
69A Kfs	QF	63.71	18.62	0.05	0.07	1.20	1.13	16.00	100.78
69A Pl	"	61.68	23.40	0.03	5.26	0.02	8.50	0.34	99.23
79A Pl	QF	54.75	28.44	0.06	10.93	0.01	5.45	0.12	99.76
80B Kfs	MP	65.14	18.71	0.01	0.03	0.40	1.62	14.31	100.22
80B Pl	"	64.31	22.58	0.02	3.50	0.02	9.57	0.25	100.25
81A Kfs	QF	63.65	18.58	0.05	0.05	1.70	0.67	16.29	100.99
81A Pl	"	60.74	24.32	0.07	6.27	0.02	7.94	0.38	99.74
82A Kfs	QF	63.74	18.68	0.07	0.05	1.32	0.86	16.18	100.90
82A Pl	"	60.83	24.40	0.05	6.20	0.02	8.03	0.40	99.93
87A Pl	QF	47.10	33.62	0.07	16.94	0.02	1.92	0.05	99.72
88A-1 Kfs	QF	64.78	18.39	0.04	0.07	0.46	0.95	16.51	99.20
88A-1 Pl	"	56.50	27.57	0.05	9.84	0.04	6.01	0.24	100.25

*Notes:* Fe as FeO. Kfs=K-feldspar; Pl=plagioclase.

*MP=metapelitic gneiss; QF=quartzofeldspathic gneiss.

### TABLE DR 3B. FELDSPAR STRUCTURAL FORMULAS (8 O)

	Rock	Si	Al	Fe	Ca	Ba	Na	Κ	X _{An}	X _{Ab}	X _{Or}
35A-5 Kfs	MP	2.993	1.010	0.001	0.003	0.007	0.092	0.885	0.003	0.094	0.903
35A-5 Pl	"	2.593	1.406	0.001	0.407	-	0.583	0.011	0.407	0.582	0.011
60A-3 Kfs	MP	2.978	1.003	-	0.003	0.006	0.078	0.984	0.003	0.073	0.924
60A-3 Pl	"	2.587	1.408	0.001	0.419	-	0.570	0.016	0.417	0.567	0.016
62A Pl	MA										
66A Kfs	QF	2.970	1.012	-	0.002	0.023	0.092	0.944	0.002	0.089	0.909
66A Pl	"	2.720	1.270	0.002	0.292	0.001	0.706	0.017	0.288	0.696	0.017
69A Kfs	QF	2.959	1.019	0.002	0.004	0.022	0.102	0.948	0.004	0.097	0.900
69A Pl	"	2.759	1.234	0.001	0.252	-	0.737	0.019	0.025	0.731	0.019
79A Pl	QF	2.476	1.516	0.002	0.530	-	0.478	0.007	0.522	0.471	0.007
80B Kfs	MP	2.991	1.012	-	0.002	0.007	0.144	0.838	0.002	0.146	0.852
80B Pl	"	2.831	1.171	0.001	0.165	-	0.817	0.014	0.166	0.820	0.014
81A Kfs	QF	2.961	1.019	0.002	0.003	0.031	0.060	0.967	0.003	0.058	0.939
81A Pl	**	2.712	1.280	0.003	0.300	-	0.687	0.022	0.297	0.681	0.022
82A Kfs	QF	2.960	1.022	0.003	0.003	0.024	0.077	0.958	0.003	0.074	0.923
82A Pl	**	2.711	1.281	0.002	0.296	-	0.694	0.023	0.292	0.685	0.023
87A Pl	QF	2.169	1.824	0.003	0.836	-	0.171	0.003	0.828	0.169	0.003
88A-1 Kfs	QF	2.982	0.998	0.002	0.004	0.008	0.085	0.969	0.004	0.080	0.916
88A-1 Pl	"	2.535	1.458	0.002	0.473	0.001	0.523	0.014	0.468	0.518	0.014
Notes: Fe a	s $\mathrm{Fe}^{2+}$ .										

