Appendix 7. Petrography of the imaged and PT modelled samples.

* TTKI-2005-14.2 was from a metapelitic gneiss from the western part of the Suite (Fig. 2a). On the erosion surface, the gneiss shows many small ~2 mm garnet grains and ~3 mm staurolite porphyroblasts.
* TTKI-2005-17.1 from a metapelitic gneiss near TTKI-2005-14.2.
* TTKI-2005-32.2 was from a strongly schistose pelitic gneiss from the same exposure than the age determination samples A1843 and 1844 (Fig. 4a, Appendix 4). On the outcrop, there are many 1‒5 mm garnet porphyroblasts, ~2 mm staurolite grains and 5‒10 mm kyanite grains.
* TTKI-2005-59.1 was from a strongly schistose metapelitic gneiss, the thin section was made from the same sample as the Sm-Nd age determination A2363. The outcrop shows abundant staurolite and kyanite porphyroblasts with a grain size of 1‒20 mm and many c. 3‒5 mm garnet grains.
* TTKI-2005-73 was taken from a boulder in a local loose rock mass on a weathered hillside. The rock contains many 1‒20 mm staurolite and kyanite porphyroblasts.
* TTKI-2005-82 was from the central part of the zone from a schistose Mg- and Al-rich, silica deficient gneiss with many 1‒5 cm kyanite porphyroblasts that randomly overgrow the flat-lying schistosity (Fig. 4b). Most monazite grains in this specimen are inclusions in cordierite, therefore monazite was expected to date the cordierite-forming reaction if monazite crystallized coevally with cordierite. If monazite in cordierite was older then it would provide the maximum age for the growth of cordierite.
* TTKI-2005-84 was from the central southern part of the Suite from a strongly schistose metapelitic gneiss. The rock has many large garnet porphyroblasts, up to 1‒2 cm in size (Fig. 4d).

TTKI-2005-14.2: The main minerals shown by the QEMSCAN analysis are qtz, pl, bt, crd, st, chl and grt; accessory minerals are ms, kfs, ky, kao, tur, rt, ilm, ap, zr, mnz, Fe-oxide and sulphides. The volume percentage and average grain size of the minerals are presented in Appendix 3. The QEMSCAN image of the whole thin section shows metamorphic layering with alternating layers of quartz-rich layers and bands rich in mica, plagioclase, cordierite and staurolite (Appendix 4). Apart from some randomly oriented biotite and chlorite other minerals are mostly elongated along the S2 schistosity. QEMSCAN images show euhedral garnet cores that have inclusion trails that are almost perpendicular to the main foliation and outer inclusion-free garnet rims whose composition also differs from that of the core (Fig. 7). Staurolite is commonly found as inclusions in cordierite but also in the matrix. Some cordierite grains are pinitized and biotite grains have altered into chlorite that is also found in the pressure shadows around garnet (Fig. 6).

The inclusion trails in garnet mostly consist of quartz and plagioclase but in these garnets, as well as other similar garnet grains in the area there are also tiny ilmenite, chlorite and biotite inclusions in the trails suggesting that the early (pre-D2) assemblage in the rock was grt-bt-chl-pl-qtz-ilm(+ms?). During the D2 chlorite (and muscovite) decomposed forming staurolite. Garnet is not decomposed into cordierite but staurolite sometimes is, therefore with increasing temperature and/or decreasing pressure garnet rims were crystallized together with cordierite in the chlorite+staurolite breakdown reaction st+chl+qtz = grt+crd+H2O. Therefore the stable assemblage at this stage was grt-bt-st-crd-pl-qtz-ilm. During cooling retrograde chlorite was crystallized again.

TTKI-2005-17.1: The main minerals are quartz, plagioclase, biotite, cordierite, chlorite, staurolite, tourmaline and garnet. The QEMSCAN analysis yielded muscovite, kaolinite, kyanite, ilmenite, apatite, zircon, monazite, rutile, ilmenite, Fe-oxide and sulphides as accessory phases. Of these, muscovite and kaolinite identified by the QEMSCAN represent pinite after cordierite. Staurolite is mostly found as inclusions in cordierite. Subhedral, partly broken garnet grains show strong zoning in the QEMSCAN images (Appendix 4). Garnet is almost inclusion-free and does not provide much information on the assemblage during the core crystallization, but likely the early assemblage was grt-st-bt-chl-pl-qtz. Much of the staurolite was decomposed into cordierite. Garnet rims seem to have crystallized together with cordierite, therefore the stable assemblage during the development of the main foliation was grt-crd-bt-chl-pl-tour-qtz.

