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Tectonic, sedimentary, and diapiric formation of the Messinian *mélange*: Tertiary Piedmont Basin (northwestern Italy)

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ABSTRACT

The Messinian *mélange* of the Tertiary Piedmont Basin is the product of different but interrelated processes (tectonic, gravitational, and diapiric) that operated sequentially over a short time span (intra-Messinian time) and in a geodynamic environment (episutural basin) for which *mélanges* have so far been poorly described. It is composed of different mappable bodies of (non-metamorphic) mixed rocks characterized by a strong facies convergence. Their geometric and stratigraphic position, the internal organization, and the nature of the bounding surfaces allow the defining of some criteria to distinguish different units of mixed rocks (*tectonically disrupted unit, gravity-driven sedimentary unit, and diapiric disrupted unit*), in each of which the role of a different prevailing *mélange*-forming process can be inferred. None of these processes operated in isolation. They were linked by complex and intimate mutual interactions and triggered by intra-Messinian tectonics. The latter produced self-generating processes of *mélange* formation in which gravitational and diapiric processes triggered and affected each other. Different pulses of overpressured fluids (often rich in methane) strongly governed sediment deformation and also played a crucial role in influencing the time relationships and causative links between the different *mélange*-forming processes. Faulting may have triggered gas hydrate dissociation, promoting the upward rise of overpressured fluids. These fluids reduced the shear strength of the overlying sediments, promoting large-scale gravity-driven phenomena. Loading provided by rapid emplacement of the gravity-driven sedimentary bodies could have, in turn, developed new overpressured conditions necessary to promote the upward rise of poorly consolidated sediments and shale diapirism.

INTRODUCTION

The term *mélange* has a long history of academic debates regarding its origin. First coined by Edward Greenly (1919) for a unit of mixed rocks in Anglesey (North Wales), which he interpreted as the product of tectonic shearing, the term *mélange* has assumed with time different meanings both descriptive and genetic.

Mélanges are the product of different processes (tectonic, sedimentary, and diapiric) of fragmentation and mixing that occur in various geodynamic environments (e.g., subduction zones and accretionary prisms, Cowan, 1978, 1985; Aalto, 1981; Cloos, 1982; Barber et al., 1986; Brown and Westbrook, 1988; Cloos and Shreve, 1988; Onishi and Kimura, 1995; forearc and back-arc basin, Page and Suppe, 1981; transform and overthrust fault

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