Forum Reply

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Viscous collision in channel explains double domes in metamorphic core complexes

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The gneiss dome of the Montagne Noire (southern France) is very fertile ground for controversies. The centuries-old vineyards on the rolling hills of its sunbaked Versant Sud may have something to do with this. Nevertheless, we express our appreciation to our colleagues Jean Van Den Driessche and Pavel Pitra for continuing this tradition in a welcomed provocative fashion. In their Comment, Van Den Driessche and Pitra (2012) dispute the existence of a double dome of foliation and a median high-strain zone in the Montagne Noire; and state that we should first disprove the structural data published in Van Den Driessche and Brun (1992) and Brun and Van Den Driessche (1994) before proposing any new models. We disagree with this way of framing the debate because we actually agree with the structural data of Van Den Driessche and Brun (1992) and Brun and Van Den Driessche (1994), which largely confirmed that of Beaud (1985). The essence of the debate is not these data, but the interpretation of the data.

Contrary to statements in Van Den Driessche and Pitra's Comment, we—and many other authors—do not rely solely on the distribution of fine-grained gneisses to document the domal structure of the Caroux. Along the comfortable walking path that follows the picturesque Gorge d'Héric (Fig. 1A), the folding of the Caroux gneissic foliation into an ENE-trending, slightly inclined, nearly isoclinal antiform plunging to the east cannot be missed. In addition, the Caroux gneisses occupy the core of an antiform of the Proterozoic to Paleozoic Schistes X, which themselves make the core of the Synclinal de Rosis that separates the Caroux dome from the Espinouse dome (Fig. 1A). Finally, and this point relates to our citation of Bouchardon et al. (1979) that Van Den Driessche and Pitra found surprising, a kyanite-bearing high-grade envelope wraps around the Caroux dome.

Surprisingly, Van Den Driessche and Pitra acknowledge that the Caroux has an "apparent dome-shaped foliation," and noticeably in Van Den Driessche and Brun (1992) and Brun and Van Den Driessche (1994), the Caroux domal structure is not called into question. Instead, these papers propose an interpretation in which the Caroux domal structure is due to intense folding of an older, thrusting-related fabric that is crosscut by flat-lying ductile extensional shearing (C′ shear plane). Van Den Driessche and Pitra also acknowledge that, between the Espinouse and the Caroux domes, there is a high-strain zone that "corresponds to the extensional detachment of the Caroux massif refolded" during its upward bending (Brun and Van Den Driessche, 1994, their figure 5). The extensional model favored by Van Den Driessche and Brun (1992) and Brun and Van Den Driessche (1994) (redrawn in Fig. 1B) is one of a detachment shear zone folded into a single dome. To apply this model to the Montagne Noire, the Caroux dome and the highly deformed and metamorphosed Synclinal de Rosis must be minimized into minor shallow-level contractional structures above a deeper core in which the foliation remains sub-horizontal (Figs. 1B and 2A$_1$). In contrast, there is no need for us to redraw the geology of the Montagne Noire to make it fit our model. The Caroux and the Espinouse subdomes, and the median Synclinal de Rosis are major structures rooted into the deeper core in which the foliation is steeply dipping (Fig. 2A$_2$).

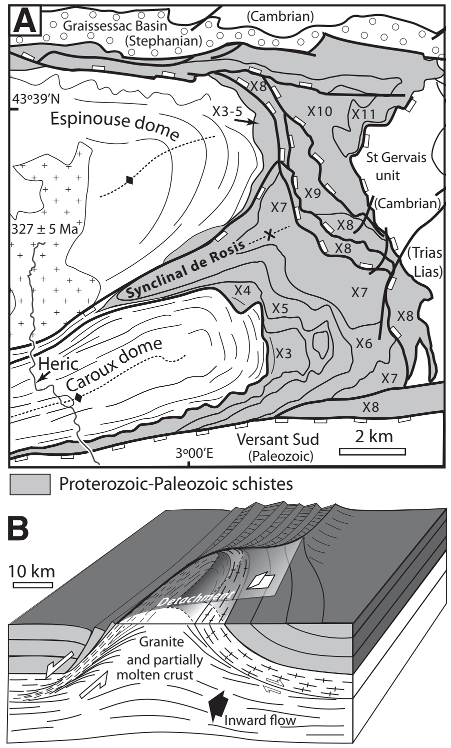

Figure 1. A: Structural map of the eastern part of the Montagne Noire (southern France). B: Model of extensional gneiss dome from Brun and Van Den Driessche (1994).

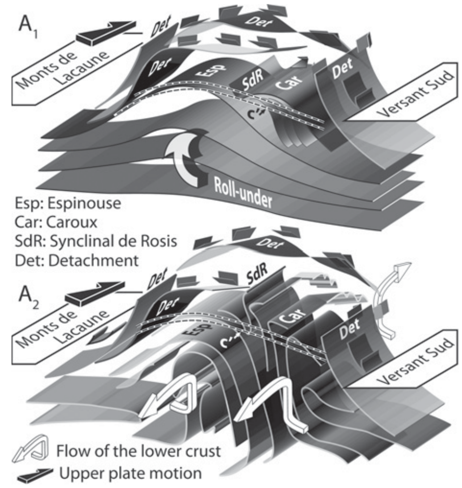

Figure 2. Foliation envelops according to Brun and Van Den Driessche (1994) (A$_1$), and Rey et al. (2011) (A$_2$).

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