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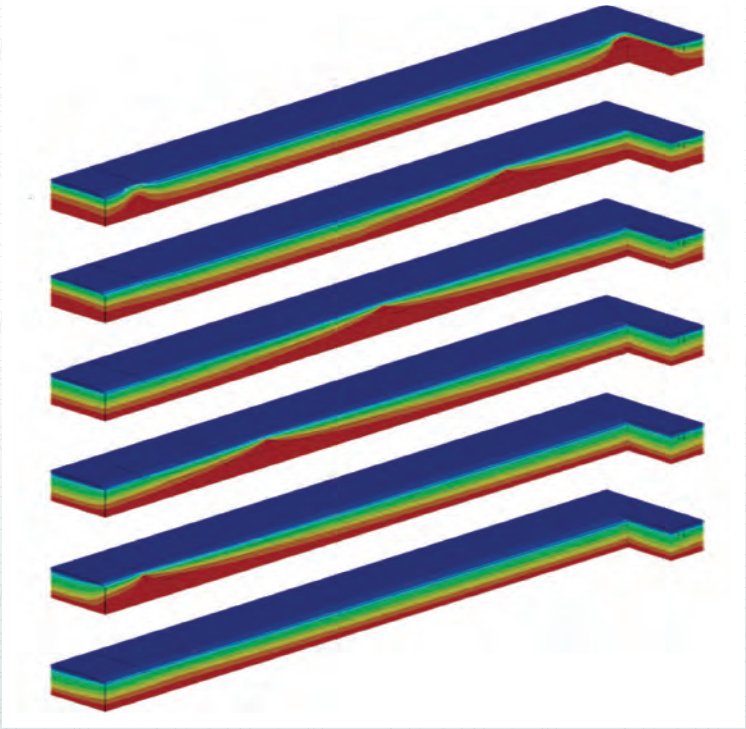
Project I 01341

Thermal History of Transform Margins



Dr. Michal Nemčok, Dr. Andreas Henk, Dr. Samuel Rybár, Dr. Lucia Ledvényiová, Dr. Júlia Kotulová, Mgr. Dominika Godová, Mgr. Jana Rigová, Dr. Tamás Csibri, Mgr. Matej Molčan, Dr. Štefánia Pramuková, , Mgr. Stanislaw Staniaszek, Mgr. Adam Baranowski, Bc. Tadeusz Gontar

I 01341

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Executive Summary

The main motivation for this study was to understand the thermal history of transform margins and spatial and temporal distribution of regions with a ductile lower crust. We completed another generation of thermal modeling, focused on how the thermal evolution of transform margins is controlled by deformation as ridge migration parallel to the margin causes a pronounced thermal perturbation. With respect to the structural architecture of transforms, described in detail in Chapters 1–3, one needs to understand that thermal history of transform margin sensu stricto is fundamentally different from that of both the associated and joining horse-tail structures. While the movements characterizing the transform sensu stricto are primarily parallel to the plate boundary, the movements characterizing the horse-tail structures in their normal fault-controlled portions are orthogonal to the ocean-continent boundary.

Sponsors

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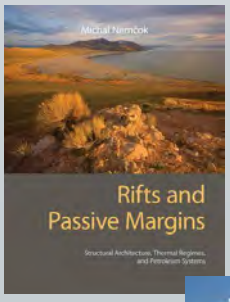
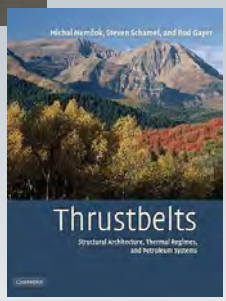
Research Interests

- Continental break-up processes and controlling factors
- Thrustbelt development and controlling factors
- Fracture development prediction





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Michal Nemčok, PhD

Research Professor

Michal holds a Ph.D. in Structural Geology from the Comenius University, Bratislava. He has 35 years of applied and basic research experience at the Slovak Geological Survey, University of South Carolina, University of Wales, Cardiff, Imperial College London, University of Salzburg, University of Wurzburg, and University of Utah. He joined EGI in 1998 and is a Research Professor and Structural Group leader. Michal has published 80+ articles, coauthored 5 monographs, and coedited five books.

