



F-TRG newsletter January –April 2018

This issue...

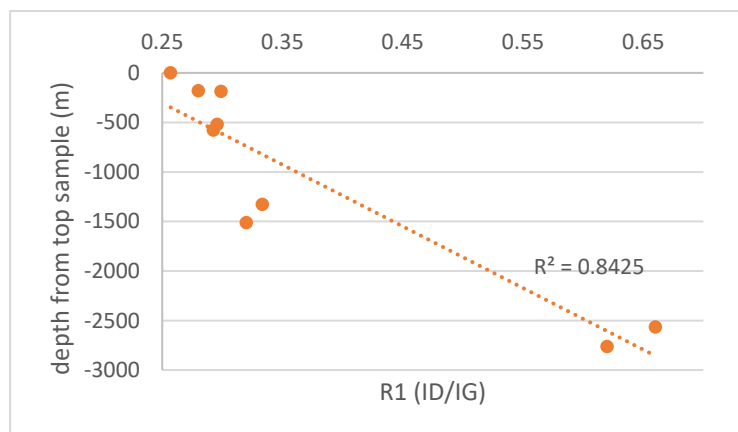
Ongoing F-TRG research, February/March sponsor visits, past and upcoming webinars, cross section building and restoration training course, 2018 sponsor meeting and recent/relevant fold-thrust belt papers.

Ongoing research and other work

Raman spectroscopy to determine thermal maturity

As part of an ongoing project investigating the controls on along strike structural variation in the French Subalpine chains, we are using carbonate samples from the field area to determine thermal maturity using Raman Spectroscopy. As carbon within rocks is heated it undergoes a reaction (thermal alteration), which involves both the formation and reordering of aromatic subunits towards stacked layers such as graphite. By analysing the relative proportions of disordered and graphite structure in the carbon using Raman Spectroscopy, we can estimate thermal maturity of the samples and determine if changes in thermal maturity correlate to changes in structural style of folds.

By projecting the positions of the samples onto cross sections we can calculate how the thermal maturity varies with depth. Preliminary results suggest a good correlation between the relative depth of the sample and its thermal maturity (indicated by the R1 ratio (ID/IG)). The next step is to calibrate



the R1 (ID/IG) for temperature. We will then apply this methodology to further samples to determine how thermal maturity varies across the fold-thrust belt.

Left: initial Raman Spectroscopy results showing R1(ID/IG) – an indicator of thermal maturity – against relative sample depth from transect 1.

News and events

In-house visits

Hannah visited Santos in Adelaide (26th-27th February) and Oil Search in Sydney (28th February-1st March). Discussions were had on model building workflows and structural issues in Papua New Guinea



(PNG). Based on these discussions the 2018 planned deliverables have been adjusted to address some of the specific issues faced when interpreting structures in PNG. Hannah also presented a lunchtime seminar to Santos and Oil Search on 'Structural style in fold-thrust belts'.

F-TRG webinars

Three webinars have been presented to sponsors so far in 2018:

- 30th January: 'Controls on fracture intensity in a carbonate anticline, Sawtooth Range, Montana' & 'An overview of the F-TRG SharePoint site' – Hannah Watkins.
- 23rd February: 'The use of photogrammetry for building 3D models and extracting geological data from fold-thrust structures' – Adam Cawood.
- 23rd March: 'Buckle folding' – Rob Butler.

The next webinar will be presented by Clare Bond on 'Uncertainty and biases in interpreting data' on 23rd April 2018 (14.30 Adelaide, 15.00 Sydney).

Training course: 'Cross section construction and restoration in fold-thrust belts'

F-TRG will be running a structural geology training course associated with the annual sponsor meeting. The course will run from Tuesday 14th August (approximate start time 09.30)-Thursday 16th August (approximate end time 12.30) at the Santos Centre in Adelaide. The training course outline is as follows:

Tuesday 14th August: course introduction, fieldtrip to Hallet Cove (data collection and cross section exercise), cross section construction techniques.

Wednesday 15th August: cross section construction exercises using multiple case studies from various fold-thrust belts globally (individual and group exercises).

Thursday 16th August: introduction to cross section restoration methods and restoration exercises.

The training course is open to up to 30 participants (15 per sponsor company); please let us know if you wish to attend (email h.watkins@abdn.ac.uk).

F-TRG sponsor meeting 2018

The final F-TRG sponsor meeting for phase 1 will be held at the Santos Centre in Adelaide on the afternoon of Thursday 16th August. Up to two representatives per sponsor company are invited to attend the sponsor meeting.

Other news and event information

The Fold-Thrust Research Group is on Twitter! Follow us ([@FoldThrust](https://twitter.com/FoldThrust)) for updates on F-TRG activities and relevant fold-thrust information.



Conferences attended

EGU (European Geosciences Union), 8th-13th April 2018, Vienna

Clare attended the 2018 EGU conference and exhibition in Vienna, where she also co-convoked a session on 'Understanding the unknowns: recognition, quantification, influence and minimisation of uncertainty in the geosciences'. Several F-TRG presentations were given at the conference:

- 'Impact of seismic image quality and presentation on interpretation uncertainty'. Juan Alcalde, **Clare Bond**, Gareth Johnson, Jennifer Ellis, **Rob Butler** & Charles Randle.
- 'Uncertainty in interpreting fold-thrust forelimbs: implications of the over reliance on models and unrepresentative analogues'. **Clare Bond**, **Rob Butler**, Adam Cawood & **Hannah Watkins**.
- 'Storage site selection process in the North Sea for the ACT ACORN CCS Project'. Juan Alcalde, **Clare Elizabeth Bond**, Alan James, Hazel Robertson, Tim Dumenil, David Christopher Pilbeam, Niklas Heinemann, R. Stuart Haszeldine, Saeed Ghanbari, Eric J. Mackay, Daniel R. Faulkner, Michael J. Allen, and Richard H. Worden
- 'Quantifying geological CO₂ storage security to deliver on climate mitigation'. Stephanie Flude, Juan Alcade, Mark Wilkinson, Gareth Johnson, Katriona Edlmann, **Clare Bond**, Vivian Scott, Stuart Gilfillan, Xènia Ogaya, and R. Stuart Haszeldine.
- 'eRock: an online, open-access repository of virtual outcrops and geological samples in 3D'. Adam J. Cawood and **Clare E. Bond**.
- 'Fracture attributes from Swift Anticline, NW Montana: mechanical stratigraphy and inferred structural development.' Adam J. Cawood, **Clare E. Bond**, **Hannah Watkins**, Mark Cooper, and Marian J. Warren.
- 'Interpreting structural geometry in fold-thrust belts: Why style matters'. **Clare Bond**, **Rob Butler**, **Hannah Watkins**, and Mark Cooper.

Recent/relevant publications

Aldega, L., Bigi, S., Carminati, E., Trippetta, F., Corrado, S. & Kavooosi, M.A., 2018. The Zagros fold-and-thrust belt in the Fars province (Iran): II. Thermal evolution. *Marine and Petroleum Geology*, 93, 376-390.

Allen, M.B., Walters, R.J., Song, S., Saville, C., De Paola, N., Ford, J., Hu, Z. & Sun, W., 2017. Partitioning of oblique convergence coupled to the fault locking behavior of fold-and-thrust belts: Evidence from the Qilian Shan, northeastern Tibetan Plateau. *Tectonics*, 36, 1679-1698.

Bersan, S.M., Danderfer, A., Lagoeiro, L. & Fernanda de Oliveira Costa, A., 2017. The kinematic evolution of the Serra Central Salient, Eastern Brazil: A Neoproterozoic progressive arc in northern Espinhaço fold-thrust belt. *Journal of South American Earth Sciences*, 80, 131-148.

Bigi, S., Carminati, E., Aldega, L., Trippetta, F. & Kavooosi, M.A., 2018. Zagros fold and thrust belt in the Fars province (Iran) I: Control of thickness/ rheology of sediments and pre-thrusting tectonics on structural style and shortening. *Marine and Petroleum Geology*, 91, 211-224.



Calamati, F., Di Domenica, A. & Pace, P., 2017. Macro- and meso-scale structural criteria for identifying pre-thrusting normal faults within foreland fold-and-thrust belts: Insights from the Central-Northern Apennines (Italy). *Terra Nova*, 30, 50-62.

Curia, D., Borghi, P., Noble, J., Berkovitch, A., Justo, D. & Alayón, M., 2017. The impact of multifocusing in the processing of land 3D seismic data in a fold and thrust belt setting: Ranquil Norte Block, Neuquén Basin, Argentina. *The Leading Edge*, 36, 9, 770-774.

Curtis, M.L., Lopez-Mir, B., Scott, R.A. & Howard, J.P., 2017. Early Mesozoic sinistral transpression along the Pai-Khoi–Novaya Zemlya fold–thrust belt, Russia. In: Pease, V. & Coakley, B. (eds) *Circum-Arctic Lithosphere Evolution*, Geological Society, London, Special Publications, 460, 355-370.

Lin, C., Liu, S., Zhuang, Q. & Steel, R.J., 2018. Sedimentation of Jurassic fan-delta wedges in the Xihuayuan basin reflecting thrust-fault movements of the western Yanshan fold-and-thrust belt, China. *Sedimentary Geology*, 368, 24-43.

Nebot, M. & Guimerà, J., 2018. Kinematic evolution of a fold-and-thrust belt developed during basin inversion: the Mesozoic Maestrat basin, E Iberian Chain. *Geological Magazine*, 155, 3, 630-640.

Obradors-Prats, J., Rouainia, M., Aplin, A.C., & Crook, A.J.L., 2017. Hydromechanical Modeling of Stress, Pore Pressure, and Porosity Evolution in Fold-and-Thrust Belt Systems. *Journal of Geophysical Research: Solid Earth*, 122, 9383-9403.

Robert, R., Robion, P., Souloumiac, P., David, C. & Sallet, E., 2018. Deformation bands, early markers of tectonic activity in front of a fold-and-thrust belt: Example from the Tremp-Graus basin, southern Pyrenees, Spain. *Journal of Structural Geology*, 110, 65-85.

Sarkarinejad, K., Pash, R.R., Motamedi, H. & Yazdani, M., 2017. Deformation and kinematic evolution of the subsurface structures: Zagros foreland fold-and-thrust belt, northern Dezful Embayment, Iran. *International Journal of Earth Sciences*, DOI 10.1007/s00531-017-1532-3.

Tang, P., Rao, G., Li, S., Yu, Y., Pei, Y., Wang, X., Shen, Z., Chen, N. & Zhao, B., 2017. Lateral structural variations and drainage response along the Misikantage anticline in the western Kuqa fold-and-thrust belt, southern Tianshan, NW China. *Tectonophysics*, 721, 196-210.

Xie, L., Pei, Y., Li, A & Wu, K., 2018. Implications of meso- to micro-scale deformation for fault sealing capacity: Insights from the Lenghu5 fold-and-thrust belt, Qaidam Basin, NE Tibetan Plateau. *Journal of Asian Earth Sciences*, 158, 336-351.

Next issue...

The next issue of the F-TRG newsletter will be issued in July 2018 and will include an update on F-TRG activities and ongoing research.