

PHD PROPOSAL FOR THE DOCTORAL SCHOOL

« Ecologie, Géosciences, Agronomie, Alimentation »

GENERAL INFORMATION

Thesis title: Dynamics of the Okavango rift system (Botswana): couplings between geodynamics, climate, and impact on the ecosystem
Acronym: DYRO
Disciplinary field 1: Geosciences Disciplinary field 2: Select an element
Three keywords: deformation, climate change, water resources, ecosystem
Research unit: Geosciences Rennes
Name of the thesis director: Dauteuil Olivier Email address of the thesis director: olivier.dauteuil@univ-rennes1.fr Name of the thesis co-supervisor 1 (if applicable): Jolivet Marc Email address of the thesis co-supervisor 1 (if applicable): marc.jolivet@univ-rennes1.fr Name of the thesis co-supervisor 2 (if applicable): Corgne Samuel Email address of the thesis co-supervisor 2 (if applicable): samuel.corgne@univ-rennes2.fr
Thesis grant (funding origin and amount):
Contact(s) (mailing address and E-mail):
Recruitment process: Recruitment process depends on thesis funding. To select the corresponding recruitment process, please visit the EGAAL website here . This information is needed for proposal publication. <input checked="" type="checkbox"/> Doctoral school contest <input type="checkbox"/> Interview <input type="checkbox"/> Other (indicate) :

SCIENTIFIC DESCRIPTION OF THE PhD PROJECT

Socio-economic and scientific context

The East African rift system propagates SW into the southern African plateau through the Kariba rift until the Okavango graben, the ultimate structure of this extensional feature. This propagation generated the endorheic system of Okavango, which is a hot-spot of biodiversity classified as World Heritage by UNSECO, and an important economic resource. The dynamics of this system is controlled by two main processes: the regional geodynamics and climate. Recent studies [Pastier et al., 2017; Chisenga et al., 2019] show that the propagation takes place with a significant strike-slip component and that the deformation is not localized only in the graben but also affects a larger region located to the south (Makgadikgadi pan) with significant seismicity [Moore et al., 2021; Materna et al., 2019]. The climate is the second major factor in the dynamics of the region. Indeed, every year a significant flood invades the Delta, and takes several months to travel the 170 km separating the apex from the toe of this alluvial fan. 98% of this water disappears by evapotranspiration and underground storage, the remainder being evacuated in the Makgadikgadi pan which constitutes the base level of the complete system [McCarthy, 2013]. In addition to the water inputs necessary for the development of the ecosystem, the circulation of water participates in the internal redistribution of sediments (mainly sands) and in the transport of dissolved elements, and therefore constitutes the key parameter of the geoecosystem. The amplitude of this flood varies enormously from year to year (by a factor of 5), so its impact varies greatly.

Assumptions and questions

We propose to assess the overall dynamics of the Okavango rift system in its integrity, considering both the Okavango graben and the Makgadikgadi pan, the two objects being, unfortunately, often studied separately, while they are intimately linked. We intend to carry out a fine characterization of the deformation of the entire zone in order to deconvolve the contribution of the different processes (geodynamics, seismicity, hydrology) at different time scales. This will make it possible to better constrain the processes and their coupling at the origin of the variability of this dynamic. For example, the Delta sensus stricto, presents zones in draining and others in flooding: is this evolution due to processes of avulsion of the alluvial fan, to regional geodynamics (fault activity), to human activity and / or wildlife? This question is fundamental in optimizing the management of this very sensitive ecosystem.

The main steps of the thesis and scientific procedure

- Morpho-structural mapping of the Okavango rift and the Makgadikgadi pan: remote sensing processing, DEM analysis
- Deformation quantification by InSAR interferometry (data in process)
- Multi-year assessment of variations in flood propagation: analysis of Sentinel images
- Numerical modelling of the deformation induced by flood loading.
- Assessment of the contributions of the different processes (climate, geodynamics, sediment transfers) to the overall dynamics of the region

Methodological and technical approaches considered

Several methods will be deployed: detailed structural mapping (Géosciences Rennes), deformation analysis by INSAR (EOST) and GNSS (Géosciences Rennes, EOST), volumetric temporal monitoring of flood propagation (LETG), digital modeling of deformation induced by hydraulic head and regional geodynamics (Géosciences Rennes). The ecosystem impact assessment will be done by Botswana colleagues and LETG. When sanitary conditions will become normal, field trips will be done.

Scientific and technical skills required by the candidate

The candidate should have the following skills: structural mapping, Geographic Information System, image processing. An experience in deformation analysis by InSAR would be appreciated.

THESIS SUPERVISION¹

Unit name: Geosciences Rennes	Team name: Paleo2D
Unit director name: O. Dauteuil	Team director name: S. Bourquin
Mailing address of the unit director: Olivier.dauteuil@univ-rennes1.fr	Mailing address of the team director: Sylvie.bourquin@univ-rennes1.fr
Thesis director Surname, first name: Dauteuil Olivier Position: Research director Obtained date of the HDR (Habilitation thesis to supervise research): 1998 Employer: CNRS Doctoral school affiliation: EGAAL Rate of thesis supervision in the present project (%): 40 Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 0 Number of current thesis supervisions/co-supervisions: 0	
Thesis co-supervisor 1 (if applicable) Surname, first name: Jolivet Marc Position: Research director Habilitation thesis to supervise research <input checked="" type="checkbox"/> yes <input type="checkbox"/> no If yes, date diploma received: 2009 Employer: CNRS Doctoral school affiliation: EGAAL Rate of thesis supervision in the present project (%): 30 Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 0 Number of current thesis supervisions/co-supervisions: 0	
Thesis co-supervisor 2 (if applicable)	

¹ In EGAAL Doctoral School, if only one scientist in thesis supervision = 100% of supervision rate; if 2 people involved in thesis supervision = from 50% to 70% of supervision rate for the director; if 3 people involved in thesis supervision = 40% / 30% / 30% of supervision rate distribution among supervisors.

