

Geometry and kinematics evolution of southern part of the Kartli foreland basin

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Our study area is a cross-section of the southern part of the Kartli foreland basin (Fig.1). Kartli foreland is located between Achara-Trialeti and Greater Caucasus thrust and fold belts and it developed during late Alpine time, probably late Miocene-Pliocene. North and central parts of Kartli foreland basin are deformed by the Greater Caucasus south-vergent thrust structures. Southern part of Kartli foreland basin is represented by Tertiary strata that have been deformed and uplifted by passive back thrusting at the triangle zone (structural boundary between Achara-Trialeti thrust and fold belt and Kartli foreland basin).

Deformation of these structures is related to north-vergent

duplexes. The duplex sequence consists of Oligocene-lower Miocene strata [1;2;3].

In this paper, we present a balanced cross-section and kinematics models of fault-bend duplex formation.

Balanced cross-section (A-B) has been constrained from interpretation of

seismic reflection profile (018707) (Fig.3). Figure 1 shows the location of the balanced cross-section (A-B) in the thrust front monocline. The technique of balancing cross-section through thrust and fold belts provides geometrical criteria, which define both the initial state and the final geometry of these structures at depth [4;8;9;13]. Construction of balanced cross-sections requires some additional assumptions that are all met in the study area:

- (1) The cross-section is parallel to the tectonic direction;
- (2) The (A-B) profile follows the main transport direction assumed in this area. Accordingly, we interpret the duplexes as thrust-related folds. Folds in the imbricate fan are of kilometeric size and generally show a northward vergence. The volume of rocks is



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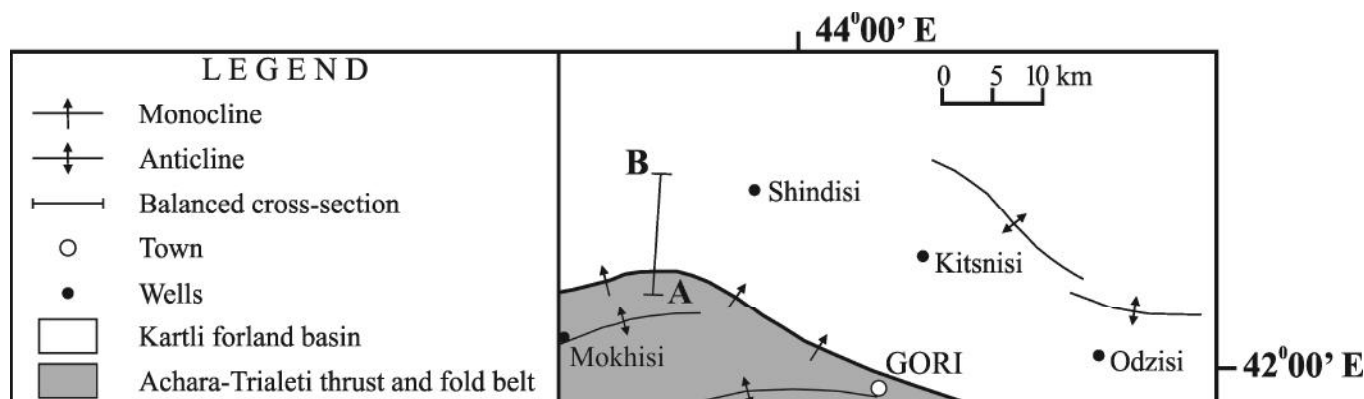


Fig. 1. Schematic tectonic map

preserved and there is no evidence of penetrative deformation;

The final geometry results a single tectonic event without changes in the tectonic transport direction.