AND MINIMUM TEMI ERATURES OF FORMATION												
	Rock	Si	Al	Fe	Ca	Ва	Na	K	X _{An}	$X_{Ab}$	X _{Or}	<i>T</i> (°C)
35A-5	MP	2.652	1.347	0.001	0.347	0.001	0.510	0.141	0.348	0.511	0.142	980–975
60A-3	MP	2.627	1.367	0.001	0.376	0.001	0.519	0.115	0.372	0.514	0.114	945–940
66A	QF	2.751	1.237	0.002	0.255	0.003	0.628	0.135	0.251	0.617	0.133	915–920
69A	QF	2.790	1.199	0.001	0.213	0.004	0.636	0.167	0.210	0.627	0.164	935–945
80B	MP	2.948	1.055	-	0.045	0.005	0.324	0.618	0.046	0.328	0.627	890–900
81A	QF	2.739	1.251	0.003	0.267	0.004	0.618	0.126	0.264	0.612	0.124	910–915
82A	QF	2.746	1.245	0.002	0.254	0.004	0.606	0.155	0.251	0.597	0.152	945–950
88A-1	QF	2.599	1.391	0.002	0.405	0.002	0.459	0.152	0.398	0.452	0.150	1015-1005
Notes:	Fempera	ature ran	ges com	puted for	r <i>P</i> =0.6–	1.0 GPa						

TABLE DR 3C. REINTEGRATED TERNARY FELDSPAR STRUCTURAL FORMULAS (8 O) AND MINIMUM TEMPERATURES OF FORMATION

TABLE DR 4A. BIOTITE ANALYSES (WT%)

	Rock*	SiO ₂	TiO ₂	$Al_2O_3$	FeO	MgO	MnO	BaO	Na ₂ O	K ₂ O	F	Cl	Total
69A	QF	37.00	4.57	15.44	14.74	13.12	0.05	0.40	0.09	9.43	0.36	0.02	95.22
80A	MP	36.50	3.75	18.47	15.56	11.44	0.04	0.14	0.10	9.50	0.10	0.23	95.74
87A	QF	37.32	4.94	15.96	12.96	14.25	0.04	0.33	0.10	9.63	0.53	0.01	95.84

Notes: Fe as FeO. Oxygen equivalent of F, Cl subtracted from totals.

*MP=metapelitic gneiss; QF=quartzofeldspathic gneiss.

TABLE DR 4B. BIOTITE STRUCTURAL FORMULAS (11 O)

	Rock	Si	$Al^{iv}$	Ti	$Al^{vi}$	Fe	Mg	Mn	Ba	Na	K	F	Cl
69A	QF	2.770	1.230	0.257	0.132	0.923	1.464	0.003	0.012	0.013	0.901	0.085	0.003
80A	MP	2.720	1.280	0.210	0.342	0.970	1.271	0.003	0.004	0.014	0.903	0.024	0.029
87A	QF	2.744	1.256	0.273	0.127	0.797	1.562	0.003	0.010	0.014	0.903	0.123	0.001
Note:	Fe as F	e ²⁺											

TABLE DR 5. ILMENITE AND SPINEL ANALYSES (WT%) AND STRUCTURAL FORMULAS

	SiO ₂	TiO ₂	$ZrO_2$	$Al_2O_3$	FeO	$Cr_2O_3$	$Nb_2O_5$	Ta ₂ O ₅	$V_2O_5$	MnO	MgO	ZnO	Total
80A Ilmenite in Matrix	0.03	53.52	0.01	0.02	45.33	0.05	0.02	0.04	0.18	0.69	0.85	0.07	100.81
114A-1 Spinel in Quartz	-	b.d.	b.d.	61.93	25.17	0.03	b.d.	b.d.	b.d.	0.08	7.59	4.99	99.79
	Si	Ti	Zr	Al	Fe ²⁺	Cr	Nb	Та	v	Mn	Mg	Zn	
80A Ilmenite in Matrix	0.001	1.000	-	0.001	0.941	0.001	-	-	0.003	0.015	0.032	0.001	
114A-1 Spinel in Ouartz	-	-	-	2.005	0.578	0.001	-	-	-	0.002	0.311	0.101	

*Notes:* Rocks are metapelitic gneisses. Formulas based on 3 oxygens for ilmenite and 4 oxygens for spinel.  $Fe^{3+}$  not detectable with structural formula calculations. V counts corrected for Ti interference; Cr counts corrected for V interference.

TABLE DR 6A. RUTILE ANALYSES (WT%) AND Zr-IN-RUTILE TEMPERATURES

	Type*	Groun [†]	SiO	TiO	ZrO ₂	Al ₂ O ₂	Fe ₂ O ₂	$Cr_2O_2$	Nh2Os	TapOr	V ₂ O ₅	MnO	MoO	Total	$T(^{\circ}C)^{\S}$
5-1 #3-1	IR	IT	0.14	97.64	0.028	0.07	1.62	0.02	0.16	0.03	n d	0.05	0.02	90.78	604
5-1 #1-2	I		0.14	97.04	0.020	0.07	1.02	0.02	0.10	0.03	0.72	0.05	0.02	100.04	952
5-3 #1	I	UHT	0.12	95.79	0.645	0.00	1.00	0.17	0.42	0.04	n.12	0.05	0.01	99.15	935
5-3 #1	I	нт	0.10	96.49	0.315	0.07	1.74	0.17	0.01	0.04	n d	0.07	0.01	99.06	822
5 3 #2 2	T	ит	0.07	96.77	0.237	0.05	1.75	0.07	0.17 h.d	0.01	0.77	0.04	0.02	00.51	701
5 2 #1 2	I		0.17	90.27	0.257	0.08	1.05	0.07	0.20	0.01 h.d	1.09	0.04	0.02	99.31	791
5-5#1-5	I		0.15	95.70	0.234	0.07	1.95	0.19	0.30	0.u.	1.00	0.04	0.02	99.00	199
5-5#2-5	I		0.10	95.75	0.202	0.05	1.91	0.18	0.54	0.02	0.07	0.05	0.02	99.30	774
5-5 #4-5	I		0.12	95.51	0.166	0.04	1.00	0.25	0.62	0.02	1.10	0.02	0.02	99.45	/0/
5-5 #5-5	I	UHI	0.09	95.50	0.944	0.04	1.58	0.29	0.55	D.d.	1.18	0.07	0.01	100.52	988
5-5 #0-5	I	UHI	0.14	95.58	0.921	0.03	1.57	0.30	0.55	0.01	1.10	0.08	0.01	100.35	985
5-4 #3	I	HI	0.11	95.97	0.398	0.06	1.94	0.13	0.39	0.02	n.d.	0.05	0.02	99.10	849
5-4 #2-1	1	HT	0.07	95.99	0.306	0.03	1.50	0.05	0.55	0.02	1.09	0.04	0.01	99.66	819
5-4 #3-1	I	HT	0.10	96.97	0.284	0.04	1.78	b.d.	0.07	b.d.	1.02	0.05	0.03	100.32	811
5-4 #5-1	1	UHT	0.16	94.87	0.840	0.08	1.84	0.11	0.27	0.01	0.85	0.06	0.02	99.11	971
5-4 #7-1	I	UHT	0.09	95.20	0.570	0.05	1.88	0.14	0.06	0.02	n.d.	0.06	0.01	98.07	918
5-4 #8-1	Ι	HT	0.11	95.60	0.338	0.06	2.04	0.17	0.21	0.03	n.d.	0.08	0.01	98.65	830
5-5 #3-1	Ι	HT	0.17	97.26	0.224	0.09	2.16	0.16	0.25	0.01	0.72	0.04	0.03	101.11	785
5-5 #5-1	Ι	UHT	0.13	95.49	1.723	0.07	2.02	0.10	0.15	b.d.	0.62	0.07	0.02	100.39	1082
5-6 #1M	М	LT	0.03	98.37	0.028	0.01	0.12	0.16	0.24	0.03	n.d.	b.d.	0.01	99.00	604
27-1 #2-14	Ι	HT	0.24	94.19	0.252	0.11	2.04	0.16	1.76	0.05	1.56	0.05	0.03	100.45	798
27-1 #1-16	Ι	UHT	0.15	94.46	0.530	0.08	1.97	0.02	1.71	0.04	1.43	0.07	0.02	100.47	909
27-1 #1-17	Ι	UHT	0.11	92.27	0.887	0.05	2.19	0.02	2.72	0.05	2.15	0.06	0.01	100.51	979
