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Quantitative palaeodrainage analysis in the Pleistocene of the Po Plain (Italy)

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During the Pleistocene, Po Plain deposits recorded repeated waxing and waning of Alpine ice caps, and thus provide an excellent opportunity to investigate the interactions between pronounced climatic fluctuations and background tectonic activity (Scardia et al., 2006), resulting in frequent changes of drainage patterns. A high-resolution Pleistocene stratigraphy, with a complete sedimentological, paleontological, petrographic-mineralogical, magnetostratigraphic, and seismic data base, was recently obtained from eleven continuous cores drilled in the Lombardy Po Plain north of the Po River (ENI and Regione Lombardia, 2002). In the present study we focus on two cores in the proximal (Cilavegna) and distal plain (Pianengo), which best exemplify the drastic change in sedimentary systems and drainage patterns associated with the onset of major Pleistocene glaciations in the Alps (∼870ky; Muttoni et al., 2003). This climatic event is recorded by a regional unconformity (named R-unconformity by Muttoni et al., 2003), traced all across the Po Basin and encountered at -81 m depth in the Pianengo Core and at -98 m depth in the Cilavegna Core. The Cilavegna Core consists of metamorphiclastic floodplain sediments, capped by the R-unconformity and overlain by quartzofeldspathic braidplain deposits. The Pianengo Core consists of metamorphiclastic deltaic to floodpain sediments, capped by the R-unconformity and overlain by alluvial-fan gravels rich in carbonate pebbles; another unconformity at -39 m depth is overlain by metamorphiclastic braidplain deposits. Our quantitative approach to paleodrainage analysis is based on comprehensive information obtained from modern settings (Garzanti et al., 2004; 2006). End-member modelling and similarity analysis allows us to objectively compare detrital modes from modern and ancient deposits, and to reconstruct the evolution of sediment pathways through geologic time (Vezzoli and Garzanti 2009). The Cilavegna Core documents stepwise south-westward shifts of major tributaries draining the axial belt. The Pianengo Core records the rapid southward progradation of transverse alluvial fans fed locally from the Southern Alps, followed by progressive establishment of the modern Adda river system. Evolving drainage patterns and river avulsions represent a major cause of compositional change in foreland-basin deposits. Lateral shifts of river courses, commonly associated with unconformities and favoured by an increase in the ratio between sediment fluxes and subsidence, provide crucial information on tectonic or climatic events, and should be given full consideration in provenance studies.

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