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Foreword

Intermontane basins: Quaternary morphoevolution of Central-Southern Italy

Pietro P. C. Aucelli · Bruno D'Argenio · Marta Della Seta · Salvatore Ivo Giano · Marcello Schiattarella

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The present collection of papers illustrates the geological and geomorphological features of a significant number of Pliocene to Quaternary intermontane basins of the Central-Southern Apennines and shows that though not strictly coeval, these depressions are the result of a common morphotectonic evolution, albeit with a variable organization of the local structures.

The Pliocene–Quaternary evolution of the Central and Southern Apennines and the morphotectonic history of this orogenic belt have been strongly influenced by the opening of the back-arc Tyrrhenian Basin, undergoing a prevalent extensional deformation. The latter discontinuously affected the whole chain, with a rejuvenation of the extension both from the north-west to the south-east and from the inner to the outer sectors of the Apennines. Large-scale counterclockwise rotations of the nappe systems were accompanied by normal (high- and low-angle) faulting responsible for the genesis of several intermontane basins along the Apennine chain axis. The Quaternary morphoevolution of the above basins was largely controlled by regional uplift, fault activity, and climate changes, whose influence is recorded in their geomorphic and stratigraphic signature.

The Central-Southern Apennines form a unique north-east-verging fold-and-thrust belt built on the western border of the African-Apulian plate from late Oligocene—early Miocene times. This belt is mainly composed of shallow- and deep-sea sedimentary covers, deriving from Mesozoic–Cenozoic circum-Tethyan domains, unconformably covered by Neogene–Pleistocene foredeep and satellite-basin deposits. As to the morphotectonic features, the belt is frequently characterized at the top by remnants of ancient landscapes, uplifted and dismembered by more recent faulting. The latter is also responsible for the creation of the additional accommodation space inside the axial zone of the chain, hosting several intermontane basins widely studied by the Italian and international scientific community.

This volume represents an effort to face classical topics related to continental basins with a quantitative and multidisciplinary approach to decipher the complex interplay between surface processes and tectonics. To this aim, we have collected 12 papers, summarizing the results of several years of researches, presented in 2012 at the session of the 86th Conference of the Geological Society of Italy

This peer-reviewed article is part of a coordinated collection of scientific researches on the comparative evolution of the intermontane basins of the central-southern Apennines.

P. P. C. Aucelli (✉)
Dipartimento di Scienze e Tecnologie, Università degli Studi di Napoli Parthenope: Centro Direzionale, Isola C4, 80143 Naples, Italy
e-mail: pietro.aucelli@uniparthenope.it

B. D'Argenio
Istituto per l'Ambiente Marino e Costiero, CNR, Calata Porta di Massa, 80133 Naples, Italy
e-mail: b.dargenio@iamc.cnr.it

M. Della Seta
Dipartimento di Scienze della Terra, Università degli Studi di Roma "La Sapienza"– Piazzale Aldo Moro, 5, 00185 Rome, Italy
e-mail: marta.dellaseta@uniroma1.it

S. I. Giano · M. Schiattarella
Dipartimento di Scienze, Università degli Studi della Basilicata, Campus Macchia Romana, Via dell'Ateneo Lucano 10, 85100 Potenza, Italy
e-mail: ivo.giano@unibas.it