Continental Break-up Processes & Controlling Factors

Continental break-up research focuses on both extensional and transform settings, with a focus on driving mechanisms and controlling factors to achieve predictive models with respect to structural architecture, thermal regimes, and petroleum systems. The main research contribution includes understanding anomalous thermal and uplift histories of transform margins, break-up mechanisms in extensional settings, and micro-continent-releasing mechanisms. A summary of his last eight years of break-up research is recorded in a monograph titled *"Rifts and Passive Margins; Structural Architecture, Thermal Regimes and Petroleum Systems"* published by Cambridge University Press, and authored by Nemčok, M. Together with co-authors, a new monograph called *Strike-slip Terrains and Transform Margins—Structural Architecture, Thermal Regimes & Petroleum Systems* is being written in contract with Cambridge University Press.

Thrustbelt Development & Controlling Factors

Michal's current research focuses on the thrustbelt-foreland interactions, with a concentration on driving mechanisms and controlling factors behind thick-skin tectonics, foreland plate flexure mechanisms, and flexural faulting in control of structural architecture and play concept elements. The main research contribution includes the factors and mechanisms leading to the lack of foreland flexing and transitions from initial inversion to full accretion. Accompanying research focuses on modeling of the fluid flow mechanisms occurring in the thrustbelt front and its foreland. A summary of thrustbelt research is written in a monograph called *"Thrustbelts; Structural Architecture, Thermal Regimes and Petroleum Systems",* published by Cambridge University Press, and authored by Nemčok, M., Schamel, S. and Gayer, R.. Current research findings are summarized in several articles included in the Geological Society of London Special Publication 377, which is edited by Nemčok, M., Mora, A., and Cosgrove, J.

Fracture Development Prediction

Fracture prediction research includes both detailed well core, rock outcrop and numerical simulation studies focused on predicting timing, location and kinematics of developing fractures. Most of the fracture studies come from thrustbelts, although some core-based studies come from various geothermal reservoirs. The main research contribution includes tools capable of predicting fracture locations, kinematics and propagation timing in two and three-dimensions for hydrocarbon reservoirs in thrustbelts, which were tested by well-based fracture data. Accompanying research includes understanding the role of mechanical stratigraphy on developing structural architecture. This research is published in a number of journals run by structural and geothermal communities.

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Research Interests

- Basin analysis with focus on depositional systems and tectonics
- Well-core and outcrop sedimentology
- Petroleum system assessment with special interest in source rocks
- Paleogeography of rifted and transform margins with implications for determining sediment entry points
- 40Ar/39Ar radio-isotopic dating.

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Samuel Rybar, PhD

Sedimentologist

Education & Experience

Samuel Rybar has been affiliated with EGI since 2015, working in EGI's Bratislava, Slovakia Lab, where his research focus is basin analysis with emphasis on applying standard methods of sedimentology, structural geology, tectonics, and organic geochemistry. Since 2016, Samuel has also served at the Faculty of Natural Sciences in the Department of Geology and Paleontology at Comenius University in Bratislava, Slovakia.

Samuel earned his Bachelor (2010) and Master (2012) in Geology and Paleontology and his Ph.D. in Sedimentology in 2016 from Comenius University. His Doctoral thesis title was Danube Basin Development During the Middle Miocene.

Samuel is fluent in English, Slovak, and German.

Regional & Basin Experience

- Onshore basins: Pannonian basin system, Vienna basin, Black Sea basin, Timan-Pechora basin, West Siberia basin, Volga-Ural basin, Dniper-Donets basin.
- Offshore basins: Central and Equatorial Atlantic basins, East India basins, sheared margin basins of West Australia.

Selected Publications

Rybár, S., Šarinová K., Sant, K., Kuiper, K.F., Kováčová, M., Vojtko, R., Reiser, M.K., Fordinál, K., Teodoridis, V., Nováková, P., Vlček, T., 2019: New 40Ar/39Ar, fission track and sedimentological data on a middle Miocene tuff occurring in the Vienna Basin: implications for the North-Western Central Paratethys region. Geologica Carpathica, 70, 5, 386-404. doi: 10.2478/geoca-2019-0022.

