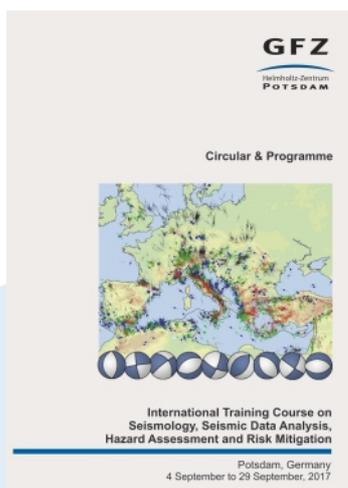




### International Training Course 2017



The GFZ section Physics of Earthquakes and Volcanoes carries out annual training courses on "Seismology and Seismic Hazard Assessment". These courses are part of the educational and training program of the UNESCO in the field of geosciences and disaster mitigation.

The courses provide theoretical fundamentals and practical training in applied seismology, especially for geoscientists and technicians from developing countries. The program is particularly useful for seismological

station and network operators, data interpreters and those concerned with seismic zoning and hazard assessment.

The Training Course 2017 will be in Potsdam/Germany. It is being organized for 26 course participants. Interested scientists and engineers can send their application and documents until May 30, 2017.

### Report about the course 2016 in Myanmar



The course 2016 took place in September-October 2016 in Nay Pyi Taw, capital of Myanmar in cooperation with the Department of Meteorology and Hydrology (Nay Pyi Taw, Myanmar). The DMH is responsible for the meteorological, hydrologic and seismic monitoring, hazard assessment and early warning in Myanmar. The invited 27 course participants came from Bangladesh, China, India, Indonesia, Nepal, Philippines, Thailand, Vietnam und Myanmar. The training

course covered the subjects seismology, microzonation, strong ground motion, seismic and tsunami hazard assessment, tsunami wave propagation and tsunami early warning. In the frame of the training course Angelo Strollo and Peter Evens (GFZ Section 2.4) set-up a new real-time connection of the existing broadband instrument in Nay Pyi Taw to the local SeisComp3 analysis computer in the department. The data of this station can be also downloaded from GEOFON ([geofon.gfz-potsdam.de/waveform/liveseis.php?station=NPW](http://geofon.gfz-potsdam.de/waveform/liveseis.php?station=NPW)). During the closing ceremony the course chairman proposed to Dr. Hrin Nei Thiam (Head of DMH) to establish a section "Seismology" and renaming the department to DMHS. Together with the GFZ Potsdam, EOS Singapore, USGS and China the department plans a 2 years project on the distribution of seismic events and the identification of tectonic units in Myanmar.



In the frame of the training course the Moment Tensor of recent earthquakes in Myanmar were re-analysed by the course participants. At the DMH a new SeisComp3 analysis computer was installed and Peter Evens (GFZ) explained the new features to the DMH(S) staff.

### Project Halmahera/Indonesia

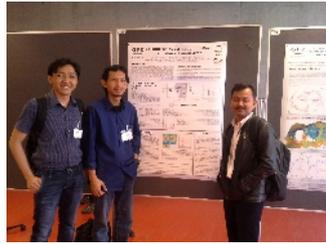
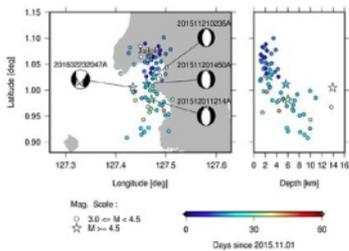


The project on Halmahera (NE Indonesia) aims at the understanding and modeling of an unusual seismic activity

under Halmahera. In 2015-2016 hundreds of felt earthquakes happened in the Jailolo Region, some of them reached M5 (GEOFON <http://geofon.gfz-potsdam.de>). First results indicate that a magmatic dike intrusion is the reason of this seismic sequence (graphic below). This increased seismic and magmatic hazard is being communicated to the government and local authorities.

