Position Profile for Chinese Applicants running for 2019 Helmholtz – OCPC – Program

PART A (Info about the Position)
Helmholtz Centre and institute: Deutsches Elektronen-Synchrotron DESY

Title of the project: Acoustic emissions testing in the Large Volume Press at beamline P61B to explore dehydration-induced brittle faulting in representative Earth materials.

Project leader: Dr. Robert Farla, beamline manager at P61B.

Web-address: http://tiny.cc/petra3p61

Description of the project (max. half page)**:**
The candidate will explore the origin of acoustic emissions (AE) in deforming candidate hydrous rock samples, typical of subduction zone settings, using the Large Volume Press (LVP) at P61B. There is reasonable suggestion that AE (i.e. nano-quakes), produced in the laboratory due to deformation, can be scaled up to explain earthquakes. In recent years, increased efforts have been made to simulate the conditions that produce AE in candidate Earth materials at relevant pressures and temperatures in the LVP [e.g. 1 and references therein]. It appears dehydration reactions and phase transitions are key processes responsible for AE (and thus earthquake genesis) [e.g. 2]. However, much remains unknown. For example, the strength of the top layer of the Earth, namely the crust and upper lithosphere is governed by a frictional relationship called Byerlee's law. Typically, the coefficient of friction in the friction law is largely independent of rock type and is too high to allow frictional sliding under pressure at greater depths. However, in the presence of a pore fluid resulting from dehydration reactions, the normal stress is reduced and the Mohr–Coulomb criterion for shear failure is satisfied. The result is brittle faulting, which may or may not be accompanied by AE. Note, that in the laboratory, these emissions are ultrasonic (MHz) in character due to restrictions in sample size (mm-scale) in the LVP. The AE, when produced, are measured using piezoelectric sensors on the back of the anvils and processed using seismic software to confirm the AE events occurred in the sample volume, and exhibit a moment magnitude distribution similar to real earthquakes. Additional requirements include the observation of an associated stress drop (observed using in situ X-ray diffraction techniques), and observation of a large crack with an expected offset (using X-ray radiography and/or post-mortem electron microscope imaging). If all criteria are met, scaling laws may be invoked to explain the origin and nature of large, intermediate and deep-focus earthquakes. Hence, the experimental technique, when implemented correctly, can provide answers to understanding the nature of earthquakes.

[1] Schubnel, A., *et al.* (2013) *Science.* DOI: 10.1126/science.1240206.
[2] Ferrand et al. (2017) *Nature Communications*. DOI: 10.1038/ncomms15247.

Required qualification of the post-doc:

- PhD in Earth Sciences, Materials Science, Engineering, Physics, or Chemistry.
- Experience with using a Large Volume Press (i.e. multi anvil press) / high-pressure techniques.
- Additional skills in programming (e.g. python) is desirable.

PART B (Materials and Procedures)

The applicants shall submit the following documents to a Chinese postdoc station affiliated to a research institution or a university, after passing through the internal selection, the qualified application shall be forwarded to OCPC, and then to Helmholtz for evaluation:

- Detailed description of the interest in joining the project (motivation letter)
- Curriculum vitae, copies of degrees
- List of publications
- 2 letters of recommendation
- Proof of command of English language

PART C (General Conditions)

Additional requirements on the postdoctoral fellows:

- Chinese citizenship from Mainland China (allows application while staying abroad)
- Max. age of 35 years, PhD degree not more than 5 years by submission of application
- Very good command of English language
- Strong ability to work independently and in a team