Mitacs

Mitacs Globalink 2021 Project Submission

Project Information

Project ID	**22796**
Project Title	**The kinematics of continental breakup: Examination of Indian vs Atlantic Ocean spreading and interplay during Gondwana dispersal using the pyGplates Python library**
Project Status	**Submitted**
Number of openings	**2**
Preferred Student's Academic Background	**Geology, Physics, Computer Science, Earth 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, considerable effort has been devoted to reconstructing the past locations and movements of tectonic plates, and the mechanisms driving this movement. To interact with plate tectonic reconstructions specialised computational environments have been developed. However, although recent compilations of global plate kinematic histories have produced an ever-increasing understanding of plate tectonic processes, they have also led to heightened model complexity. As the timespan, size and complexity of plate reconstructions has increased it has been necessary to develop and

implement methods to visualise, model, and manipulate reconstructions to extract information to test geological hypotheses. One such widely used plate reconstruction application is GPlates. This open-source software has a Python interface known as pygplates that will be used in this project to investigate the kinematics of Gondwana's dispersal. The motivation for this is that despite the development of such tools questions remain regarding supercontinent dispersal kinematics. For example, although it is well-established that spatially separate but temporally coincident events may be linked, identifying such links in the geological record, and understanding the causal mechanisms remains speculative. As such, in this project an analysis of Indian and Atlantic Ocean opening during Gondwana's dispersal will be undertaken. These two oceans were chosen as they opened simultaneously and thus it is plausible that their histories are linked. The hypothesis that spreading in the Indian and Atlantic Oceans was coupled during the dispersal of Gondwana will be tested through analysis of plate kinematics extracted using pygplates. The interplay, and competition, between these two oceans has profound implications for our understanding of supercontinental dispersal as it shows how multiple breakup axes may interact to influence resultant continental configurations. In addition, this project will investigate how collision between India and Asia may have influenced the geographically distant opening of the Atlantic Ocean.

Please describe the required skills/background of the student:

This project is intended for a student in geophysics, computer science, mathematics, physics, data science or a related discipline. Previous experience programming, and in particular working with Python is required. In addition to experience working with Python, previous experience of 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 pygplates 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 with the associated pygplates Python library 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'. The student will use pygplates as this allows specific attributes to be extracted from reconstructions. An application of this is that the kinematics of poorly understood geological processes (such as supercontinent dispersal) can be quantitatively studied. Initially, the student will obtain a working knowledge of the GPlates environment, including both the GUI and pygplates library, as well as building an understanding of the components and limitations of Mesozoic plate tectonic reconstructions. The student will then compile, compare, and contrast different reconstructions of Gondwana's dispersal from the literature. The next stage will be to develop a pygplates code that can be used to extract key kinematic parameters from the plate models. These kinematic parameters will initially include angular velocity, latitude/longitude and velocity magnitude, but later iterations will include the ability to examine the obliquity of plate divergence during rifting and spreading. These kinematic attributes will be used to examine cotemporaneous breakup events with a focus on the role Indian vs. Atlantic Ocean spreading. This will allow the kinematics of spatially separate but temporally coincident events to be compared and develop further understanding of Gondwana's disintegration. The primary project deliverable will be quantitative comparison of Indian and Atlantic Ocean opening which will be in the form of a written report, accompanying dataset, and Python code utilising pygplates, all of which may contribute towards future publications.

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:

Always

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

Always

Making observations outside of a laboratory or controlled environment:

Never

Performing controlled experiements:

Very often

Programming, scripting, or coding:

Always

Reading research literature:

Very often

Solving mathematical problems:

Always

Using hand or machine tools, laboratory equipment, or scientific instruments:

Never

Writing reports:

Very often

Meeting or discussing with the supervisor:

Always

Working on tasks that require teamwork:

Always

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: