



F-TRG newsletter January-April 2017

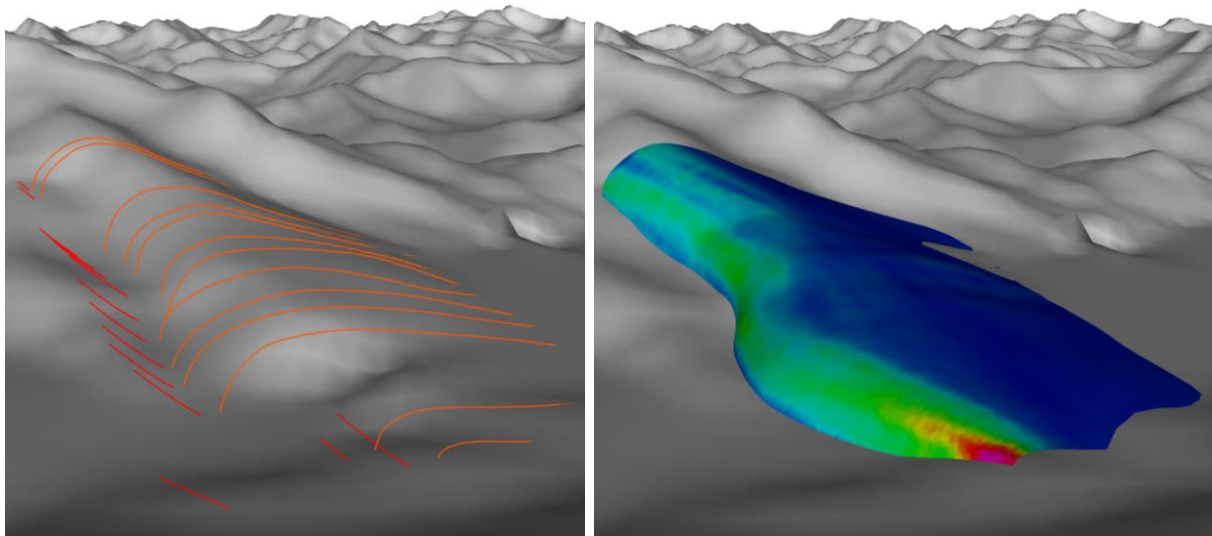
This issue...

This issue of the F-TRG newsletter includes updates on F-TRG research in the Sawtooth Range, Montana, ongoing student projects, information on F-TRG webinars, relevant publications and upcoming conference information.

Ongoing research and other work

3D model building, Sawtooth Range, Montana

F-TRG have recently been working on field data collected last June from the Sawtooth Range in Montana. We are using field bedding data, published geological maps, UAV photography and DEM data to construct 3D models of anticlines, beginning with the Swift Reservoir anticline in the northern Sawtooth Range. This structure is the frontal anticline of the Madison Group carbonates, which define the large-scale structure of the fold-thrust belt. 3D models will be used to analyse along strike variation on a 2 km segment of the fold, and to assess how fracture intensity and orientation vary at different positions on the structure.



Above left: top Madison Group horizon lines (orange) and frontal fault lines (red) created using field bedding data on parallel cross sections. Above right: 3D surface for the top Madison Group carbonates, constructed from horizon lines. Fold curvature (colour-mapped on 3D model) highlights the variation in structural geometry along strike.

Along strike structural variation, Sawtooth Range, Montana

Using the field dataset collected from the Sawtooth Range last June, we are continuing to use regional-scale cross sections to analyse how structural style may vary along strike within a fold-thrust belt, and the role of varying the level of detachment in this thin-skinned system. The Sawtooth Range exposes



a sequence of Cambrian-Cretaceous limestones and shales, which form very different fold geometries on a small scale, with displacement accommodated on multiple detachment horizons.

Interpretation of structural geometry in fold-thrust belts

F-TRG, along with Mark Cooper (University of Aberdeen, Sherwood Geoconsulting), have been working on an invited paper for the Journal of Structural Geology titled 'Interpretation of structural geometry in fold-thrust belts'. The paper addresses some of the key issues with interpretation of structural geometry of fold-thrust structures using three key case studies in the French Alps, Canadian Rockies and Papuan fold belt, Papua New Guinea. The article also discusses uncertainty in seismic interpretation, damage prediction and the role of a multi-layered sequence in fold-thrust systems. We hope the paper will be published at the end of 2017/early 2018.

Masters projects

We currently have two MGeol students working with F-TRG for their final-year dissertation projects. One student is using carbonate samples from the French Sub-Alpine chains to determine thermal maturity of the fold-thrust belt, and the implications of structural loading by overlying thrust sheets on the petroleum system. The second student is applying a workflow for identifying detachments from well-log data to the Papuan fold belt to aid in seismic interpretation of the Agogo/Hedina/Iagifu regions.

Conferences attended

Rob gave an invited keynote presentation at the Deepwater Depositional Systems: Advance and Applications conference at the Geological Society of London, 25th-27th January 2017. His talk was titled 'Structural controls on sand fairways in submarine thrust systems: examples from the Annot and other Western Alpine systems'.

News and events

F-TRG webinar March 2017

An online seminar titled 'Structural styles in fold-thrust belts' was presented to sponsor companies Oil Search and Santos on 21st March. The seminar explored uncertainty in subsurface fold forelimb geometries; how end member models are used to infer geometry of poorly imaged regions; issues with these end-member models; and potential methods for improving subsurface uncertainty. The seminar slides are available to sponsors via our SharePoint site. A second seminar will be presented to sponsors in June/July 2017 (date to be confirmed).

New F-TRG publication

We have a new paper published in the Journal of Structural Geology titled 'Using laterally compatible cross sections to infer fault growth and linkage models in foreland thrust belts'. The paper presents 6



cross sections through the Vercors region of the French Sub-Alpine Chains and uses these to analyse how fold geometry and thrust displacement vary along strike. Thrust zone displacement profiles are also used to infer fault linkage and displacement transfer throughout the fold-thrust belt. Click on the link to read the paper: <http://www.sciencedirect.com/science/article/pii/S0191814117300196>

Rob also has published a paper (in press) on 'Basement-cover tectonics, structural inheritance, and deformation migration in the outer parts of orogenic belts: A view from the western Alps', which covers many of the topics and field sites visited on part 2 of the F-TRG sponsors meeting in October 2016. See recent/relevant papers section at the end of the newsletter for more information.

F-TRG sponsor meeting 2017

Following the F-TRG sponsor meeting in October 2016, it was agreed that the 2017 F-TRG meeting would be held in the UK at the end of October/beginning of November 2017, coinciding with a conference at the Geological Society of London titled 'Fold and Thrust Belts: Structural style, evolution and exploration', 31st -2nd November 2017. The business meeting will be accompanied by a fieldtrip to the Pembrokeshire coast, West Wales, looking at small-scale Variscan fold-thrust structures. Dates are yet to be confirmed but will either be 28th -30th October or 3rd -5th November 2017.

Upcoming conference: Deformation, Rheology and Tectonics (DRT)

Clare, Rob and Hannah are part of the organising committee for the DRT conference to be held in Inverness, Scotland. The conference will be held between 30th April-4 th May 2017 and will include a series of oral and poster sessions, as well as pre, mid and post conference field excursions to the Scottish Highlands. Conference topics will focus on small to large scale aspects of structural geology, including rock mechanics and physics of fractured rocks; interplay between fluid flow, deformation and mineral reactions; structural geology, tectonics and geophysics for exploration of production of energy resources; continental tectonics and mountain building: from deep to shallow; and 3D geometry and kinematics or tectonic structures.

For more information see <http://www.abdn.ac.uk/geosciences/events/drt2017-1091.php>.

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 and abstract deadlines etc 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

Alcalde, J., Bond, C. E., Johnson, G., Butler, R. W. H., Cooper, M. A. & Ellis, J. F., 2017. The importance of structural model availability on seismic interpretation. *Journal of Structural Geology*, 97, 161-171.

Alcalde, J., Bond, C. E., Johnson, G., Ellis, J. F. & Butler, R. W. H., 2017. Impact of seismic image quality on fault interpretation uncertainty. *GSA Today*, 27, 2, 4-10.

Brandes, C., Tanner, D. C. & Winsemann, J., 2016. Kinematic 3-D Retro-Modeling of an Orogenic Bend in the South Limón Fold-and-Thrust Belt, Eastern Costa Rica: Prediction of the Incremental Internal Strain Distribution. *Pure and Applied Geophysics*, 173, 3341-3356.

Butler, R. W. H., 2017 (in press). Basement-cover tectonics, structural inheritance, and deformation migration in the outer parts of orogenic belts: A view from the western Alps. In *Linkages and Feedbacks in Orogenic Systems*, edited by Law, R. D., Thigpen, J. R., Merschat, A. J. & Stowell, H. H. Geological Society of America Memoir 213, 1-20.

Ghanadian, M., Faghih, A., Fard, I., A., Kusky, T. & Maleki, M., 2017. On the role of incompetent strata in the structural evolution of the Zagros Fold-Thrust Belt, Dezful Embayment, Iran. *Marine and Petroleum Geology*, 81, 320-333.

Ghanadian, M., Faghih, A., Greasemann, B., Fard, I., A. & Maleki, M., 2017. Analogue modeling of the role of multi-level decollement layers on the geometry of orogenic wedge: an application to the Zagros Fold–Thrust Belt, SW Iran. *International Journal of Earth Science*, DOI 10.1007/s00531-017-1462-0.

Granado, P., Ferrer, O., Muñoz, J. A., Thöny, W. & Strauss, P., 2017. Basin inversion in tectonic wedges: Insights from analogue modelling and the Alpine-Carpathian fold-and-thrust belt. *Tectonophysics*, 703-704, 50-68.

Jimenez-Bonilla, A., Torvela, T., Balanyá, J. C., Expósito, I. & Díaz-Azpiroz, M., 2016. Changes in dip and frictional properties of the basal detachment controlling orogenic wedge propagation and frontal collapse: The external central Betics case. *Tectonics*, 35, 3028-3049.

Torres Carbonell, P. J., Rodríguez Arias, L. & Atencio, M. R., 2017. Geometry and kinematics of the Fuegian thrust-fold belt, southernmost Andes. *Tectonics*, 36, 33-50.

Totake, Y., Butler, R. W. H. & Bond, C. E., 2017. Structural validation as an input into seismic depth conversion to decrease assigned structural uncertainty. *Journal of Structural Geology*, 95, 32-47.

Watkins, H., Butler, R. W. H., Bond, C. E., 2017. Using laterally compatible cross sections to infer fault growth and linkage models in foreland thrust belts. *Journal of Structural Geology*, 96, 102-117.



Next issue...

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