



7th RhEoVOLUTION Meeting 18-21 February 2025, Sète (France)

Tuesday 18 February

13h45: Welcome – short presentation of the RhEoVOLUTION project – review of the 4 years of functioning of the project

14h-14h45: Tour de table – 3-minute pitch to introduce yourself, your role in the project or, for outsiders, in the meeting and THE result or question that he or she wishes to present and discuss in the meeting.

Texture and anisotropy

14h45-15h: Andréa Tommasi & Maurine Montagnat : Introduction: Modeling texture and anisotropy evolution. Which are the RhEoVOLUTION aims, current situation and issues for both olivine and ice

15h-16h15: Nicholas Rathmann: Modeling ice and olivine CPO evolution and its effect on large-scale flow in two-way coupled simulations. 30 min presentation + clair/pas clair exercise (20 minutes discussion in groups to define questions / 25 minutes questions discussed in plenary, remaining questions kept for Wednesday discussion time)

16h15-16h45: *Coffee break*

16h45-17h45: Agnes Kiraly (videoconference): A parameterization of the viscous mechanical anisotropy of olivine (Hill coefficients) – 30 min presentation + clair/pas clair exercise

17h45-19h: Discussion on the parameterizations of viscoplastic anisotropy for hexagonal and orthorhombic polycrystals, including the GOLF law for ice

- *What are the most effective approaches to express the relationships between texture & mechanical anisotropy (elastic/viscoplastic)?*

19h: *Diner*

Wednesday 19 February

9h-9h30: Antonin Hilzheber & Thomas Chauve: R3Ice and its use to simulate the evolution of texture and viscoplastic anisotropy along a streamline in a glacier

9h30-10h45: Discussion on how to effectively simulate viscous anisotropy in large-scale flows if not using IA surrogates to emulate small-scale simulations.

10h45-11h15: *Coffee break*

11h15-12h30: J. Bolibar (videoconference): Differentiable programming as a new scientific modelling paradigm – 30min présentation + clair/pas clair

12h30 Lunch

14h-14h30: Nestor Cerpa: Predicting the evolution of elastic anisotropy of olivine during deformation by AI approaches: current situation and issues.

14h30-15h: Fernando Carazo: Constructing a "good" texture database. Comparison of different approaches to describe olivine textures and obtain the minimum representative sampling of this database.

15h-15h30: Discussion

- *Should we separate the prediction of the evolution of the anisotropy from that of the relation between texture and anisotropy?*
- *How to ensure a complete description of all possible texture and velocity gradients combinations?*

15h30-16h: Coffee break

16h-17h : Simon Gsell & Martin Lardy (Irphe, Marseille) – PINNs pour inférer la rhéologie de fluides complexes (biologiques) à partir de champs de vitesse expérimentaux - 30min presentation + clair/pas clair

17h-19h: Discussion

- *How to avoid error accumulation when using NN iteratively to predict texture evolution: Construct a better database? Change NN architecture? Integrate physical constraints? Which constraints? Texture is not a mechanical field... usual constraints like positive entropy or incompressibility do not apply.*
- *Which are the best texture descriptors?*
- *Should we separate the prediction of the evolution of the anisotropy from that of the relation between texture and anisotropy?*

19h: Diner

Thursday 20 February

Modelling strain localization & coupling between scales

9h-9h30: Andréa Tommasi: Modelling spontaneous strain localization in the mantle using stochastic descriptions of a rheology and a damage evolution controlled by the viscous dissipation rate. Modelling strategy and main results for a highly non-linear flow law.

9h30-10h: Felipe Saez: Strain localization in Newtonian and power-law materials in which damage results in an increase of the preexponential parameter, for damage controlled by the local dissipation rate or by the pressure field (to simulate fluid-assisted softening).

10h30-11h: Coffee break

11h-11h30: Lilou Zeller: Review literature – coarse-graining & scale-coupling methods in other domains.

11h30-12h: Nestor Cerpa: Reduced Order Models

12h-12h30: Discussion – How to scale up our stochastic modeling results?

- *How the results of our model can be used to construct a macro-scale law? Should we keep the microscale flow law, which represents the dominant deformation process at the microscale = dislocation creep) and add a new term? What form should it take?*
- *May we just use the same strategy as in the present models and consider that the upscaling would be natural? In this case, which should be the flow and evolution law parameters?*
- *How can stochasticity be maintained at the larger scale? By imposing it on “homogenized” values of the material parameters that control the strain localization regime diagram, which should characterize the material properties at the large-scale mesh scale? In the μm -mm scale, these values represented a given microstructure evolution process. What do they represent at m-km and larger scales?*
- *Coupling involves interactions in both directions. How does the large scale change the small? The most obvious is: if localized, the local dissipation rate increases, so damage is easier.*

12h30: Lunch

Experimental constraints on the feedbacks between evolution of the microstructure and texture and strain distribution

14h-15h30: Thomas Mineau: Experimental constraints on the feedbacks between evolution of the microstructure and texture and strain distribution by in-situ EBSD analyses and digital image correlation on Mg AZ31 deformed in traction at 250°C and 10^{-3} s^{-1}

- *Results of the in-situ EBSD test series on the new starting material / comparison with previous results & Preparation for experiments with digital image correlation. Discussion around Thomas PhD work and upcoming experiments*

15h30-16h: Thomas Chauve: Evolution of strain fields in response to dynamic recrystallization in polycrystalline ice.

16h-16h30: Coffee break

Additional work in progress and future directions in the project

16h30-17h: Maurine Montagnat: Implementation of the attractor scheme to represent the effect of dynamic recrystallization on texture evolution in VPSC

17h-17h15: Lilou Zeller: ADELI rewrite - objectives, work plan, current state

17h15-19h: Future directions: Quantifying feedbacks between fluids and strain localization by two-phase flow models - presentation and discussion around Felipe Saez PhD project & Nestor Cerpa submitted ERC project

19h: *Diner*

Friday 21 February

RhEoVOLUTION team : Where we are & future directions

9h-10h: Work in small groups - *review of the present state and work plan for the next 6 months.*

10h-10h30: Coffee break

10:30-12:30: Round table: Where we are & future plans with practical resolutions

12h30: Lunch & departure

Participants

RhEoVOLUTION team - on site

1. Andréa Tommasi (GM)
2. Nestor Cerpa (GM)
3. Felipe Saez (GM)
4. Thomas Mineau (GM)
5. Lilou Zeller (GM)
6. Maurine Montagnat (IGE)
7. Thomas Chauve (IGE)
8. Antonin Hilzheber (IGE)
9. Fabrice Barou (GM)
10. Riad Hassani (Géoazur)

Invited participants - on site

1. Nicholas Rathmann (Niels Bohr Institute, DK)
2. Jean Furtoss (PPrime, FR)
3. Mathilde Bonnetier (IGE)
4. Simon Gsell (Irphe)
5. Martin Lardy (Irphe)
6. Bertrand Wattrisse (LMGC)
7. Delphine Roubinet (GM)

Videoconference

1. Marco Lopez-Sanchez (Univ. Oviedo)
2. Fernando Carazo (CONICET, AR)
3. Jordi Bolibar (IGE)
4. Agnes Kiraly (Univ. Oslo, NO)