Petrographic study of the andalusite-bearing graphitic schists from the Northern Karakoram (Sarpo Laggo, K2 and Gasherbrum Glaciers moreins, Xinjiang, China)

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The Karakoram terrane comprises the southern part of the Asian side of the India-Asia collision zone and is the geological equivalent of the Central Tibet Qiangtang terrane. The geology of the Karakoram terrane can be divided into: (a) a northern dominantly sedimentary terrain intruded by diorite-granodiorite intrusions (e.g. Broad Peak diorites) with uplifted lower crustal metamorphic core complexes (e.g. K2 gneiss), (b) the Karakoram batholith, a ~700 km long granite batholith, and (c) the Southern Karakoram metamorphic complex composed of regional Barrovian facies kyanite- and sillimanite- grade gneisses. Opposite to the Southern Karakoram metamorphic complex, which has been widely studied (e.g. Desio and Zanettin, 1970; Searle et al., 1989; Searle and Tirrul, 1991; Allen and Chamberlain, 1991; Fraser et al., 2001; Rolland et al., 2001; Rolland and Pêcher, 2001; Gaetani et al., 1990b), the metamorphic terranes of the Northern Karakoram are still largely unknown and most of the geological maps of the area are highly incomplete (e.g. Searle, 2011). Most of the data actually available on the metamorphites of the Northern Karakorum terrane derive from two Italian expeditions (1988 and 2006; EV-K2-CNR) in the Shaksgam Valley, north of K2 and Gasherbrum (Desio et al., 1991; Gaetani et al., 1990a; Groppo and Rolfo, 2008). Due to the difficult accessibility of the area, most of the metamorphic rocks have been collected from the Sarpo Laggo, K2 and Gasherbrum Glaciers morains.

We present the results of a preliminary petrographic study on andalusite-bearing, two micas graphitic schists (± garnet, ± cordierite, ± staurolite): this study has allowed to define the main mineral assemblages and microstructures and to make some hypothesis on the nature of the protolith and on the P-T conditions experienced during metamorphism.

The locally well preserved clastic structure and the observed mineral assemblages suggest that the protolith of these phylladic micaschists was a sedimentary rock characterized by arenaceous levels alternating to pelitic levels. The former arenaceous levels are now dominated by quartz, with minor biotite and white mica, whereas the former pelitic levels mainly consist of fine-grained biotite and white mica, abundant graphite and Al-rich minerals (andalusite ± garnet ± staurolite).

All the studied samples show the evidence of two deformation events: the first event (D_1) was responsible for the development of a pervasive foliation (S_1), which is often crenulated by the following deformation event (D_2). The crenulation associated to the D_2 event is locally so pervasive that a new foliation S_2 develops. Both S_1 and S_2 are defined by the iso-orientation of white mica and biotite; chlorite is locally present in S_2.

The studied samples are characterized by abundant andalusite porphyroblasts that are mainly concentrated in the pelitic levels. Andalusite is generally well preserved and locally shows a chiastolitic structure; it is locally partially or completely replaced by a fine-grained aggregate of white mica ± chlorite. Andalusite growth is syn- to post-S_1. Garnet and staurolite are more rare and their growth is post-S_1.

The most complete mineral assemblage, useful to constrain peak metamorphic conditions, is syn- to post-D_1 and consists of biotite + white mica + andalusite + quartz ± garnet ± staurolite ± cordierite. This assemblage constrains peak metamorphic conditions of about 500-600°C, 1.5-2.5 kbar, i.e. low pressure amphibolite facies conditions. Late white mica and chlorite flakes statically overgrowing the S_2 suggest a retrograde evolution under greenschist facies conditions.

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Although not collected in place, these samples thus provide important information on the nature of the metamorphic rocks outcropping at the head of Sarpo Laggo, K2 and Gasherbrum valleys.

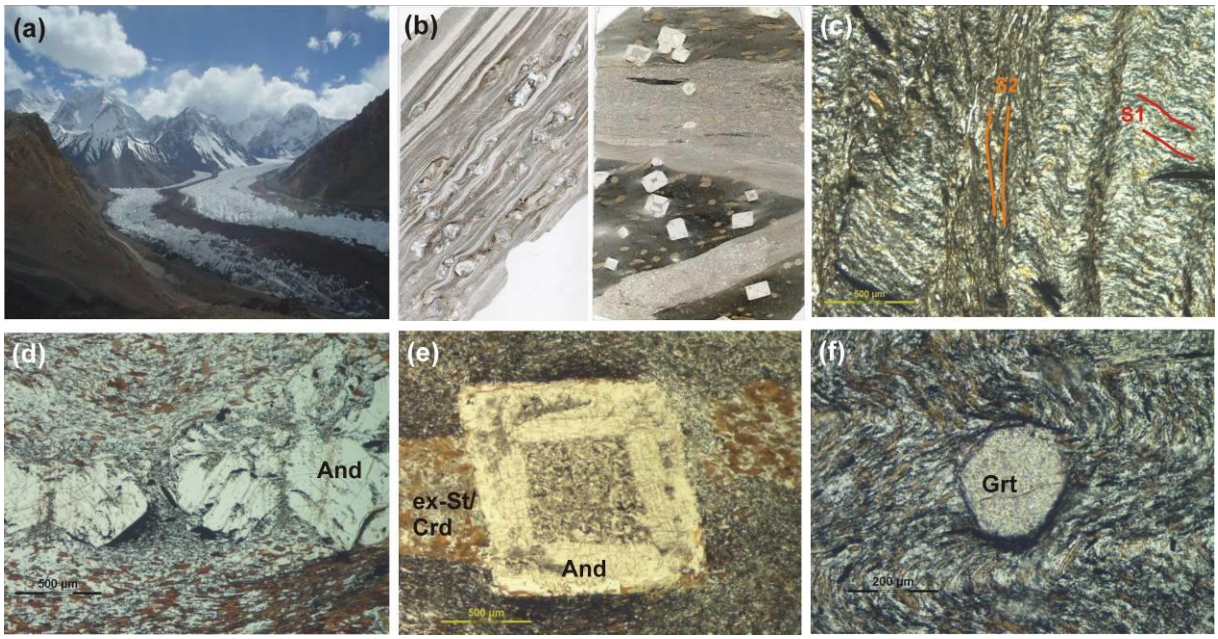

Figure 1. (a) Gasherbrum Glacier with its lateral and central morains. (b) The studied andalusite-bearing graphitic schists consists of former arenaceous levels (lighter in colour) alternating with former pelitic levels (darker). Andalusite porphyroblast mainly grew in the former pelitic layers. (c) Detail of the foliation S_1 crenulated by the deformative event D_2. A new foliation S_2 locally develops. (d,e) Details of andalusite porphyroblasts, locally with a chiastolite structure. (f) Garnet porphyroblast post-S_1.

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