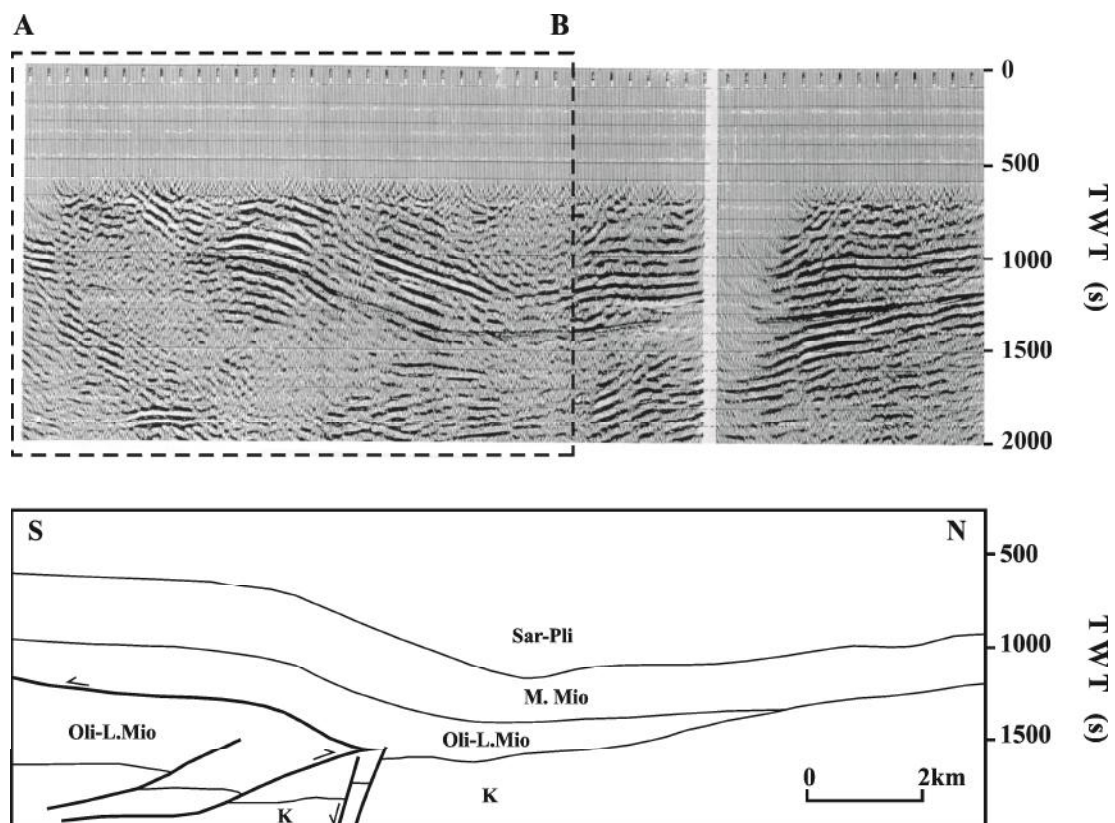


Fig. 2. Seismic reflection profile (018707) and geological cross-section [3]

