

English abstract:

Tectono-metamorphic evolution of the Aulus Basin metasediments in the vicinity of the Lherz peridotite massif, the Northern Pyrenean Zone

The North Pyrenean Metamorphic Zone occurs parallel to the WNW-ESE trending North Pyrenean Fault that is currently preserved along the northern slope of the Pyrenees. It comprises Mesozoic carbonates and marls which recorded Albian high temperature and low pressure metamorphism (GOLDBERG AND LEYRELOUP 1990, BERNUS-MAURY 1984). This metamorphic record is not regionally developed, but localized to regions of crustal thinning and mantle upwelling due to formation of pull-apart basins during drifting of Iberia towards Mediterranean (105-90 Ma) (SIBUET ET AL. 2004, GOLDBERG AND LEYRELOUP 1990, MONTIGNY ET AL. 1986, CHOKROUNE 1976). The North Pyrenean Metamorphic Zone is well known by presence of cca. forty ultramafic bodies enclosed in metasediments. The largest body among them, the Lherz peridotite body, occurs in brecciated metasedimentary sequence of the Aulus basin in the central Pyrenees. The peridotite itself is also brecciated at its margins and shows HT foliations in lherzolites steeply dipping to the ESE. This fabric has been interpreted as oriented planes of refertilization of refractory harzburgite by interaction of the depleted mantle with upwelling asthenospheric partial melts (LEROUX ET AL., 2007). The emplacement of the Lherz peridotite body into the brecciated metasedimentary sequence of the Aulus basin has been matter of a long living debate (i.e. LAGABRIELLE AND BODINIER 2008, VIELZEUF AND KORNPBST 1984, MINNIGH ET AL. 1980, CHOKROUNE 1973). In spite of several presented models, however, there is no study concerning tectono-metamorphic evolution of the metasediments around the peridotites.

The continuous stratigraphic sequence of the Aulus basin is not preserved in recent erosion surface due to tectonic reworking in Albian and Eocene times. However, sedimentation started with Rhetian to Hettangian metadolomites and "hornfels", and continues to the Middle Jurassic to Lower Cretaceous dolomitic carbonates. On the regional scale, the sequence is folded and covered by the Upper Cretaceous non-metamorphosed flysch sediments (COLCHEN ET AL. 1997). The metamorphic fabric (S_1/M_1) has developed parallel to bedding during the upwelling of mantle beneath the basin and is characterized by high temperature coarse-grained foliation S_1 and intrafoliational isoclinal folds. In the vicinity of the Lherz peridotite massif, this early tectono-metamorphic fabric occurs in isolated domains elongated in east-west directions and surrounded by hydraulic and sedimentary breccias. Distinct kind of breccia occurs along faults steeply dipping to the ESE that show growth of tremolite in the matrix. General orientation of the S_1 fabric is not disturbed by brecciation and dips to the WNW at shallow angles. Metacarbonates show coarse-grained microstructure having either migrated or annealed straight grain boundaries. Locally, the microstructure shows strong shape preferred orientation of calcite, scapolite and phlogopite providing intense stretching lineation plunging to the west. The HT foliation is locally folded into folds with sub-vertical axial planes and folds axes gently plunging to the west. This leads to development of a mylonitic fabric in the fold limbs parallel to the foliation.

Metamorphic peak is characterized by calcite-dolomite-tremolite mineral assemblage together with scapolite, titanite and phlogopite. Large euhedral scapolite crystals are zoned and often contain inclusions of various minerals (tourmaline, mica ect.). Scapolites are preferentially retrogressed from cores when fractured and common breakdown products are represented by clay minerals, muscovite, feldspar (albite) and quartz. However, the attribution of the breakdown process to a deformation phase is not yet clear. Locally we observe growth of small aggregates of clinocllore that can be attributed to the D_2 deformation.

Mineral assemblages recorded in the studied metasediments are interpreted as the result of metamorphic evolution in localized pull-apart basin between two overstepped sinistral faults of the North Pyrenean transform fault system. During this process the HT- LP metamorphism in the pull-apart region has been associated with a) folding of S_1 metamorphic fabric, b) HT normal faulting and fluid migration, c) tilting of crustal blocks with developed S_1 fabric along the HT normal faults.

In the present-day pattern of the Pyrenees, the area around the Lherz peridotite body is supposed to represent a fossil Albian pull-apart basin. Preservation of such pull-apart domain during subsequent Eocene Pyrenean shortening and building of a mountain range is interpreted to be the result of strain concentration into LT marble mylonites along the northern and southern margins of the Aulus basin.