M. Schiattarella
e-mail: marcello.schiattarella@unibas.it

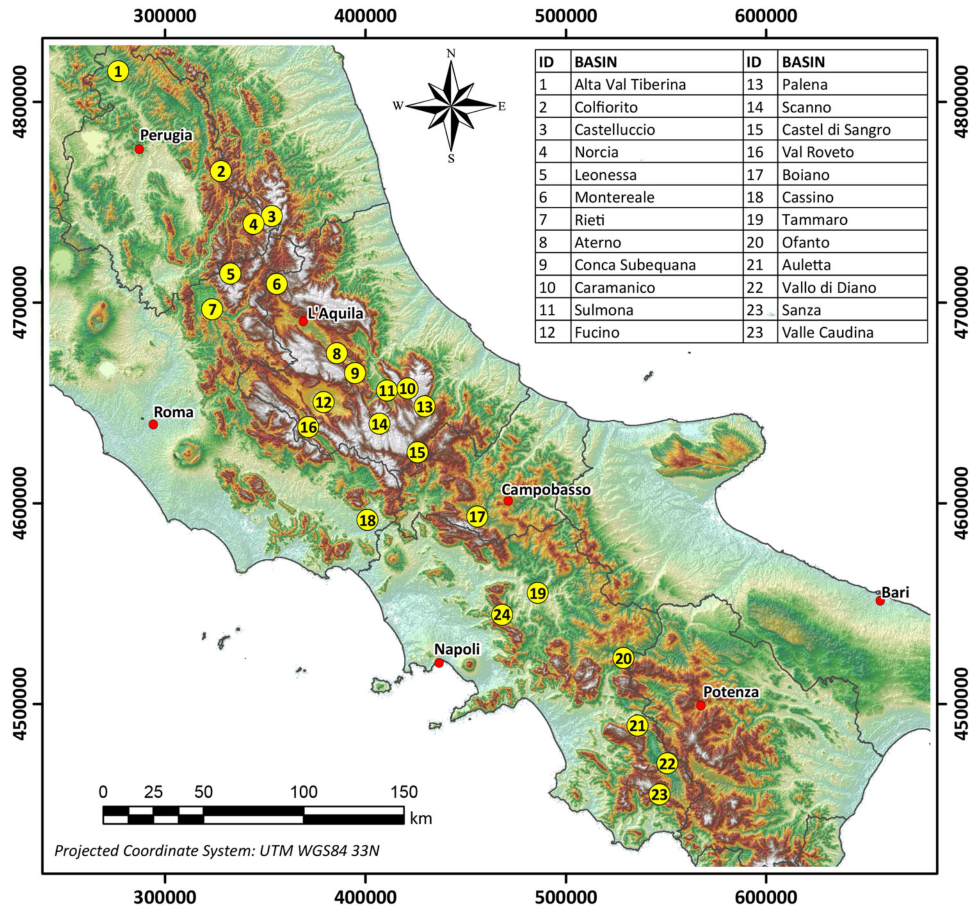

Fig. 1 Location of the study areas discussed in the present collection of papers

titled "*Intermontane basins: morphoevolution, tectonics and Quaternary climate oscillations*", and at the 16th Joint Geomorphological Meeting, "*Morphoevolution of tectonically active belts*" organized by the Italian Association of Physical Geography and Geomorphology (AIGeo), under the auspices of the International Association of Geomorphologists (IAG).

Given the above introduction, let us now briefly summarize the contents of this volume consisting of a selection of representative case histories (Fig. 1).

The paper by ARINGOLI et al. illustrates the Pleistocene morphotectonic evolution of four intermontane basins in the axial zone of the Central Apennines (Fig. 1, basins n. 2,3,4,5) focusing on the evolution of the drainage network, the behavior of the master faults and their interaction with the sedimentary infill. The authors recognized two generations of planation surfaces, older than the development of the Colfiorito, Norcia, Castelluccio, and Leonessa basins, displaced by the Pleistocene tectonics thus generating a morphological offset of hundreds of meters leading to the basins formation. The filtered topography allowed the authors to outline a NW-sloping trend of the surfaces containing two topographic depressions separated by a NE-oriented bulge. Finally, a gravimetric survey allowed the authors to measure the thickness of the clastic infill for each basin, and also to identify the basins depocenter, thus to correlate them to the master faults activity during the Pleistocene.

The work by MELELLI et al. presents a geomorphological analysis of the recent extensional tectonics of the upper Tiber Valley (Fig. 1, basin n. 1), a structure elongated for 70 km in NNW–SSE direction and presently hosting the Tiber River. In this study, 36 drainage basins of Tiber River tributaries have been analyzed, pointing out that the drainage network records meaningful evidence of tectonic control, such as abrupt changes in stream directions, knickpoints, and alignments of steepness anomalies with meaningful length in adjacent basins. Evidence of neotectonics is highlighted also by specific landforms, such as the entrenched alluvial fans, the triangular facets, and the fault scarps. A quantitative analysis was also performed, using linear, areal, and volumetric indexes related to drainage basins and river networks. The ranges of values, according to the existing literature, confirm a condition of wide-ranging morphological disturbance, especially for the central and eastern sector of the basin. These data confirm that the neotectonic activity is the main factor for controlling the morphological system.

The work by MICCADEI and PIACENTINI focuses on the link existing among several intermontane basin, drainage networks, and karst landscapes located in the Central Apennines, from the Rieti basin to the Castel di Sangro basin (Fig. 1, n. 7–15). Aims of this study are to better understand both the geomorphological and drainage systems evolution of the central Apennines landscape. They used a comparison between the main geological and geomorphological features of the basins, and the analysis of the hanging karst landscape and of the drainage system by means of a 100-km long swath profile across the Central Apennines. The Authors showed a lack of synchrony in the Late Pliocene—Early Pleistocene basin formation related to the eastward migration of the extensional tectonics, the development of NW–SE and NNW–SSE-oriented fault-bounded basins that produced a strong rearrangement of the drainage network and an enlargement of the endorheic areas. From the late Middle Pleistocene, the tectonic uplift forced a change from endorheic to open drainage systems, in turn producing several deep gorges.

The work by ESPOSITO et al. focuses on the review of some selected Quaternary Deep-Seated Gravitational Slope Deformations (DSGSD) and Massive Rock Slope Failures, which occurred in correspondence of typical slope morphostructural settings of the intermontane basins of central Apennines. The Authors outline also that DSGSD processes and large rockslide and rock avalanches can be considered as geomorphic constraint to understand the main morpho-evolutionary phases of the slope systems bordering the intermontane basins.

FUBELLI et al. provide further constraints to the reconstruction of the geological history of the Rieti intermontane basin, one of the western tectonic depressions of the Central Apennines (Fig. 1, basin n. 7). The Authors focused their attention on the Farfa River basin, covering the southern portion of the Rieti intermontane basin, and geostatistically reconstructed the bounding surfaces of the Gelasian PaleoFarfa River alluvial body, in order to outline the drainage system adjustment in response to the opening of the Rieti intermontane basin. The approximate top and basal surfaces of the Gelasian alluvial body, as well as the summit erosional ''Paleosuperficie *Auctt*.'', have been used as important geomorphic markers testifying that the NW–SE master fault bordering the present Rieti Plain was likely already active in the Gelasian.

The multidisciplinary study by CHIARINI et al., supported by new paleomagnetic and radiocarbon chronological data, provides important constraints to the geometry and evolution of the un-dissected Montereale Basin (Central Apennines, Fig. 1, n. 6). Geophysical and stratigraphic data allowed them to estimate the thickness and geometry of the chronologically constrained Quaternary sedimentary infilling and to outline the presence of two sedimentary fault-controlled sub-basins. A major unconformity was outlined and related to stream piracy that has led to a substantial reduction of the catchment area since the Early Pleistocene endorheic stage.

The work by SAROLI et al. presents the preliminary outcome of photogeological analysis, geological survey, and borehole stratigraphic correlation, aiming to add new data on the Cassino Basin (Fig. 1, basin n. 18) and to define the thickness of its Quaternary infill. The study area is located in the southernmost part of the so-called Latina Valley in the central Apennines. The basin hosts a Quaternary paleo-lake created by the damming of the lava flows coming from the close Roccamonfina volcano. This study has revealed that the accommodation space and the thickness of the lacustrine and alluvial deposits could have been influenced by an inherited horst-and-graben structure, likely generated in the early Pleistocene. The subsequent evolution of the basin has been strongly controlled by regional faults, probably still active.

The work by AMATO et al. reconstructs the palaeoenvironmental evolution of the largest intermontane basin of the Molise Apennine (Boiano basin), especially during the Middle Pleistocene, using a multisciplinary approach, which includes geomorphological and deep stratigraphical, tephrostragraphical, geochronological, and palaebotanical data. It suggests that the main palaeoenvironmental changes were driven by NW–SE extensional tectonic phases, active in this sector since Middle Pleistocene, by volcanoclastic deposition of several fall-out eruptions, mainly of the Roccamonfina volcano and secondly of the Phlegrean Fields, and by 100-ky climatic cycles. The subsidence was not homogeneous within the basin, as testified by the different thicknesses of the infilling recorded in the deep cores appositely drilled close to the Boiano town, one of the most depressed areas of the basin. It is likely that the separation between the Boiano and Sepino basins, as well as the capture of the Boiano basin by the Biferno River, occurred between 350 and 250 ka.

CARTOJAN et al. illustrate some morphostructural features of the Tammaro River basin, using GIS-based analytical techniques. The Tammaro River basin corresponds to a sector of the southern Apennines experiencing a general SW-NE extension, with evidence of recent seismicity. The geomorphological features of the basin seem to be mainly controlled by NE–SW-striking faults. Other sets of faults are also documented on the basis of clear morphotectonic evidence, including displacements of several orders of palaeosurfaces.

DONADIO et al. present a reconstruction of the Late Quaternary evolution of the Valle Caudina intermontane basin, located in the southern Apennines between the Taburno and the Avella–Partenio Mts. (Fig. 1, basin n. 24). The depositional patterns, investigated by deep cores and geoarcheolgical data, coupled with the geomorphological analysis, allowed to recognize lacustrine and fluvial–lacustrine sediments, interbedded with tephra layers originating from Phlegrean Fields and Vesuvio volcanoes, which represent significant chronological markers. The two lacustrine episodes are connected with volcanic events: the older predates the Campanian Ignimbrite deposit (∼39 kyr BP), while the younger was deposited before of 5 kyr BP, as indicated by the recovery of Neolithic artifacts. The presence of Roman ruins in the center of the valley suggests that the lake has suffered a substantial downsizing or has disappeared between 5 kyr BP and the Roman Age.

The opening kinematics and the morphotectonics of three Pliocene to Quaternary intermontane basins of the Southern Apennines are discussed by GIANO et al. that also outline the role played by pre-existing landforms and structures (Fig. 1, basin n. 21, 22, 23). They analyzed the long-term landscape evolution of the Auletta, Vallo di Diano, and Sanza basins using the arrangement of several planation surfaces as relevant geomorphological markers in reconstructing the tectonic history of a large area. The Vallo di Diano basin is interpreted as a structural low generated by extension in the Pleistocene, but probably already active as a Pliocene seaway, whereas both the Auletta and Sanza Pleistocene basins represent two lateral branches with oblique kinematics inherited from a pre-existing set. The authors propose for such basins a new type of fault-bounded basin, named “transfer-zone basin”.

Finally, the paper by LABELLA et al. focuses on the morphotectonic evolution of the Ofanto Basin, a wide intermontane trough of the southern Apennines filled by Pliocene to Quaternary sediments of both marine and continental origin. The results obtained from both quantitative and morphostructural analyses support the idea that long-term processes driven by the differential tectonic behavior of the two basin flanks rather than being a passive litho-structural control are responsible for both the fluvial network asymmetry of the Ofanto River catchment and the arrangement of the ancient land surfaces.

In spite of some differences in the state of the research, described in each paper the general outcome of this volume may be summarized as follows:

a) Most basins are older than previously assessed in the dedicated scientific literature;
b) Strike-slip tectonics was often responsible for the embryonic (i.e., Pliocene) formation of the intermontane basins of the Apennine orogen, whereas high-angle extensional faulting developed only in the early-to-middle Pleistocene time span in the axial zone of the chain;
c) The analysis of the geomorphic anomalies of drainage networks is an efficient tool to detect the recent and active tectonics not otherwise recorded;
d) The interplay between tectonics and climate may be recognized both in the landforms and the sediments of many basins and could be a key for the future research on the intermontane basins.

In conclusion, we hope that this collection of papers may be of some assistance in understanding the regional morphotectonics of the Apennines and may serve as a first large-scale approach to its Pliocene and Quaternary history.