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Deformation assisted by fluids in quartz veins of shear zones: an example from Iron Formations of Quadrilátero Ferrífero, Brazil.

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The evidences of fluid activity in rocks are well recognized. In many cases, the fluid is responsible to remobilize many elements (e.g. Au, Mn, Si) that may be transported over a long distance and precipitated as new minerals in regions of low stress of the rock. In many deformed rocks, the origin of a large number of structures (veins, pressure shadows, dissolved grain boundaries, etc) may be correlated to the fluid activity. However, the fluids are important not only during the crack-and-seal process but also after the sealing ceases. As an example of how the fluids are responsible to rearrange the structure of the rock, we studied many quartz veins of one iron-formation from Brazil. The rocks were collected in Quadrilátero Ferrífero (QF), Brazil, that is one of the most important metalogenetic provinces in the world. It is assumed the existence of a deformational and metamorphic gradient in the rocks of QF, increasing the occurrence of penetrative structures from southwest to northeast. However, the effects of the local shear zones in the deformation pattern of QF may not be neglected. Shear zones are generally recognized as structures that accommodate deformation, eventually with intense fluid percolation. It is indubitable that there is a relationship between the fluid activity and the deformation accommodation in shear zones. So, to investigate how the fluid activity can affect the mechanisms of accommodation of deformation in rocks of shear zones from QF, we characterized the crystallographic preferred orientation (CPO) of some quartz vein by EBSD (electron backscattering diffraction). All the samples came from the same outcrop and from the same dextral shear zone, localized in the low-deformation region of QF, under greenschist metamorphic conditions. The samples were oriented according to the XYZ reference system, with X parallel to the foliation and Z normal to the XY plane.

The veins are quartz-rich layers parallel to the rock foliation. They do not exhibit any kind of fibrous structures that can indicate a sense of growth of the quartz crystals inside the vein. The less deformed veins are composed of tabular crystals of quartz, with the optical axes oriented sub-parallel to the foliation. Mechanical Dauphiné twinning of quartz may also be observed in the single crystals. On the other hand, the deformed veins are represented by polycrystalline layers of quartz, with two distinct CPOs of c-axes: 1) oblique to the foliation and 2) parallel to the Y axis.

We suppose that the veins are the result of a concurrence between transformation, recrystallization and recovery of quartz assisted by fluid activity at low temperature and confining pressure. In the related deformation conditions, slip on basal planes and mechanical twinning are consistent with a strong c-axis CPO of quartz sub-parallel to the foliation, but it is not acceptable to the c-axis CPO around Y. To achieve this distinct crystallographic orientation, it is necessary a slip system on prismatic planes followed by grain boundary migration. At low temperatures, one possible situation to explain the CPO under theses conditions is the progressive deformation assisted by fluid activity. A posterior static recrystallization by discontinuous grain growth of quartz may be responsible for the concentration of the c-axis around the Y, intensifying the CPO.