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Obduction at plate boundaries : thermo-mechanical modelling

Thibault Duretz (1,2), Philippe Agard (2), Philippe Yamato (3), and Evgueni Burov (2)

(1) Institute of Geology and Palaeontology, University of Lausanne, 1015 Lausanne, Switzerland (thibault.duretz@erdw.ethz.ch), (2) ISTEP, UPMC-Paris6, UMR 7193, T 46-00 E1, 4 Place Jussieu, 75252 Paris Cedex 05, France, (3) UMR CNRS 6118 géosciences, université de Rennes 1, 35042 Rennes cedex, France

Obduction involves the emplacement of fragments of oceanic lithosphere (ophiolites) over a continental one. Ophiolitic sequences, composed of mafic to ultramafic lithologies, are characterized by a much higher density than continental material. For this reason the processes that control obduction are not straightforward and remain enigmatic in the framework of plate tectonics.

The occurrence of large ophiolitic complexes in Oman (the Semail ophiolite) or New Caledonia nevertheless suggests that obduction can take place over large, regional-scale areas. Such obducted ophiolites are generally underlain by a thin, high temperature metamorphic sole and thrust onto high-pressure continental metamorphic units, both of which formed as a result of short-lived, almost coeval processes ($\sim$10 Ma offset between these main metamorphic events).

In this study we present two-dimensional thermo-mechanical models of obduction. These models involve several different geodynamic settings (based on margin geometry, presence of a ridge, boundary conditions,...) that may lead or not to obduction. Major, first-order geological features (petrological, geochronological, structural data) are critically used to discriminate between these different models.

An important result is that few situations actually enable to reproduce obduction in our numerical simulations, which indicates that only a narrow range of parameters can lead to realistic obduction. After assessing the respective influence of the key parameters, we finally propose a geodynamic model for the formation of the Semail ophiolite which is consistent with available data.