MINERALOGICAL AND GEOCHEMICAL EVOLUTION OF ALPINE SERPENTINITES DURING SUBDUCTION DYNAMICS

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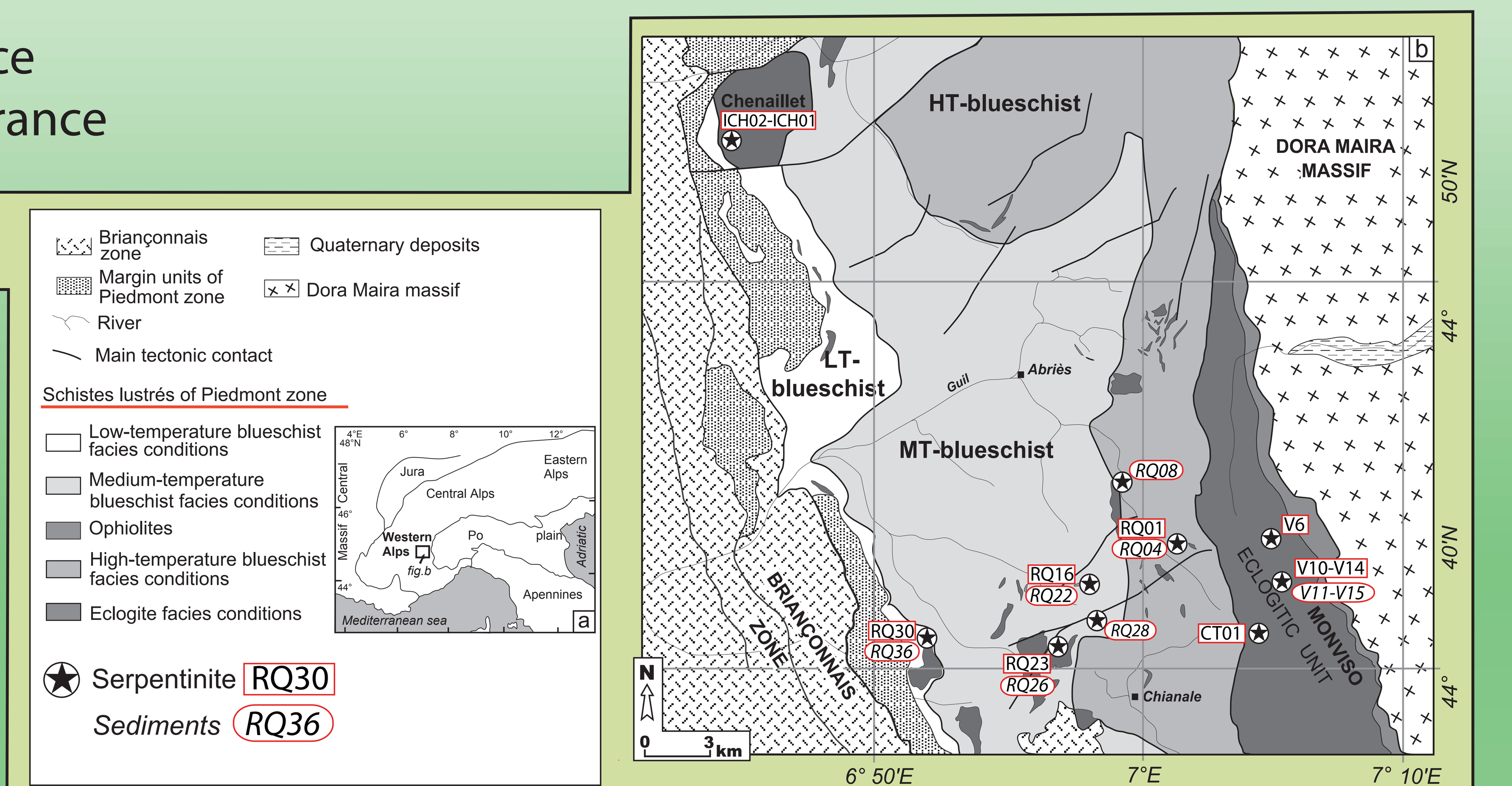
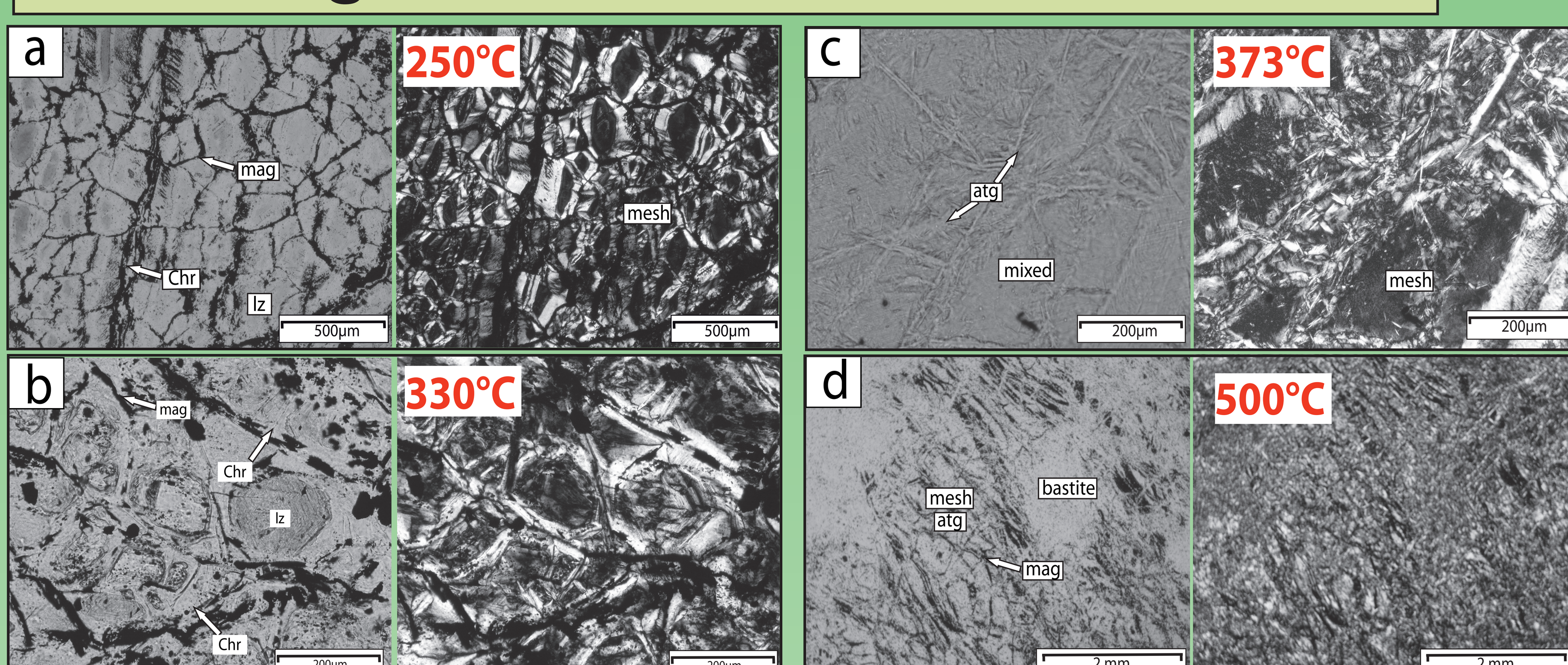


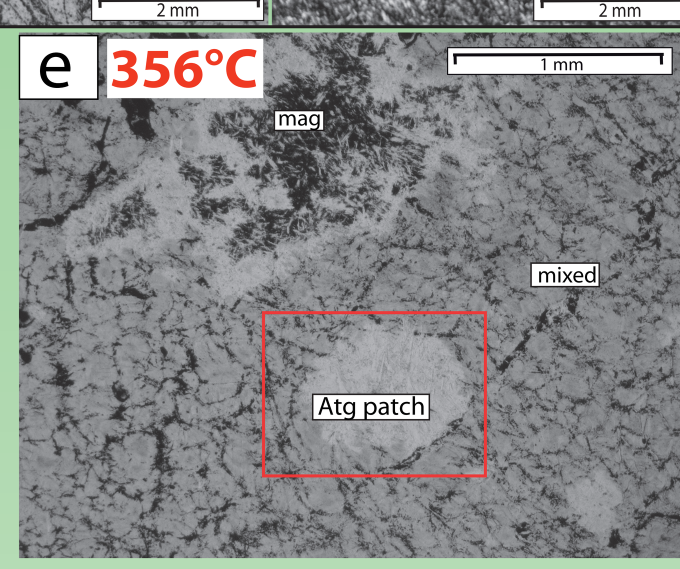
Introduction

Serpentinites observed in accretionary wedge result from two serpentinization processes: (i) during fluid/rock interactions in oceanic context and (ii) during the first step of subduction. Progressive serpentinization from the ridge to subduction zone affects physical, geochemical and rheological properties of the oceanic lithosphere. Exhumed serpentinite units are commonly characterized by different co-stability serpentine species (chrysotile, lizardite and antigorite). To understand and clarify their respective stability domain in subduction context, we studied alpine serpentinites under different high pressure conditions. In this paleo-accretionary wedge, different oceanic units have been metamorphosed from low temperature blueschist facies condition (T<350; P<1GPa) to eclogitic facies conditions (T>500°C, P> 2GPa). Based on Raman spectroscopy analysis, we estimate the metamorphic temperature conditions reached by selected samples and we characterize the serpentine species associations. Our results show a progressive destabilization of lizardite/chrysotile in favor of antigorite along the increasing subduction gradient. Additionnaly, our geochemical bulk rocks and in situ (LA-HR-ICP-MS) analysis on serpentinites and associated metasediments indicates a progressive enrichment in fluid-mobile elements (FME: As, B, Li, Sb) during increasing of metamorphic conditions. This highlights elementary exchange and fluids circulation between metasediments and serpentinites into the accretionary wedge. We propose that FME from metasediments are transferred by water and silica rich fluids at mantle depths into serpentinites which constitute a secondary reservoir for these elements.

