Comparative subductology- cracking the code of subduction zone seismic behaviour

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**Background:** Subduction margins produce some of the largest and most destructive earthquakes and tsunami on Earth. Since 2004 >250,000 people have been killed as the direct or indirect result of subduction zone earthquakes. Recent earthquakes (e.g., 2011 Tōhoku-oki, Japan and 2004 Sumatra-Andaman) have demonstrated our poor understanding of the complex behaviour of these fault zones and underestimation of their impact. The discovery of a completely new style of slip mechanism, episodic slow slip events, in which slip occurs faster than the plate motion rate but too slowly to produce seismic waves, is one of the most exciting discoveries in the field of Earth Science of the last two decades. In order to understand how subduction zone earthquakes rupture and to effectively manage and mitigate the hazards they pose, we need to improve our understanding of the processes that govern different styles of subduction zone seismic behaviour. **What makes some subduction plate boundary faults fail in >M9 earthquakes, whereas others slip silently in slow slip events?**

Seismic reflection profile across the Hikurangi subduction margin, New Zealand

**Project Aims:** The aim of this PhD project is to contribute to our knowledge of the mechanics of fault slip by determining the structure and physical properties of subduction margins using active source seismic reflection and drilling data. The PhD student will systematically catalogue the structural and stratigraphic characteristics of subduction margins that experience different styles of seismic behaviour, including margins in New Zealand, Japan and Barbados. The project will seek to find correlations between seismic behaviour and subduction zone properties such as accretionary wedge taper angle, structural style of the incoming plate, incoming sediment lithology and thickness and physical properties of the décollement based on seismic attribute analysis. A new understanding of how subduction characteristics differ between margins which exhibit different styles of seismicity will allow a better assessment of seismic hazard at margins where seismic behaviour is not well constrained. During the PhD there may also be the opportunity to assist in the collection of new seismic data across the Hikurangi margin, New Zealand.
**Methods:** The student will:

1) Build a database of available seismic reflection (2D and 3D), seismic refraction, well data and seismicity data from a number of subduction margins worldwide (e.g. Japan, New Zealand, Costa Rica, Barbados).

2) Conduct seismic stratigraphic interpretations to characterise the upper and lower plates, integrating seismic and well data to assess the structure, lithology and physical properties of the accretionary wedge, incoming plate and décollement.

3) From these interpretations the student will measure geometric characteristics including accretionary wedge taper angle, fault density, fault displacement trends and look for relationships between these properties and seismic behaviour along each margin.

4) The student will then compare and contrast properties from different margins which exhibit contrasting styles of seismic behaviour- are there any characteristics, or combinations of characteristics which correlate with different styles of seismic behaviour?

**Outcomes:** Results will be published in high-profile journals and the PhD student will have the opportunity to present major findings in at least one international conference. This PhD project would suit a student who is interested in structural geology, seismic hazard, tectonics and seismic reflection data interpretation. The student will gain training and experience in the use of Petrel seismic interpretation software. *A passion for science that matters to society is critical.*

**To apply:** Please contact Rebecca Bell (rebecca.bell@imperial.ac.uk), including a CV with your course grades with your email. The closing date for applications is 31st January 2017. The project will be funded by a departmental scholarship (UK and EU nationals only). Overseas students with other sources of funding are also welcome to apply.