PROGETTO CROP - Crosta Profonda

Sottoprogetto CROP 04 - Appennino Meridionale

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representative of the principal steps that describe the caterpillar-like motion of the tectonic wedge:

1) forward transport of the Apenninic nappes on top of a long thrust flat;
2) development of a steep ramp at the front of the tectonic wedge;
3) deactivation of the leading edge of the duplex system and out-of-sequence migration of the active thrusts towards the axis of the mountain chain;
4) forward migration of the active thrusts beneath and beyond the previously abandoned leading edge.

We carefully analysed the different systems tracts of the Ofanto and Bradano depositional sequences along the CROP-04 transect in order to provide additional information about the relationships between thrust propagation and sedimentation in late Pliocene and early Pleistocene times. In this paper, new constraints about the kinematic evolution of the thrust belt-foredeep system in the 3.70 - 0.60 Ma interval will be presented. The new data have allowed us a quite accurate age determination of the growth of the principal tectonic structures both in the buried Apulia carbonates (e.g. San Gregorio Magno antiform) and in the roof units of the Apennine duplex system (e.g. San Fele antiformal stack and Ofanto synform).

GEOLOGICAL INTERPRETATION OF THE CROP - 04 SEISMIC LINE

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The interpreted CROP - 04 line is a stack section derived from a recent reprocessing down to 10 seconds TWT of the original seismic data. The new stack shows a remarkable improvement with respect to the previous one that had been obtained by a standard processing sequence. The principal steps of the reprocessing sequence are described in Mazzotti *et al.* (this volume). In this paper we shall describe the principal elements that have contributed to the interpretation of the seismic line and the main steps we have taken in order to reach the final geological profile.

Surface-geology information. Significant improvements of the available geological information mostly concern the age and facies of the Mesozoic-Tertiary Monte Marzano carbonates, of the Pliocene deposits filling the Ofanto, Ruoti-Baragiano and Potenza synforms and of the Pleistocene deposits disconformably overlying the Apenninic nappes in the Vulture region. Improvements also concern the geometry and kinematics of the Daunia, Tufillo-Serra Palazzo and Sannio imbricates that form the outer margin of the thrust belt. The revised surface geology of the study region is shown in the enclosed structural map at the scale 1:250.000.

Subsurface-geology information. Several boreholes located along the CROP - 04 line, together with several commercial lines calibrated on wells and tied to the CROP - 04 seismic profile, have provided important constraints for the identification and characterization of the tectonic structures in the buried Apulia carbonates and in the Apennine allochthonous sheets (see Patacca *et al.*, this volume). In addition, the integration between surface and surface data on the Pliocene and Pleistocene deposits crossed by the CROP - 04 line allowed us the establishment of important constraints on the kinematics of the thrust belt-foredeep system between 3.70 and 0.60 Ma (see Patacca and Scandone, 2001 and this volume).

Interpretation of the seismic line. The available surface and subsurface information has been plotted on the seismic line in order to define the shallow geological structures in terms of composition and tectonic-unit attribution. In a second step, a line drawing of the seismic profile from the Tyrrhenian coast to the outer margin of the Apennines has been done. Finally, major geological bodies corresponding to the different tectonic units of the thrust belt have been delimited, together with the principal faults, consistently with the well data, with the line drawing and with the information on the overall structural architecture derived from all the available seismic lines in the area. In such a way, a preliminary interpretation of the entire seismic line has been obtained.

Time-Depth conversion. The interpreted time section has been digitised and subsequently depth-converted by means of the software GeoSec 4.2 using the following velocity values for the different rock units:

- 2200-2300 m/s to the Pliocene-Pleistocene deposits disconformably overlying the Apulia carbonates and unconformably covering the Apenninic nappes;
- 3000-3500 m/sec to the North-Calabrian, Sicilide, Sannio, Serra Palazzo and Daunia units, as well as to the Albidona Formation;
- 5000-5500 metres to the Alburno-Cervati and Monti della Maddalena carbonates;
- 4000-4500 m/sec to the Lagonegro nappes;
- 5500-6000 m/sec to the Apulia carbonates, including the Triassic evaporites;
- 4500-5000 m/sec to the Verrucano-like siliciclastic deposits underlying the Apulia

carbonates (see Puglia 1 and Gargano 1 wells).

Structural restoration. The depth-converted section obtained by using the lower velocity values has been structurally restored by means of GeoSec 4.2 until a balanced section at the top of the buried Apulia carbonates has been obtained. Finally, the balanced section has been time-converted in order to check the correspondence between the tectonic structures and the geometry of the seismic reflectors. Where the reconstructed geometry did not fit the observed reflectors, new operations of structural restoration have been performed until a satisfactory result has been obtained.

The constructed geological profile, though consistent with the geometry of the seismic reflectors, obviously represents a subjective interpretation of the reality. Current schemes in the recent geological literature, popular among oil geologists, postulate quite modest horizontal displacements in the buried Apulia carbonates that form the backbone of the Southern Apennine duplex system. In our structural reconstruction, on the contrary, a telescopic shortening of several tens of kilometres is required in Pliocene and Pleistocene time in order to justify the forward transport of the Apenninic nappes, the creation of huge antiformal stacks in the allochthonous sheets and the imbrication of the entire pile of nappes along the outer margin of the mountain chain between 3.7 and 0.65 Ma.

THE EVOLUTIONARY STAGES OF THE SANT'ARCANGELO BASIN (BASILICATA, SOUTHERN ITALY)

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The Sant'Arcangelo basin is a wide piggyback basin in the southern Apennines (Caldara *et al*., 1994; Camarlinghi *et al*., 1994; Casero *et al*., 1988; Hippolyte *et al*., 1994; Pieri *et al.,* 1994; Roure *et al*., 1994; Calabrò *et al*., *in press*). It developed from middle Pliocene to middle Pleistocene (Caggianelli *et al*., 1992; Caldara *et al*., 1988; Pieri *et al.,* 1994) back to the front of the Apennines thrust sheet. It is filled by siliciclastic sequences over 4000 metres thick (Vezzani, 1966; 1967; Lentini & Vezzani, 1974; Carbone *et al*., 1991), strongly controlled by synsedimentary tectonic activity.

The stratigraphic setting (Pieri *et al*., 1993; Pieri *et al*., 1994) consists of four depositional sequences (**A**, **B**, **C**, **D**), bounded by unconformities, some of which being syntectonic unconformities, and correlative conformities.

Each sequence marks the main evolutionary stages of the basin filling. The sedimentological features of the first two marine sequences, sequence (or stage) **A**, deposited during the middle Pliocene, and sequence (or stage) **B**, developed during the late Pliocene-early Pleistocene, suggest that during these stages the basin can be recognized as an "open piggyback". On the contrary, sequence **C**, early-middle Pleistocene in age, shows different sedimentological features, its development having been controlled by the growth of a ramp fold (Alianello anticline). This structure split the basin into two parts. In the outer part, which maintained a connection with the Bradanic Trough, the basin conserved characteristics of an "open piggyback" and marine conditions lasted until the middle Pleistocene; on the contrary, the inner part was separated from the sea and assumed the characteristics of a "closed piggyback basin", where exclusively continental sediments were deposited.

Finally, the fourth sequence **D**, continental in origin and middle Pleistocene in age, represents the last evolutionary stage of the basin and was brought about by the emergence of an outer thrust which caused the physical isolation of the basin from the rest of the foredeep, in which sedimentation continued for the entire Pleistocene. In this last stage the entire Sant'Arcangelo Basin can be defined as a "closed piggyback".

References

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