Geophysical Research Abstracts
Vol. 13, EGU2011-5138-1, 2011
EGU General Assembly 2011

Towards continuous P-T paths? Multicalibration approach and application to subduction dynamics (Schistes Lustrés complex, France)

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Our understanding of the dynamics of subduction zones chiefly depends on the precision of metamorphic rock trajectories. Ideally, continuous P-T paths with a precision on the km-scale or below would be needed to further constrain our knowledge of deformation, reequilibration processes and element/fluid transfer along subduction zones. Thanks to improved interconsistent thermodynamic databases, multiple thermodynamic softwares and analytical tools, quantitative constraints on these metamorphic trajectories are indeed now accessible. The question is, however: is this enough?... This contribution therefore attempts to (1) critically evaluate the precision with which metamorphic P-T-t histories are retrieved today and (2) discuss implications for processes taking place at the plates interface, in the so-called subduction channel (Shreeve and Closs, 1986). We have compared and combined P-T estimates using several independent approaches: from minerals assumed to be in textural equilibrium (the classical approach), from electron microprobe compositional maps (which significantly increases the number of analyses to choose from), and from pseudosection modelling predictions. Multi-equilibrium calculations were performed with Tweequ and Thermocalc, and pseudosections were built with Perple_X and Theriak-Domino. These P-T estimates were in addition compared with maximum temperatures deduced from the Raman spectroscopy of carbonaceous matter. We have then applied these methods on a regional scale to study the metamorphic evolution of the Liguro-Piemontese "Schistes Lustrés" paleo-accretionary complex (SL; Haute Maurienne, W. Alps), whose good preservation should in principle provide detailed insights into subduction dynamics. The different methods used here yield the peak of pressure for the lower unit of the SL at the following conditions: 480°C-23kbar. They also allow us to constrain the retrograde path for both the middle and lower SL units. The results show that P-T conditions can be determined with a precision of $\pm$0.5–1 kbar and $\pm$20°C at best. The critical comparison of the various methods also allows identifying which improvements could help refine, in the near future, these thermobarometric estimates. In order to account for the observed tectonic patterns, major lithological boundaries and the P-T and Tmax data presented in this study, an interpretation of the tectonometamorphic evolution of the SL complex is finally proposed. This evolution underlines the importance of underplating processes and early structuration within the accretionary complex.