



*Fold and Cleavage Forming Mechanisms, Illusions, and Deceptions in the Rocky Mountains (and Other Fold-Thrust Belts): a Discussion*

**SPEAKERS**

Jürgen Kraus & Paul F. Williams

**Time: 12:00 pm  
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**Location: Schlumberger, Second Floor of the Palliser One Building, 125 9th Ave. Calgary T2G 0P6**

Based on discussions with colleagues and reviewing the latest literature, inconsistent views of deformation in fold-and-thrust belts exist. There is also a discrepancy between published geometrical/kinematic models and observation.

For example, most representative fold-thrust models do not account for a footwall syncline, the only one that does is trishear fold-propagation folding according to Wallace and Homza (2004). Trishear involves ductile deformation, however deformation in the Rockies is perceived to be brittle. Is ductile deformation really limited to higher-grade metamorphic terranes such as the Monashees? Is the strain in the Rockies penetrative or not? Is flexural slip a brittle or a ductile mechanism and is it really the general folding mechanism in a multilayer sequence? Why should folds be parallel when parallel folding

does not produce the fold profiles observed? How does cleavage form and how does it get refracted, as seen in the Mississippian? How is cleavage formation related to folding? How do mesoscale structures such as parasitic folds relate to large structures? How can they be used in fold-thrust models? Do folds really form as asymmetrical structures and how can this be proven?

We dig into the structural toolbox to address these and other fundamental questions. We further compare the most recent published accounts of geometrical and kinematic fold-thrust models with our own observations and interpretations.

We conclude that many of the accepted models are possible however rare in nature, and we integrate them into unifying, generally applicable models.

## **BIOGRAPHIES**

Jürgen Kraus is a structural geologist and international exploration geologist with his own consulting company, Franconia Geoscience Ltd. He held his first petroleum-related position in 1987. Jürgen received an M.Sc in Structural Geology and Geophysics from Göttingen University in 1991 and a Ph.D. in Structural Geology from the University of New Brunswick in 1998.

After assignments with the Geological Survey of Canada, Aachen Technical University, and the Saskatchewan Geological Survey, he joined Shell Canada in 2001 and created drilled prospects in the Foothills at Waterton and Pincher Creek. Jürgen established his consultancy in 2003 and has worked on international oil and gas projects for various companies since.

Apart from the Foothills, Jürgen's experience in fold-and-thrust belts goes back to the 1980s (Rhenish massif as the central European extension of the Appalachians), his M.Sc. mapping in the Moine thrust belt in the Scottish Caledonides, and the Longmenshan in Sichuan Province of China.

Paul F. Williams, Professor Emeritus at the University of New Brunswick, is an internationally acclaimed structural geologist who has influenced his subject tremendously for more than 45 years. He has published over 80 peer-reviewed scientific papers, and 'An Outline of Structural Geology', co-authored by Paul, is regarded as one of the most influential structural geology textbooks of the 20th century. He mentored over 50 graduate students and post-doctoral fellows.

In 1980, Paul established the Canadian Tectonics Group, which will hold their 36<sup>th</sup> annual workshop in Muskoka in October. The Journal of Structural Geology has dedicated two special volumes to Paul's lifetime achievements, one in recognition of his

contributions as a scientist, the other for his contributions as a mentor.

In 2013, Paul won the inaugural Henk Zwart Medal in structural geology for his outstanding contribution to the advancement of science in the field of rock deformation.

## **REFERENCES**

McMechan, M.E., 1995, Rocky Mountain Foothills and Front Ranges in Kananaskis County, West of Fifth Meridian: Geological Survey of Canada "A" Series Map I865A.

Wallace, W.K, and Homza, T.X., 2004, Detachment Folds versus Fault-propagation Folds, and Their Truncation by Thrust Faults, in K. R. McClay, 2004, Thrust tectonics and hydrocarbon systems: AAPG Memoir 82, p. 324-355.

Fig. 1: Paul Williams and Jürgen Kraus.

Figl. 2: Truncated footwall syncline: view from the Kananaskis Highway (Hwy 40), near Porcupine Creek, toward Mount Lorette. Photo by Tim Hartel. Map snippet from McMechan (1995).