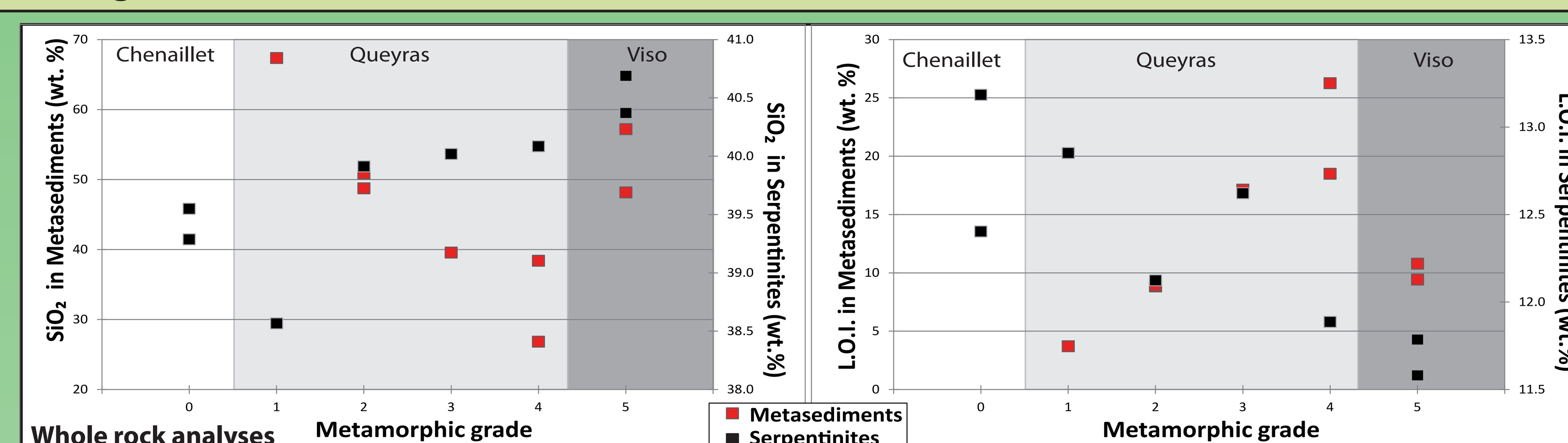
Mineralogical evolution



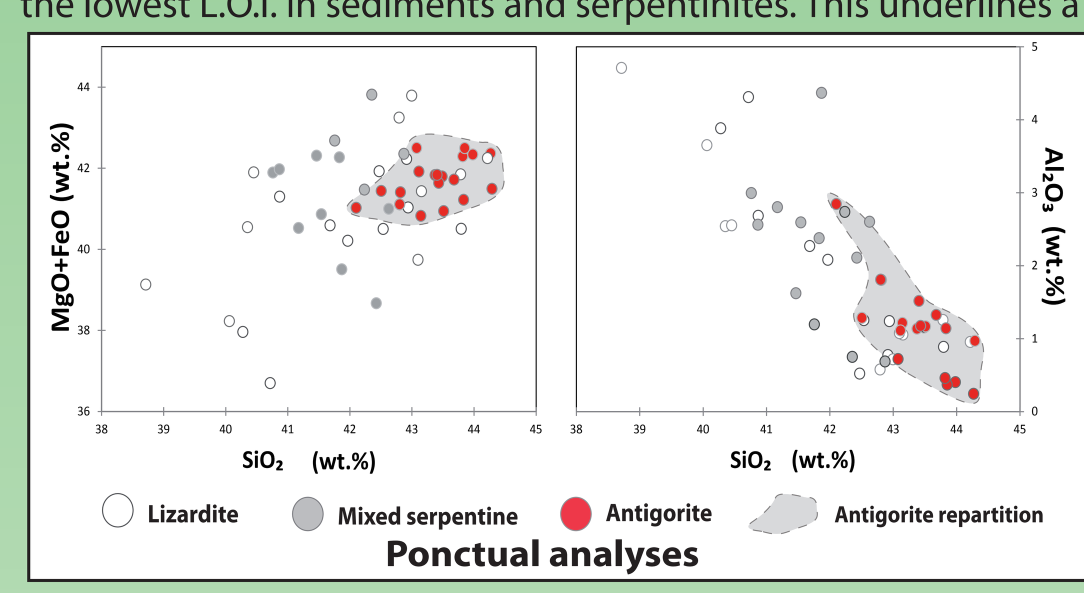
We show a progressive destabilization of lizardite/chrysotile **(a,b)** in favor of antigorite **(c,d,e)** along the increasing subduction gradient. In Viso some metamorphic olivine are observed. Lizardite seems to completly disappeared around 380°C. Serpentinites are mainly dominated by pseudomorphic lizardite **(a)** showing hourglass texture replacing primary olivine surrounded by magnetite underlying the mesh texture. Relictual pyroxenes are still preserved in the core of some bastites. Raman spectroscopy reveal a particular kind of spectra interpreted as the results of a mix between lizardite and antigorite compositions. Particular antigorite patch texture is observed in RQ23 **(e)**.



