



Research Networking Programmes

Short Visit Grant or Exchange Visit Grant

(please tick the relevant box)

Scientific Report

The scientific report (WORD or PDF file – maximum of eight A4 pages) should be submitted online within one month of the event. It will be published on the ESF website.

Proposal Title:

Strain heterogeneities and dynamic recrystallization in anisotropic materials: Insights from Ice Deformation Experiments and Modelling

Application Reference N°: 7243

1) Purpose of the visit

The purpose of the visit was to use the short visit of S. Piazolo to the Laboratoire de Glaciologie et de Géophysique de l'Environnement to continue the fruitful collaboration between Piazolo and Montagnat over the years (e.g. Piazolo et al. 2008, Montagnat et al. 2011, Piazolo et al. 2015) finalizing several projects that have been ongoing as well as to set-up new collaborative projects.

2) Description of the work carried out during the visit

Project 1) Non basal dislocations in ice:

The team of M. Montagnat, T. Chauve (PhD student of M. Montagnat) and S. Piazolo used the visit of S. Piazolo to work for 5 days on existing experimental data produced by Montagnat and analysed using EBSD by Piazolo and T. Chauve with special focus on the activation of the non-basal slip system in ice. A visit of Prof. J. Wheeler (Liverpool) at the same time of Piazolo's visit added to the fruitful collaboration. During the visit, the collaborative team reviewed the data available, selected the best datasets, analysed the datasets together and decided on the structure of a publication to be submitted before the end of 2015. This manuscript will be headed by T. Chauve and M. Montagnat in collaboration with Piazolo and Wheeler.

Project 2: Stress and strain heterogeneities in anisotropic crystalline materials
S. Piazzolo and M. Montagnat spend one full day on the structure of a review on stress and strain heterogeneities in anisotropic crystalline materials. The researchers agreed on the general structure of the manuscript and on a detailed plan dividing up the work load. In this review, we will bring together the knowledge gained in both material science and earth science. Piazzolo will present the proposed review structure to the chief editor of the Journal of Structural Geology (Prof. C. Passchier) at a joint international meeting (SGTSG Australia) in mid-November 2015. We aim to have a manuscript submitted by mid 2016.

Project 3: Numerical simulations combined with experimental data: Insights into the effect of substructure on annealing behaviour

We spend 3 days to review the dataset available to the team (Montagnat, Piazzolo, Chauve) available for a manuscript that combines numerical simulations and in-situ experiments in order to understand annealing behaviour of crystalline materials including ice and magnesiums. In discussion with A. Tommasi (skype meetings) the team decided on the best datasets to use for numerical simulations, discussed how to link the datasets from ice and magnesium and on the structure and emphasis of the manuscript. As a result, there is now a detailed manuscript outline (with completed introduction and technique sections), and a detailed work plan. The manuscript will be headed by Piazzolo and we aim to submit the manuscript by the end of 2015/early 2016.

To the delight of all collaborators, the visit of S. Piazzolo proved highly effective, with manuscript outlines completed, work load divided and detailed publication plan.

3) Description of the main results obtained

Main results - Project 1:

- non basal dislocations accommodate stress and strain heterogeneities in ice
- using detailed EBSD analysis and Weighted Burgers Vector analysis allows in-depth characterisation of dislocation types within a crystalline material

Main results - Project 2:

- Studies of stress and strain heterogeneities conducted on metals, ice and geological materials are highly complementary and their combination allow to draw general conclusions about the importance and details of stress and strain heterogeneities

Main result - Project 3:

- grain boundary migration in pre-deformed, then annealed samples can be used to track the variability of stored energy within a crystalline material
- numerical simulations combined with in-situ experimental data can be used to quantify the effective energy of different substructures

4) Future collaboration with host institution (if applicable)

- Continued collaboration in terms of the project 1-3 as outlined above
- new collaboration focussing on 3D XRD analysis at the synchrotron in Grenoble. Piazzolo has already datasets to allow testing of data treatment techniques (to be tested by T. Chauve), and will be collaborating with Montagnat and Chauve in terms of the experimental set-up, application and data analysis of a planned 3D XRD experiments at the Synchrotron.

5) Projected publications / articles resulting or to result from the grant (*ESF must be acknowledged in publications resulting from the grantee's work in relation with the grant*)

Dislocations in ice revealed by EBSD and Weighted burgers vector analysis (to be submitted , Dec. 2015).

The effect of substructure heterogeneities on microdynamic processes during post-dynamic recrystallization in ice and magnesium: Coupled sequential EBSD observations and numerical modeling (to be submitted to Acta Materialia, Dec. 2015, Jan. 2016)

Stress and strain heterogeneities and their effect on the onset of recrystallization in polycrystalline rocks: A Review (to be submitted to Journal of Structural Geology, May/June 2016)

6) Other comments (if any)

In addition to the discussions and outcomes noted above, Piazzolo and Montagnat discussed ongoing research in the two respective research groups and through this helped both to refine current models and publication strategies.

The duration of the stay was from 24th August till the 4th of September 2015. Piazzolo fly from Australia to Zuerich conducted some fieldwork (not part of MicroDice Short Visit) and then took the train from Zuerich to Grenoble, stayed in Grenoble till the 4th of September. Piazzolo took the train back to Zuerich, had to stay one more night in Zuerich before leaving for Australia on the 5th of September 2015.