Project partner is the BMKG ([www.bmkg.go.id](http://www.bmkg.go.id)) who is also partner of the GFZ in the frame of the Tsunami Early Warning Project GITEWS. Together with former course participants and new colleagues we installed a seismic and geodetic temporary network in the region, complemented by 2 volcano gas-monitoring stations.

In addition, a training program accompanies the project. Pak Nova Heryandoko and Pak Rasmid (both BMKG) are visiting the GFZ in 2017. Within the GFZ sections 1.1, 2.1, 2.2 (GIPP), 2.4, and 3.1 are involved in this project.



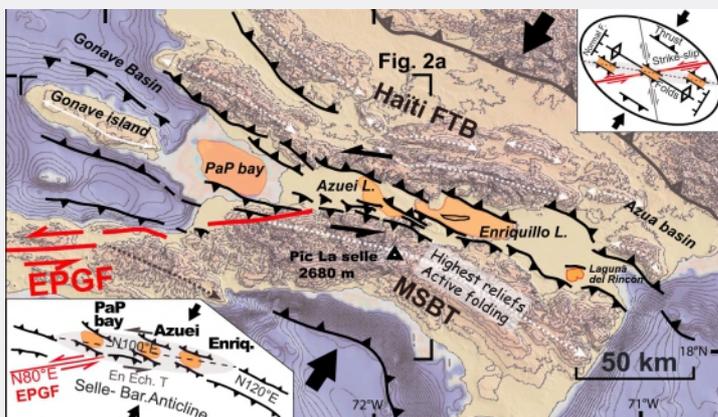
Relocation of seismic events during the seismic swarm indicate a linear structure of the seismic events. Pak Nova Heryandoko (middle) presented his seismological investigations on the seismicity in the Jailolo Bay as poster at the Annual conference of the German Geophysical Society in March 2017.

## Paper published and Forum

### Newdeskarl Saint Fleur - Haiti



The former course participant (2015) Newdeskarl Saint-Fleur published an important article in the *Geophysical Research Letters* (doi:10.1002/2015GL065505) on the seismo-tectonics and seismic hazard of Haiti. The prevailing consensus is that the 2010 Mw7.0 Haiti earthquake left the Enriquillo-Plantain Garden strike-slip fault (EPGF) unruptured but broke unmapped blind north dipping thrusts. Using high-resolution topography, aerial images, bathymetry, and geology, they identified previously unrecognized south dipping NW-SE striking active thrusts in southern Haiti. One of them, Lamentin thrust, cuts across the crowded city of Carrefour, extends offshore into Port-au-Prince Bay, and connects at depth with the EPGF. They propose that both faults broke in 2010. The rupture likely initiated on the thrust and propagated further along the EPGF due to unclamping. This scenario is consistent with geodetic, seismological, and



field data. The 2010 earthquake increased the stress toward failure on the unruptured segments of the EPGF and on neighboring thrusts, significantly increasing the seismic hazard in the Port-au-Prince urban area. The numerous active thrusts recognized in that area must be considered for future evaluation of the seismic hazard.

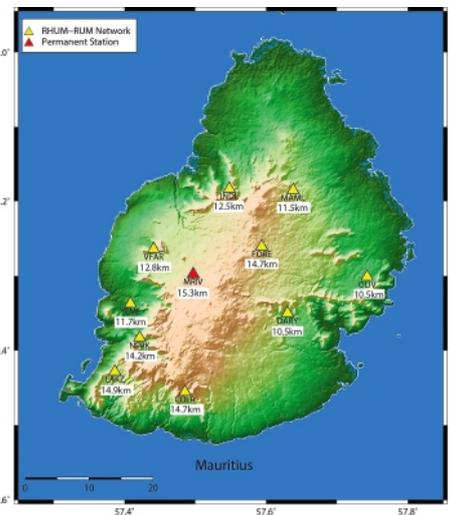
### Manvendra Singh - Mauritius



Manvendra Singh (course participant 2013) is a Research Scientist at the Mauritius Oceanography Institute, Mauritius. He is currently doing his PhD in Seismology at Goethe-Universität, Frankfurt, under the supervision of Prof. Dr. Georg Rumpker. The topics of Mr. Singh's PhD thesis are 'Intra plate seismicity and crustal-thickness variations in the south-west Indian ocean'. For his thesis he is also using array methods to detect and locate events in Mauritius-Rodrigues-CIR region.