27-1 #2-17	Ι	HT	0.19	90.00	0.310	0.09	2.50	0.08	3.98	0.38	2.68	0.09	0.02	100.31	820
27-1 #1M	М	LT	0.03	97.76	0.041	0.02	0.10	b.d.	0.51	0.03	1.17	b.d.	b.d.	99.68	633
27-1 #2M	М	LT	0.04	97.12	0.042	0.04	0.09	b.d.	0.12	0.01	0.93	0.02	b.d.	98.40	635
27-1 #3M	М	LT	0.08	96.25	0.028	0.05	0.34	0.09	1.21	b.d.	1.16	0.01	b.d.	99.22	604
27-1 #4M	М	LT	0.05	97.78	0.053	0.02	0.09	0.03	0.10	b.d.	0.83	b.d.	b.d.	98.97	645
27-1 #5M	М	HT	0.03	96.91	0.085	0.05	0.08	0.04	1.04	0.05	1.12	0.02	b.d.	99.44	692
27-2 #1-2	IR	LT	0.05	97.41	0.013	0.01	0.88	b.d.	0.48	b.d.	1.37	0.03	0.01	100.24	551
40A-2 #1-1	Ι	HT	0.17	96.48	0.193	0.07	2.85	b.d.	0.07	0.02	0.75	0.03	0.02	100.66	770
43A-1 #2-An	Ι	UHT	0.11	94.14	0.826	0.08	2.03	0.06	1.00	0.06	0.92	0.04	0.01	99.27	969
43A-1 #1-7	Ι	UHT	0.09	95.91	1.096	0.06	1.92	0.02	0.15	b.d.	0.74	0.03	0.01	100.01	1010
43A-1 #2-7	Ι	UHT	0.09	94.04	1.284	0.06	1.88	0.05	0.34	0.01	0.89	0.03	0.01	98.67	1035
43A-1 #1-8	Ι	UHT	0.08	95.31	1.712	0.06	1.63	0.04	0.05	b.d.	0.77	0.06	0.01	99.72	1082
43A-1	М	LT	0.03	97.72	0.032	0.02	0.37	0.07	0.81	0.03	0.77	0.01	b.d.	99.86	614
68A #2-4	Ι	UHT	0.09	95.93	0.729	0.04	1.86	0.05	0.98	0.02	1.24	0.03	0.01	100.98	951
68A	М	LT	0.01	98.88	0.026	0.03	0.21	0.10	0.38	0.02	1.04	b.d.	b.d.	100.69	599
80A	М	LT	0.02	98.94	0.042	0.04	0.26	0.03	0.47	0.03	0.53	b.d.	b.d.	100.36	634
113Ad	М	LT	0.06	97.47	0.031	0.04	0.68	0.04	0.47	0.01	0.54	0.01	0.01	99.34	612
114A #1-1	Ι	UHT	0.18	95.49	0.967	0.09	2.18	0.03	0.01	b.d.	0.78	0.04	0.02	99.79	992
114A #2-1	Ι	UHT	0.16	96.20	0.822	0.07	1.94	0.03	0.17	0.01	0.73	0.05	0.02	100.20	968
114A-1 C-5	Ι	UHT	0.15	96.11	0.888	0.07	1.80	0.02	0.17	b.d.	1.06	0.05	0.02	100.35	979
114A-1 I-5	Ι	HT	0.11	94.96	0.466	0.05	2.10	0.04	1.44	0.07	1.29	0.06	0.01	100.60	868
114A-1 #D6-5	Ι	HT	0.14	95.86	0.173	0.05	2.05	0.02	0.65	0.05	1.20	0.05	0.02	100.28	759
114A-1 #1-6	Ι	UHT	0.22	95.26	1.596	0.12	2.08	0.02	0.03	0.01	0.71	0.04	0.03	100.11	1070
114A-1 #1M	М	LT	0.03	97.69	0.050	0.04	0.33	0.06	0.75	0.01	0.93	0.01	0.01	99.91	649
114A-1 #2M	М	LT	0.02	98.75	0.018	0.03	0.34	0.04	0.10	0.01	0.69	b.d.	0.01	100.00	572

