

**AAPG International Conference
Barcelona, Spain
September 21-24, 2003**

Jan Golonka¹, Nestor Oszczytko¹, Halina Jedrzejowska-Tyczkowska², Piotr Misiarz², Jacek Matyszkiewicz³, Barbara Olszewska⁴ (1) Jagiellonian University, Krakow, Poland (2) Polish Oil and Gas Institute, Krakow, Poland (3) University of Mining and Metallurgy, Krakow, Poland (4) Polish Geological Institute, Krakow, Poland

Jurassic Plate Tectonics and Paleogeography of the Tethyan and Peri-Tethyan Realm in Poland and adjacent areas

Tethyan Realm

The Jurassic history of the Pieniny/Outer Carpathian basins reflects the evolution of the Circum-Tethyan area, especially its Alpine Tethys part. Continued sea-floor spreading occurred during the Jurassic time within the Neotethys. The Ligurian Ocean, as well as the central Atlantic and Penninic Ocean were opening during Early - Middle Jurassic (Fig1). The oldest oceanic crust in the Ligurian-Piedmont Ocean is dated as late Middle Jurassic in Southern Apennines and in the Western Alps. Pieniny data fit with the supposed opening of the Ligurian and Penninic Ocean basins (Golonka et al., 2000). Stampfli (2001) recently postulates single Penninic Ocean separating Apulia and Eastern Alps blocks from Eurasia. We propose similar model for the Pieniny Klippen Belt Ocean in the Carpathians. The orientation of this ocean was SW-NE (see discussion in Golonka & Krobicki, 2001). The Pieniny Ocean was divided into the northwestern and southeastern basins by the Czorsztyn Ridge (Fig2). The deepest parts of both basins are documented by deep water, extremely condensed, Jurassic-Early Cretaceous pelagic limestones and radiolarites. The shallowest ridge sequences are known as the Czorsztyn Succession. In this succession the Early Jurassic Bositra ("Posidonia") marls are followed by Middle - Jurassic-earliest Cretaceous crinoidal and nodular limestones and the Late Cretaceous pelagic marl facies. The transitional slope sequences between deepest basinal units and ridge units consist of mixed cherty, limestone and marly facies. This Jurassic Ocean was connected with older, Triassic embayment of Vardar-Transilvanian Ocean.

Major plate reorganization happened at the end of Jurassic. The Central Atlantic began to propagate to the area between Iberia and the Newfoundland shelf. The Meliata-Halstatt was closed and subduction jumped to the northern margin of the Inner Carpathian terranes and began to consume the Pieniny Klippen Belt Ocean (Birkenmajer, 1986). The Outer Carpathian rift had developed with the beginning of calcareous flysch sedimentation. The Western Carpathian Silesian Basin probably extended in the Eastern Carpathian (Sinaia or "black flysch") as well as to the Southern Carpathian Severin zone (Sandulescu, 1988). The Silesian Ridge separated the Silesian and Magura basins. The subsidence and spreading in the Silesian Basin was accompanied by the extrusion of basic lavas (teschenites) in the Western Carpathians during Hauterivian-Barremian and diabase-melaphyre within the "black flysch" of the Eastern Carpathians (Golonka et al., 2000; Lucinska-Anczkiewicz et al., 2000). The extension of the Silesian-Sinaia basin is mark by the beginning of the sedimentation in the Skole-Tarcau area.

The Jurassic separation of Bucovino-Getic microplate from European plate is perhaps related to the origin of the Silesian Ridge. The direct connection is obscured however by the remnants of the Transilvanian Ocean in the area of the eastern end of Pieniny Klippen Belt Basin. These remnants are known from the Inacovce-Krichevo unit in Eastern Slovakia - and Ukraine (Soták et al., 2000). In this area existed a junction of the different basinal units - PKB-Magura-Ocean, Transilvanian Ocean and Outer Carpathian Basin. The eastward-northeastward subduction along the Silesian Ridge and Bucovinian-Getic Terrane was perpendicular or oblique to the southward subduction at the northern margin of the Inner-Carpathian-Eastern Alps terrane. The Silesian - Sinaia basin developed as a back-arc basin. The eastward subduction of Getic-terrane is connected with the northward subduction under Rhodopes-Moesia plate mentioned above. The displacement within Transilvanian Ocean which is began in Barremian is perhaps also related to this subduction.

