Mitacs Globalink 2021 Project Submission

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Project Information

Project ID	**22795**
Project Title	**Deformable plate tectonic modelling of passive margins**
Project Status	**Submitted**
Number of openings	**2**
Preferred Student's Academic Background	**Geology, Earth Science, Physics, Computer Science**
Preferred internship start date	**2021-05-31**
Start Date is Flexible	**Yes**
Languages	**English**

If the project requires that the intern speaks a language in addition to English or French in order to conduct the research, please specify the language(s):

Please provide a brief description of your specialized research area:
I am a structural geologist focusing on deformation processes, and associated hazards as well as natural resources. Much of my research focuses on the structural, tectonic and magmatic evolution of rifted margins but I also work on geological hazards. My work to date has largely focused on the continental margins of the North Atlantic and surrounding regions, but I also work on projects focused on the continental interiors such as the causes of intraplate seismicity and magmatism. My work requires a multifaceted approach incorporating field-, computer, and lab-based studies.

Please provide a brief description of the research project:
Since the advent of plate tectonic theory, following the concept of continental drift, a considerable effort has been devoted to understanding the past locations and movements of tectonic plates, as well as the mechanisms driving their movement. However, significant poly-phase deformation occurs in adjacent continental domains prior to, simultaneously with, and after continental breakup which is not typically accounted for in traditional 'rigid' -type models. Constraining this deformation is essential for understanding the regional development and the mechanisms driving and controlling rifting and breakup. In this project the student will primarily use published constraints to construct deformable plate tectonic models for the East African conjugate margins of Madagascar and

Somalia/Kenya/Tanzania using GPlates, an open source plate tectonic modelling environment. The aim of this work is to test both the capability of the GPlates deformable modelling approach and the published model inputs, including time and location of necking zones and earliest oceanic crust. In addition, the student will experiment with the inclusion of independent micro-continental fragments (e.g. Comoros microcontinent and the Bur region in Somalia) and locally defined limits of continental crust, which are hypothesised to strongly influence deformation. The results also allude towards a complex poly-phase progression of rifting that led to the formation of continental fragments surrounding the Western Somali Basin. These deformation episodes are likely linked to changes in plate kinematics and had significant consequences for the age and crustal makeup of the Somali margin.

Please describe the required skills/background of the student:
This project is intended for a student in geophysics, geology, Earth Sciences or a related discipline. Previous experience with computation aspects of Earth Sciences and in particular exposure to plate tectonic modelling and reconstructions is desirable (e.g., GPlates). This experience could either be in the form of taught university courses or independent projects and/or work experience. Whilst not essential, experience working with GPlates specifically would be considered a substantial benefit.

Please describe the required role of the student:
This project will be 100% computer-based and undertaken on the McMaster University campus in Hamilton, Ontario, making use of the computational infrastructure already in place. The student will use GPlates to investigate the kinematics of Gondwanas dispersal. GPlates is an open-source, interactive, plate-tectonic reconstruction environment that can either be accessed through the graphical user interface (GUI), or through the Python library, 'pygplates'. In this project the student will use published constraints in the GPlates GUI environment to construct deformable plate tectonic models for the East African conjugate margins of Madagascar and Somalia/Kenya/Tanzania. The aim of this work is to test both the capability of the GPlates deformable modelling approach and the published model inputs, including time and location of necking zones and earliest oceanic crust. First, the student will be expected to obtain constraints for models from the literature such as locations of key structures for example basin-bounding faults and continent-ocean boundaries/transitions. This will involve an extensive and systematic literature review. Next, the student will construct deformable plate models in GPlates that include variable parameters for pre-rift crustal thickness, age of rift onset and the locations of key structural features. In addition, the student will experiment with the inclusion of independent micro-continental fragments (e.g. Comoros microcontinent and the Bur region in Somalia) and locally defined limits of continental crust, which are hypothesised to strongly influence deformation. The results will allow us to unravel the complex poly-phase progression of rifting that led to the formation of continental fragments surrounding the Western Somali Basin. These deformation episodes are likely linked to changes in plate kinematics and had significant consequences for the age and crustal nature of the Somali margin. The project deliverables will be a temporally constrained crustal thickness and deformation model, with accompanying GPlates rotation file for the East African margin.

Activities

Please indicate how frequently the Globalink Research Intern will be engaged in the following activities during their research internship:

Analyzing data or information:
Always

Conducting surveys or administering questionnaires:
Never

Conducting interviews:
Never

Creating drawings, models, or designs:
Very often

Gathering information from archives, published works, documents, or recordings:
Very often

Making observations outside of a laboratory or controlled environment:
Never

Performing controlled experiements:
Often

Programming, scripting, or coding:
Very often

Reading research literature:
Very often

Solving mathematical problems:
Very often

Using hand or machine tools, laboratory equipment, or scientific instruments:
Never

Writing reports:
Very often

Meeting or discussing with the supervisor:
Very often

Working on tasks that require teamwork:
Very often

Locations

Will the entirety of the research project take place at the university campus location indicated in your Profile?
Yes

Additional Comments

If you have any additional comments, please provide them here:

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