Submitted to:

International conference on "Mechanical Instabilities in Rocks & Tectonics"
organised by Jean-Pierre Burg, David Mainprice & Jean-Pierre Petit
4 - 6th September 1991 MONTPELLIER, FRANCE

To be published in Terra Abstracts

Sent to: Mrs. L. FAYNOT (Instability Conference)
Centre Géologique et Géophisique
U.S.T.L., Place Eugène Bataillon
34095 MONTPELLIER Cedex 5
FRANCE tel. 67.63.49.83 Fax 67.52.39.08

09.33

DEVELOPMENT OF APPARENT CRYSTAL-PLASTIC DEFORMATION MICROSTRUCTURES IN QUARTZ BY STABLE EXTENSIONAL MICROCRACKING PLUS SOLUTION-PRECIPITATION CREEP

BAS DEN BROK (HPT-lab, dept of Geology, Inst of Earth Sci, PO Box 80.021, 3508 TA Utrecht, The Netherlands)

Deformation features frequently observed in deformed quartz rocks, such as undulatory extinction, deformation bands, subgrains and recrystallized grains, are commonly believed to be typical crystal-plastic deformation microstructures. However, quite similar deformation microstructures have now been produced experimentally in quartzite by stable extensional microcracking plus solution-precipitation creep.

The experiments were performed on a dense natural quartzite (150-250 μm grain size) in a Griggs solid-medium apparatus at a temperature of ~800°C, a confining pressure of ~1200 MPa, a strain rate of $\sim 10^{-7}\ s^{-1}$ and 0.4 wt-% of added water. As samples were shortened, axially aligned transgranular and grain boundary microcracks were developed. These microcracks progressively opened and were filled up with fine-grained, polygonal to euhedral quartz (5-25 μm). The new grain aggregates are characterized by abundant microscale voids, fine intergranular channels and fluid inclusion trails, and are interpreted to have formed by precipitation from solution. With increasing strain the microstructure starts to look more and more like a crystal-plastic microstructure, with "subgrains" and "recrystallized" grains. Healed irregular microcracks along which rotation has taken place give the impression of undulatory extinction, and deformed new grain aggregates look like subgrains and recrystallized grains.

The experiments show that typical "crystal-plastic" deformation features in quartz, such as undulatory extinction, deformation bands, subgrains and recrystallized grains, may also result from stable extensional microcracking plus solution-precipitation creep. These microstructures should therefore not be used as criteria for crystal-plastic deformation.