

GENESIS AND EVOLUTION OF THE LANGHE BASIN, WITH EMPHASIS ON THE LATEST OLIGOCENE-EARLIEST MIOCENE AND SERRAVALLIAN

GENESI ED EVOLUZIONE DEL BACINO DELLE LANGHE, CON PARTICOLARE RIGUARDO AL PASSAGGIO OLIGOCENE-MIOCENE ED AL SERRAVALLIANO

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ABSTRACT

The Langhe Basin represents the western part of the so-called Tertiary Piedmont Basin (Northern Italy), extends over an area of about 1,800 square km and is filled by an Oligocene-Miocene sedimentary succession more than 4,000 m thick.

Its history begins with the sedimentation of alluvial fan and/or fan-delta deposits, followed by shallow-marine transgressive deposits (Early Oligocene). The drowning of the area, starting in the upper part of the Early Oligocene, is recorded by open sea mudstones containing sandstone units related to overloaded, high-density flows guided by the complex bottom topography, in turn controlled by syndimentary tectonics.

The processes of sedimentation related to high density flows intensify from the Latest Burdigalian to the Serravallian, with the deposition of alternating sandstones and mudstones that spread out over almost the entire area.

The history of the Basin continues during the Tortonian with predominant pelitic, open sea sedimentation. It ends in the Messinian with sediments that record a sudden drop of the sea level.

This note addresses two time-intervals in the history of the Langhe Basin, i.e. the Latest Oligocene-Earliest Miocene and the Serravallian.

During the Latest Oligocene-Earliest Miocene the Langhe Basin extends approximately in a W-E (or WNW-ESE) direction, is about 30 km wide and is characterized by pelitic sediments; it is delimited to the north by a high (Alto Monferrato High) and to the south by a WNW-ESE structural-morphological element.

During the Serravallian the Langhe Basin takes on a shape noticeably different from the previous configuration. It becomes elongated for at least 75 km in a WSW-ENE direction. It is filled by over 1,000 m of sediments, mostly related to high density flows. The Basin is delimited to the south, in its northeastern sector, by the frontal slope and the submerged platform of a large delta apparatus, passing to an area of continental sedimentation and then to an area with outcropping bed-rock. The Finale Platform developed south of the emerged area.

Finally the histories of the Langhe Basin and adjacent paleogeographic domains are compared.

RIASSUNTO

Il Bacino delle Langhe rappresenta il settore occidentale del Bacino Terziario Piemontese, si estende su un'area di circa 1.800 kmq ed è colmato da una successione oligo-miocenica potente oltre 4.000 m.

La sua storia inizia con la sedimentazione di depositi di conoide alluvionale e/o di delta-conoide, seguiti da sedimenti marini di acque basse (Oligocene inferiore). L'annegamento dell'area, a partire dalla parte sommitale dell'Oligocene inferiore, è testimoniato da peliti di mare aperto contenenti corpi arenacei connessi a flussi ad alta densità, sovraccarichi di sedimento, la cui distribuzione è guidata dalla complessa topografia dei fondali, a sua volta controllata dal tettonismo sinsedimentario.

I processi di sedimentazione connessi a flussi ad elevata densità si intensificano a partire dal tardo Burdigaliano fino al Serravalliano, con la deposizione di alternanze arenaceo-pelitiche che si distribuiscono sull'intera area.

La storia del bacino continua nel Tortoniano con la prevalente sedimentazione di peliti di mare aperto e termina nel Messiniano con depositi che testimoniano un brusco abbassamento del livello marino.

In questo lavoro viene rivolta particolare attenzione a due intervalli tempo: a) sommità Oligocene-base Miocene, b) Serravalliano.

Nel primo intervallo il Bacino delle Langhe si estende approssimativamente in direzione W-E (o WNW-ESE), ha un'ampiezza di circa 30 km ed è caratterizzato da sedimentazione pelitica. È delimitato a nord dall'Alto dell'Alto Monferrato e verso sud dall'Alto Monregalese-Finalese.

Nel Serravalliano il Bacino delle Langhe assume una configurazione notevolmente diversa rispetto alla precedente. Si allunga in direzione WSW-ENE per almeno 75 km ed è riempito da oltre 1.000 m di sedimenti connessi in gran parte a flussi ad elevata densità. Il Bacino, nel suo settore nord-orientale, è delimitato verso

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sud dal pendio frontale e dalla piattaforma sommersa di un apparato delizioso che passa ad un'area a sedimentazione continentale e quindi ad un'area nella quale affiora il substrato roccioso. A sud dell'area emersa si sviluppa la Piattaforma di Finale.

A conclusione del lavoro la storia del Bacino delle Langhe viene confrontata con quella delle regioni adiacenti.

KEY-WORDS: STRATIGRAPHY, SANDSTONE PROVENANCE, PALAEOGEOGRAPHY, OLIGOCENE-MIOCENE, EPISUTURAL BASIN.

PAROLE CHIAVE: STRATIGRAFIA, PROVENIENZA DELLE ARENARIE, PALEOGEOGRAFIA, OLIGOCENE-MIOCENE, BACINO EPISUTURALE.

1. INTRODUCTION

The Langhe Basin represents the western part of the so-called Tertiary Piedmont Basin (TPB). It is located in the region named "Langhe" and extends from southern Piedmont to the northern part of western Liguria (Northern Italy).

GELATI & GNACCOLINI (1998) define the Langhe Basin as an episutural basin set upon a complex of Alpine allochthonous units, already set in place in the Upper Eocene. The Basin develops along the northern margin of the "peri-Thyrrhenian area" (BOCCALETTI *et al.*, 1990), and is a satellite basin in a post-collision "back-arc-thrust belt-foredeep system".