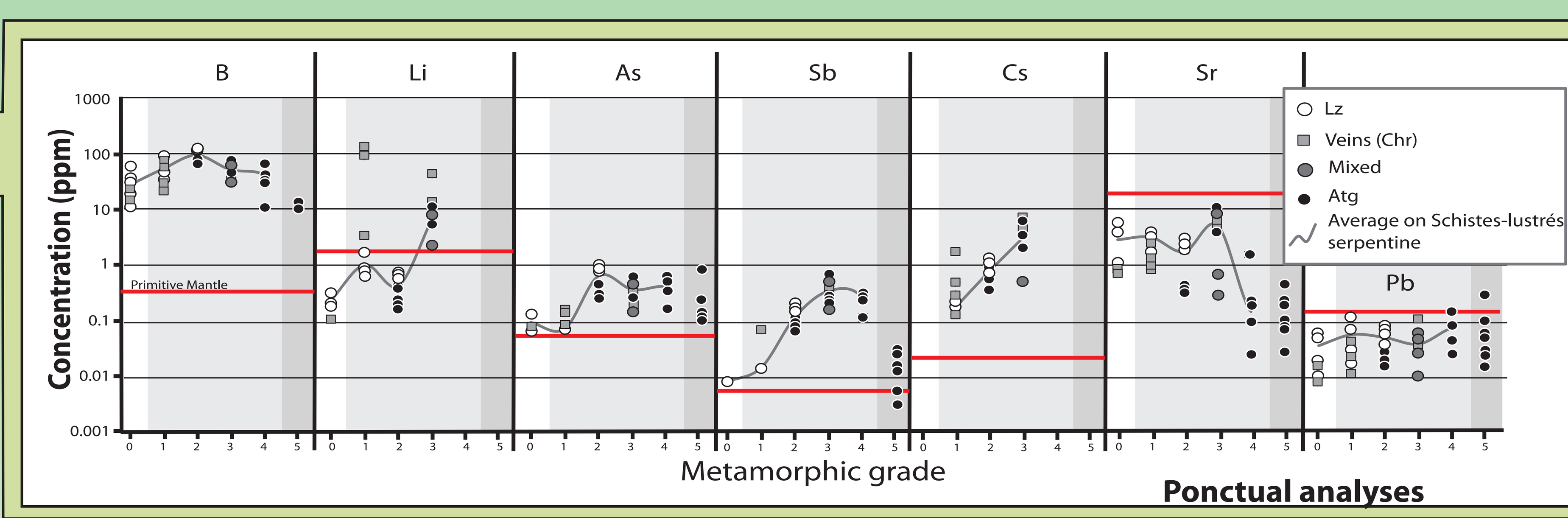
Major Element Evolution



Serpentinites are relatively homogeneous in term of major elements. We assume that they derive from a protolith having depleted lherzolite composition. SiO_2 content is slightly increasing with metamorphic grade, whereas L.O.I. tends to decrease. This is the opposite for metasediments. Viso present the highest level in SiO_2 and the lowest L.O.I. in sediments and serpentinites. This underlines a strong dehydration of all the unit.

