



## Geology of the Curone and Staffora Valleys (NW Italy): field constraints for the Late Cretaceous – Pliocene tectono-stratigraphic evolution of Northern Apennines

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### ABSTRACT

In the northwestern part of Northern Apennines, between Curone and Staffora Valleys, the tectonic superposition between the External Ligurian Units (i.e. the ophiolitic-bearing chaotic complex of the Gropallo Unit and the non-ophiolitic Cassio Unit), the Middle Eocene – Miocene wedge-top basin Epiligurian Units succession, and the Late Messinian – Pliocene Po Plain succession, records the multistage tectono-stratigraphic evolution from subduction to continental collision. Our geological map, at the 1:20,000 scale, allows us to define 6 main tectonic stages on the basis of (i) the crosscutting relationships between main faults and local to regional stratigraphic unconformities and (ii) the differentiation among different types of chaotic rock unit (olistostromes and broken formations) deposited since Late Cretaceous to late Messinian. This approach provides a new understanding on the tectono-stratigraphic evolution of this sector, and its meaning in the evolution of the northwestern part of Northern Apennines.

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### 1. Introduction

In the hanging wall of the Apenninic thrust front, the northwestern part of Northern Apennines belt (between Voghera and Piacenza) is characterized by complex structural relationships among discontinuous remnants of ophiolite-bearing chaotic units (e.g. Boccaletti & Coli, 1982) of Late Cretaceous age (i.e. Western External Ligurian Unit, see Marroni & Pandolfi, 2007), non-ophiolitic External Ligurian Units (e.g. Eastern External Ligurian Unit, see Marroni & Pandolfi, 2007), and the overlaying wedge-top basin Epiligurian Units (Figure 1). Although this sector is covered by different editions of the Geological Map of Italy (e.g. Bellinzona, Boni, Braga, & Marchetti, 1971; Boni, 1969; Vercesi et al., 2005, 2015), the understanding of the tectono-stratigraphic relationships between these different units is complicated by poor rock exposures and lack of continuous outcrops. A new detailed geological mapping, focused on (i) the crosscutting relationships between main faults and local to regional stratigraphic unconformities and (ii) the differentiation among different types of chaotic rock unit (i.e. olistostromes and broken formations) of various age, provides further specific data covering the partial lack of geological information, allowing a new understanding on the tectono-stratigraphic evolution of this sector and

its meaning in the evolution of the northwestern part of Northern Apennines.

On the basis of a new geological mapping at the 1:5000 scale, detailed structural and stratigraphic observations, and targeted collection of biostratigraphic data, we present the ‘Geological map of the Curone and Staffora Valleys (Northern Apennines, Italy)’ (see Main Map) at the 1:20,000 scale. This Geological Map represents the northern prolongation of the ‘Geological Map of the Villalvernia – Varzi Line between Scrivia and Curone valleys (NW Italy)’ by Festa, Fioraso, Bissacca, and Petrizzo (2015).

### 2. Methods

The geological map was produced from about four years (2014–2017) of fieldwork at the 1:5000 scale and accompanying detailed structural analyses and stratigraphic observations. The definition of the structural setting of the sector was defined through the mapping of the crosscutting relationships between main faults and local to regional stratigraphic unconformities that are documented in the attached geological map at the 1:20,000 scale (see Main Map), using the topographic maps ‘CTR – Carta Tecnica Regionale’ of Regione Piemonte and Regione Lombardia. The dis-