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Paleogeographic and paleodrainage changes during Pleistocene glaciations (Po Plain, Northern Italy)

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ABSTRACT

The Po Basin, a Pliocene marine gulf between the Alps and the Apennines, was filled progressively from west to east and finally capped by fluvial sediments during the Pleistocene. By ~1.25 Ma, a meandering trunk river (paleoDora Baltea) reached westernmost Lombardia (Cilavegna); at ~1 Ma, the paleoAdda, entering the plain through the Como Valley, joined the paleoTicino in the Milano area. The coastline was directed NNE/SSW, and the open sea persisted east of ~10°E. Metamorphiclastic prodelta sediments of the Alpine trunk river reached central Lombardia (Pianengo) by MIS 36 and eastern Lombardia (Palosco) at MIS 31. Trunk-river delta foresets accumulated rapidly in easternmost Lombardia (Ghedi) during the Jaramillo. Fluvial sedimentation, continuous at Pianengo since MIS 28, eventually reached Ghedi at MIS 22. In this time interval, the embayment secluded between the prograding trunk-river delta and the Southalpine front was progressively filled by Southalpine fan deltas.

With the onset of major Alpine glaciations in the late Matuyama, detrital supply increased markedly and fluvial deposits spread all over Lombardia. Because of outward growth of Alpine fans, the paleoDora Baltea was replaced at Cilavegna by the paleoSesia and paleoToce. Milano lay in the paleoAdda braidplain. Southalpine alluvial fans reached as far south as Pianengo. The paleoOglio glacier exited Lake Iseo at Cremignane.

In the early Brunhes, accumulation rates markedly dropped in Lombardia; carbonaticlastic paleoPiave turbidites accumulated rapidly at Venezia, capped by the prograding paleoPo delta and finally by fluvial paleoBrenta–Bacchiglione deposits. Subsequently, accumulation rates decreased further, and paleosols developed during stages of prolonged exposure. The paleoTicino continued to flow southwest of Milano, where detritus from the paleoOlona is documented locally. PaleoAdda sediments were deposited at Milano and sedimentaclastic detritus at Trezzo up to a few meters from ground surface, indicating that the final shift of River Adda to the Lecco branch of Lake Como was a very recent event. The paleoOglio exited Lake Iseo in its present position. At Ghedi the paleoChiese was replaced by the paleoAdige, and finally re-established before development of a paleosol overlain by topmost Pleistocene marsh deposits (MIS 2).

This study indicates new guidelines for studies of drainage evolution, and more in general of depositional architecture in foreland basins.

Contents

1. Introduction . . . 26
   1.1. Drainage changes in provenance studies . . . 26
   1.2. Drainage evolution in a foreland basin . . . 27
   1.3. Walther's law of petrofacies . . . 27
   1.4. The Po foreland basin . . . 27
   1.5. Factors controlling Pleistocene sedimentation . . . 28
2. Sequence stratigraphy of the Po Plain . . . 28
   2.1. Dating subsurface successions . . . 28
   2.2. MIS-based chronostratigraphy . . . 29
   2.3. The eleven Regione Lombardia cores . . . 29
   2.4. Paleontological evidence . . . 30

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3. Petrography of Pleistocene sediments . . . 32
3.1. Provenance analysis . . . 32
3.2. Paleodrainage analysis . . . 32
3.3. Cilavegna core . . . 36
3.4. Milano area cores . . . 37
3.5. Pianengo core . . . 38
3.6. Agrate core . . . 41
3.7. Trezzo core . . . 41
3.8. Palosco core . . . 42
3.9. Cremignane core . . . 42
3.10. Ghedi core . . . 42
4. Sedimentary evolution . . . 43
4.1. The Po Basin before the onset of major glaciations . . . 43
4.2. The Po Basin after the onset of major glaciations . . . 43
4.3. The Upper Po Basin . . . 45
5. Conclusion . . . 46
Acknowledgments . . . 46
Appendix A. Supplementary data . . . 46
References . . . 46

I am a mole and I live in a hole,
I spend my day digging through the clay,
When you call me and I can't be found,
Look for me underground.