Mr. Singh has recently published one paper in an international journal. Singh, M., A. Kaviani, and G. Rumpker (2016), The crustal structure beneath Mauritius from teleseismic P receiver functions: Oceanic or continental?, *Geophys. Res. Lett.*, 43, 9636–9643, doi:10.1002/2016GL070529.

The title of the recently published article was on crustal structure beneath Mauritius, a topic of debate. For this study, we used data from 10 temporary stations deployed in Mauritius under the RHUM-RUM project (www.rhum-rum.net) in addition to one permanent station. By applying the H-k stacking technique (Zhu & Kanamori,



2000) to 382 P-receiver function obtained from the data, we derive crustal thicknesses of approximately 10–15 km (Figure 1). We also observed lack of clear multiples on our data, which we explained by presence of a transitional Moho, where the velocity increases gradually. Our findings suggest oceanic crust thickened by crustal underplating due to the mantle plume currently located beneath La Réunion. This is in contrast to some recently published theories about the existence of microcontinent 'Mauritia' beneath Mauritius, based on the zircons (~3200Ma) found on the island of Mauritius.

The presence of zircons on the island can be explained by the presence of fragments of previously delaminated continental lithosphere entrapped in asthenosphere, as was shown for the zircons (53-3200Ma) found on the Mid Atlantic Ridge. The existence of such fragments for long duration is also supported by the anomalous sulphur isotopes observed in plume lavas. A similar explanation may be given for the presence of zircons in Mauritius. Moreover, our results show a remarkable difference in the reported Moho depths in comparison to the Seychelles microcontinent (~33km) which also exhibits granitic outcrops, not observable in Mauritius. With all the previous data and results, including that of the present study from the island of Mauritius, we favor the existence of thickened (underplated) oceanic crust.

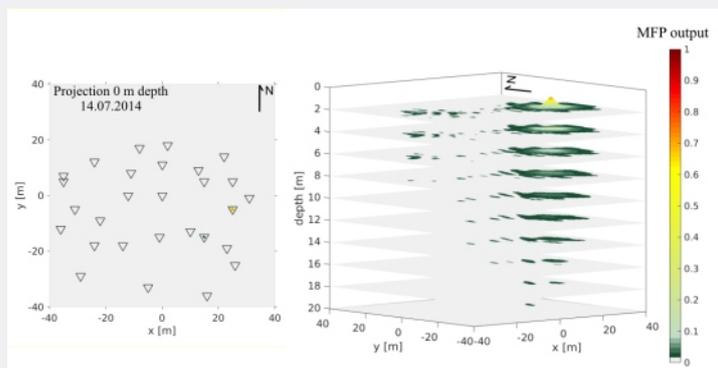
## Working in Leipzig - Hortencia Flores Estrella



I took part in the International Training Course "Seismology and Seismic Hazard Assessment" in 2009 in Potsdam, Germany, just after finishing my PhD in Mexico City in Seismology. For me it was quite interesting to meet personally some of the authors who I had referenced in my PhD work. But also, to come in contact with seismologist from 16 different countries with different seismological conditions and problems to solve, was an exceptional experience.

The impact of the course and the stay in Germany was so big, that I decided to apply for a postdoctoral scholarship to the DAAD, which allowed me to return to Germany in summer 2010.

Nowadays, I work in the Institute for Geophysics and Geology of the University of Leipzig as a Geoscientist. I still do my work using seismic noise records with two main objectives: to obtain the velocity structure of the near surface subsoil, or to localize and characterize seismic noise sources produced by natural CO<sub>2</sub> degassing areas in the Czech Republic as shown in the Fig. (Flores-Estrella et al., 2016).