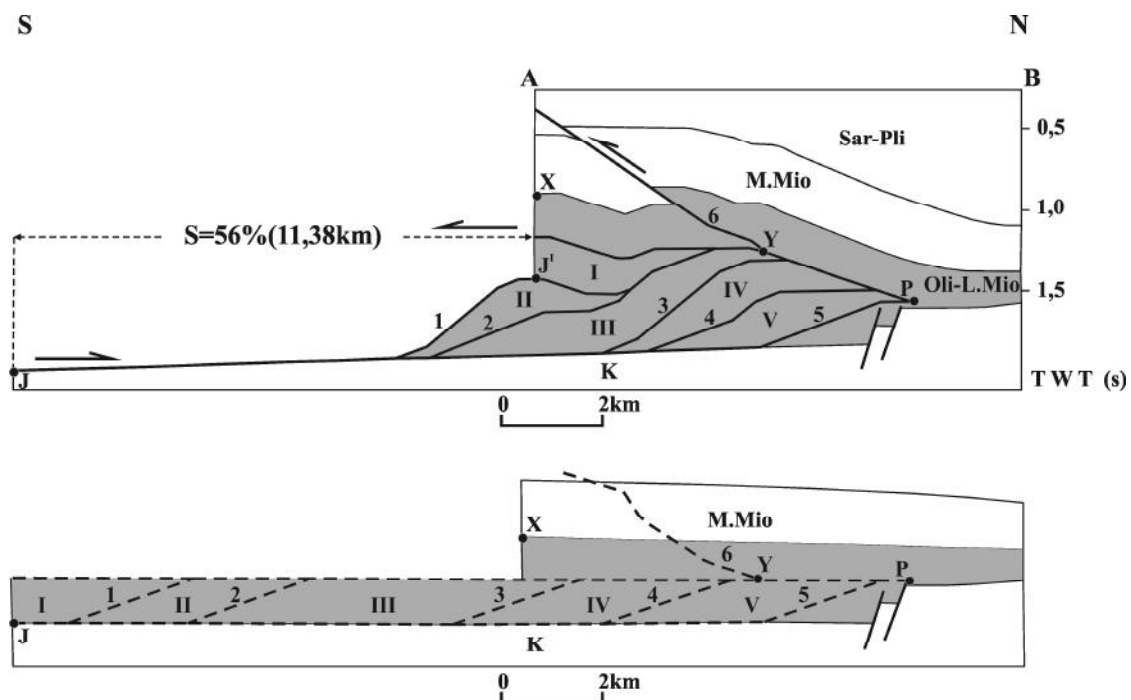


Fig. 3. Balanced and reconstructed cross-sections

I-V — Duplex sequence; 1-6 — Thrust sequence (5 and 6 thrusts are synchronous).
P — Deformation front.