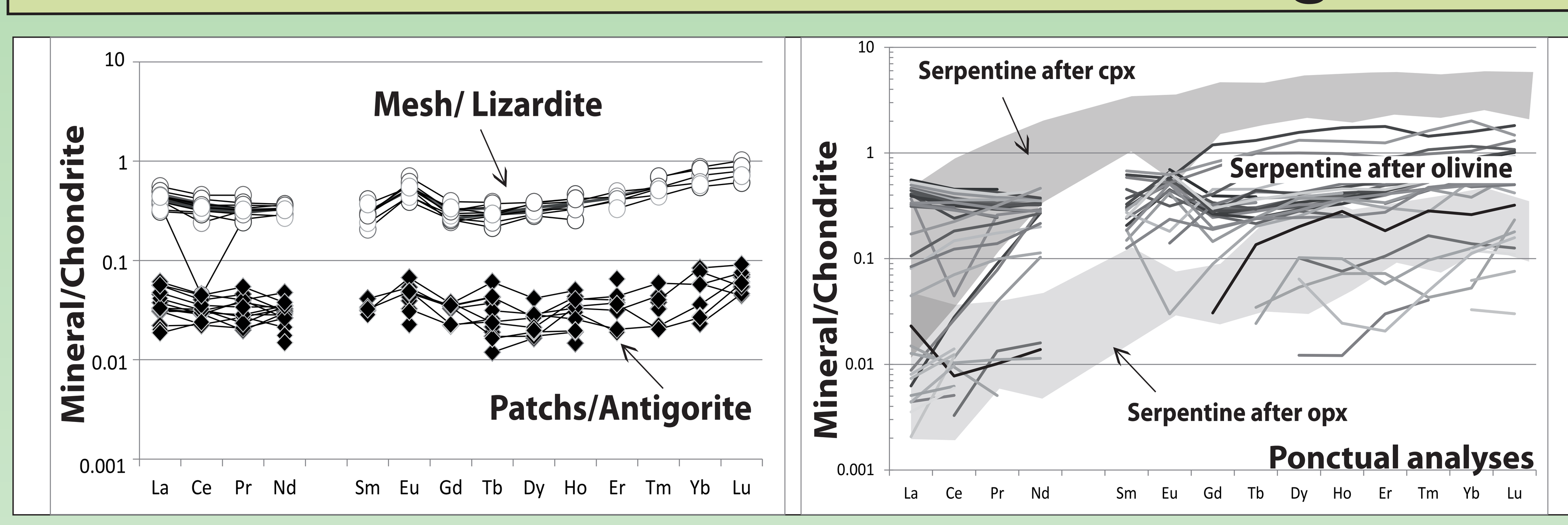


It appears some differences in term of major elements between each species of serpentine. Lizardite have the most heterogeneous compositions in SiO_2 and MgO+FeO, whereas antigorite is most homogeneous and has the higher contents in SiO_2 and MgO+FeO. This observation is particularly clear in sample RQ23 at the thin section scale where antigorite patches are systematically SiO_2-rich compare to the surrounding lizardite mesh.

