RING Team Newsletter, March 2016

In This Issue...

Congratulations

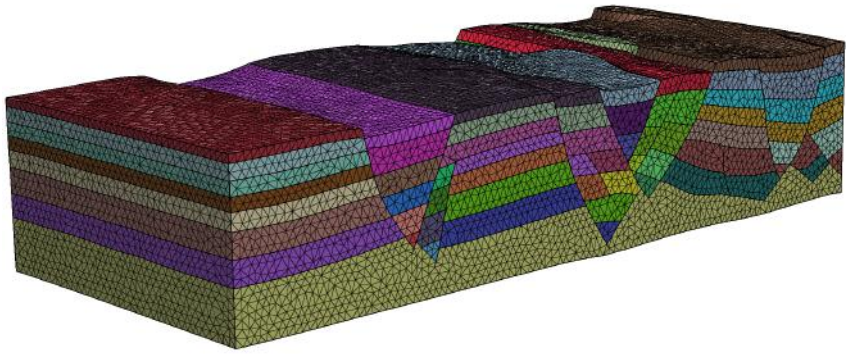
The paper presented by Paul Cupillard at the SEG 85^{th} annual meeting was ranked in the top 31 papers!

Society of Exploration Geophysicists
The international society of applied geophysics

2016 RING Meeting on the September 20-23, in Nancy, France... Save the Date!

As each year, we are pleased to invite contributions from partners to be included in the proceedings and in the presentation program. Papers of interest cover:

- Important methodological advances in Geomodeling theories.
- Improvements and derivative works of technologies initiated by the team (SKUA-GOCAD Research Plugins and RING stand-alone libraries).
- Case studies and applications of RING technologies.



[Data courtesy of IFPEN and C&C Reservoirs]

Registration and instruction for author will soon be available at http://ring.georessources.univ-lorraine.fr/.

Important dates

- Abstract due: May 16, 2016
- Notification of acceptance: June 15, 2016
- Full paper due: August 1, 2016
- Technical presentations: September 20-23, 2016.

In addition to the technical sessions and Steering Committee, the RING team will propose trainings to showcase RING technologies.

Many thanks . . .

Pierre Jacquemin

will retire on March 13rd. Pierre obtained a PhD about the automation of talc crunchers in 1980, then joined the CRPG in 1982 as a CNRS research engineer. This is where he started working with Jean-Laurent Mallet on GEOL, an automatic mapping software which was the precursor of Gocad. Since then, Pierre has always been in charge of maintaining the computer infrastructure of the team. We are currently reorganizing in conjunction with the IT services of Université de Lorraine to ensure the persistence of this critical service. When the Gocad project started in 1989, Pierre ensured the compatibility of Gocad with multi-platform graphical user interfaces. This was a tremendous challenge in the early 90's, where at least 4 different versions of the UNIX system existed. He also took in charge a significant part of the organization of the annual Consortium Meetings. This included several trips to the US during the 90's, which could be a risky business (Pierre escaped a tropical storm going to SEG'98 in New Orleans, but the car didn't)...

Pierre's essential, tireless and dedicated support has made it possible for the other researchers to focus on advancing the science of geomodeling. Pierre did also his part in the science, by contributing in particular in the field of structural restoration and then by making progresses in seismic interpretation of faults and horizons. During all these years, Pierre also taught computer programming to generations of ENSG students, a delicate and important mission, indeed! Pierre, thanks for your contributions and your dedication, and best wishes to you for a well-deserved retirement!

A 3D model imprinted in glass offered by Jean-Laurent Mallet to Jean-Jacques Royer and Pierre Jacquemin as a retirement gift.

