Late Paleozoic crustal extension and high-T/low-P metamorphism in the eastern North Tianshan (NW China)

Xinghua Ni*[1,2], Bo Wang[1], Mathieu Soret[2], Dominique Cluzel[3], Yan Chen[2], Jiashuo Liu[1,2], and Faure Michel[2]

[1]State Key Laboratory for Mineral Deposits Research, School of Earth Sciences and Engineering, Nanjing University – Chine

[2]Université d'Orléans – ISTO Orléans – France

[3]Institut de Sciences Exactes et Appliquées, Université de la Nouvelle-Calédonie – Nouvelle-Calédonie

Résumé

The Late Paleozoic crustal evolution of the eastern North Tianshan remains controversial due to the lack of structural and metamorphic constraints. We present new structural, petrological and geochronological data of the Xiaopu metamorphic complex (XMC) to address this issue. The XMC shows a well-preserved prograde Buchan-type metamorphic sequence made of garnet, andalusite-staurolite and sillimanite zones. Structural observations indicate that garnet, sillimanite, andalusite and staurolite grew syn-kinematically during a transtensional event (D2). Mineral inclusions in garnet cores oriented at high angle with the external foliation probably record an earlier deformation stage (D1). Synchronous detachment faults and ductile thrusts (D3) overprinted the previous structures and correspond to the exhumation of the metamorphic complex associated with intrusion of granitic bodies. LA-ICP-MS zircon U-Pb ages of pre-D2 gneissic granodiorite, syn-D2 granitic dikes and post-D2 diorites constrain the occurrence of D2 between 341 and 305 Ma. Apatite U-Pb ages of mylonitic rocks from the detachment fault indicate that D3 occurred at _˜285 Ma. Geothermobarometers were used to estimate pressure-temperature (P-T) conditions of the XMC. Peak conditions show progressive temperatures increase from andalusite-staurolite schists (_˜590℃) to sillimanite migmatites (_˜690℃) at nearly constant pressures (_˜4 kbar), probably suggesting a significant thermal effect of large intrusive bodies. Monazite U/Th-Pb ages of 313-311 Ma for sillimanite-bearing schists and migmatites confirm the synchronous HT/LP metamorphism and intrusion of the nearby 316-312 Ma Xiaopudong pluton. Two sillimanite migmatites also show retrograde conditions at _˜617℃, 2.2 kbar and _˜590℃, 2.3 kbar, respectively. Their P-T paths suggest an episode of decompression and cooling under high thermal gradients, similar with that of metamorphic core complexes. 40Ar-39Ar ages of mica from gneissic granodiorite and sillimanite schists are in the range of 298-284 Ma, consistent with a later cooling and exhumation associated with D3. These data reveal a long-term crustal thinning (transtension/extension) of the North Tianshan during the early Carboniferous to early Permian. Such extensional tectonics facilitates decompression melting of the lower crust and even lithospheric mantle of the North Tianshan arc. Subsequent ascent and emplacement of the melt caused high thermal gradients and partial melting of the mid-crustal rocks and promotes crustal exhumation.

*Intervenant

Mots-Clés: North Tianshan, Carboniferous, Permian, crustal thinning, high, T and low, P metamorphism, crustal exhumation