Surname, first name: Corgne Samuel

Position: Professor

Habilitation thesis to supervise research yes no If yes, date diploma received: 2014

Employer: university of Rennes 2

Doctoral school affiliation: STT

Rate of thesis supervision in the present project (%): 30%

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

Private partner (if CIFRE funding, private funding,...)

Surname, first name:

Position:

Employer:

Rate of thesis supervision in the present project (%):

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

International partner (if Cotutelle thesis)

Surname, first name:

Position:

Employer:

Rate of thesis supervision in the present project (%):

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

Professional status of previous PhD students supervised by both director and co-supervisors (from 5 years)

Surname, first name: Pastier Anne-Mouwenn

Date of PhD beginning and PhD defence: 10/2014 -2/2028

Thesis supervision: O. Dauteuil, F. Moreau

Professional status and location: Post-doctorat – GFZ Potsdam

Contract profile (post-doc, fixed-term, permanent): post-doc

List of publications from the thesis work:

A.-M. Pastier, O. Dauteuil, M. Murray-Hudson, F. Moreau - Toward of new geodynamic model

of Okavango Delta: geodetic analysis and geophysics review. *Tectonophysics*, 712-713, 469-481
<http://dx.doi.org/10.1016/j.tecto.2017.05.035>, 2017.

Surname, first name : Dovchintseren Dagvasuren

Date of PhD beginning and PhD defence : 09-2017 / 12-2018

Thesis supervision : M. Jolivet – R. Braucher

Professional status and location : Uncknown

Contract profile (post-doc, fixed-term, permanent) :

List of publications from the thesis work :

Jolivet M., Braucher R., Dovchintseren D., Hocquet S., Schmitt J-M., and ASTER Team. The Tavan Har mountain (Gobi, Mongolia): A natural example of a 50 km-scale morphology controlled by wind flows around an obstacle. *Geomorphology*, in press.

Surname, first name: Morin Julien

Date of PhD beginning and PhD defence: 09-2016 / 09-2019

Thesis supervision: M. Jolivet

Professional status and location: CDD ENEDIS (Pau)

Contract profile (post-doc, fixed-term, permanent):

List of publications from the thesis work :

J., **Jolivet M.**, Robin C., Heilbronn G., Barrier L., Bourquin S., and Jia Y., 2018, Jurassic paleogeography of the Tian Shan: an evolution driven by far-field tectonics and climate. *Earth Science Reviews*, 187, 286-313.

J., **Jolivet M.**, Barrier L., Laborde A., Haibing Li., and Dauteuil O., 2019, Planation surfaces of the Tian Shan range (Central Asia): Insight on several 100 Myrs of topographic evolution. *J. Asian Earth Sci.*, 177, 52-65.

Morin J., **Jolivet M.**, Shaw D., Bourquin S., and Bataleva E., 2020, New sedimentological and palynological data from the Yarkand-Fergana Basin (Kyrgyz Tian Shan): Insights on its Mesozoic paleogeographic and tectonic evolution. *Geoscience Frontiers*, 12(1), 183-202.

Five main recent publications of the supervisors on thesis subject:

C. Picart, **O. Dauteuil**, F. Guillocheau, M. Pickford, F. Mvondo Owono - Cenozoic deformation of the South African plateau, Namibia: Insights from planation surfaces, *Geomorphology*, 350, 1, <https://doi.org/10.1016/j.geomorph.2019.106922>, 2020.

A.-M. Pastier, **O. Dauteuil**, M. Murray-Hudson, F. Moreau - Toward of new geodynamic model of Okavango Delta: geodetic analysis and geophysics review. *Tectonophysics*, 712-713, 469-481
<http://dx.doi.org/10.1016/j.tecto.2017.05.035>, 2017.

- **O. Dauteuil**, C. Picart, F. Guillocheau, M. Pickford, B. Senut - Cenozoic deformation and geomorphic evolution of the Sperrgebiet area (Southern Namibia). *Communications of the Geological Survey of*

Namibia. 18, 1-18, 2018.

Jolivet M., Dauteuil O., Barrier L., Audran A., Radenac A., and Murray-Hudson M. Landscape dynamics of the Okavango Delta (Botswana): a regressive erosion model. *Geomorphology*, in review.

Jolivet M., Dauteuil O., Radenac A., Blowing the rivers: regional-scale control of the drainage network by wind in northern Kalahari (Africa). *Aeolian Research*, in review.

THESIS FUNDING

Origin(s) of the thesis funding: PhD agreement of university of Rennes 1

Gross monthly salary: 1 770€

Thesis funding state : Non acquired

Funding beginning date/Funding ending date: 01/10/2021 / 3 ans

Date: 17 Mars 2021

Name, signature of unit director:



Name, signature of team director: Sylvie BOURQUIN



Name, signature of thesis project director:

