



F-TRG newsletter April-July 2017

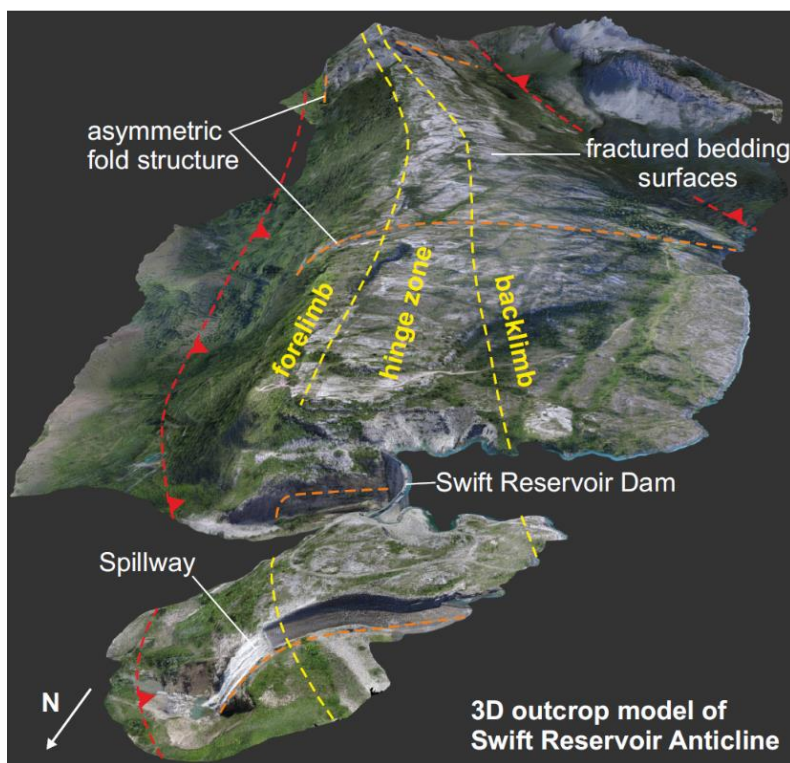
This issue...

This issue of the F-TRG newsletter includes an update on ongoing F-TRG research projects based on data from Montana and the French Alps; updates on masters projects working with F-TRG data; recent and upcoming conferences relevant for F-TRG sponsors; information on an upcoming F-TRG webinar and recent/relevant publications.

Ongoing research and other work

Controls on fracture intensity in a carbonate anticline

F-TRG are currently working on a dataset from the Sawtooth Range of Montana to identify controls on fracture intensity in a carbonate anticline. A 3D model of the Swift Reservoir anticline was constructed using bedding data, a DEM, and a UAV photogrammetry model. Field fracture intensity data has been compared with structural attributes from the 3D model to identify whether fracture



intensity varies systematically with changes in structural geometry and strain. In the upcoming months thin sections from fracture intensity sampling sites will be analysed using SEM techniques to identify lithological control on fracture intensity. Once complete, results of this project will be available to sponsors online, and the work will be prepared as a manuscript for submission to a journal for publication.

Left: annotated 3D model of the Swift Reservoir anticline constructed from UAV photogrammetry.

Along strike structural variation in the French Sub-Alpine chains

We are currently using field data collected from the French Sub-Alpine chains to construct a series of cross sections through the Chartreuse, Bauges and Bornes regions of the French Alps to illustrate structural variation along strike. Like many other fold-thrust belts globally, the structural style of the



French Sub-Alpine chains is known to vary along its length. In the south, shortening is accommodated by well-developed hangingwall anticlines on moderate-high displacement emergent thrusts. The thrusts are often splayed. In the north, anticlines often exhibit overturned forelimbs and are accompanied by well-developed asymmetric synclines in the absence of through-going thrusts. The question we aim to address is what controls this variation? In doing so we will explore the various potential controls on structural style, including changes in mechanical stratigraphy and palaeotemperature variation along the length of the fold-thrust belt. Fieldwork planned for August-September 2017 will contribute to this project. An update will be presented to sponsors during our F-TRG sponsor meeting in October 2017.

Masters projects

From January-April this year, we had two MGeol students working with F-TRG data for their final-year dissertation projects. One project used Raman spectroscopy on carbonate samples from the French Sub-Alpine chains to determine thermal maturity of the fold-thrust belt. The workflow used in this project will form the basis for sample analysis following F-TRG fieldwork in August/September this year. The second student project used well-log data, provided by Santos, to identify detachments in the Agogo/Hedina-lagifu region of the Papuan fold belt. The results of both projects will be shared online with sponsors.

Two MSc students are currently working on seismic, well and outcrop data provided by Oil Search and Santos for their dissertation projects. One project involves analysing how structural style varies along strike in the Agogo/Hedina-lagifu regions of the Papuan fold belt. The second project focuses on generating multiple interpretations of two seismic lines to explore alternative structural models and the implications for the petroleum system. If successful, the results of these projects will be shared with sponsors at the 2017 F-TRG sponsors meeting in October this year.

Conferences attended

Rob, Clare and Hannah presented research at the DRT (Deformation, Rheology and Tectonics) 2017 conference in Inverness, Scotland in April-May 2017. Presentations involving F-TRG members included:

- The pegmatite paradox: competing rates of deformation and crystallization (**R. Butler** & T. Torvela).
- FracPaQ: a MATLAB™ toolbox for the quantification of fracture patterns (D. Healy R. Rizzo, D. Cornwell, N. Farrell, **H. Watkins**, N. Timms & E. Gomez-Rivas).
- Forelimb damage styles in carbonate fold-thrust structures; French Sub-Alpine chains (**H. Watkins, R. Butler & C. Bond**).
- Seismic expression of fault deformation zones using multi-attributes: limits and challenges (D. Iacopini & **R. Butler**).



- Sandstones along thrusts: their origins and implications (Y. Totake, **R. Butler**, **C. Bond**, D. Iacopini & A. Aziz).
- Controls on fracture intensity and orientation on a plunging carbonate anticline; Sawtooth Range, Montana (**H. Watkins**, A. Cawood, **C. Bond**, M. Cooper & M. Warren).
- Deformation bands in Numidian sandstones of Sicily: a petrographic-structural study (E. Fazio, R. Punturo, G. Barreca, S. Gambino, R. Maniscalco & **R. Butler**).
- Fluid Flow in deforming media: interpreting stable isotope signatures of marbles (**C. Bond**).
- Deformation of stacked fluvio-deltaic succession – linking strain partitioning and fracture ‘damage’ (A. Cawood & **C. Bond**).

News and events

F-TRG webinar August 2017

Following a successful F-TRG webinar in March 2017, we are in the process of organising a second webinar for sponsors of F-TRG in August 2017. The webinar topic will be ‘Along strike structural variation in fold-thrust belts’. A series of case studies will be presented from F-TRG work and other published examples to highlight how fold-thrust structures can vary along strike on a range of scales. We will also explore potential causes of this structural variation, leading into a discussion for all participants. The webinar will be held on Monday 7th August 2017 (15.00-16.00 Adelaide; 15.30-16.30 Sydney).

New F-TRG publication

We have a new paper published ‘Implications of heterogeneous fracture distribution on reservoir quality; an analogue from the Torridon Group sandstone, Moine Thrust Belt, NW Scotland’. The paper published by the Journal of Structural Geology will form part of a special issue on ‘the spatial arrangement of faults and fractures’. We use field data, collected as part of Hannah’s PhD, to construct 3D models of four anticlines, which are kinematically and geomechanically restored to predict strain distribution. Modelling results are compared with field fracture data to determine the key controls on fracture distribution and fractured reservoir quality. For more information see <http://www.sciencedirect.com/science/article/pii/S0191814117301141>

F-TRG sponsor meeting 2017

The 2017 F-TRG sponsor meeting will be held on 25th-28th October 2017 in Pembrokeshire, UK, with delegates meeting in Pembrokeshire in the afternoon/early evening of 24th October. The meeting will include two and a half days in the field, looking at Variscan fold-thrust structures along the Pembrokeshire coastline; half a day of presentations/knowledge exchange updating sponsors on F-TRG activities in the past year; and a business meeting to decide on F-TRG activities for the following



year. The F-TRG meeting coincides with a conference at the Geological Society of London titled 'Fold and Thrust Belts: Structural style, evolution and exploration', 31st -2nd November 2017.

Upcoming conference: Fold and Thrust Belts: Structural style, evolution and exploration

Rob is involved with organising the 'Fold and Thrust Belts: Structural style, evolution and exploration' conference at the Geological Society, London. The conference is to be held between 31st October-2nd November 2017. Proposed themes for the conference include:

- Case studies documenting the temporal and spatial evolution of structural style.
- New techniques and approaches to understanding fold-thrust belts.
- New Exploration discoveries in fold and thrust belts, and their impact on understanding and prospectivity.
- Understanding and predicting fold-thrust belt geometry.
- Evolving stress fields and their impact on fault and fracture networks.
- Hydrocarbon modelling in fold and thrust belts.

For more information on the conference see the link below. <http://www.geolsoc.org.uk/PG-Fold-and-Thrust-Belts-Structural-style-evolution-and-exploration>

Other news and event information

The Fold-Thrust Research Group is on Twitter! Follow us (@FoldThrust) for updates on F-TRG activities and relevant fold-thrust information.

Recent/relevant publications

Alsop, G. I., Marco, S., Levi, T. & Weinberger, R., 2017. Fold and thrust systems in Mass Transport Deposits. *Journal of Structural Geology*, 94, 98-115.

Calderon, Y., Baby, P., Hurtado, C & Brusset, S., 2017. Thrust tectonics in the Andean retro-foreland basin of northern Peru: Permian inheritances and petroleum implications. *Marine and Petroleum Geology*, 82, 238-250.

Cawood, A. J., Bond, C. E., Howell, J. A., Butler, R. W. H. & Totake, Y., 2017. LiDAR, UAV or compass-clinometer? Accuracy, coverage and the effects on structural models. *Journal of Structural Geology*, 98, 67-82.

Cruciani, F. Barchi, M. R., Koyi, H. A. & Porreca, M., 2017. Kinematic evolution of a regional-scale gravity-driven deepwater fold-and-thrust belt: The Lamu Basin case-history (East Africa). *Tectonophysics*, 712-713, 30-44.

Li, J. & Mitra, S., 2017. Geometry and evolution of fold-thrust structures at the boundaries between frictional and ductile detachments. *Marine and Petroleum Geology*, 85, 16-34.



Mahoney, L., Hill, K., McLaren, S & Hanani, A., 2017. Complex fold and thrust belt structural styles: Examples from the Greater Juha area of the Papuan Fold and Thrust Belt, Papua New Guinea. *Journal of Structural Geology*, 100, 98-119.

Ruh, J. B., 2017. Effect of fluid pressure distribution on the structural evolution of accretionary wedges. *Terra Nova*, 29, 202-210.

Ruh, J. B., Gerya, T. & Burg, J-P., 2017. Toward 4D modeling of orogenic belts: Example from the transpressive Zagros Fold Belt. *Tectonophysics*, 702, 82-89.

Shu, L., Yin, H., Faure, M. & Chen, Y., 2017. Mesozoic intracontinental underthrust in the SE margin of the North China Block: Insights from the Xu-Huai thrust-and-fold belt. *Journal of Asian Earth Sciences*, 141, 161-173.

Totake, Y., Butler, R. W. H., Bond, C. E. & Aziz, A., 2017. Analyzing structural variations along strike in a deep-water thrust belt. *Journal of Structural Geology*, in press.

Warren, M. J. & Cooper, M., 2017. Classic hydrocarbon traps and analog structures in the southern Canadian Rockies. *AAPG Bulletin*, 101, 4, 589-597.

Watkins, H., Healy, D., Bond, C. E. & Butler, R. W. H., 2017. Implications of heterogeneous fracture distribution on reservoir quality; an analogue from the Torridon Group sandstone, Moine Thrust Belt, NW Scotland. *Journal of Structural Geology*, in press.

Yosefnejad, D. M., Nagel, T. J. & Froitzheim, N., 2017. Three-dimensional modelling of folds, thrusts, and strike-slip faults in the area of Val de Ruz (Jura Mountains, Switzerland). *Swiss Journal of Geoscience*, doi:10.1007/s00015-017-0261-8.

Next issue...

The next issue of the F-TRG newsletter will be issued in October 2017 and will include an update on F-TRG activities to date and ongoing research.