Salt tectonics in the Inner Western Carpathians (Silica Nappe, Aggtelek Hills): investigating the role of inherited Triassic salt structures during the Alpine deformation

Éva Oravecz, Gábor Héja, and László Fodor

Eötvös Loránd University of Sciences, Department of Applied and Physical Geology, Hungary (orav.eva@gmail.com)

MTA-ELTE Geological, Geophysical and Space Sciences Research Group, Hungary

The Permian to Lowermost Triassic Perkupa Evaporite forms the base of the enigmatic Silica Nappe (uppermost tectonic unit of the Aggtelek Hills, Inner Western Carpathians) and played the role of the main detachment level during the Cretaceous nappe stacking. Regionally, the Silica Nappe is one of the most enigmatic tectonic units of the Alpine-Carpathian area as up until now, it had many unanswered structural problems, like do the three or four different folding directions necessarily suggest multiple folding phases, how to solve the problem of extreme thickness changes in pre-orogenic sediments or why are young-on-older contacts so frequent in the area. Furthermore, several previous studies suggested that there may be salt diapirs rooting in this evaporitic detachment level but their role in the evolution of the Silica Nappe has not been studied in details.

In this study new approaches were applied in order to explain the abovementioned questions and to understand the deformation of the problematic Aggtelek Mts. Detailed geological mapping and structural analysis resulted in the recognition of extensive salt tectonics in the Inner Western Carpathians. Field results showed that not only simple salt diapirs but also map-scale salt walls were present in the southernmost part of the Silica Nappe. The observed onlap surfaces on the salt flaps and the extreme thickness changes within the Lower Triassic formations suggested that these salt structures originally formed syn-sedimentary with the respect to the Early Triassic sedimentation. Starting probably from the latest Early Triassic, sedimentation occurred in minibasins, the evolution of which was controlled by the continuously growing salt structures. Salt movements were coupled with doming and drag folding along the salt structures that resulted in slumping and syn-sedimentary normal faulting in the sedimentary cover.

These pre-existing salt structures and normal faults strongly influenced the geometry and kinematics of the subsequent Cretaceous deformation: the majority of shortening was localized at the salt walls and diapirs while the minibasins were left mostly unaffected. When the salt walls were squeezed, secondary salt welds formed that were now mapped as linear rauhwacke zones. Due to further shortening, the welds were reactivated as oblique thrust welds and the minibasin borders evolved into young-on-older thrust contacts. After peeling the effects of evaporite deformation off the Cretaceous shortening, the main tectonic transport direction was estimated to
be towards S-SE.

Consequently, the structural evolution of the Silica Nappe is much more complex than previously thought but many long-standing problems could be explained by considering structural inheritance and bringing pre-orogenic salt tectonics into the interpretation. Nevertheless, the Aggtelek Mts. turned out to be a good area to further study the effects of inherited salt structures on the evolution of fold-and-thrust belts and to draw conclusions on how to separate salt-related folding from regular shortening related structures in poor outcrop conditions.

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