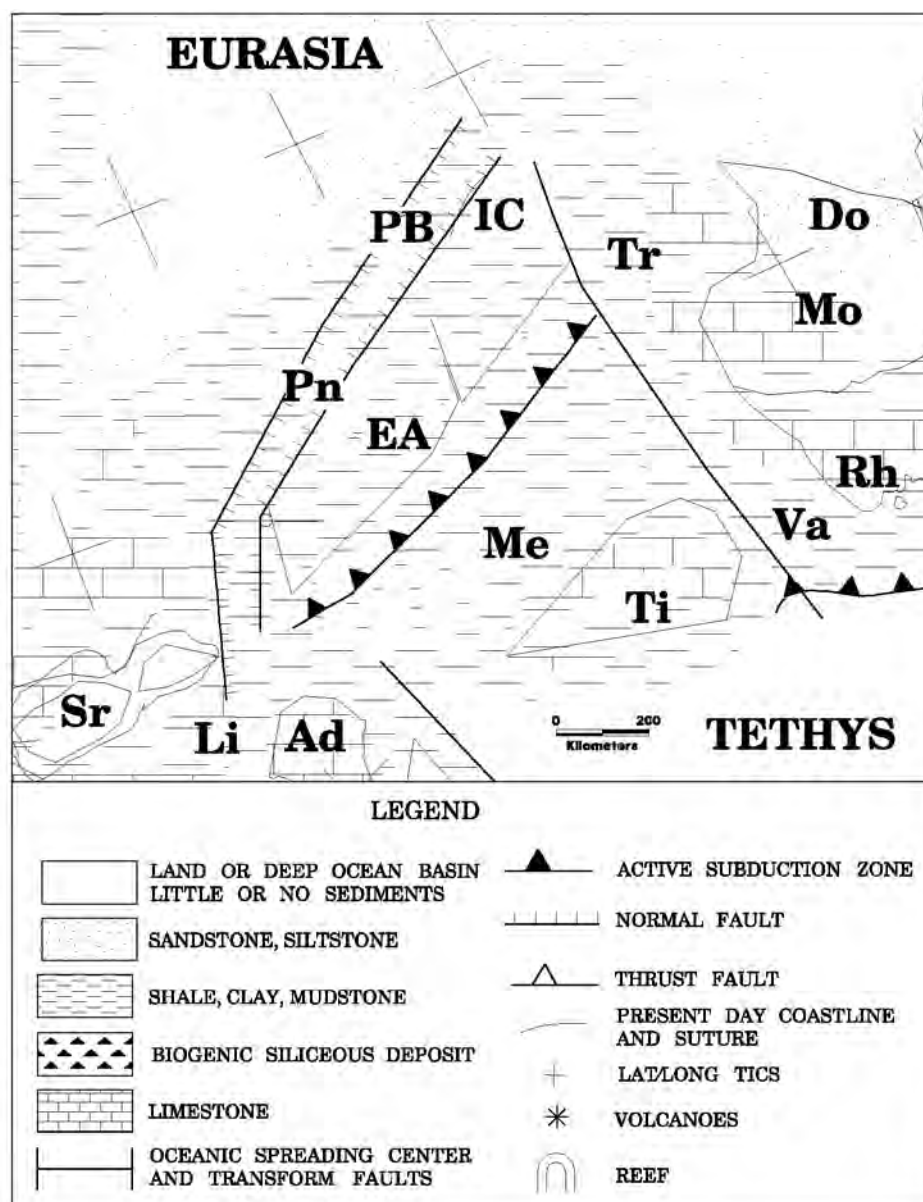


Fig. 1. Palaeogeography of the circum-Carpathian area during Early Jurassic; plates position at 195 Ma. Abbreviations of oceans and plates names: Ad - Adria (Apulia), Do - Dobrogea, EA - Eastern Alps, IC - Inner Carpathians, Li- Ligurian rift (site of future Ligurian Ocean), Me - Meliata/Halstatt Ocean, Mo - Moesia plate, PB - Pieniny Klippen Belt rift (site of future Pieniny Klippen Belt /Magura Basin), Pn - Penninic rift (site of future Penninic Ocean), Rh - Rhodopes, Sr - Sardinia, Ti - Tisa plate, Va - Vardar Ocean.

