Salt Tectonics in Compressional Settings: Comparison of the S Pyrenees and the N Carpathians

Piotr KRZYWIEC1 and Jaume VERGÉS2

1 Polish Geological Institute, ul. Rakowiecka 4, 00-975 Warsaw, Poland
2 Institute of Earth Sciences “Jaume Almera”, CSIC, Lluís Solé i Sabarís s/n, Barcelona 08028, Spain

Evaporites in general, and rock salt in particular, are of key importance for evolution of fold-and-thrust belts, as evaporitic layers often form preferred levels of detachments within the orogenic wedge. The combined effects of the foredeep basin morphology during deposition of evaporites and distribution of the surrounding non-evaporitic depositional systems influence the position, extent and thickness of the foredeep evaporitic successions. The continuous forward propagation of the thrust front often result in forward and upward migration of the evaporitic units.

The Carpathians and the Pyrenees belong to the Alpine–Himalayan orogenic belt formed by the closure of the Tethys Ocean. At present, the frontal part of the S Pyrenees is well exposed, whereas front of the Polish Carpathians is mostly buried, especially in their central segment described below. In both the S Pyrenees and N Carpathians, the foredeep evaporitic layers constitute the principal detachment levels for the late development of both fold-and-thrust nappes. Previously published cross-sections of the Wieliczka salt mine (Tołwiński 1956) suggest that also in this area triangle zone might have developed, and that the entire salt mine might be located within the core of this zone. Formation of the Wieliczka triangle zone and associated backthrust might have been controlled by lateral facies changes of the evaporitic unit – transition from thick salt-dominated domain to thin anhydrite-dominated domain. Additional control on both evaporitic facies distribution as well as tectonic style and location of backthrusting could have been exerted by morphology of the pre-evaporitic basement.

Acknowledgements

Comparative study of the Carpathian and the Pyrenean orogenic fronts is supported by the Polish (the Ministry of Science, project No 6.12.0002.00.0), and the Spanish funds for the bi-lateral scientific co-operation.

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Role of Basement Tectonics in Evolution of Salt Diapirs: the Mid-Polish trough Versus the Dead Sea Basin

Piotr KRZYWIEC¹ and Rami WEINBERGER²

¹ Polish Geological Institute, ul. Rakowiecka 4, 00-975 Warsaw, Poland
² Geological Survey of Israel, 30 Malkhi Israel st., Jerusalem 95501, Israel

During the extensional basin subsidence, salt layers underlying a thick sedimentary overburden can start to flow, giving rise to the development of a variety of halokinetinc structures, such as salt diapirs, salt pillows and salt walls. Salt flow can be triggered by extensional faulting of the sub-salt “basement” (Koyi et al. 1993), as well as by thin-skinned extension of the post-salt sedimentary cover (Vendeville and Jackson 1992a,b). In intracontinental settings salt structures are particularly often related to sub-salt fault zones as in such basins localised extension and subsidence is associated with significant faulting within the pre-salt basement.

The Mid-Polish Trough (MPT) formed the axis of the Polish Basin which belonged to the Permian-Mesozoic system of West- and Central-European epicontinental basins (Ziegler 1990). During the Permian, the MPT formed the easternmost part of the Southern Permian Basin. Prior to its Late Cretaceous – Paleocene inversion, the MPT was filled with several kilometres of Permian and Mesozoic sediments, including thick Zechstein salts. The presence of these Zechstein salts gave rise to the development of a complex system of salt structures in the central and northwest segments of the MPT.

Recently completed regional analysis of seismic reflection data from the entire territory of the Mid-Polish Trough allowed to formulate some rules concerning relative roles of the basement, cover and salt tectonics. Using results of interpretation of seismic data from the entire territory of the Mid-Polish Trough allowed to formulate some rules concerning relative roles of the basement, cover and salt tectonics. Within the Dead Sea basin, the presence of thick Pliocene salt and active Quaternary normal faulting resulted in the development of numerous unconformities in its vicinity that document consecutive stages of its development. During inversion within peripheral parts of the Mid-Polish Trough salt pillows were formed entirely related to the Mid-Polish Trough inversion and related lateral salt flow. Growth of such salt structures is documented by local thickness variations of the Upper Cretaceous deposits. Analysis of seismic data provided also information on Cenozoic reactivation of selected salt structures. Within the Drawno – Czópola salt structure system extensional reactivation of their topmost parts is observed. Similar activity connected with significant localised subsidence and deposition of brown coal seams has been described above the Damasławek salt diapir (Krzywiec et al. 2000).

A similar interaction between basement faulting, a thick salt layer and its supra-salt sedimentary cover was documented in many other basins, with good example provided by the Dead Sea Basin. This basin is a continental depression located within the rift valley that accompanies the Dead Sea Transform (DST). It is widely agreed that the basin is a rhomb-shaped pull-apart graben that was formed due to the left-lateral displacement along the segmented DST. The basin is bounded on the east and west by a series of oblique-normal (basinwards) faults, which suggest that the basin underwent active transtensional rifting.

Within the Dead Sea basin, the presence of thick Pliocene salt and active Quaternary normal faulting resulted in the development of numerous salt structures (e.g. Sedom and Lisan diapirs) and in different degrees of decoupling between the thick-skinned basement tectonics and the thin-skinned cover tectonics (cf. Al-Zoubi and Ten Brink 2001, Al-Zoubi et al. 2001, Larsen et al. 2002). The location of the Sedom salt diapir was dictated by the existence of oblique-normal faults in the margins of the basin. Presently, salt entirely pierced its overburden and extruded on the surface where it presently forms Mount Sedom with surface expression up to 200 m (Weinberger et al. 1997, Weinberger et al. 2006a). The present uplift rate of Mount Sedom,