Orogenic eclogites as recorders of deep crustal flow

Donna L. Whitney[1], Clémentine Hamelin [1], Christian Teyssier[1], Jonas Vanardois[1,2], Pierre Trap[2], Françoise Roger[3], Patrice Rey[4]

[1] University of Minnesota, Minneapolis USA

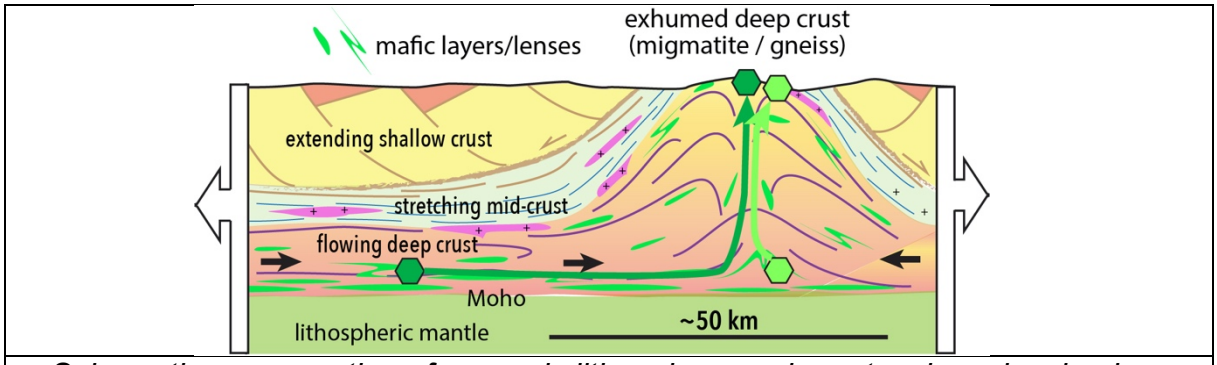
[2] Université de Franche-Comté, 25030 Besançon, France

[3] Université Montpellier, 34095 Montpellier Cedex 5, France

[4] University of Sydney, Sydney, Australia

Eclogite enclosed in gneiss or migmatite occurs in many exhumed hot orogens. Eclogite may occur within rocks that did not experience high-pressure (HP) metamorphism, but more commonly, both inclusion and host experienced coeval HP metamorphism that is recorded only by the eclogite. These rocks (eclogite, gneiss) represent a deep crustal flow system that experienced large-magnitude flow: vertically during exhumation from near-Moho depths and laterally prior to exhumation. The extent of deep-crust lateral flow is difficult to document, but eclogites in migmatite provide clues as to whether deep crust flowed long distances (tens of km or more) or whether the HP rocks were more locally sourced.

We have reconstructed the flow paths of orogenic eclogite in migmatite from the southern French Massif Central (FMC) using mineral and rock composition (bulk, mineral major/trace elements; O isotopes in zircon and garnet; bulk Sm-Nd, Lu-Hf, Rb-Sr), textures (inclusions, symplectites), extent of zircon recrystallization, and deformation fabrics. Because eclogite and host shared a flow history, we can therefore detect the provenance of the host migmatite. For example, in the Montagne Noire migmatite dome, we can distinguish between eclogite that experienced protracted HT metamorphism and deformation during flow in the deep crust from eclogite that was more locally-sourced. Ongoing work is applying this methodology to eclogites and other mafic rocks in the southern and eastern FMC, including distinguishing between eclogites formed in subducted oceanic crust vs. deep orogenic crust.



Schematic cross-section of orogenic lithosphere under extension, showing how deep-crustal rocks exhumed in the same gneiss/migmatite complex may be far-traveled or more locally-sourced.