TTKI-2005-32.2: The thin section shows metamorphic banding with a layer rich in muscovite, biotite, chlorite and garnet and another layer rich in plagioclase and quartz. The main minerals in the thin section are plagioclase, biotite, chlorite, quartz, muscovite, garnet, staurolite, K-feldspar and ilmenite. In the mica-rich layer, muscovite and chlorite are mostly alteration products of staurolite and cordierite. The accessory minerals are kaolinite, tourmaline, rutile, apatite, zircon, monazite and sulphides. Garnet is surrounded by quartz and does not have systematic inclusion trails, neither does it show compositional zoning in the QEMSCAN images. Garnet has biotite inclusions but it was also altered into hydrous phases during the retrograde stage, so it is difficult to say which inclusions represent the early stage of metamorphism. Staurolite is surrounded by pinite (Appendix 4), suggesting that staurolite first altered into cordierite that was later pinitized.

In this sample, it seems that the early assemblage was grt-st-chl-bt-pl-qtz followed by crd-bt-chl-pl-qtz assemblage. During the retrograde stage, cordierite was altered into chlorite and muscovite, the assemblage bt-chl-ms-pl-qtz representing this event.

TTKI-2005-59.1: The main minerals in the thin section are quartz, plagioclase, biotite, staurolite, kyanite, and garnet, accessories are muscovite, chlorite, Fe-oxide, ilmenite, apatite, zircon and monazite. The thin sections show an earlier foliation (S2) that is crenulated and kyanite and staurolite are crystallized along the axial plane of the S3 crenulation cleavage. Garnet has inclusion trails that are almost perpendicular to the S3 in the core of the grain but curved near the rims. The inclusions in garnet are mainly quartz, plagioclase, biotite and ilmenite; the early assemblage in the rock presumably was grt-bt-pl-qtz-ilm(-ms?), followed by grt-ky-st-bt-pl-qtz. Garnet shows zoning in the QEMSCAN images (Appendix 4).

TTKI-2005-73: In the thin section the main minerals are quartz, plagioclase, biotite, kyanite, chlorite, garnet and staurolite, accessory minerals are K-feldspar, muscovite, kaolinite, tourmaline, Fe-oxide, rutile, ilmenite, apatite, zircon, monazite and sulphides (Appendices 3–4). The sample shows a strong crenulation that can also be seen as curved inclusion trails in staurolite and kyanite. Garnet cores have straight inclusion trails that are curved at the edge, indicating that growth of the garnet core preceded the crenulation. Garnet is zoned in the QEMSCAN images (Appendix 4). Garnet has quartz, plagioclase, biotite and ilmenite inclusions, therefore the early assemblage that preceded the development of the crenulation cleavage was grt-bt-pl-chl-qtz. The later assemblage that crystallized during the D3 crenulation was grt-st-ky-bt-chl-pl-qtz.

TTKI-2005-82: The gneiss comprises coarse kyanite, biotite, cordierite, chlorite, plagioclase, muscovite and tourmaline (Fig. 4b). Cordierite was formed in the reaction between kyanite and biotite forming coronas between these two minerals (Fig. 5g).

TTKI-2005-84: Rock comprises quartz, plagioclase, biotite, chlorite, staurolite and garnet as main minerals. Accessory phases are muscovite, kaolinite, tourmaline, ilmenite, apatite, zircon, monazite, rutile, ilmenite, Fe-oxide and sulphides. Garnet has inclusion trails of quartz, plagioclase and ilmenite that are perpendicular or oblique to the matrix schistosity that wraps around garnet. Garnet cores have a few muscovite inclusions, indicating that the early assemblage was grt-ms-bt-pl-qtz-ilm. Staurolite wraps around the garnet rims, suggesting that it crystallized during the development of the matrix foliation, the stable assemblage at this stage being grt-st-bt-chl-pl-qtz-ilm (Appendix 4).