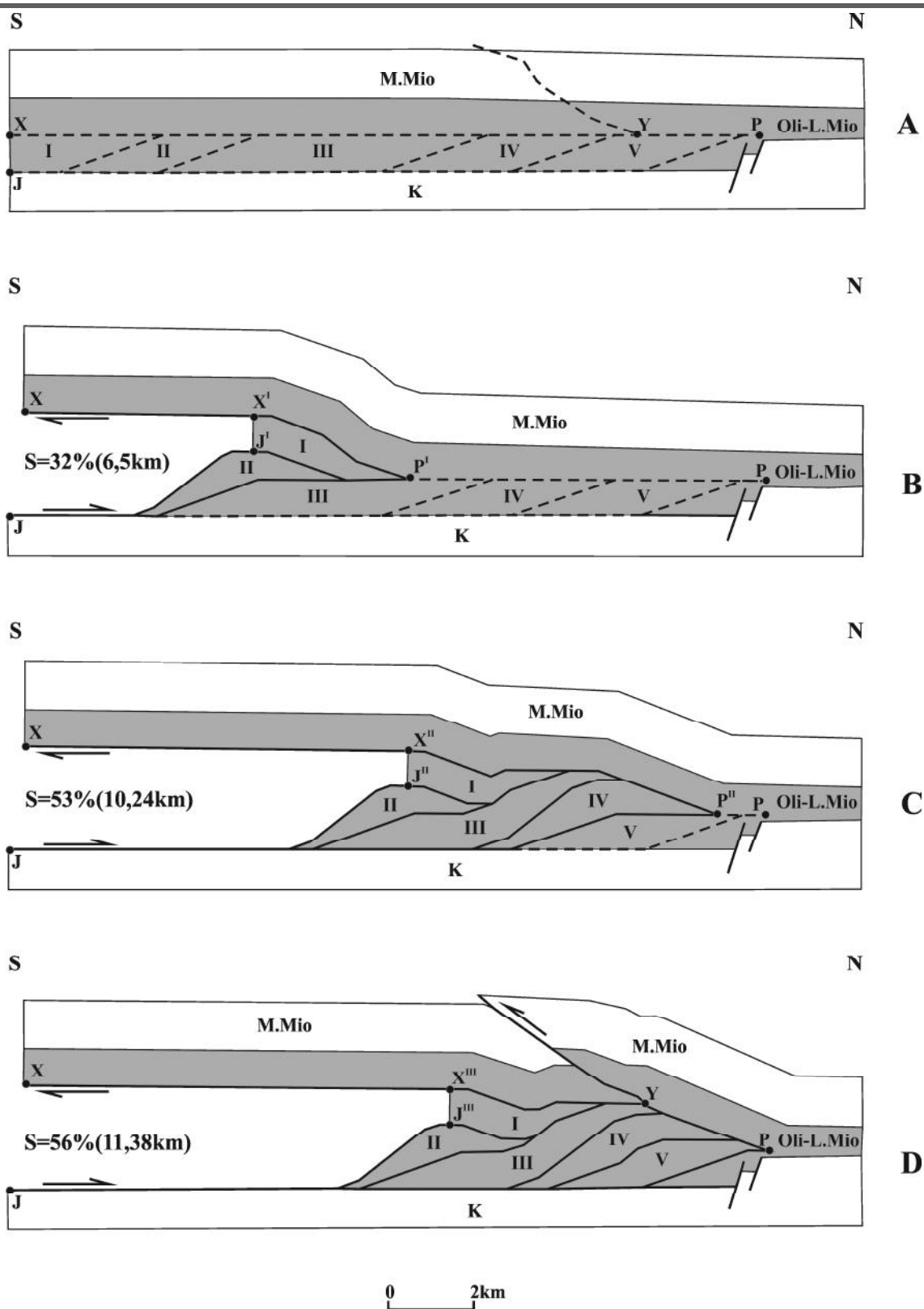


Fig. 4. Forward kinematics model

I-V — Duplex sequence; S — Shortening ;
 $P'-P''-P$ — Deformation front.

Seismic reflection data (Fig.2) in the southern part of Kartli foreland basin, near Mokhisi reveal the presence of small passive-roof duplexes in Oligocene-Lower Miocene rocks. Our

interpretation of the seismic data (Fig.3) reveals five constructional duplexes: I, II, III, IV and V. The tops and bottoms of the duplexes are defined by back thrust and sole thrust, which are folio wed by bedding planes within Oligocene–Lower Miocene. The obvious structures above the back thrust are anticline which, we are going to show are the result of passive uplift of the cover over the thickened duplexes beneath. The seismic data have been studied previously by Banks et al. [3]. The amount of shortening obtained for this part of the balanced cross-section is 56% (–11,38 km) (Fig.3).

Section balancing of the seismic reflection profile, together with the forward kinematics modeling, was used to develop a tectonic model for the evolution of the southern part of Kartli foreland basin. Kinematics models predicting the geometric evolution of the fault-related folds [12] closely simulate the geometry of natural structures and provide the basis for geometric reconstructions of fold-thrust structures [7]. Forward geometric modeling permits testing of cross-section viability by attempting to pass from the undeformed state to the deformed state [5;6;11]. The section balancing and sequential reconstructions have validated that the cross-sections are geometrically and kinematically admissible. Forward kinematics modeling shows (Fig.4) that duplexes (I–V) are of foreland direction (from S to N) and are overlain by a passive back thrusting (from N to S). After formation of the (I–V) duplexes, the formation of (V) duplex is related to formation of out-of-sequence to back thrusting (Fig. 4C).

Duplexes and imbricate thrust systems commonly form important structural hydrocarbon traps [10]. The geometry of these systems at depth is commonly uncertain because of poor seismic data. The structural details along the balanced cross-section provide new data on the geometry and evolution of a compressive duplexes. Our structural analysis and geometrically and kinematically viable tectonic model for the evolution of the duplex structures in the southern part of the Kartli foreland basin have important implications for the mechanism of the passive back thrusting.

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