Notes: Rocks are metapelitic gneisses. All Fe as Fe₂O₃. V counts corrected for Ti interference; Cr counts corrected for V interference.

*I=inclusion in garnet core; IR=inclusion in garnet rim; M=matrix.

[†]LT=low temperature; HT=high temperature; UHT=ultrahigh temperature.

[§]Temperatures calculated at 0.6 GPa, 0.6 GPa, and 1.0 GPa for the LT, HT, and UHT groups, respectively.

TABLE DR 6B. RUTILE STRUCTURAL FORMULAS (12 O)

	Туре	Group	Si	Ti	Zr	Al	Fe ³⁺	Cr	Nb	Та	V	Mn	Mg
5-1 #3-1	IR	LT	0.012	5.897	0.0011	0.007	0.098	0.001	0.006	0.001	-	0.003	0.003
5-1 #1-2	Ι	UHT	0.009	5.791	0.0286	0.005	0.113	0.017	0.015	-	0.038	0.003	0.002
5-3 #1	Ι	UHT	0.008	5.822	0.0255	0.007	0.118	0.011	0.030	0.001	-	0.005	0.002
5-3 #2	Ι	HT	0.006	5.881	0.0124	0.003	0.107	0.009	0.007	-	-	0.002	0.001
5-3 #2-2	Ι	HT	0.013	5.831	0.0093	0.007	0.111	0.005	-	-	0.041	0.003	0.003
5-3 #1-3	Ι	HT	0.012	5.788	0.0100	0.006	0.118	0.012	0.011	-	0.057	0.002	0.002
5-3 #2-3	Ι	HT	0.008	5.802	0.0079	0.003	0.116	0.011	0.012	-	0.053	0.002	0.002
5-3 #4-3	Ι	HT	0.010	5.787	0.0074	0.004	0.114	0.014	0.023	-	0.052	0.001	0.002
5-3 #5-3	Ι	UHT	0.007	5.762	0.0369	0.004	0.096	0.018	0.020	-	0.062	0.005	0.001
5-3 #6-3	Ι	UHT	0.011	5.760	0.0360	0.003	0.094	0.019	0.020	-	0.062	0.006	0.001
5-4 #3	Ι	HT	0.009	5.855	0.0157	0.005	0.119	0.008	0.014	-	-	0.003	0.003
5-4 #2-1	Ι	HT	0.006	5.809	0.0120	0.003	0.091	0.003	0.020	-	0.058	0.003	0.001
5-4 #3-1	Ι	HT	0.008	5.825	0.0111	0.003	0.107	-	0.003	-	0.054	0.003	0.003
5-4 #5-1	Ι	UHT	0.013	5.786	0.0332	0.007	0.112	0.007	0.010	-	0.046	0.004	0.003
5-4 #7-1	Ι	UHT	0.007	5.867	0.0228	0.004	0.116	0.009	0.002	-	-	0.004	0.001
5-4 #8-1	Ι	HT	0.009	5.857	0.0134	0.005	0.125	0.011	0.008	0.001	-	0.006	0.001
5-5 #3-1	Ι	HT	0.014	5.806	0.0087	0.008	0.129	0.010	0.009	-	0.038	0.002	0.004
5-5 #5-1	Ι	UHT	0.011	5.769	0.0675	0.007	0.122	0.006	0.005	-	0.033	0.005	0.003
5-6 #1M	Μ	LT	0.003	5.970	0.0011	0.001	0.007	0.010	0.009	0.001	-	-	0.001
27-1 #2-14	Ι	HT	0.019	5.675	0.0098	0.011	0.123	0.010	0.064	0.001	0.082	0.004	0.004
27-1 #1-16	Ι	UHT	0.012	5.695	0.0207	0.007	0.119	0.001	0.062	0.001	0.076	0.005	0.002
27-1 #1-17	Ι	UHT	0.009	5.582	0.0348	0.005	0.132	0.001	0.099	0.001	0.114	0.004	0.001
27-1 #2-17	Ι	HT	0.015	5.473	0.0122	0.008	0.152	0.005	0.145	0.008	0.143	0.006	0.003
27-1 #1M	Μ	LT	0.003	5.888	0.0016	0.002	0.006	-	0.019	0.001	0.062	-	-
27-1 #2M	Μ	LT	0.003	5.920	0.0017	0.004	0.006	-	0.004	-	0.050	0.001	-
27-1 #3M	Μ	LT	0.006	5.836	0.0011	0.005	0.020	0.006	0.044	-	0.062	0.001	-
27-1 #4M	Μ	LT	0.004	5.927	0.0021	0.002	0.005	0.002	0.004	-	0.044	-	-
27-1 #5M	Μ	HT	0.003	5.861	0.0033	0.005	0.005	0.003	0.038	0.001	0.059	0.001	-
27-2 #1-2	IR	LT	0.004	5.842	0.0005	0.001	0.053	-	0.017	-	0.072	0.002	0.001
40A-2 #1-1	Ι	HT	0.013	5.790	0.0075	0.007	0.171	-	0.003	-	0.039	0.002	0.003
43A-1 #2-An	Ι	UHT	0.009	5.746	0.0327	0.008	0.124	0.004	0.037	0.001	0.049	0.003	0.001
43A-1 #1-7	Ι	UHT	0.007	5.800	0.0430	0.006	0.116	0.001	0.005	-	0.039	0.002	0.001
43A-1 #2-7	Ι	UHT	0.008	5.771	0.0511	0.005	0.115	0.003	0.013	-	0.048	0.002	0.001
43A-1 #1-8	Ι	UHT	0.007	5.789	0.0674	0.006	0.099	0.003	0.002	-	0.041	0.004	0.001
43A-1	Μ	LT	0.003	5.886	0.0012	0.002	0.022	0.005	0.029	0.001	0.041	0.001	-
68A #2-4	Ι	UHT	0.007	5.748	0.0283	0.004	0.111	0.003	0.035	-	0.065	0.002	0.001
68A	Μ	LT	0.001	5.896	0.0010	0.003	0.013	0.006	0.014	-	0.054	-	-
80A	Μ	LT	0.002	5.924	0.0016	0.004	0.016	0.002	0.017	0.001	0.028	-	-
113Ad	Μ	LT	0.005	5.901	0.0012	0.004	0.041	0.002	0.017	-	0.029	-	0.001
114A #1-1	Ι	UHT	0.015	5.786	0.0380	0.008	0.132	0.002	-	-	0.041	0.003	0.003
114A #2-1	Ι	UHT	0.012	5.802	0.0321	0.007	0.117	0.002	0.006	-	0.039	0.003	0.002
114A-1 C-5	Ι	UHT	0.012	5.785	0.0346	0.007	0.108	0.002	0.006	-	0.056	0.004	0.003
114A-1 I-5	Ι	HT	0.009	5.717	0.0182	0.005	0.127	0.003	0.052	0.001	0.068	0.004	0.001
114A-1 #D6-5	Ι	HT	0.011	5.771	0.0068	0.005	0.124	0.002	0.024	0.001	0.064	0.004	0.003
114A-1 #1-6	Ι	UHT	0.018	5.764	0.0626	0.011	0.126	0.001	0.001	-	0.038	0.003	0.003
114A-1 #1M	М	LT	0.003	5.879	0.0020	0.003	0.020	0.004	0.027	-	0.049	0.001	0.001
114A-1 #2M	М	LT	0.002	5.927	0.0007	0.003	0.020	0.003	0.003	-	0.036	-	0.001
Note: All Fe as	Fe ³⁺ .												

