Localization of a crustal-scale shear zone controlled by water-present partial melting of orthogneiss

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Résumé

It is widely accepted that partial melting of the orogenic crust drastically reduces rock viscosity, thereby promoting strain localization. Additionally, the orogenic crust is typically considered to lack free water. As a result, it is generally assumed that most of the melt within the orogenic crust originates from dehydration reactions involving muscovite and biotite, making metapelites the most fertile lithology. Based on this understanding, partial melting of metapelites can be considered as the primary control on strain localization within the orogenic crust.
However, in the External Crystalline Massifs (ECM) of the Alps, the East Variscan Shear Zone (EVSZ) presents contradictory features with shear zones localized within orthogneisses and a higher melt fraction observed in orthogneisses than in the surrounding metasedimentary rocks. Structural analyses, petrological observations and phase equilibrium modelling support the occurrence of water-fluxed partial melting of orthogneisses at low temperature conditions, producing high-melt fractions.
Our results suggest that the water-fluxed melting of orthogneisses has a primary rheological control on the initiation, localization, and evolution of crustal-scale shear zones in the middle crust. Consequently, the distribution and geometry of orthogneisses at the crustal scale could be regarded as critical parameters influencing the rheological inheritance governing the tectonic evolution and localization of bulk strain in the continental lithosphere.

Mots-Clés: Partial melting, Shear zone, Variscan belt

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