1. Introduction

The alluvial plain of northern Italy (Po Basin) is one of the most intensively cultivated and populated areas in Europe, hosting ~20 million people and considerable groundwater and hydrocarbon resources (Fig. 1). Mineralogical studies of Quaternary sediments, also aimed at tracing auriferous deposits, have been carried out in the area since the dawn of sedimentary petrology (De Filippi, 1839; Artini, 1891). Data on subsurface geology have been gathered since the 1950's by means of seismic surveys and drillings for oil and water exploration (Pieri and Groppi, 1981; Dondi and D'Andrea, 1986; Regione Emilia-Romagna and ENI-Agip, 1998; Regione Lombardia and ENI-Agip, 2002; Muttoni et al., 2003; Scardia et al., 2006). Moving from such extensive knowledge and from a complete petrographical–mineralogical data base including modern sediments (Garzanti et al., 2004, 2006, 2010), we reconstruct here the successive changes in paleogeography and paleodrainage of Alpine rivers triggered by waxing and waning of ice sheets during the Pleistocene. Paleodrainage analysis was extended backwards to the recent geological past by using a new objective method based on statistical treatment of high-resolution petrographic and heavy-mineral data (Vezzoli and Garzanti, 2009).

1.1. Drainage changes in provenance studies

Evolving drainage patterns and river avulsions provide crucial information on tectonic or climatic events punctuating the

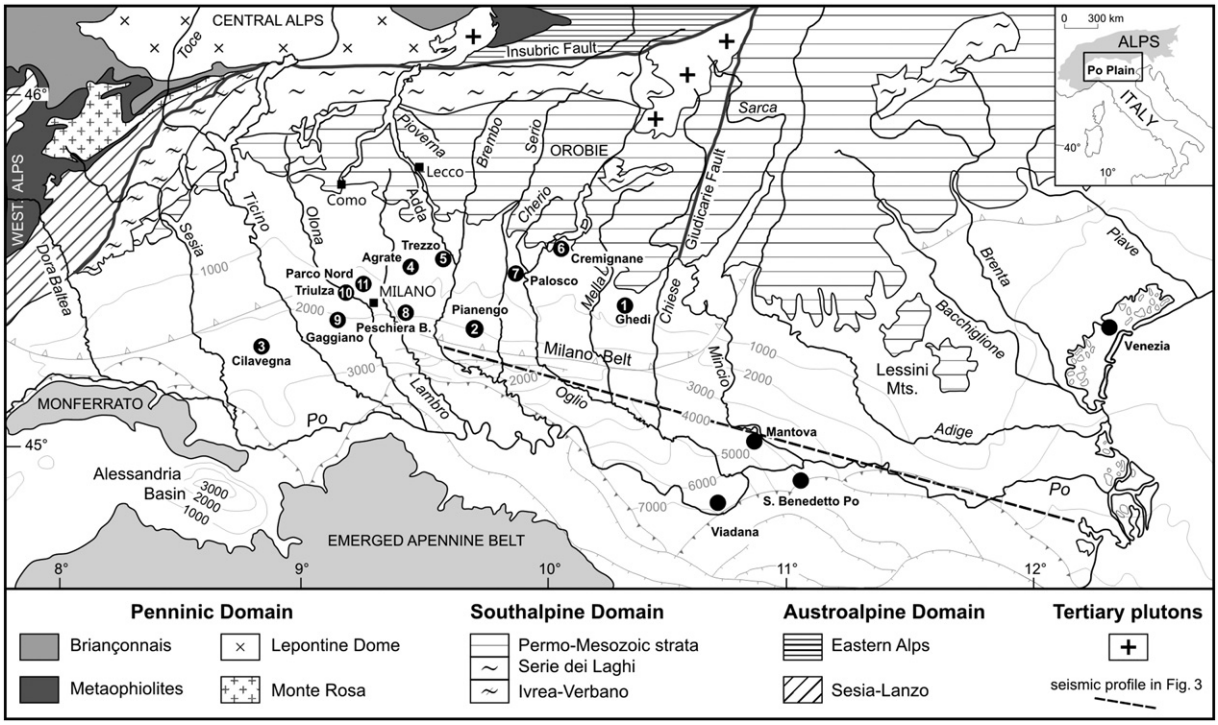

Fig. 1. Location and geological map of the Po foreland basin and adjacent Alpine and Apennine belts. Exposed and buried structures are shown, along with isobaths (m) of the base of the Pliocene. Black dots indicate Regione Lombardia (RL 1 to 11), Mantova-Viadana, and Venezia cores.