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Ductile extension of syn-magmatic lower crusts, with application to volcanic passive margins: the Ivrea Zone (Southern Alps, Italy)

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Deep seismic reflection profiles of present-day volcanic passive margins often show a 2-layered lower crust, from top to bottom: an apparently ductile 12 km-thick middle-lower layer (LC1) of strong folded reflectors and a 4 km-thick supra-Moho layer (LC2) of horizontal and parallel reflectors. Those layers appear to be structurally disconnected and to develop at the early stages of margins evolution. A magmatic origin has been suggested by several studies to explain those strong reflectors, favoring mafic sills intrusion hypothesis. Overlying mafic and acidic extrusives (Seaward Dipping Reflectors sequences) are bounded by continentward-dipping detachment faults rooting in, and co-structurated with, the ductile part of the lower crust (LC1). Consequently the syn-rift to post-rift evolution of volcanic passive margins (and passive margins in general) largely depends on the nature and the properties of the lower crust, yet poorly understood. We propose to investigate the properties and rheology of a magma-injected extensional lower crust with a field analogue, the Ivrea Zone (Southern Alps, Italy). The Ivrea Zone displays a complete back-thrusted section of a Variscan continental lower crust that first underwent gravitational collapse, and then lithospheric extension. This Late Paleozoic extension was apparently associated with the continuous intrusion of a large volume of mafic to acid magma. Both the magma timing and volume, and the structure of the Ivrea lower crust suggest that this section represents an adequate analogue of a syn-magmatic in-extension mafic rift zone which aborted at the end of the Permian. Notably, we may recognize the 2 layers LC1 and LC2. From a number of tectonic observations, we reconstitute the whole tectonic history of the area, focusing on the strain field evolution with time, in connection with mafic magma injection. We compare those results with available data from extensional mafic lower crusts at rifts and margins.