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Opening kinematics of the Auletta and Vallo di Diano basins, southern Italy: constraints from structural analysis, paleomagnetism, and neutron texture analysis

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Abstract

Opening kinematics of the Auletta and Vallo di Diano basins, southern Italy: constraints from structural analysis, paleomagnetism, and neutron texture analysis

Opening kinematics of the Auletta and Vallo di Diano basins at Campania-Lucania border (southern Italy) have been studied by means of structural analysis of striated faults, paleomagnetism, and neutron texture analysis of lacustrine and slope deposits. On the grounds of the new constraints, it is likely that the studied intermontane basins underwent a polyphased brittle tectonics since late Pliocene times, as occurred in other sectors of the axial zone of southern Apennines.

Key words: *Neotectonics, fault kinematics, anisotropy of magnetic susceptibility, neutron texture analysis, southern Apennines (Italy).*

INTRODUCTION

The southern Apennines are a north-east verging fold-and thrust belt derived from the deformation of the African palaeomargin, strongly dismembered by neotectonics and therefore articulated in longitudinal and transversal structural depressions. In the last decades, several Authors have delineated a complex Quaternary tectonic picture for the axial zone of the southern Italian Apennines, which implies superimpositions of strike-slip and extensional movements along fault surfaces (ASCIONE *et alii*, 1992 a, b; HYPPOLITE *et alii*, 1994; SCHIATTARELLA, 1998; GIANO *et alii*, 2000; among others). On the other hand, a more simple Quaternary tectonic evolution, characterized by a continuous active SW–NE extension, was proposed on the basis of seismic data from Agri, Auletta and Vallo di Diano basins (BARCHI *et alii*, 2007; AMICUCCI *et alii*, 2008). In order to discriminate between so different models, a multidisciplinary approach is achieved bringing together data from several sources and methods. In particular, opening kinematics of the Auletta and Vallo di Diano basins at Campania-Lucania border (southern Italy) have been studied by means of structural analysis of striated faults, paleomagnetism, and neutron texture analysis of lacustrine and slope deposits. The latter was performed in order to investigate the influence of the tectonic regime on crystallographic preferred orientation (i.e. textures) of rock-forming minerals.

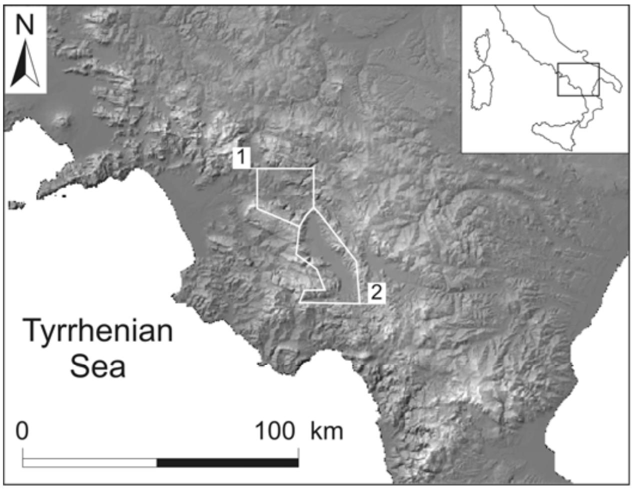

Fig. 1 – Location map of the studied areas. 1) Auletta basin; 2) Vallo di Diano and Sanza basin

GEOLOGICAL SETTINGS OF THE AULETTA AND VALLO DI DIANO BASINS

The lower valley of the Tanagro River is a 310 km^2 wide catchment of the Campania-Lucania Apennine, which longitudinally crosses a 100 km^2 wide tectonic depression tectonic (the so-called Auletta basin, Ascione *et alii*, 1992b) after having run through the Vallo di Diano valley,

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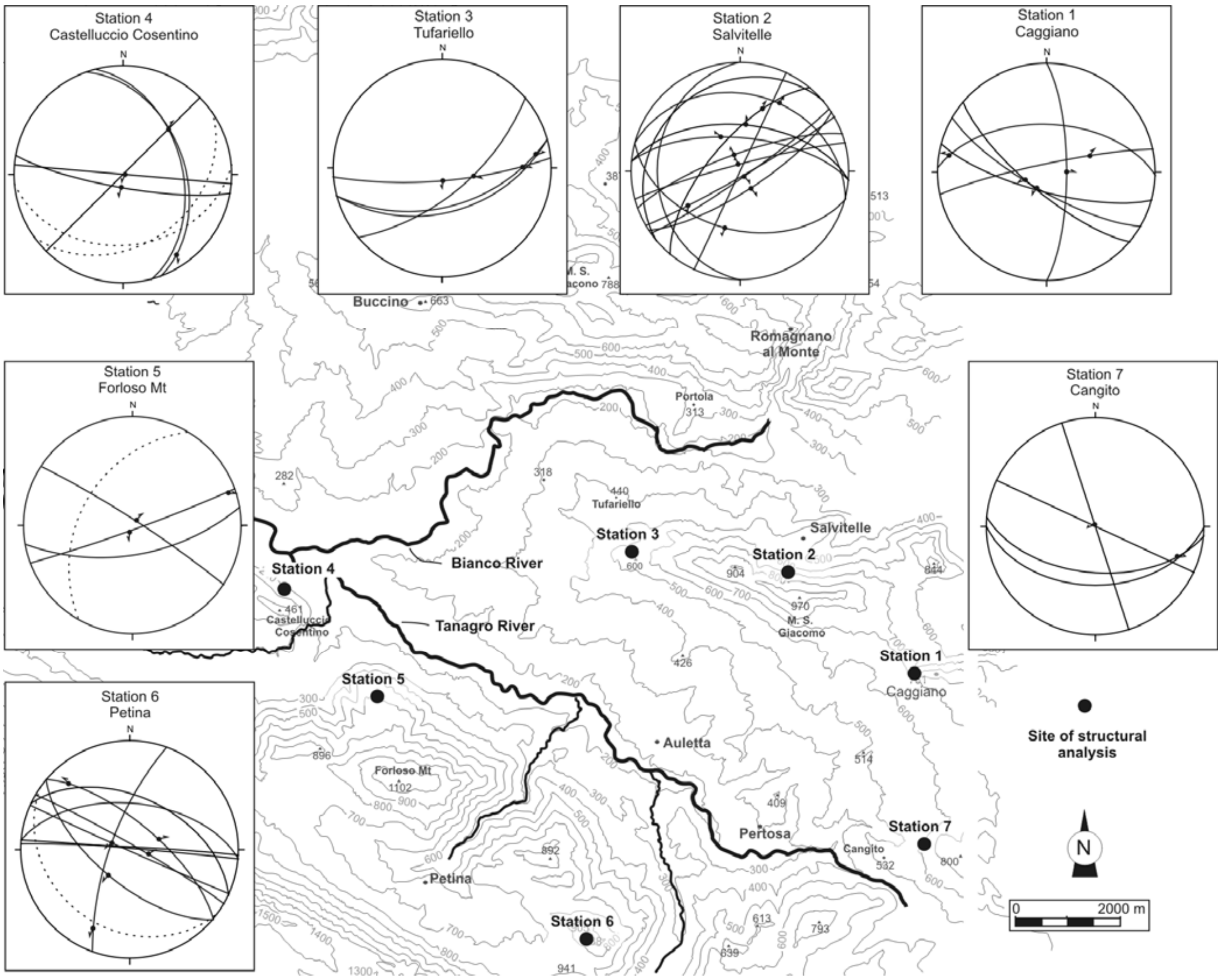

Figure 2 - Survey sites and stereographic projection (Wulff net, lower hemisphere) of fault planes and striations in the Auletta basin.

representing its upper portion of the whole drainage area (Fig. 1).

The Auletta basin is located between the carbonate massifs of the Alburni Mts to the south and Marzano Mts to the north, both characterized by high relief. A very thick middle Pliocene to middle Pleistocene sequence (at least 500 m in the depocentral area of the basin, AMICUCCI *et alii*, 2008), both of marine and continental origin, filled the basin and are shaped by erosion land surfaces and fluvial dissection. N110-130° trending high-angle faults with polyphase kinematics, as well as NE-SW striking faults, are largely diffused in the Mesozoic carbonate mountains and in the Quaternary basin itself.

The SW margin of the tectonic depression is bordered by a N120-130° trending and NE-dipping master fault (Alburni Line) which has strongly controlled the stratigraphic and geomorphological evolution of the basin.

The activity of the 20 km-long Alburni Line provoked the tilting of continental deposits and land-surfaces in the hanging-wall of the fault (AMICUCCI *et alii*, 2008; GIOIA & SCHIATTARELLA, 2010).

