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Role of Late Jurassic intra-oceanic structural inheritance in the Alpine tectonic evolution of the Monviso meta-ophiolite Complex (Western Alps)

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Abstract – The eclogite-facies Monviso meta-ophiolite Complex in the Western Alps represents a well-preserved fragment of oceanic lithosphere and related Upper Jurassic – Lower Cretaceous sedimentary covers. This meta-ophiolite sequence records the evolution of an oceanic core complex formed by mantle exhumation along an intra-oceanic detachment fault (the Baracun Shear Zone), related to the opening of the Ligurian–Piedmont oceanic basin (Alpine Tethys). On the basis of detailed geological mapping, and structural, stratigraphic and petrological observations, we propose a new interpretation for the tectonostratigraphic architecture of the Monviso meta-ophiolite Complex, and discuss the role played by structural inheritance in its formation. We document that subduction- and exhumation-related Alpine tectonics were strongly influenced by the inherited Jurassic intra-oceanic tectonosedimentary physiography. The latter, although strongly deformed during a major Alpine stage of non-cylindrical W-verging folding and faulting along exhumation-related Alpine shear zones (i.e. the Granero–Casteldelfino and Villanova–Armoine shear zones), was not completely dismembered into different tectonic units or subduction-related mélanges as suggested in previous interpretations. The present-day architecture of the Monviso meta-ophiolite Complex results from nappe-scale folding with a significant component of shearing, and strain partitioning of the Alpine deformation, which were controlled by the inherited occurrence of (i) lateral and vertical variations of facies and thickness of sediments, (ii) an intra-oceanic fault-rock assemblage, which acted as weak horizons in concentrating deformation, and (iii) remnants of a volcanic ridge, which consists of massive metabasalt. Thus, the recognition of pre-collisional, intra-oceanic, tectonostratigraphic inheritance represents an important step in reconstructing the tectonic evolution of meta-ophiolite units in orogenic belts.

Keywords: Western Alps, Jurassic Monviso ophiolite, structural inheritance, oceanic core complex, Alpine tectonics

1. Introduction

Structural inheritance is a key factor in influencing and controlling the tectonic evolution and structural deformation pattern of orogenic belts during each stage of the Wilson cycle (Wilson, 1966; Dewey & Spall, 1975), where continents recurrently disintegrate and reassemble, and oceanic crust and lithosphere form, subduct and recycle. Although different contrasting models exist, several studies document the significant role of structural inheritance on the location of extension and continental break-up, rift and passive margin evolution and segmentation (e.g. Dunbar & Sawyer, 1989; Piqué & Laville, 1996; Theunissen *et al.* 1996; Tommasi & Vauchez, 2001; Petersen & Schiffer, 2016). Observation that rift propagation is not random but tends to follow the trend of pre-existing orogenic fabrics and plates, systematically reactivating ancient lithospheric structures, provides evidence for the active role played by inherited structures in rifting processes (e.g. Tommasi & Vauchez, 2001). In convergent tectonic settings, oceanic extensional detachment faults (e.g. Maffione *et al.* 2015), as well as fracture zones (e.g. Toth & Gurnis, 1998; Hall *et al.* 2003; Leng & Gurnis, 2011), represent among others, important inherited structures which may provide ideal conditions to nucleate new subduction zones. Oceanic detachment faults, which are commonly associated with oceanic core complexes documented along the slow- (Atlantis Massif, Mid-Atlantic Ridge – MAR) and ultraslow-spreading (Atlantis Bank, Southern Indian Ridge – SWIR) ridges (e.g. Cannat, 1993; Tucholke, Lin & Kleinrock, 1998; Boschi, Früh-Green & Delacour, 2006; Karson *et al.* 2006; Dick, Tivey & Tucholke, 2008; Miranda & Dilek, 2010), pervasively cut the lithosphere to a depth of 7–8 km (e.g. Dick, Tivey & Tucholke, 2008; Escartin *et al.* 2008; Reston & Ranero, 2011). They represent weakness zones in the lithosphere, characterized by mylonitic to cataclastic shear zones up to hundreds of metres thick and dominated by serpentine minerals and other phyllosilicates (e.g. talc and chlorite; see Boschi, Früh-Green & Delacour, 2006; Boschi *et al.* 2013).

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