Thematic set:
Polygenetic mélanges

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Redefinition of the Ligurian Units at the Alps–Apennines junction (NW Italy) and their role in the evolution of the Ligurian accretionary wedge: constraints from mélanges and broken formations

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Abstract: We document that the undifferentiated chaotic Ligurian Units of the Monferrato–Torino Hill sector (MO-TH) at the Alps–Apennines junction consist of three different units that are comparable with the Cassio, Caio and Sporno Units of the External Ligurian Units of the Northern Apennines. Their internal stratigraphy reflects the character of units deposited in an ocean–continent transition (OCT) zone between the northwestern termination of the Ligurian–Piedmont oceanic basin and the thinned passive margin of Adria microcontinent. The inherited wedge-shaped architecture of this OCT, which gradually closed toward the north in the present-day Canavese Zone, controlled the Late Cretaceous–early Eocene flysch deposition at the trench of the External Ligurian accretionary wedge during the oblique subduction. This favoured the formation of an accretionary wedge increasing in thickness and elevation toward the SE, from the MO-TH to the Emilia Northern Apennines. Our results therefore provide significant information on both the palaeogeographical reconstruction of the northwestern termination of the Ligurian–Piedmont oceanic basin and the role played by inherited along-strike variations (stratigraphy, structural architecture and morphology) of OCT zones in controlling subduction–accretionary processes.

Supplementary material: A spreadsheet with X-ray fluorescence spectrometry and inductively coupled plasma mass spectrometry whole-rock major and trace element composition of mantle peridotites, and photomicrographs of mantle peridotites are available at https://doi.org/10.6084/m9.figshare.c.4519643

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Several interlinked geological, physical and mechanical factors are thought to control the localization and style of subduction–accretionary processes, and the shape and dynamics of the frontal wedge at convergent margins. The main factors are as follows: (1) the structural and palaeogeographic inheritance from ancient oceanic basins and associated continental margins (e.g. nature, physiography, internal tectonostratigraphic architecture, etc.; see Malatesta *et al.* 2013; Spalla *et al.* 2014; Balestro *et al.* 2018; Marotta *et al.* 2018; Roda *et al.* 2018; Festa *et al.* 2019*a*, and references therein); (2) the thickness of the subducted trench sediments; (3) the obliquity of the subduction; (4) the plate convergence rate (e.g. Clift & Vannucchi 2004; Vannucchi *et al.* 2008; Remitti *et al.* 2011; Heuret *et al.* 2012; Malatesta *et al.* 2013; Festa *et al.* 2018; Geersen 2019). The interplay and combination of all or some of these factors played a significant role in the tectonic evolution of the Alps–Apennines orogenic system, which was controlled at regional scale by the oblique convergence and counterclockwise rotation of the Adria microplate relative to the European plate (e.g. Rosenbaum *et al.* 2002; Molli & Malavieille 2011; Argnani 2012; Zanchetta *et al.* 2012). This oblique convergence drove the Late Cretaceous–early Cenozoic subduction of the Northern Alpine Tethys (Ligurian–Piedmont Ocean), the diachronous (i.e. younging from north to south) continental collision between the European continental margin and the Adria microplate (African plate), and the subsequent intra-continental deformation (e.g. Polino *et al.* 1990; Marroni *et al.* 2010, 2017; Molli *et al.* 2010; Mosca *et al.* 2010; Remitti *et al.* 2011; Festa *et al.* 2013, 2019*a*).

In the sector of the Alps–Apennines junction (i.e. the Monferrato and Torino Hill in NW Italy, MO-TH hereafter; Fig. 1), the Ligurian Units, which represent the remnants of the deposition at the ocean–continent transition (OCT) between the Ligurian–Piedmont Ocean and the thinned passive margin of Adria, are unconformably overlain by a middle–upper Eocene–upper Miocene episutural succession, represented by the Tertiary Piedmont Basin (e.g. Mutti *et al.* 1995; Piana & Polino 1995). In contrast to the Ligurian Units in the Northern Apennines (e.g. Bettelli *et al.* 1989; Vescovi *et al.* 1999; Marroni *et al.* 2001, 2010; Principi *et al.* 2004; Marroni & Pandolfi 2007; Catanzariti & Perilli 2011, 2015; Vercesi *et al.* 2015), the Ligurian Units of the MO-TH were always described as an upper Cretaceous–Paleogene(?) undifferentiated chaotic complex or mélange (i.e. 'undifferentiated complex' *sensu* Bonsignore *et al.* 1969; 'La Pietra chaotic complex' *sensu* Dela Pierre *et al.* 2003; Festa *et al.* 2009). As a consequence, a characterization and distinction of the tectonostratigraphic architecture of these units is lacking. Therefore, a systematic and detailed investigation of the Ligurian Units in the MO-TH may provide significant constraints for the reconstruction of the tectonostratigraphic architecture of the OCT zone at the Western Alps–Northern Apennines junction (i.e. the 'Ligurian knot' *Auct.*).

This paper aims to define for the first time the tectonostratigraphic setting of the chaotic Ligurian Units in the MO-TH through