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# Incipient strain partitioning in a slate belt: Evidence from the early Variscan Monts d'Arrée slate belt (Brittany, France)

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**Abstract**

Partitioning of strain is a fundamental process during mountain building. It commonly causes a compartmentalisation of a bulk regional strain into deformational domains with contrasting strain characteristics and largely oriented parallel to the orogenic grain. The Monts d'Arrée slate belt (Brittany, France) offers an opportunity to study strain partitioning in a slate belt deformed in an overall transpressional regime. The slate belt consists of highly deformed, low-grade, siliciclastic metasediments of upper Silurian to lower Devonian age. The deformation occurred during an early Variscan nappe stacking event ('Bretonian phase'). An extensive structural analysis has demonstrated that the slate belt reflects the initial stages of strain partitioning. The slate belt primarily reflects coaxial, contraction-dominated deformation. It resulted in NW-verging folding and a pervasive cleavage development, giving rise to a pronounced mechanical anisotropy. During the later stages of deformation, incipient strain partitioning lead to the development of punctuated strain heterogeneities, consistently reflecting dextral, belt-parallel, strike-slip strain. These structures are not organised in networks or domains. Incipient strain partitioning in the Monts d'Arrée slate belt did not reach the stage of compartmentalisation by the formation of an interlinked discontinuity network or wrench-dominated deformational domains.


*Keywords:* Contraction; Kinematic analysis; Simple shear; Slate belt; Strain partitioning; Transpression; Variscan

## 1. Introduction

Deformation zones in the middle to upper crust commonly show a very complex architecture, primarily because of the wide range of ways in which strain is accommodated during mountain building processes in continental crust. In recent years, it has become evident that complex structural patterns observed in deformation zones do not comply with simple two-dimensional simple-shear models and should be interpreted in a more realistic way, considering three-dimensional, non-coaxial non-plane strain (cf. Holdsworth et al., 1998 and references therein). Such three-dimensional, non-coaxial non-plane strain commonly shows a high degree of strain heterogeneity, reflecting strain partitioning. Strain partitioning gives rise to compartmentalisation of the bulk regional strain (cf. Jones and Tanner, 1995), developing deformational domains with contrasting strain characteristics, and enabling to maintain strain compatibility within different crustal levels (cf. Jones et al., 2005). Examples show that within transpression zones this kinematic partitioning is expressed by the development of contraction- and wrench-dominated domains, each with a particular spatial and temporal relationship between structural features (e.g. Holdsworth et al., 2002a,b; Tavarnelli et al., 2004; Clegg and Holdsworth, 2005).

In middle- to upper-crustal levels such deformation zones commonly develop in siliciclastic, predominantly argillaceous, metasedimentary series. The resulting slate belts commonly show a pronounced mechanical anisotropy, materialised by a pervasive, steeply dipping slaty cleavage. Many of such belts are commonly interpreted as crustal transcurrent shear zones.

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In recent work, however, the significance of coaxial shortening and pure shear has been recognised in most cases (e.g. Passchier et al., 1997; Robertson and Smith, 1999; Solar and Brown, 2001).

In this paper we focus on the Monts d'Arrée slate belt (MASB), which is situated in the Central Armorican terrane (CAT) in Brittany (France) (Fig. 1a). The MASB is a high-strain domain within the CAT, reflecting an early Variscan orogenic event ('Bretonian phase') related to the oblique convergence and collision of the Léon microcontinent with the northern margin of the Armorica microcontinent (cf. Faure et al., 2005). The excellent exposure of the MASB offers a unique opportunity to evaluate the way slate belts accommodate non-coaxial non-plane strain in a transpressional regime. An extensive structural analysis has revealed the predominance of a coaxial contraction-dominated deformation, expressed by NW-verging folding and a pervasive cleavage development. Subsequent deformation is expressed by punctuated strain heterogeneities, consistently reflecting dextral, belt-parallel, strike-slip strain. The MASB reflects the initial stages of strain partitioning in a slate belt, not reaching the stage of compartmentalisation in deformational domains or an interlinked network of shear zones.

