Geophysical Research Abstracts
Vol. 18, EGU2016-6049, 2016
EGU General Assembly 2016

Brittle-ductile deformation effects on zircon crystal-chemistry and U-Pb ages: an example from the Finero Mafic Complex (Ivrea-Verbano Zone, western Alps)

Antonio Langone (1), Padrón-Navarta José Alberto (2), Alberto Zanetti (1), Maurizio Mazzucchelli (3,1), Massimo Tiepolo (4), Tommaso Giovanardi (5), and Mattia Bonazzi (6)

(1) National Research Council, Institute of Geosciences and Earth Resources, 27100 Pavia, Italy (langone@crystal.unipv.it), (2) Géosciences Montpellier, CNRS - Univ. Montpellier, 34095 Montpellier, France, (3) Dipartimento di Scienze Chimiche e Geologiche, Università degli Studi di Modena e Reggio Emilia, 41125 Modena, Italy, (4) Dipartimento di Scienze della Terra "A. Desio", Università degli Studi di Milano, 20133 Milano, Italy, (5) Instituto de Geociências, Universidade de São Paulo, 05508-900 São Paulo, Brazil, (6) Dipartimento di Scienze della Terra e dell'Ambiente, Università di Pavia, 27100 Pavia, Italy

A detailed structural, geochemical and geochronological survey was performed on zircon grains from a leucocratic dioritic dyke discordantly intruded within meta-diorites/gabbros forming the External Gabbro unit of the Finero Mafic Complex. This latter is nowadays exposed as part of a near complete crustal section spanning from mantle rocks to upper crustal metasediments (Val Cannobina, Ivrea-Verbano Zone, Italy). The leucocratic dyke consists mainly of plagioclase ($An_{18-24}Ab_{79-82}Or_{0.3-0.7}$) with subordinate amounts of biotite, spinel, zircon and corundum. Both the leucocratic dyke and the surrounding meta-diorites show evidence of ductile deformation occurred under amphibolite-facies conditions.

Zircon grains (up to 2 mm in length) occur mainly as euhedral grains surrounded by fine grained plagioclase-dominated matrix and pressure shadows, typically filled by oxides. Fractures and cracks within zircon are common and can be associated with grain displacement or they can be filled by secondary minerals (oxides and chlorite).

Cathodoluminescence (CL) images show that zircon grains have internal features typical of magmatic growth, but with local disturbances. However EBSD maps on two selected zircon grains revealed a profuse mosaic texture resulting in an internal misorientation of ca. 10^o. The majority of the domains of the mosaic texture are related to parting and fractures, but some domains show no clear relation with brittle features. Rotation angles related to the mosaic texture are not crystallographically controlled. In addition, one of the analysed zircons shows clear evidence of plastic deformation at one of its corners due to indentation. Plastic deformation results in gradual misorientations of up to 12^o, which are crystallographically controlled.

Trace elements and U-Pb analyses were carried out by LA-ICP-MS directly on petrographic thin sections and designed to cover the entire exposed surface of selected grains. Such investigations revealed a strong correlation between internal zircon structures, chemistry, U-Pb isotope ratios and mylonitic fabric.

U-Pb data return highly discordant and variable ages: in particular, the $^{206}Pb/^{238}U$ ages range from Carboniferous to Triassic within the same zircon grain. The youngest $^{206}Pb/^{238}U$ data derive from narrow axial stripes oriented parallel or at low angle with respect to the foliation planes. These stripes are characterized by an overall HREE, Y, U and Th enrichment possibly reflecting deformation of the grain in presence of interstitial fluid phases, likely related to a concomitant magmatic activity. Deformation related structures (cracks and fractures) within zircon grains acted as fast-diffusion pathways allowing fluids to modify the geochemistry and isotopic systems of zircon.

Our results suggest that fluid-assisted brittle-ductile deformation can severely modify the trace elements and isotopic composition of zircon with unexpected patterns constrained by stress regime. In similar cases, our observations suggest that, for a more appropriate interpretation of the petrologic evolution and age variability, a direct characterization of the internal structures of zircons still placed in their microtextural site is highly recommended.