Jean-Jacques Royer

officially retired on Feb 8 2016. Jean-Jacques did his entire career with CNRS and was affiliated with the Gocad/RING project since its inception in 1989. Originally a mining engineer, Jean-Jacques did a PhD in geostatistics and has developed a broad knowledge in mathematics, mining exploration, reservoir engineering, seismic interpretation, unconventional resources, geochemistry, geothermal energy, among others. Summarizing 40 years of career is a difficult task. Most Gocad/RING Meeting attendees are aware of his contributions to geostatistics and geomodeling, which were both integrative and mathematically solid. Jean-Jacques has lived many other lives: he was known to ENSG students as a polyvalent and knowledgeable teacher, he was the treasurer of CODATA (International Council for Science: Committee on Data for Science and Technology) from 2000 to 2008, the editor of several books (Springer Codata Series and the Computer Series of the Science de la Terre Volumes 9 to 32), a tireless traveler and a dedicated advisor to undergraduate and graduate students. He spent significant time working at developing international collaborations. Some of these have been very successful. I will mention the work he did with colleagues from Quebec on geologically-driven gold exploration, which received in 2013 the Barlow Medal for best geological paper from CIM. I have lost count of the many countries that Jean-Jacques visited to give lectures or conferences; it would probably be faster to count countries he has not been to!

Jean-Jacques, you are always welcome to share your knowledge and expertise with the RING team! In any case, thank you some much for your dedication and for being a great team player throughout all these years. Best wishes from all of us for a happy retirement!

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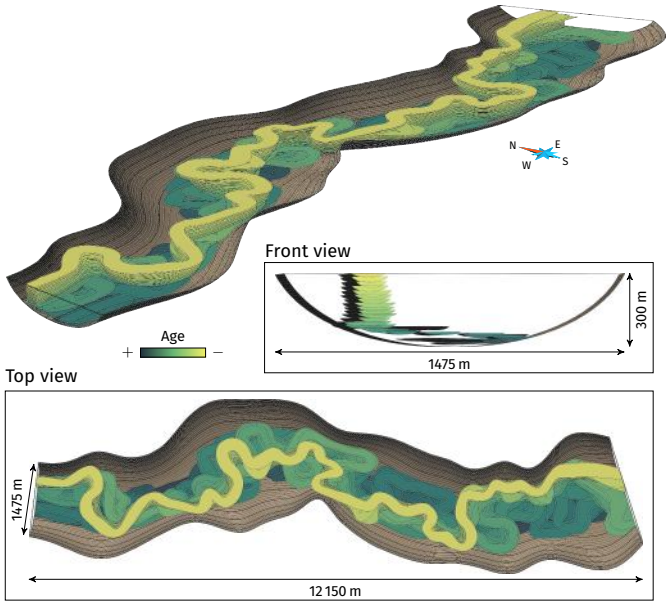
Upcoming PhD defenses

Guillaume Rongier, March 15^{th}.

Connectivity of channelized sedimentary bodies: analysis and simulation strategies in subsurface modeling.

This work aims at better estimating and reproducing the connectivity when simulating channels. First, we developed a methodology to objectively compare channel simulations by focusing on the connectivity. Second, we propose a new method to simulate channels while preserving at best the connectivity. This method relies on a formal grammar system to simulate the channels and on geostatistical simulation to migrate the channels.



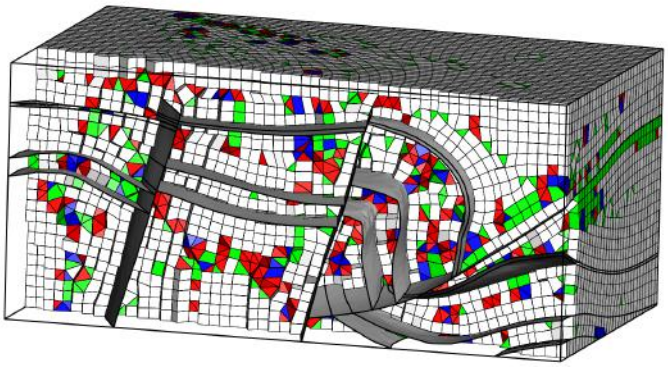
The presented model shows channels evolving within a master channel, a nested structure often seen in turbiditic environments. The master channel results from a L-system simulation materialized by NURBS surfaces. The channels result from a stochastic migration process based on sequential Gaussian simulation. Lateral migration dominates a first migration phase at the bottom of the master channel. Aggradation dominates the second phase at the top of the master channel. This two-phase development affects the channel stacking, so the connectivity between the channels.

