VARIOUS SCENARIOS OF ALCAPA BLOCK INDENTATION IN THE CARPATHIAN REALM (POLISH WESTERN OUTER CARPATHIANS).

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SUMMARY

The goal of the study was to reconstruct the most possible scenario of the geodynamic evolution of the northern part of the Carpathian accretionary wedge. The indentation of the ALCAPA block seems to play the main role in the formation of this part of the wedge. Present study is focused on the various types of the indenter movement. I tested the indenter movement (in the present day geographic coordinates): 1) to north; 2) to northeast; 3) first to north and next to northeast; 4) to northeast with simultaneous counterclockwise rotation of the indenter. Last two models are most closely resembling the Western Outer Carpathian arch. These experiments produced structures similar to the map-scale structures observed in the Polish segment of the Western Outer Carpathians. They also explained the superposition of the two heteroaxial shortening events identified in the Polish Western Outer Carpathians. However, only the last model explained the counterclockwise rotation of the rocks detected by palaeomagnetic investigations in the entire Polish Carpathians and in the Carpathian Foredeep.

INTRODUCTION

Scaled analogue experiments have been used to investigate the Palaeogene and Neogene evolution of the Western Outer Carpathians (Fig. 1). The arcuate Outer Carpathian belt represents the external pile of nappes of the Pannonian-Carpathian-Dinaric system (PANCARDI). The Intra-Carpathian region is composed of two major blocks: a) ALCAPA – the Eastern Alpine-Western Carpathian-Northern Pannonian, and b) TISZA-DACIA – the Southern Pannonian-Eastern Carpathian one (Fodor et al., 1999). The Polish Western Outer Carpathians, which compose the northernmost part of the Outer Carpathians, is a north-verging fold-and-thrust belt. The main structure of this belt was formed during the Palaeogene and Neogene, when the Outer Carpathians was an accretionary wedge. The belt is mainly composed of Lower Cretaceous to Lower Miocene flysch strata and comprises several nappes (Książkiewicz, 1977). Two of these nappes, the Magura and Silesian nappes, extend along the entire belt. The other nappes are exposed mostly in the eastern part of the Polish Western Outer Carpathians.

Mesostructural investigations of the rocks of the Polish Western Outer Carpathians suggest that these rocks were deformed during two shortening events (Aleksandrowski, 1989; Decker et al., 1997). The horizontal regional compression was oriented NNW-SSE during the first event and NE-SW during second. Folding and thrusting of the first event were of synsedimentary character. During the next, NE- directed event, the NNE- striking thrust faults and related folds were overprinted and refolded. A question, how structures of these two events were generated, remains still a matter of discussion. There are two possibilities. All these structures were formed during the clockwise rotation of the regional stress field or during the counterclockwise rotation of the rocks in the stable regional stress field. The results of the palaeomagnetic investigation in the Western Outer Carpathians suggest the second possibility (Márton and Tokarski, 2000).

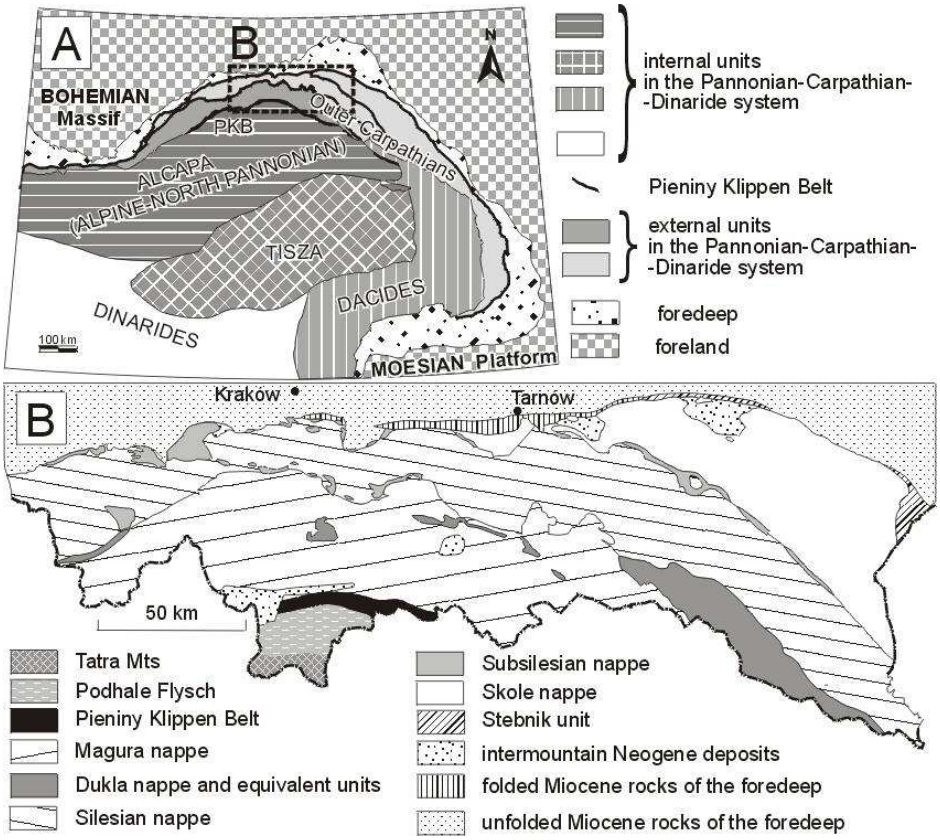

Figure 1 - Map of the Pannonian-Carpathian-Dinaride system (A) and Polish part of the Outer Carpathians (B).

EXPERIMENTAL SET-UP

The goal of the study was to reconstruct the most possible scenario of the geodynamic evolution of the northern part of the Carpathian accretionary wedge. The indentation of the ALCAPA block seems to play the main role in the formation of this part of the wedge. Therefore the method of the analogue modelling was used in this study. All experiments were made in the TectoModel Lab Wroclaw, in the Institute of Geological Sciences Polish Academy of Sciences. The physical models were built using sand as analogue material to represent the brittle upper crust. The modelling was carried out using the layers about the different colour. The indenter had the semi-triangular shape simulating the northern shape of the ALCAPA block. The different ways of the movement of the ALCAPA indenter were tested basing on the literature: 1) to the north (Mastella and Konon, 2002); 2) to northeast (Nemčok et al., 1998); 3) first to the north, and next to northeast (Aleksandrowski, 1989); 4) to northeast with simultaneous counterclockwise rotation of the indenter (Fodor et al., 1999). All those directions are delivered in the present-day geographic coordinates. The aim of the experiments was to find the procedure for the indentation modelling, which would produce structures similar to the map-scale structures of the Western Outer Carpathians.

The material used for the modelling was quartz sand from Mine of Quartz Sand at Osiecznica (Poland). The grains size of sands was 0.063-0.15 mm. The sand contains about 0.05 % of Fe_2O_3, 0.08 % of TiO_2, 0.80 % of Al_2O_3, the rest (98 %) being SiO_2. The mechanical properties of the sand were measured with shear box at University of Warsaw, Faculty of Geology, Institute of Hydrogeology and Engineering Geology. The density of sand was 1.55 g/cm3. The cohesion of the sand was 23 kPa and the internal friction of the sand was 28º.

EXPERIMENTAL RESULTS AND CONCLUSIONS

The results of modelling have shown that it is possible to produce structures similar to the map-scale structures observed in the Polish segment of the Western Outer Carpathians. In the all experiments the semi-triangular indenter were used. Such indenter produced the shape of model with the appropriate curve. However, the different type of the indentation caused the different internal structure of the models.

Two last experiments produce the models, which have main features of the structure similar to the structure of the Western Outer Carpathians. In first model of them the indentation was first to north and next to northeast. In the second model indentation was to northeast with simultaneous counterclockwise rotation of the indenter. Almost all models had asymmetrical shape, which was narrower in western part. However only during the last scenario, when the indenter was counterclockwise rotated and simultaneously moved in the NE direction the rotation of the experimental material is marked clearly.

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