**Supplementary materials**

**Figures Supplementary**

**Fig. S1 –** BSE images of monazite from different samples showing replacement textures with allanite growth.

**Fig. S2 –** BSE images and chemical X-ray maps (Y, Th) of monazite grains within proto- and mylonitic paragneisses.

**Fig. S3 –** U–Th–Pb data of monazite within protomylonites from each analysed grain (left column) and ordered (right column). Box high is the 2𝝈 uncertainty. On the diagrams of the left column the concordance between the two U–Pb systems is shown by a colour code reported on the top of the column; the unfilled boxes are the 208Pb/232Th data. The textural position of the grain is also shown as well as information about the chemistry. The diagrams on the right column highlight isotopic data concordant (green filled boxes) and discordant (unfilled and dashed boxes) for the three systems.

**Fig. S4 –** U–Th–Pb data of monazite within mylonites from each analysed grain (left column) and ordered (right column). Box high is the 2𝝈 uncertainty. On the diagrams of the left column the concordance between the two U–Pb systems is shown by a colour code reported on the top of the column; the unfilled boxes are the 208Pb/232Th data. The textural position of the grain is also shown as well as information about the chemistry. The diagrams on the right column highlight isotopic data concordant (green filled boxes) and discordant (unfilled and dashed boxes) for the three systems.

**Fig. S5 –** BSE and X-ray maps of zoned (Type “Z”) titanites within calc-silicate. The darker shade on the BSE image or cold colours in the X-ray maps for the external domains indicate lower content of LREE. The coloured scale of the X-ray maps represents the intensity of the characteristic X-ray emission for each elements.

**Fig. S6 –** BSE and X-ray maps of zoned (Type “unZ”) titanites within calc-silicate. The coloured scale of the X-ray maps represents the intensity of the characteristic X-ray emission for each element.

**Tables Supplementary**

Tab. S1 - EPMA (major and minor elements) chemical results for monazite.

Tab. S2 - Monazite textural features.

Tab. S3 – LA-ICP-MS U–(Th–)Pb data analytical details.

Tab. S4 – U–Th–Pb monazite data.

Tab. S5 - EPMA (major and minor elements) chemical results for titanite.

Tab. S6 - U–Pb and trace elements titanite data.