According to LAUBSCHER *et al.* (1992) this Basin is a significant patch within the Ligurian knot, an area between the Northern Apennines and the Ligurian Alps, framed by important dislocation surfaces and characterized by intricate subsurface structure. According to these authors the regional kinematics of the Ligurian knot is compatible with a model that envisages an Oligocene-Early Miocene northwest translation of the Adriatic indenter, coupled with collapse in the Liguro-Provençal sea and rotation of the Sardinia-Liguria complex into the roll-back of the Adriatic subduction zone. The Langhe Basin appears as the wedge-shaped northeastern end of the collapsed Ligurian Sea.

The complex subsurface structure of the region under study is characterized by superimposed crusts of different origin (NADIR, 1988; BIELLA *et al.*, 1992; BUNESS & GIESE, 1990). In particular, BIELLA *et al.* point out a "crocodile pattern" structure, characterized by indentations of crust and upper mantle belonging to lithospheric fragments of different provenance (Alpine, Apennines, Padano-Insubric). MILETTO & POLINO (1992), addressing the pattern of Bouguer anomalies in the region, report an important mass deficit not only due to the considerable thickness of surface Plio-Quaternary successions, but also to the possible sedimentary origin of the

accretion wedges under the surface, revealed by seismic survey.

In addition to LAUBSCHER *et al.* (1992), VANOSI *et al.* (1994), CASTELLARIN (1994), and MUTTI *et al.* (1995) also relate the Cenozoic genesis and evolution of the area studied to the opening of the Liguro-Provençal Basin. CARRAPA (2002) evaluated the validity of certain mechanisms, proposed as responsible for the subsidence observed in the Tertiary Piedmont Basin, through the application of various numerical models: this leads to the dismissal of several basin-forming mechanisms such as stretching, flexural loading and strike-slip, while focusing on lithospheric buckling as the most promising origin for the Tertiary Piedmont Basin. Nevertheless, CARRAPA (2002) does not exclude the possibility that stretching was an important mechanism during the Oligocene.

2. THE LANGHE BASIN

The Langhe Basin (Fig.1), equivalent to the Langhe Sub-basin of GELATI & GNACCOLINI (1998), extends over an area of about 1,800 square km and is filled by an Oligocene-Miocene sedimentary succession more than 4,000 m thick. This paper investigates the portion of this succession between the Earliest Oligocene, in direct contact with the pre-Cenozoic substratum, and the Serravallian (Fig.2). Lithostratigraphy, sequence-stratigraphy and rock provenance are addressed in detail.

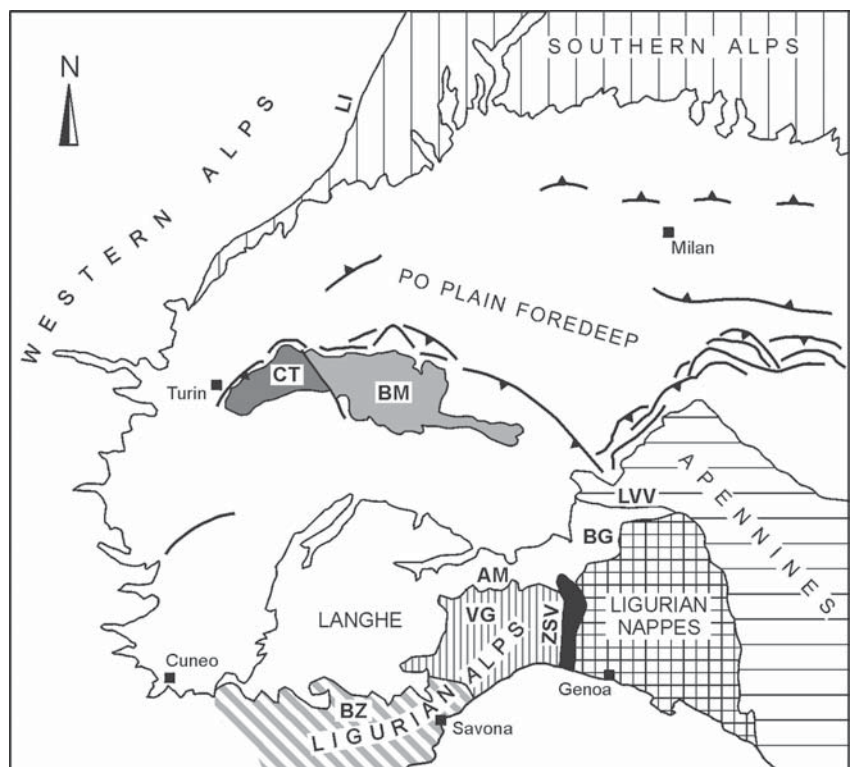


Fig.1 – The Langhe region at the intersection between the Alps and the Apennines. **CT**: Collina di Torino; **BM**: Basso Monferrato; **AM**: Alto Monferrato; **BG**: Borbera-Grue Zone; **ZSV**: Sestri-Voltaggio Zone; **LVV**: Villalvernia-Varzi Line; **VG**: Voltri Group; **BZ**: Briançonnais Zone.

La regione delle Langhe nella zona di giunzione tra Alpi ed Appennini. **CT**: Collina di Torino; **BM**: Basso Monferrato; **AM**: Alto Monferrato; **BG**: Zona Borbera-Grue; **ZSV**: Zona Sestri-Voltaggio; **LVV**: Linea Villalvernia-Varzi; **VG**: Gruppo di Voltri; **BZ**: Zona Briançonnais.