	Rock*	Tom	oratura	$(^{\circ}C)$	Comments					
Orthonyrovene-Clinonyrovene Thermometry										
Orthopy	/roxene-Cr	inopyro		hermom	<u>etry</u>					
66A	QF		809		-	-	Calculated at $P=0.6$ GPa			
105A	V	1000			•	-	Calculated at <i>P</i> =1.0 GPa			
Garnet-	Orthopyroz	kene-Pla								
		$T_1$	$T_2$	$T_3$	$P_1$	$P_2$	_			
69A	QF	692	775	731	0.59	0.61	$T_3$ calculated at $P_2$			
79A	"	712	722	714	0.50	0.50	"			
81A	"	753	718	726	0.61	0.60	"			
82A	"	684	717	670	0.56	0.56	"			
87A	"	794	797	806	0.58	0.58	"			
Kyanite	Zone Ove	rprint								
3-2	V		674		0.	83	Contains amphibole			
7	"		581		0.	90				
8-1	"		576		0.	61				
9-1	"		532		0.:	50				
11a	"		585		0.	90				
11b	"		614		0.	80				
15-1	"		490		0.4	45				
18-s1	"		545		0.:	56				
24-2	"		534		0.:	58				
25	"		548		0.	61				
26-1	"		662		0.	67	Contains amphibole			

## TABLE DR 7. CONVENTIONAL THERMOBAROMETRY RESULTS

*Notes*:  $T_1$ -  $P_1$  and  $T_2$ -  $P_2$  calculated following Aranovich and Berman (1997) using intersections between equilibria (DR 3) and (DR 4), and between equilibria (DR 2) and (DR 4), respectively.  $T_3$  calculated using equilibrium (DR 3) following Harley (1984).

*QF=quartzofeldspathic gneiss; V=cross-cutting vein.