This work will be defended both at the University of Lorraine and at the University of Neuchatel. Many thanks to external committee members: Klaus Mosegaard, Thierry Mulder, Michael Pyrcz, Julien Straubhaar, Vanessa Teles, Gregoire Mariethoz and Sebastien Strebelle for their time and expertise.

Arnaud Botella, April 1^{st}.

Unstructured volumetric meshing of geological models for physical phenomenon simulations.

The objective of this thesis is to develop volumetric meshing methods for geological models. We propose a volumetric unstructured meshing method to build two mesh types: an adaptive tetrahedral mesh and an hex-dominant mesh (*i.e.* made of tetrahedra, triangular prisms, quadrilateral pyramids and hexahedra).



The Figure shows an hex-dominant mesh made from a geological model of the Corbières area (Pyrénées, France). The mesh is the result of the tetrahedral recombination algorithm developed during the PhD. It is made with 12% of tetrahedra (red), 6% of pyramids (blue), 10% of prisms (green) and 72% of hexahedra (white).

Many thanks to external PhD committee members: Jean-Francois Remacle, Jean Virieux, Adrien Loseille and Geraldine Pichot for their time and expertise.

About PhD defenses

- PhD oral presentations will be recorded and available on-line at the RING channels
- Training and applications related to these work are available for sponsors on our website (http://trainings.ring-team.org).

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Welcome!

Pierre Anquez

Surface model repair and automatic creation of sealed geological models.

Pierre graduated from the ENSG Nancy in 2015 and recently joined the RING team as a new PhD student. The topics of his thesis is about automatic creation of watertight geologic models, at the crossroads between geomodeling, geometry processing and topology. Guillaume Caumon, Bruno Lévy (INRIA, Alice team) and Jeanne Pellerin (post-doctoral researcher in WIAS-Berlin) supervise his thesis.

During his free time Pierre likes running, which he has been for long practicing for fun but with now a brand new goal: participate to a competitive half-marathon.

Modeste Irakarama

Reduction of structural uncertainties associated with faults by waveform inversion.

Modeste holds a master's degree in numerical geology from ENSG-Nancy. He joined the RING team in December 2015 as a PhD student to work on structural uncertainties the arise from poorly imaged fault zones. In particular, his work aims at proposing an ensemble of acceptable structural models by minimizing waveform misfits. Modeste is advised by Guillaume Caumon Paul Cupillard and Paul Sava (Colorado School of Mines).

In his spare time, Modeste enjoys watching animated films and running.

New Secretary

Sophie Romain will be in charge of the RING administrative work until Fatima comes back from her maternity leave.

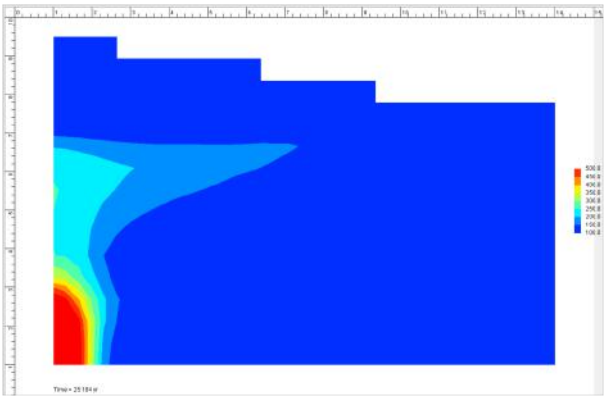
Margaux Raguenel

Flow simulation in fractured reservoirs on unstructured meshes.

Margaux is a new PhD student who will work on flow simulations in fractured reservoirs, especially on geothermal reservoirs. After a master's degree in Numerical Geology at the ENSG in Nancy, she realized a research internship with Total E&P UK on taking structural frame into account during the stochastic simulation of fault networks. She first joined the team with a short-term project on cutting a tetrahedral mesh by an implicit surface. Her PhD is part of the GEOTREF project, which will lead to collaborations with academic and industrial partners. Margaux is advised by Francois Bonneau, Thomas Driesner (ETH Zurich) and Judith Sausse.