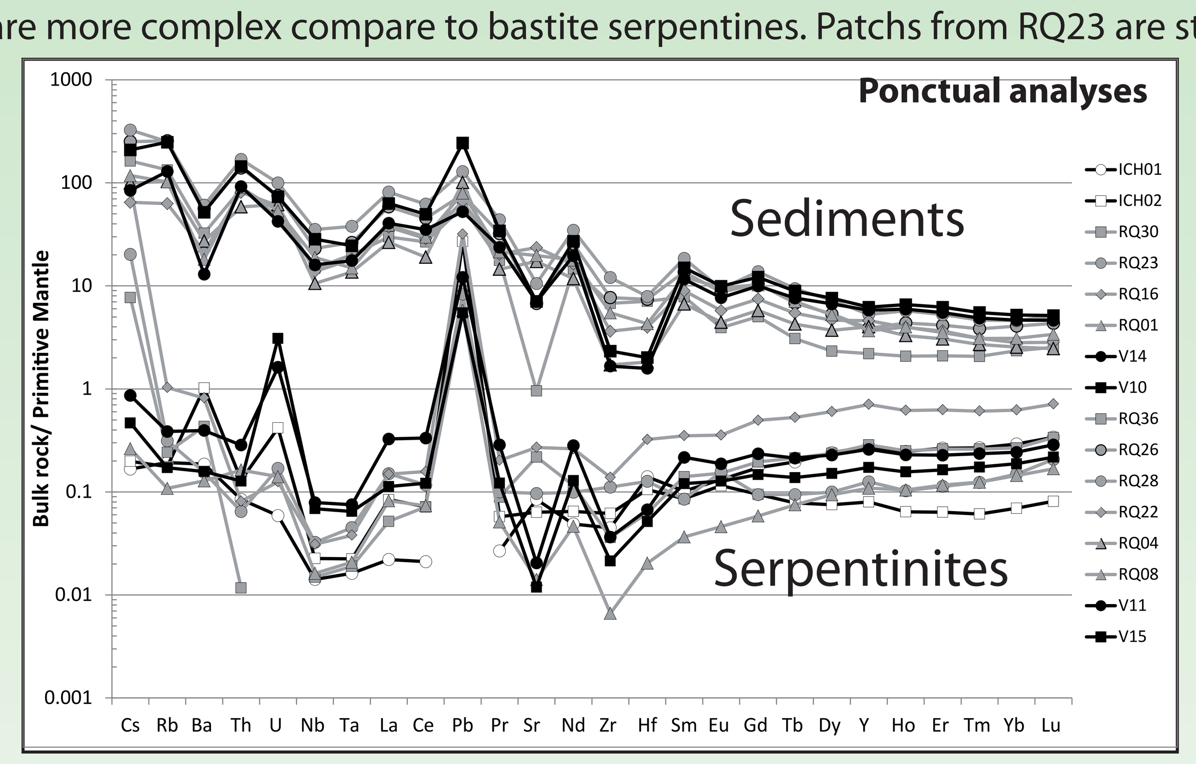


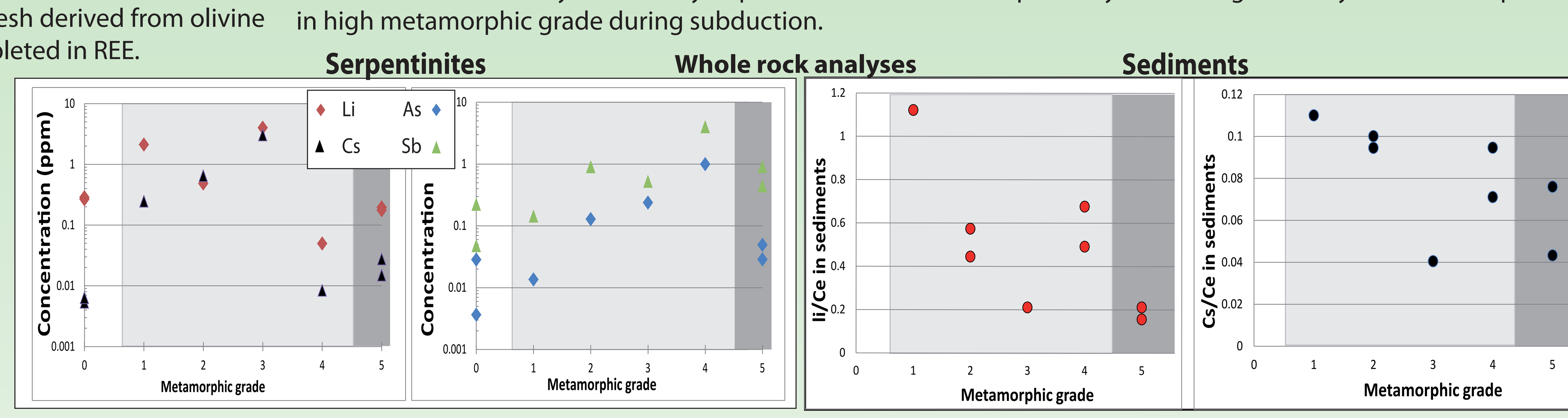
Concerning Fluid-Mobile-Elements, we observed a strong enrichment along the metamorphic gradient. This enrichment seems to be independant of serpentine variety. In grade 3 (RQ23), patchs are systematicaly less enriched. For several elements we see a stronger depletion in highest metamorphic grade (Li, Cs, Sr). Sediments associated to serpentine are relatively homogeneous and seems to be depleted in FME along the metamorphic gradient. Whereas the high quantity of sediments compare to ultramafic rocks and the concentration observed, they represent the source for FME. Viso is systematically depleted in trace elements probably lost during the dehydration of serpentine in high metamorphic grade during subduction.