Instrumental array projections and Matched Field Processing, MFP, normalized output for the noise measurement campaigns on a mofette field (CO<sub>2</sub> degassing point) in the NW Bohemia/Vogtland Region, Czech Republic. The triangles in the xy projections correspond to the stations. The distribution of the MFP maximum with the depth shows what seems to be a fluid pathway.

Flores-Estrella, H., Umlauf J., Schmidt A. and Korn M. 2016. "Locating mofettes using seismic noise records from small dense arrays and Matched Field Processing Analysis in the NW Bohemia/Vogtland Region, Czech Republic". Accepted in *Near Surface Geophysics*.

## Elisa Josiane Rindrarisaona - Madagascar

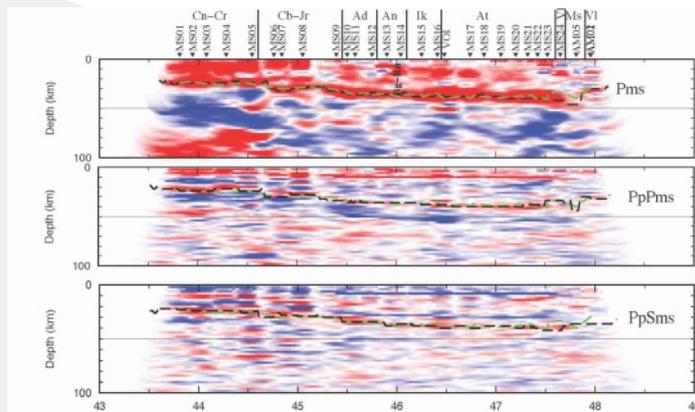


I am currently working at the section 2.4 at the GFZ as Humboldt Postdoc fellow (Working with Prof. F. Tilmann). The objective of my project is to study the lithosphere structure in the southern part of Madagascar using different seismological methods including P and S-waves receiver functions, ambient noise correlation, surface wave tomography and

joint inversion of receiver function and surface wave dispersion. The study of the crustal structure in the southern part of Madagascar using different seismological methods was finished and published in the GJR.

Currently I am working on the surface wave tomography to study the upper-mantle structure beneath Madagascar. Then, I will be studying the seismic hazard/attenuation in Madagascar, in which I will work with Prof. F. Cotton (Section 2.6).

I was attending the courses in 2013 when finalizing my DAAD application with my supervisor (Prof. F. Tilmann). I got one year fund as long term scientist through DAAD scholarship, started in October 2014. When I came here at GFZ, I applied to the Humboldt foundation and got two years fund. My experience at the GFZ has been great, all people in my section are very helpful and friendly. Also, I have given an opportunity to learn German language for 3 months before my DAAD scholarship, and few months evening courses in the beginning of my Humboldt fellowship. Speaking German makes life easier and more sociable, especially outside the institute.



Stacking image for the receiver functions along the main profile migrated for directly converted phase (top) Ps and for the two multiples (middle) PpPs and (bottom) PpSs+PsPs. Positive and negative velocities contrasts are shown in red and blue, respectively. In each panel, black lines indicate the maximum Moho amplitude. The green lines show the Moho obtained from the H-k stacking for comparison.

(JGR, 10.1002/2016JB013565; Crustal structure of southern Madagascar from receiver functions and ambient noise correlation: Implications for crustal evolution)

## Former course participants as visitors at GFZ



In March 2017 Valentina Protopopova and Najib Kakar visited the GFZ. We spoke about possible future cooperation and additional seismic GEOFON stations in Afghanistan. Najib is also cooperating with section 4.1 (Dr. B. Schurr and Dr. S. Kufner) on temporary seismic station deployments, investigating the slab break-off in the Hindu-Kush Region.

## Contact

Helmholtz Centre Potsdam  
GFZ German Research Centre for Geosciences  
Dr. C. Milkereit  
Telegrafenberg, 14473 Potsdam/Germany  
Phone: (+49 331) 288 -1289 or -1201  
Fax: (+49 331) 288 -1296 or -1204  
E-mail: course-un@gfz-potsdam.de