The Vallo di Diano basin is a NW-SE-trending elongated basin, about 35 km-long and 7 km-large. A N140-150°-striking master fault bounds the eastern side of the basin whereas the western flank is affected by N120°-trending left-lateral strike-slip faults (ASCIONE *et alii*, 1992a). The sedimentary infill of the basin is constituted of fluvio-lacustrine deposits and coeval slope to alluvial fan deposits located along the flanks of the basin. Two different depositional episodes have been recognized in the lacustrine succession (SANTANGELO, 1991), responsible for the formation of an older cycle cropping out in the southern sector of the valley, lower-middle Pleistocene in age (0.7 ± 0.2 Ma, in SANTANGELO, 1991), and of a younger lacustrine depositional cycle, mid-Pleistocene to Holocene in age, filling the depocenter of the basin. A recent $^{40}Ar/^{39}Ar$ radiometric dating of sanidine crystals from tephra layers, interbedded in this portion of the fluvio-lacustrine sequence, allowed to better constrain the age of the older deposits, set to 706.3±8.1 ka (DI LEO *et alii*, 2009). In addition, an age of 106.7±1.6 ka has been proposed by the same authors for a weathered horizon at the top of the Grotta S. Angelo succession (Fig. 3), located on the eastern side of the valley in the central portion of the basin.

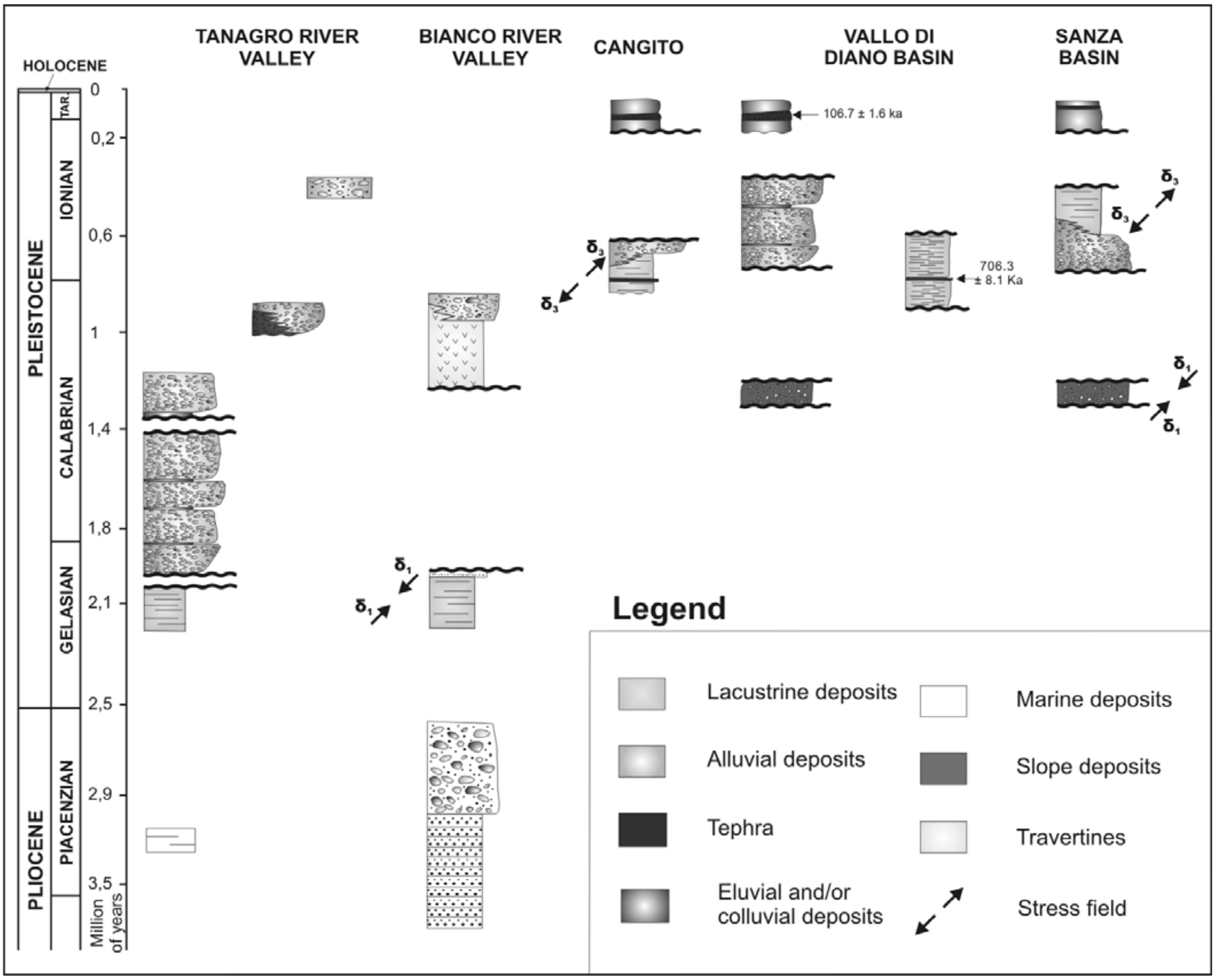

Figure 3 – Stratigraphic synthesis of the investigated basins and tectonic events recognized by structural analyses, paleomagnetic data and quantitative texture analysis.