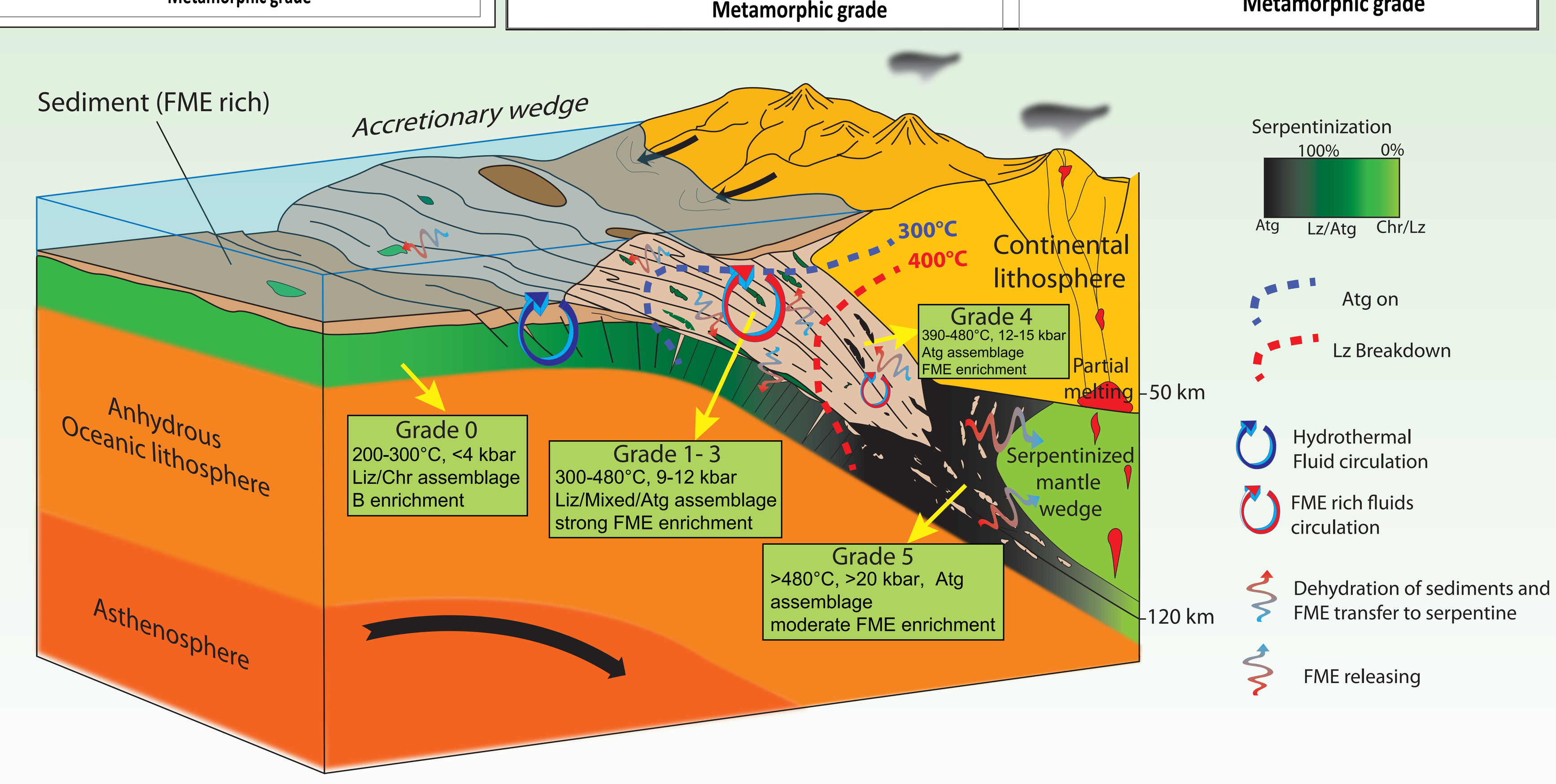
Trace elements evolution and Exchanges



Concerning REE, whole rock analysis reveal an heterogeneous origine depending from sample location. LA-HR-ICP-MS permit to identifiate trace element composition in-situ for serpentine in mesh, bastite or veins. All samples are depleted compare to the primitive mantle. REE diagram realised in mesh derived from olivine are more complex compare to bastite serpentines. Patchs from RQ23 are strongly depleted in REE.







Conclusions

We indicate a progressive transition from lizardite/chrysotile assemblage to antigorite. An enrichment in fluid-mobile elements (FME: As, B, Li, Sb...) is observed during increasing of metamorphic conditions in low metamorphic grade units of the accretionary wedge. Homogeneisation and/or metasomatism is involved during antigorite propagation. Viso represents the highest grade unit and is interpreted as a paleo-subduction channel. Serpentinites are systematicaly depleted in trace elements and associated sediments are partly dehydrated.

This highlights cations exchange and fuid circulations from the metasediments to the serpentinites into the accretionary wedge from 30 to 70 km depth and temperature comprises between 350 and 500 °C. Thus, serpentinites are the vector of transfer for fluid mobile elements (FME) at great depth. In this studied case, serpentinites abruptly released FME above 500°C.