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Integrating geological observations at active plate margins through numerical modeling: an example from South Island, New Zealand

J. Braun

Geosciences-Rennes, Centre Armoricain de Recherche en Environnement (CAREN), Université de Rennes 1, Rennes, France (Jean.Braun@univ-rennes1.fr / Phone: +33-2-2323-6884)

In recent years much advance has been made in our understanding of complex geological systems in active tectonic environments such as convergent plate margins by integrating geological and geophysical data in the construction of conceptual and numerical models of the physical processes at play in those systems. To illustrate this point, I will show an example based on the numerical modeling of crustal deformation, surface erosion and heat transport in South Island, New Zealand. Results of the numerical models help us integrate the diverse observational constraints into a coherent tectonic model for the area. The strength of these numerical models resides in their ability to deal with very large strain and to be coupled to surface processes models. Usually limited to two dimensions, these models are now being expanded to full three-dimensionality, with the help of enhanced computing power and improved computational methods.

I will also present the results of a new deformation model that assumes a linear rheology for the deforming ductile crust; coupled with a simple erosion model, the model is able to represent a wide range of observations including strain localization in the vicinity of the Alpine Fault (the presence of mylonitic fabrics), the geometry of metamorphic isograds, the distribution of thermochronological ages for a wide range of systems as well as present-day vertical movements as documented by GPS observations. This model suggests that the primary factor controlling the crustal scale morphology of the system is the enhanced erosion (related to the very high precipitation rates) observed along the western side of the orogen. This new model also demonstrates that a simple,

linear rheology is able to reproduce the strain localization observed in many tectonic settings without the need for strain softening.