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Dynamic recrystallization of and crystallographic preferred orientation in plagioclase at amphibolite-facies conditions

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We report on dynamic recrystallization of and crystallographic preferred orientation in plagioclase at amphibolite-facies conditions. Analyzed samples are mylonites derived from (1) amphibolite in the Poroshiri Ophiolite of Hokkaido, (2) amphibolite and (3) granodiorite in the Ivrea Zone of NW Italy, (4) amphibolite in the Oman Ophiolite, and (5) amphibolite in the Kohistan Arc of N Pakistan. Applications of Spear's (1980) hornblende-plagioclase thermometry to the chemical compositions of hornblende and plagioclase grains formed during deformation in samples (1), (2), (4) and (5), and of Whitney and Stormer's (1977) two-feldspar thermometry to the chemical compositions of K-feldspar and plagioclase grains formed during deformation in the sample (3) yield deformation temperatures of 530-650 degrees C. A *c*-axis preferred orientation subparallel to foliation and subperpendicular to lineation (Y-maximum pattern) of dynamically recrystallized quartz grains in the sample (3) also supports the deformation at an amphibolite-facies condition.

Monomineralic plagioclase-aggregate layers in these samples contain coarser-grained (100-1500 x10^{-6}m) porphyroclasts in finer-grained (smaller than 200 x10^{-6}m) matrix grains, except the sample (5) which lacks plagioclase porphyroclasts. Both porphyroclasts and fine-grained matrix grains show evidence for crystal plastic deformation such as undulose extinction, deformation twinning and subgrain boundaries. Although chemical compositions of porphyroclasts vary among samples (An_{41-62}, An_{51-60}, An_{36-38} and An_{89-93} in samples (1), (2), (3) and (4), respectively), no significant difference in chemical composition is recognized between porphyroclasts and fine-grained matrix grains. This indicates that fine-grained matrix grains are dynamically recrystallized grains. Dynamically recrystallized grains in contact with porphyroclasts have crystallographic orientations mostly unrelated with those of porphyroclasts, which suggests dynamic recrystallization not by subgrain rotation, but by grain boundary migration. Dynamically recrystallized plagioclase grains in all samples exhibit a crystallographic preferred orientation such that their $\{121\}$ planes and [1-11] axes are oriented subparallel to foliation and lineation, respectively. In addition, $\{121\}$ planes and [1-11] axes have maxima oblique to foliation and lineation, respectively, toward $sigma_1$-normal and $sigma_3$ directions, respectively, inferred from the sense of shear deduced from asymmetric microstructures. This obliqueness suggests that the $\{121\}$ and [1-11] preferred orientations reflect stress orientations rather than orientations of shear plane and shear direction.

It is therefore concluded that at amphibolite-facies conditions, plagioclase dynamically recrystallizes through grain boundary migration, and also that a crystallographic preferred orientation with $\{121\}$ plane and [1-11] axis subparallel to foliation and lineation, respectively, commonly develops. The dominant slip system and the reason why $\{121\}$ and [1-11] preferred orientations reflect stress orientations need to be further investigated.