

NEOGENE GEODYNAMIC EVOLUTION OF THE CENTRAL APENNINIC FORE-DEEP

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A model of the geodynamic evolution and the related sedimentation of the Central Apennine foredeep from Messinian to Recent times has been developed from integrating field observations, photogeology, well log analysis and interpreted seismic lines. These seismic interpretations were calibrated by well data. The proposed model is significantly different from those recently published.

In summary, the segment of the North African margin, which makes up this study, was progressively bent and integrated into the foredeep from West to East during geological time. During each flexural cycle one can distinguish:

- . an initial rapid phase, during which a narrow trough was created and infilled in rapidly by massive and thick turbidite sands.
- . an intermediate phase characterised by repeated tectonic pulsations, the widening of the foredeep and the deposition of alternating massive sands and thinner fine grained laminated units.
- . a final phase of quietude dominated by fine grained sedimentation.

Subsequently, this newly formed and infilled foredeep was uplifted and deformed and the locus of the flexing moved towards the East. The previous foredeep series was thrust against a newly created trough. Transported sedimentary basins (piggy-back basins) were formed on top of the thrusting units, so that, at any one time, terrigenous sedimentation could occur in a piggy-back basin and in its associated foredeep. In this study particular effort was made to distinguish and reconstruct both the early phase massive turbidite infilling and the coeval piggy-back basins.

Four main flexural domains can be distinguished in the region (from the Apennine margin to the Adriatic Sea):

- . a pre-evaporitic domain (Laga flysch s.s.)
- . a post-evaporitic/pre-Pliocene domain (Colombacci domain)
- . a Lower Pliocene domain (Cellino and *G. puncticulata* flysch)
- . a Middle Pliocene domain (*G. crassaformis* flysch)

The Laga flysch extends westwards of the Montagna dei Fiori trend. In this foredeep domain two main depocentres can be distinguished: the first is located west of the Aquasanta anticline, and the second is found in the Valle Castellana area where it has a thickness of 1700 metres. Only in the Camerino syncline, where the rate of flexing was least, is the northwards continuation of the Laga flysch not eroded. The southern continuation of the basin into the Gran Sasso massif is poorly known, although it appears that here too the rate of flexing was low. The Laga flysch is stratigraphically bounded by the Tortonian marls at the base and the evaporitic Gessoso-solfifera at the top. The Laga flysch shales out eastwards from the Montagna dei Fiori trend as can be demonstrated on seismic and controlled by the Villadegna 1 well.

The Colombacci domain extends continuously along a relatively narrow belt sub-parallel to the Apennine margin from the Morrone di Pacentro area in the south to the Romagna area in the north. The cycle is bounded by Messinian evaporites at the base and the *Sphaeroidinellopsis* Key Bed at the top. The maximum rate of flexing was to the east

of the Montagna dei Fiori. Here the syn-flexural massive/confined turbiditic sands of Civitella del Tronto attain 500 metres thickness. The turbiditic sands are followed by thick interbedded sands/clays. Near the top of these cycles a thin, 80 centimetres thick, tuffaceous ash level is found. The upper part of the cycle consists of predominantly silty clays with some sands; there are some interbedded chemical limestones of decimetre to metre bed thickness (Colombacci levels s.s.).

The Colombacci domain is affected, together with its pre-flexural substratum by severe low angle (thin skinned) thrusting. In particular the early flexural trough (Civitella sands) was thrust strongly against the inner margin of lower Pliocene flexural domain (the Cellino flysch). This frontal ramp (Roccafina Damo fault) can be traced on the surface continuously from the Morrone area to the Vomano valley and by using seismic lines to the Marche region.

The Lower Pliocene domain is extensive being found between the Roccafina Damo margin and the Adriatic coast. From a geodynamic point of view the domain can be subdivided into two sub-domains:

- . the *G. margaritae* flexural sub-domain
- . the *G. puncticulata* flexural sub-domain

The early flexural *G. margaritae* trough (Cellino flysch trough) extends without break from the west of the Maiella mountain, through the Cellino area and northwards to the Marche region. The rate of flexing seems to have been relatively consistent (some 650 metres of massive turbidites are found at Cellino compared with about 550 metres in the Treia area). During the intermediate and final stages of development the basin widened largely towards the east, extending to the Adriatic coast. In the middle of the Lower Pliocene it was the early inversion of the Cellino trough which caused the shift of the foredeep to the east.

The *G. puncticulata* basin for a large part overlaps the earlier *G. margaritae* flexural sub-domain. The Cellino flysch and its substratum commence being thrust against the inner *G. puncticulata* trough. A coeval *G. puncticulata* piggy-back basin is well defined east of Altavilla and in the Loro Piceno area. A trend of stacked folds thrusting the Cellino flysch (Nereto trend) is progressively built up; it can be traced continuously in the study area from the eastern Maiella margin to the Jesi area in the north. However the structural shortening is much less in the Marche region than in the Piceno and Abruzzi areas. Inversion and uplift of the *G. puncticulata* flysch sub-domain was initiated from the late Lower Pliocene. This tectonic deformation was of long duration.

A trend of stacked thrust folds (Tortoreto or coastal trend) is present from the east of the Maiella mountain, through the present day coast line, to the west of the Conero Mount. This deformation is out of sequence, the oldest and deepest thrust fold being the outermost one (dating early Middle Pliocene) and the youngest and shallowest being Upper Pliocene in age. A spectacular Middle-Upper Pliocene piggy-back basin extends continuously between the Tortoreto and Nereto trends, Penecontemporaneous flysch troughs are progressively created east of the Tortoreto folds ramp system.

The Nereto trend was also reactivated during the Middle Pliocene tectonic phase. There are often back-thrusting at the edge of the main east verging thrusts.

Finally it should be noted that the compressional structural shortening extends much more towards the north east (just to the middle Adriatic area) in the Marche region, than in the Piceno-Abruzzi area where it does not go beyond the coastal belt. This compensates for the lesser shortening of the inner foothills in the *G. puncticulata* tectonic phase.

CENTRAL APENNINIC FORE-DEEP BALANCED CROSS-SECTIONS