Nemčok, M., **Rybár, S.**, Odegard, M., Dickson, W., Pelech, O., Ledvényiová, L., Matejová, M., Molčan, M., Hermeston, S., Jones, D., Cuervo, E., Cheng, R. & Forero, G., 2015: Development history of the southern terminus of the Central Atlantic; Guyana–Suriname case study. In: Nemčok, M., Rybár, S., Sinha, S.T., Hermeston, S.A. & Ledvényiová, L. (eds.) Transform Margins: Development, Controls and Petroleum Systems. Geological Society, London, Special Publications, 145-179, 431. doi: 10.1144/SP431.10

Rybár, S., Kováč, M., Šarinová, K., Halásová E., Hudáčková, N., Šujan, M., Kováčová, M., Ruman, A. & Klučiar, T. 2016: Neogene changes in paleeogeography, palaeoenvironment and the provenance of sediment in the Northern Danube Basin. Bulletin of Geosciences, 91, 2, 367-398. doi: 10.3140/bull.geosci.1571

Nemčok, M. & **Rybár, S.**, 2016: Rift–drift transition in a magma-rich system: the Gop Rift–Laxmi Basin case study, West India. In: Mukherjee, S., Misra, A.A., Calvés, G. & Nemčok, M. (eds.) Tectonics of the Deccan Large Igneous Province. Geological Society, London, Special Publications, 445. doi: 10.1144/SP445.5

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Júlia Kotulová, PhD

Research Scientist

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Research Interests

- Unconventional Gas Systems
- Organic geochemistry
- Petroleum geology
- Organic petrology
- Basin modeling (PetroMod)
- Petroleum systems
- Anoxic events
- Calibration of organic and inorganic thermometers

Júlia earned a Ph.D. in Geology, an B.Sc., RNDr. (M.Sc. equivalent) in Geology, Geochemistry and Economic geology from Comenius University, Bratislava, Slovakia. Julia joined EGI in 2011 with extensive experience as a geochemist and petroleum geologist, having spent the previous nine years working at the Department of Geophysics and Non-Renewable Energy Sources, State Geological Institute of Dionýz Štúr (Geological Survey), Bratislava, Slovak Republic. Prior to this, Julia worked with the Geological Institute at Slovak Academy of Sciences. Julia collaborates with the geochemistry lab and other researchers in the Salt Lake City office from her primary location in EGI's Bratislava office.

Research Related to Hydrocarbon Systems

- Integration of geology, geochemistry, and basin modeling for a holistic understanding of hydrocarbon generation, migration, entrapment, and preservation in order to identify regional characteristics and to de-risk new exploratory plays and prospects. Design, acquisition, implementation and interpretation of geochemical data applied to petroleum exploration and exploitation.
- Design, implementation and management rock, oil, and gas sampling and analytical programs.
- Organic geochemistry research into the molecular and isotopic composition of source rocks, oils, and gases for reservoir geochemistry, source rock quality, and thermal maturity evaluation.
- Organic petrology research with an emphasis on source rock evaluation, coal and paleoenvironmental/organic facies characterization; multi-dimensional geochemical basin modeling for the reduction of petroleum exploration risk.

Global Basin Studies

Júlia has experience with various types of basins around the globe – from the Carpathian accretionary wedge, fore-arc basins, back-arc Black Sea and Danube Basins, and the intra-arc Transcarpathian Neogene Basin to the Intermountain Basins of Slovakia – with a focus on petroleum systems, geohistorical models, thermal evolution, and fluid flow dating and duration. Her experience with passive margin basins includes the Central and Equatorial Atlantic and NW Australian margins. She also has experience with shale gas research (Central Europe, Russia, Ukraine and South America) for biogenic and thermogenic shale gas systems, geological storage of CO_2 as related to the Northern part of the Pannonian basin system, Ocean Anoxic Events research (Aptian OAE 1a and Oligocene Antarctic glaciation Oceanic Anoxic Oi-1 events), PetroMod geochemical models and Petrel 3-D geological models (East Slovakian Neogene and Intermountain Horna Nitra Neogene basins), and visual kerogen analysis (Tethys: Aptian; Paratethys: Cretaceous to Neogene in the Carpathian accretionary wedge and the Circum Black Sea region, Neogene in the North part of the Pannonian Basin).

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