

Kyanite-bearing anatectic metapelites from the Eastern Himalayan Syntaxis, Eastern Tibet, China : textural evidence for partial melting and phase equilibria modeling

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The Eastern Himalayan Syntaxis (EHS), or Namche Barwa antiform, Tibet, China, marks the eastern termination of the Himalayan Range. In the EHS, the overall E-W trending India-derived Higher Himalayan Crystallines are bent in a N-S orientation and are actively indenting and exhuming into and from underneath the Asian-derived rocks of the Lhasa terrane, strongly altering the otherwise linear trend of the Yarlung Zangbo Suture Zone (YZSZ). As reflected by its tormented landscape, the EHS is characterized by extreme denudation and exhumation rates. Up to now, no consensus has been made on the metamorphic history of the metamorphic core of the EHS, and the mechanisms that drove its burial and exhumation are still strongly debated.

In the core of the EHS, rare kyanite-bearing anatectic paragneisses locally occur as boudins within sillimanite-bearing paragneisses. Worldwide, kyanite-bearing anatectic rocks are seldom found and such an occurrence within a young and active orogenic belt provides both an excellent opportunity to study partial-melting of aluminous paragneisses in the kyanite stability-field and a unique insight into the evolution of the Himalayan range and Tibetan Plateau.

Previous studies described kyanite-bearing boudins found at the foot of the Namche Barwa massif, near the locality of Zhibai (Liu and Jhong 1997 and references therein, Burg et al. 1998), in the core of the EHS. These rocks consist of an early HP-granulite assemblage (garnet-kyanite-biotite-quartz-plagioclase-K-feldspar-rutile) variably overprinted by a late high temperature but lower pressure assemblage including sillimanite pseudomorphs after kyanite cordierite-spinel coronas after sillimanite and orthopyroxene coronas after garnet. These studies outlined the unique character of these rocks and tentatively estimated P-T conditions for peak and retrograde metamorphism. However, partial melting was not taken into account, leading to much controversy on the peak conditions (amphibolite vs HP-granulite facies) and therefore on the maximum depth of burial.

In the present study, we describe kyanite-bearing anatectic paragneisses from the NW side of the Yarlung Zangbo River, in the western rim of the EHS. These rocks were found at the eastern end of an E-W cross-section that in an eastward direction crosses granitic batholiths of the Lhasa terrane, metamorphosed and deformed units of the YZSZ and a metasedimentary sequence. This sequence is characterized by an eastward increasing metamorphic grade going from 2-micas garnet schists through garnet-kyanite-staurolite gneisses and sillimanite-bearing gneisses to kyanite-bearing anatectic gneisses. At the outcrop scale, the kyanite-bearing rocks occur in the same setting as the boudins described in the inner core. However, they lack the late lower-P

high-T overprint, being devoid of corona assemblages.

In this contribution, we present textural evidences for partial-melting of these rocks in the kyanite stability field supported by phase equilibria modelling with THERMOCALC. The studied rocks have broadly pelitic to semi-pelitic compositions and are characterised by the assemblage garnet-kyanite (\pm sillimanite)-biotite-quartz-plagioclase-K-feldspar \pm rutile/ilmenite with sillimanite locally occurring as pseudomorphs after kyanite. Although the rocks are strongly deformed, melt related textures are locally preserved in the matrix as (1) fine grained feldspar-rich domains corroding relict coarser grained quartz ribbons and (2) films and pockets of randomly oriented fine grained biotite and feldspars surrounding corroded kyanite. However, melt related textures are best preserved in polymineralic inclusions within garnet porphyroblasts, consisting of rounded quartz and/or skeletal biotite surrounded by optically continuous pools of feldspar, with crystalline garnet faces towards the inclusions. All the above textures are consistent with the continuous reaction biotite + kyanite + quartz \pm plagioclase = garnet + melt \pm K-feldspar (R1) which marks the entrance to the HP-granulite facies. In addition retrograde textures related to melt crystallization are observed in form of biotite-fibrolite aggregates locally corroding garnet rims and suggesting that the melt solidified in the sillimanite stability field.

Phase equilibria modelling in the NCKFMASHTO system with THERMOCALC is in progress. Preliminary pseudosections built with the bulk compositions of one pelitic and one semi-pelitic sample show that for these rocks the biotite-kyanite-garnet-quartz-plagioclase-K-feldspar-liquid-rutile +/- ilmenite field in which reaction R1 operates, occurs within the P-T range of \sim 800-875°C and \sim 10-17 kbar. In addition these pseudosections show topologies that are consistent with substantial melt loss during prograde metamorphism. Preliminary minimum P-T estimates of \sim 13.5-14.5 kbar and \sim 830°C are inferred for the metamorphic peak based upon the the intersection of composition isopleths reflecting the grossular contents and XFe of homogeneous cores of garnet in the metapelitic sample. Subsequent solidification of melt in the sillimanite stability field implies strong post-peak decompression at high temperatures.

References

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