Outside of the lab, she plays badminton and watches a lot of movies and TV shows.

The following simulation is the base case for a sensitivity analysis that aims at determining the impact of petrophysical parameters and geological heterogeneities on the hydrothermal behavior of a natural system.



The picture shows the thermal profile due to the cooling of a 900 °C pluton (bottom left) after 25000 years of cooling. The cooling simulation has been done with HYDROTHERM (USGS, Ingebritsen & Hayba, 1994).

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About Research

Jonathan Edwards will present his work at the EAGE "Second Conference on Forward Modelling of Sedimentary Systems " in Trondheim (25-28 April 2016). He will present a method to output correlations of stratigraphic columns by searching for probabilities of stratigraphic units associations in a training model built by forward stratigraphic modeling. Since the first RING meeting, some functionalities has been added. The method is now able to automatically build geomodels from stochastic correlations.

Marion Parquer will present her work both at the 78^{th} EAGE Conference and Exhibition in Vienna (Austria) in May 2016 and in the GEOSTATS2016 conference in Valencia (Spain) in September 2016. She will present a stochastic backward migration method of the main channel integrating oxbow lakes and point bars which has been observed on the seismic image. As a first proof of concept, this method has been applied on satellite images of the Tyung river (Russia). This area presents an interesting channel belt more or less preserved. The first results are quite encouraging and permit to approach the underground architecture of a reservoir.

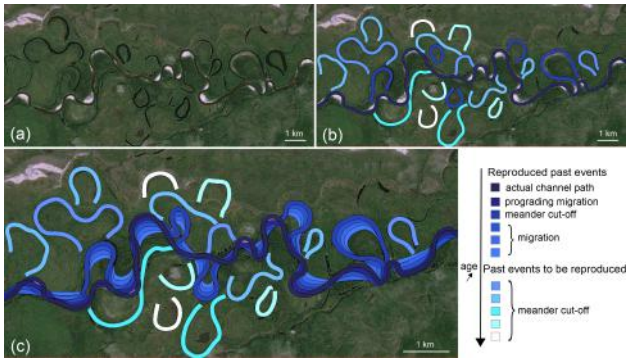

Figure 1. (a) Satellite image of the Tyung meander belt river (Russia). (b) Digitization of all the oxbow lakes and of the main channel path. Relative ages of oxbow lakes. (c) Proposition of a potential paleo-channel path of the system incorporating some of the abandoned meanders and reproducing some horizontal migration and progradation.

Benjamin Chauvin will give a talk at the AAPG Conference and Exhibition in Calgary (Canada, 19-22 June 2016). The presentation is entitled :

> *"Defining proper boundary conditions in 3D structural restoration: a case study restoring a 3D forward model of suprasalt extensional structures."*

It will be about how defining physically consistent boundary conditions for 3D mechanics-based restoration. This work is applied on an extensive context analog model obtained from a sand box deformed in laboratory (see the model on the first page of this letter). This work have been done in collaboration with Chevron Corporation and Harvard University.

Antoine Mazuyer will present his work at the 7th International Symposium on In-Situ Rock Stress, in Tampere (Finland 10-12 May 2016). The title of the oral presentation is:

> *"Stress Estimation in reservoirs by a stochastic inverse approach"*

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Key Features

On October 6^{th}, 2015, Guillaume Caumon gave a keynote presentation on Accurate geological modeling for subsurface applications and the need for uncertainty assessment at GeoBerlin, the annual meeting of the German Geological Society-Geological Association (DGGV) and German Mineralogical Society (DMG).

Meet us!

- 78^{th} EAGE Conference and Exhibition in Vienna.
  - François Bonneau
  - Modeste Irakarama
  - Marion Parquer
- AAPG 2016 Annual Convention and Exhibition in Calgary.
  - Benjamin Chauvin
- Second EAGE Conference on Forward Modelling of Sedimentary Systems in Trondheim.
  - Jonathan Edwards
- 7^{th} International Symposium on In-Situ Rock Stress in Tampere.
  - Antoine Mazuyer

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