## 2. Geological setting

The Central Armorican terrane (CAT) represents a part of the perigondwanan microcontinent Armorica, rifted off the northern margins of Gondwana during early Ordovician times. The remains of a similar perigondwanan microcontinent are located north of the CAT in the Léon domain (Fig. 1a). The CAT consists of a nearly continuous sedimentary sequence ranging in age from Arenig to Namurian (Guillocheau and Rolet, 1982). This sequence is deposited on top of

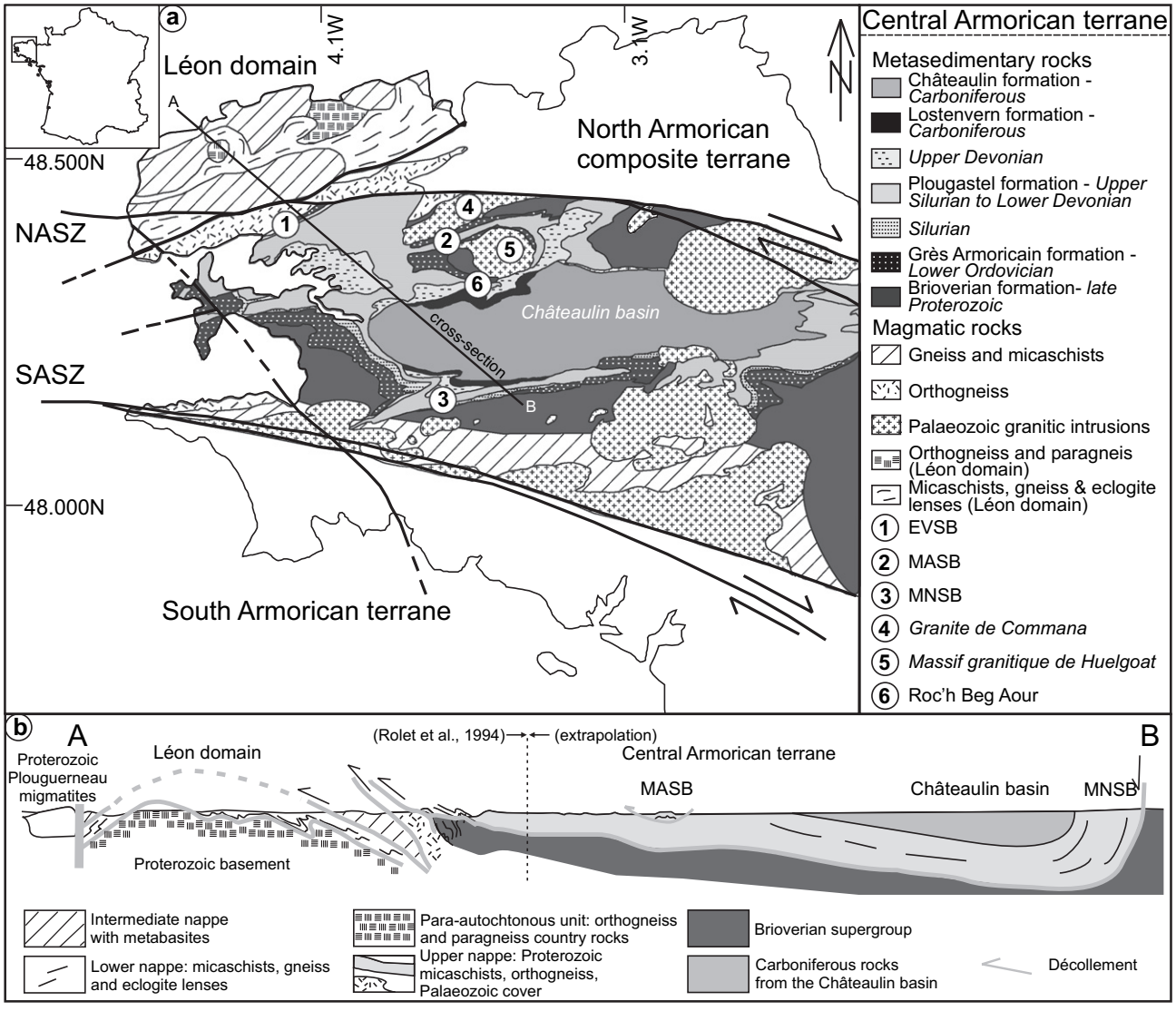


Fig. 1. (a) Tectonic setting of the Central Armorican terrane (CAT) in western Brittany (after Le Corre et al., 1991), showing the slate belts, (1) Elorn Valley slate belt (EVSB), (2) Monts d'Arrée slate belt (MASB), (3) Montagnes Noires slate belt (MNSB), the granitic intrusions of (4) Commana, and (5) Huelgoat, and the outcrops (6) Roc'h Beg Aour. (b) Tentative structural section across the Léon domain and the Central Armorican terrane, omitting Late Palaeozoic granitoid intrusions (after Rolet et al., 1994; Faure et al., 2005; van Noorden, 2007). NASZ, North Armorican shear zone; SASZ, South Armorican shear zone.