The direction of Tertiary plate movement in the Eastern Carpathians: comparison of field data with sand-box models

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North-striking nappes of the Eastern Carpathian fold-thrust belt have traditionally been interpreted as recording E–W Tertiary convergence. This was difficult to be reconciled with contemporaneous S-ward movement components in the Southern Carpathian foreland.

A detailed study of the structural evolution of the orogenic arc in the southern Eastern Carpathians reveals the following features: (a) curvature of nappes by 80; (b) contraction axes derived from fault-slip data exhibt fanning, their spread is systematically smaller than the curvature of the arc; (c) contraction axes trending 130 are normal to local structural trend; (d) orogen-parallel extension is low (%); (e) the cross-sectional width of the lateral part of the Tertiary fold-thrust belt (Southern Carpathians) is 0.8 of that of the frontal part (Eastern Carpathians).

Sand-box models were carried out to simulate the formation of arcuate accretionary wedges at plate corners linking two differently oriented plate margin segments which both have convergent and/or strike-slip movement components. The main variable in these experiments was the indentation angle, i.e. the angle between the movement direction and the normal to the frontal face of the indenter. All experiments produced fanning contraction axes and curved nappes. However, the relation between contraction axes and local structural trend, the position in which contraction axes are normal to structural trend, the amount of orogen-parallel extension, and the ratio between lateral and frontal wedge widths emerged to be critically dependent on the indentation angle. Comparison of the field data with experimental results yields thus a local plate movement direction for the Eastern Carpathian arc which deviates by 30 to 35 from the normal to strike of the straight Eastern Carpathians (i.e. 120 to 125 in present coordinates).

This plate movement direction is in accordance with the model of a Tertiary clockwise rotation of the Tisia–Dacia block around a rotation pole in western Moesia. In contrast to translational plate movements, a rotation around a pole which is close to the moving plate leads to local movement vectors which are not parallel. In the case of the Tisia-Dacia block, the postulated rotation provides an explanation for the following contemporaneous local movement directions: E to ESE (almost pure convergence) in the Eastern Carpathians, ESE to SE in the Eastern Carpathian arc, and E to ESE (right-lateral strike-slip or transpression) in the Southern Carpathians.