RESULTS AND CONCLUSION

Fault kinematics of the Auletta basin area are resumed in the plots of Figure 2: high-angle faults generally show a marked poly-modal distribution of the kinematic indicators. In particular, the NNW-SSE trending fault of the Alburni Mts (Station 6 in Figure 2) exhibits a superimposition of two sets of striations: a former left-lateral transtensional kinematics (rake nearly 15°) and a later dip-slip kinematics. N120°-trending left-lateral strike-slip faults are regional tectonic structures responsible for the genesis of many Quaternary intermontane basins of the southern Apennines, and their kinematic history is quite homogeneous all along the chain (SCHIATTARELLA, 1998). Moreover, faults and fractures compatible with a NE-SW extension have been detected in the lower-middle lacustrine deposits of the Vallo di Diano (DI LEO *et alii*, 2009). Paleomagnetic data (Fig. 3) from lower and middle Pleistocene deposits of the studied areas indicate a change of tectonic stress field during the Quaternary. In particular, lower Pleistocene lacustrine deposits of the Auletta basin and slope deposits of the Sanza basin registered a magnetic anisotropy related to a deformational stress field with a NE-SW shortening axis, whereas an extensional deformational event with a NE-SW trending $\sigma3$ axis affected the middle Pleistocene lacustrine deposits of the Sanza basin. The first event is kinematically compatible with the direction of compression of the stress field related to the N120°-trending strike-slip faulting (DI LEO *et alii*, 2009). A further contribution to our reconstruction comes from the quantitative texture analysis of calcite crystals from middle Pleistocene lacustrine deposits outcropping in the western sector of the Vallo di Diano basin (Cangito section, Fig. 3). Quantitative Texture Analysis shows a preferred orientation of the (00l) poles (i.e. <c> axes) at high angle with respect to the bedding plane (Fig. 4). (00l) poles are distributed along a girdle perpendicular to the XZ plane and with an angle of about 60° counter-clockwise to the XY plane (i.e. bedding plane). (00l) poles also show maxima lying close to the XZ plane. Such relations between the crystallographic preferred orientation and the bedding plane, have been