The Peri-Tethyan Realm

The remnants of carbonate platforms with reefs (Štramberk) along the margin of Silesian Basin were results of the fragmentation of the Peri-Tethyan European platform in this area. This platform in southern Poland and Ukraine was covered by marine Jurassic-Cretaceous carbonate series exceeding 1000 m in thickness, partially overlain by Tertiary molasse series or by the Carpathian thrust units. The lithology of the Upper Jurassic and lower Cretaceous deposits

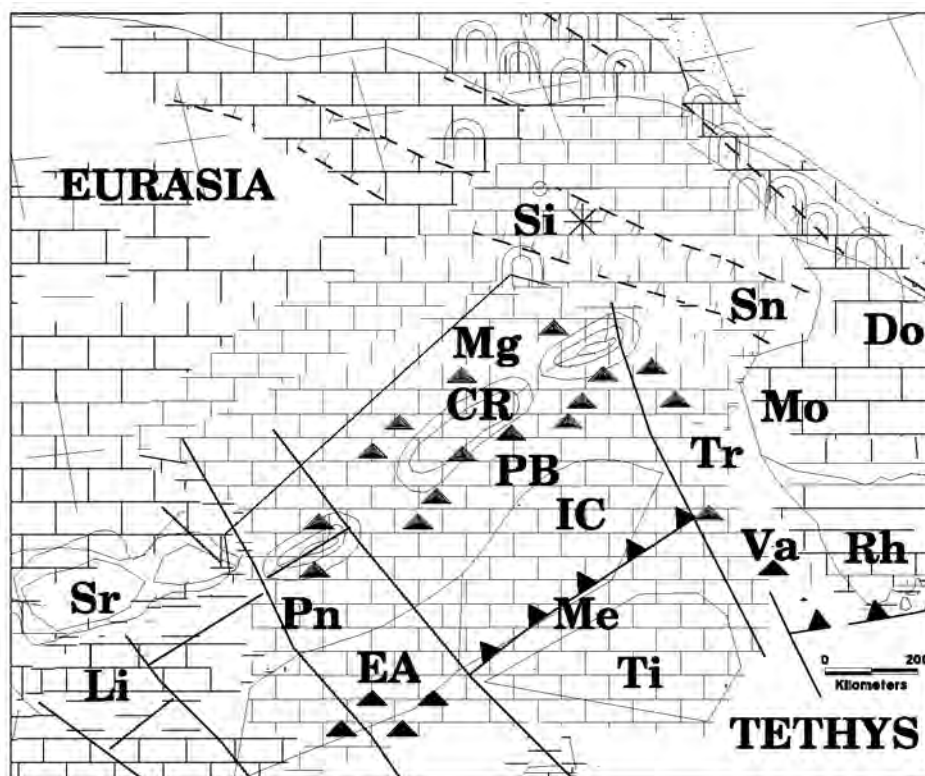


Fig. 2. Palaeogeography of the circum-Carpathian area during Late Jurassic; plates position at 152 Ma. Abbreviations of oceans and plates names: Ad - Adria (Apulia), CR - Czorsztyn Ridge, Do - Dobrogea, EA - Eastern Alps, IC - Inner Carpathians, Li - Ligurian Ocean, Me - Meliata/Halstatt Ocean, Mg - Magura Subbasin, Mo - Moesia plate, PB - Pieniny Klippen Belt Subbasin, Pn - Penninic Ocean, Rh - Rhodopes, Si - Silesian Basin, Sn - Sinaia Basin, Sr - Sardinia, Ti - Tisa plate, Tr - Transilvanian Ocean, Va - Vardar Ocean. For explanation of lithological symbols - see Fig. 1.

reflects the main stages of sedimentation on the European platform caused by eustatic changes of sea-level as well as local tectonics. Two megasequences could be distinguished here, (Golonka and Kiesling, 2002). Lower Zuni II, began with the Middle Jurassic transgression and ended with Early Tithonian regression. Lower Zuni III lasted from Early Tithonian to the general Early Valanginian regression. There is a gap between Lower and Upper Cretaceous deposits in the whole Carpathian Foredeep area. The Lower Zuni II starts with sandstone-gaize series passing upward to the Callovian nodular limestones covered by Lower Oxfordian calcareous sponge (Morycowa and Moryc, 1976, Golonka, 1978, Olszewska, 2001). The carbonate buildups of thickness from few dozens to few hundreds meters are common within the calcareous sponge series. They form hills in the Polish Jura Chain between Kraków and Częstochowa (Matyszkiewicz, 1997) and have been recognized in the numerous 2-D and 3-D seismic subcrop sections. The Upper Oxfordian calcareous-marly Niwki series) are followed by Kimmeridgian algal-oolitic Sobków series. The barrier reefs and associated fore-reef and back-reef facies occur within Sobków series. They trend NW-SE and reach 30-50 m of thickness. The reefs were built mainly by the algae. The dolomitic-calcareous Tithonian Ropczyce series and Berriasian upper algal series Debica Series belong to the Lower Zuni III megasequence.

