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Deformation microstructures of a Kamila amphibolite mylonite and their formative temperatures

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The Kohistan complex and the Kamila amphibolite belt in the northern Pakistan are considered to represent a Cretaceous island arc crust and a part of its lower crust, respectively. Here we report deformation microstructures of a Kamila amphibolite mylonite sample and their formative temperatures.

The amphibolite mylonite sample studied is composed of 100 μm to 1 mm thick alternating layers of hornblende + pyroxene, plagioclase, and hornblende + plagioclase + quartz, intercalating a 3 mm thick layer of garnet + quartz + plagioclase. Composite planar fabrics of a top-to-south sense of shear are developed in this sample; C plane defined by compositional layering (= foliation), S plane defined by lenticular domains of plagioclase aggregate clockwise oblique to the C plane, and C $'$ plane anticlockwise oblique to the C plane.

Hornblende + pyroxene layers contain pyroxene porphyroclasts of grain sizes $\approx$ 200 μm scattered in matrix mainly composed of hornblende grains with grain sizes $\approx$ 30 μm. Hornblende exhibits a strong crystallographic preferred orientation with (100) and [001] subparallel to foliation and lineation, respectively. Orthopyroxene porphyroclasts are elongated subparallel to foliation, and are accompanied by asymmetric tails mainly composed of hornblende indicating a top-to-south sense of shear. In addition, pyroxene porphyroclasts are surrounded by fine-grained ($\approx$ 10 μm) hornblende and quartz, suggesting a breakdown reaction of pyroxenes (orthopyroxene + clinopyroxene + H2O = hornblende + quartz), which is a retrograde reaction from granulite facies to amphibolite facies.

Plagioclase layers are composed of dynamically recrystallized plagioclase grains of An_{47-54} in composition. Lenticular domains of plagioclase are likely porphyroclasts in origin. Plagioclase grains are polygonal in shape, and weakly aligned clockwise oblique to foliation, which also suggests a top-to-south sense of shear. Plagioclase exhibits a distinct crystallographic preferred orientation with {131} and <1-12>clockwise oblique to foliation and lineation, respectively by $\approx$ 20 degrees. But {131} and <1-12>are aligned subparallel to the S plane, suggesting the dominance of {131}<1-12>during the dynamic recrystallization of plagioclase.

We applied three pyroxene geothermometers to the chemical compositions of orthopyroxene and clinopyroxene porphyroclasts, which yielded temperatures around 850 degrees C. We also applied a hornblende-plagioclase geothermometer to the average chemical compositions of hornblende and plagioclase in hornblende + plagioclase + quartz layers, and obtained a temperature of $\approx$ 610 degrees C. Thus, the amphibolite mylonite studied likely experienced a peak metamorphism of granulite facies at $\approx$ 850 degrees C, and subsequently a retrograde metamorphism of amphibolite facies at $\approx$ 610 degrees C, during which it was sheared by top-to-south thrusting.