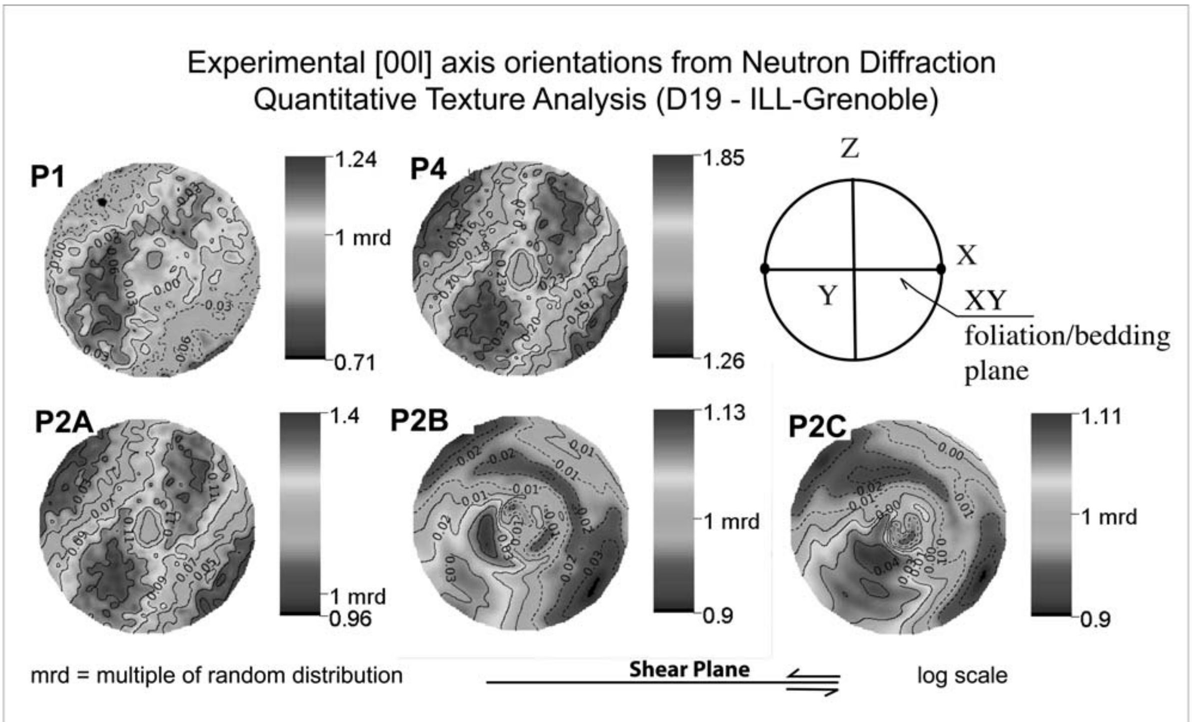

Figure 4 – Crystallographic preferred orientation of calcite in lacustrine deposits of Cangito area. Pole figures represent the orientation of the (00l) planes in multiple of random distribution (mrd) and log scale. The plane of pole figures is the XZ plane and the equatorial line is parallel to the bedding plane trace.

described in natural, experimental and numerical deformation of calcite and calcite aggregates, as related to a dextral shear parallel to the XY plane, at low temperature conditions (Leiss & Molli, 2003).

On the grounds of the new constraints, it is likely that the studied intermontane basins underwent a polyphased brittle tectonics since late Pliocene times, as occurred in other sectors of the axial zone of the southern Apennines chain (SCHIATTARELLA, 1998; GIANO *et alii*, 2000), rather than an unique long-lasting extensional stage with a counter-Apennines axis.

REFERENCES

AMICUCCI L., BARCHI M.R., MONTONE P., RUBILIANI N. (2008) - *The Vallo di Diano and Auletta extensional basins in the southern Apennines (Italy): a simple model for a complex setting*. Terra Nova, **20**, 475–482.

ASCIONE A., CINQUE A., SANTANGELO N., TOZZI M. (1992a) - *Il bacino del Vallo di Diano e la tettonica trascorrente plio-quaternaria: nuovi vincoli cronologici e cinematici*. Studi Geol. Camerti, Vol. Spec. **1992/1**, 201-208.

ASCIONE, A., CINQUE, A. TOZZI, M. (1992b) - *La Valle Del Tanagro (Campania): una depressione strutturale ad evoluzione complessa.* Stud. Geol. Camerti, **1992 ⁄ 1**, 209–219.

BARCHI M., AMATO A., CIPPITELLI G., MERLINI S. & MONTONE P. (2007) - *Extensional tectonics and seismicity in the axial zone of the Southern Apennines*. Boll. Soc. Geol. It., Spec. Vol., **7**, 47-56.

DI LEO P., GIANO S.I., GIOIA D., MATTEI M., PESCATORE E., SCHIATTARELLA M. (2009) - *Evoluzione morfotettonica quaternaria del bacino intermontano di Sanza (Appennino meridionale).* Il Quaternario, **22**, 189-206.

GIANO S.I., MASCHIO L., ALESSIO M., FERRANTI L., IMPROTA S., SCHIATTARELLA M. (2000) – *Radiocarbon dating of acting faulting in the Agri high valley, southern Italy.* Journal of Geodynamics, 29, 371-386.

GIOIA D. & SCHIATTARELLA M. (2010) - *An alternative method of azimuthal data analysis to improve the study of relationships between tectonics and drainage networks: examples from southern Italy.* Zeitschrift für Geomorphologie, 54, in press.

HIPPOLYTE J. C., ANGELIER J., ROURE F. (1994) – *A major geodynamic change revealed by Quaternary stress patterns in the Southern Apennines (Italy).* Tectonophysics, **230**, 199-210.

LEISS B. & MOLLI G. (2003) – ‘*High-temperature’ texture in naturally deformed Carrara marble from the Alpi Apuane, Italy*. Journal of Structural Geology, **25**, 649-658.

SANTANGELO N . (1991) - *Evoluzione stratigrafica, geomorfologica e neotettonica di alcuni bacini lacustri del confine Campano-Lucano (Italia meridionale).* PhD thesis, , Università di Napoli “Federico II”, 1-109.

SCHIATTARELLA M. (1998) - *Quaternary tectonics of the Pollino Ridge, Calabria-Lucania boundary, southern Italy.* In: HOLDSWORTH R.E., STRACHAN R.A., DEWEY J.F. (eds), “Continental Transpressional and Transtensional Tectonics”. Geological Society, London, Spec. Publ. **135**, 341-354.