During the earliest Late Jurassic deeper neritic deposits prevailed. These gave way to upward shoaling conditions (calcareous sponge series, a deeper basin (calcareous-marly series), and a final shallow water environment (algal-oolitic series and younger Cretaceous series) (Zdanowski et al., 2001). The Tithonian and Lower Cretaceous deposits are absent in the western part of the basin in the Polish Jura Chain (Matyszkiewicz, 1997). The basinal facies prevailed in the central part of the foredeep comparing with the Oxfordian shallower water sediments of the Krakow region. This research has been partially supported financially by the Polish Committee for Scientific Research (KBN) - grant 5 T12B 013 23.

- Birkenmajer, K., 1986. Stages of structural evolution of the Pieniny Klippen Belt, Carpathians. *Studia Geol. Pol.*, 88: 7-32.
- Golonka, J. (1978) Mikrofacje górnej jury przedgórz Karpát; Upper Jurassic Microfacies in the Carpathians Foreland. *Biul. Inst. Geol.*, 310: 1-37. In Polish, English summary.
- Golonka J. and Kiessling, W., (2002) Phanerozoic time scale and definition of time slices, In: Phanerozoic reef patterns. (Eds. W. Kiessling, E. Flügel, E. and J. Golonka SEPM Spec.Publ., 72: 11-20.
- Golonka, J. & Krobicki, M. 2001. Upwelling regime in the Carpathian Tethys: a Jurassic-Cretaceous palaeogeographic and paleoclimatic perspective. *Geological Quarterly*, 45: 15-32. Warszawa.
- Golonka, J., Oszczytko, N. & Slaczka, A. 2000. Late Carboniferous - Neogene geodynamic evolution and paleogeography of the circum-Carpathian region and adjacent areas. *Ann. Soc. Geol.Pol.*, 70: 107-136.
- Lucinska- Anczkiewicz A., Slaczka A., Villa J. & Anczkiewicz R., 2000:39AR/40 AR dating of the Teschenite association rocks from the Polish Outer Carpathians. *Mineralogical Society of Poland-Special Papers*, 17: 210-211.
- Matyszkiewicz, J. (1997) Microfacies, sedimentation and some aspects of diagenesis of Upper Jurassic sediments from the elevated part of the Northern peri-Tethyan Shelf: a comparative study on the Lothen area (Schwäbische Alb) and the Cracow area (Cracow-Wielun Upland, Polen). *Berliner Geow. Abh.*, 21: 1-111
- Morycowa, E. & Moryc, W. (1976) Rozwój utworów jurajskich na przedgórzu Karpát w rejonie Dąbrowa Tarnowska-Szczucin. *Rocznik Polskiego Towarzystwa Geologicznego*, 46:231-288. In Polish, English summary.
- Olszewska, B.W. (2001) Stratygrafia malmu i neokomu podłoża Karpát fliszowych i zapadliska w świetle nowych danych mikropaleontologicznych. *Przegl. Geol.* 49: 451. In Polish, English summary.
- Sandulescu, M., 1988. Cenozoic Tectonic History of the Carpathians, In: Royden, L. & Horváth, F., (eds.), *The Pannonian Basin: A study in basin evolution*. American Association of Petroleum Geologists Memoir, 45: 17-25.
- Soták, J. Biron, A., Prokešová, R. & Spišiak, J., 2000. Detachment control of core complex exhumation and back-arc extension in the East Slovakian Basin. *Slovak Geol. Mag.* 6: 130-132.
- Stampfli G. M.(Ed.) 2001. *Geology of the western Swiss alps - a guide book*. Mémoires de Géologie (Lausanne), 361: 1-195.
- Zdanowski, P., Baszkiewicz, A. and Gregosiewicz, Z. (2001) Analiza facjalna najwyższej jury i kredy dolnej rejonu Zagorzyc. *Przegl. Geol.* 49:161-178. In Polish, English summary.