Linking mineral growth and re-equilibration to *in-situ* Th-Pb allanite and $^{40}Ar/^{39}Ar$ mica ages in low to medium-grade metapelites (eastern Tibet)

L. AIRAGHI[1*], P. LANARI[2], C. WARREN[3], E. JANOTS[4], J. DE SIGOYER[4]

[1] Sorbonne Université, ISTeP, 4 place Jussieu, 75005 Paris, France (*correspondence : laura.airaghi@upmc.fr)

[2] Institute of Geological Sciences, University of Bern, CH-3012 Bern, Switzerland

[3] School of Environment, Earth and Ecosystem Sciences, The Open University, Milton Keynes, UK

[4] Université Grenoble Alpes, ISTerre, Grenoble, France

Linking ages to metamorphic stages in low to medium-grade metamorphic rocks can be particularly challenging due to the rarity of suitable geochronometers. This study focuses on a series of garnet-biotite allanite-bearing metapelites, collected in the the Longmen Shan (eastern Tibet) where the timing of metamorphism has is still largely unconstrained. Garnet and biotite grew between peak-P and peak-T conditions (11-6 kbar, 550-600°C). Allanite (REE-rich epidote) is observed in different microstructural sites and exhibits different epidote rings. Where allanite is observed as inclusions in garnet (Aln 1, pre-garnet), garnet shows very low Y concentrations due to the fractionation of Y in allanite and epidote before the garnet growth. In samples where allanite is observed only in the matrix (Aln2), both garnet and allanite preserve zoning in yttrium. The Y incorporation in garnet is attributed to dissolution-precipitation reactions involving allanite and occurring during the garnet growth. Aln 2 is therefore syn to post-garnet. This relative chronology is confirmed by *in-situ* Th-Pb allanite ages: *c.* 200 Ma for Aln 1, *c.* 180 Ma for Aln2. The growth of allanite correlates with the appearance of biotite in the stable mineral assemblage. *In-situ* $^{40}Ar/^{39}Ar$ biotite ages of *c.* 200 Ma (core) and 180 Ma (rims) are in good agreement with the two populations of allanite ages, suggesting that biotite still records crystallization ages above 550°C. By contrast, white mica grains in matrix preserve evidence for multiple (re)crystallization events at peak-P, peak-T and during the late greenschist overprint. Consistently, $^{40}Ar/^{39}Ar$ ages appear to span the timing of early prograde white mica crystallization (at c. 200 Ma) and of late re-crystallization (c. 140 Ma). Biotite and muscovite therefore experienced different Ar retention histories, controlled by dissolution-precipitation processes rather than by diffusion. Several thermo-geochronometers need therefore to be combined to derive unambiguous petrochronological information in low to medium-grade metapelites.