

## THE POLYPHASE DEFORMATION HISTORY OF THE ANTOLA UNIT (NORTHERN APENNINE, ITALY)

Nicola Levi and Alessandro Ellero

*Istituto di Geoscienze e Georisorse, CNR, Pisa, Italy.*

### ABSTRACT

The Antola Unit (AU) occurs at the top of the Northern Apenninic nappe pile, cropping out in the area regarded as the boundary between Alpine and Apenninic units. The relationships among all these units are sealed by the Tertiary Piedmont Basin (TPB) (Late Eocene-Miocene). The AU is characterized by a succession that consists of an Helminthoid Flysch, correlated to the External Ligurian successions. The first part of the AU deformation history represents the Early to Middle Eocene Meso-Alpine tectonics, related to closure of the Ligure-Piemontese oceanic basin and the subsequent continental collision; the second one is related to the reactivation of the Meso-alpine structures during the Late Oligocene-Early Miocene.

The first deformation phase (D1) is characterized by structures, as for example folds and boudinage, affecting mostly the base of the AU and showing features indicative of soft-sediment conditions. All these structures are deformed by a folding phase (D2) characterized by the devel-

opment of sub-isoclinal folds and extensional tectonic contacts. The structures related to the D1 and D2 tectonic phases are sealed by the TPB deposits. The third deformation phase (D3), affecting also the TPB deposits (Early Oligocene), is characterized by the development of open, asymmetric, overturned folds with sub-horizontal axial planes. The axes orientation is strongly variable, with fold-facing ranging from North to East. The D3 structures are deformed by a D4 folding phase, characterized by the development of open concentric folds with sub-vertical axial plane.

The kinematics indicators of the D1 phase are indicative of an "Alpine" vergence during the early stage of its emplacement. The D2 is indicative of a NE-ward emplacement, probably related to a gravitational tectonic phase. The Alpine structural setting was subsequently reactivated during the Late Oligocene-Early Miocene age, as supported by the occurrence of the D3 phase folding structures affecting the TPB deposits.

