Subject offered for a contract starting in September 2011

SUBJECT TITTLE: ***Seismic and tsunami risk studies in the Sumatra Subduction zone from Andaman to Java***

Advisor: **Professor Satish SINGH, singh@ipgp.fr**
Second Advisor/ Supervisor:
Host lab/ Team :
IPGP- Team Geosciences Marines – UMR7154

Financing: Doctoral contract with or without assignment

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Presentation of the subject: (1 or 2 pages)

The Sumatra subduction zone is one of the most seismically active zones on the earth and has experienced three great earthquakes in the last six years, including one of the largest earthquakes of the 21st century on December 26, 2004 (M~9.3) producing a devastating tsunami in the Indian Ocean region, which took more than 230,000 lives and unaccountable loss of properties. The second earthquake (M~8.7) occurred three months later on March 28, 2005 about 150 km SE of the 2004 event. The Earth waited for three years, and then broke again in September 2007 at ~1300 km SE of the 2004 event producing a twin earthquake of magnitudes 8.5 and 7.9 at 12 hours interval, leaving a gap of ~700 km (Mentawai Islands) between the second and third earthquake. A small part of this patch ruptured on October 25, 2010, Mw=7.8 producing a tsunami up to 8 m high on Pagai Islands. Recent geodetic and seismological studies suggest that this gap is fully locked and may produce a great earthquake up to Mw=9 in the coming future.

In order to understand the earthquake and subduction zone processes, and mitigate the seismic and tsunami risks in the region, we have developed a strong partnership with seismic industry who have acquired and provided us with an exceptional quality of deep seismic reflection data (21000 km) covering the whole 4500 km of the subduction system from Andaman Islands to Java, that includes different subduction settings, such as thick sediments in the Bay of Bengal and thin sediments in Java, the ruptured zone and locked zone. These data provide unprecedented seismic images of the subduction zone down to 60 km depth covering the subduction front, accretionary prism, forearc and volcanic arc, which have never been achieved before (Singh et al. 2008; 2011). Since the data are acquired prior to an imminent earthquake in the Mentawai locked zone, they are extremely valuable for seismic and tsunami risk mitigation and can be used to study the pre- and post-earthquake variations.

In this project, we propose to analyse and interpret these data along with earthquake, heat

flow, and bathymetric data to define the earthquake segmentation along the subduction zone, characterize the seismogenic zone and assess the seismic and tsunami risk along the plate boundary. After the two un-expected disastrous earthquakes of the 21st century (Sumatra and Japan), it has become urgent to understand the whole sunduction zone, particularly in the light of the Japan earthquake and its similarity with the Java section. For example, we should be able to answer why a part of the subduction zone is aseismic while the other zone is locked capable of producing a great earthquake. Why we had Mw=9.3 earthquake in 2004 and why we only have Mw=8 near Java so for? What happens when thick sediments are subducted in the Bengal of Bengal as compared to very thin near Java?

References:

Singh, S.C. et al. (2011). Aseismic zone and earthquake segmentation associated with a deep subducted seamount in Sumatra, *Nature Geoscience* **4**, 308-311.

Singh, S.C., Carton, H., Tapponnier, P. et al. (2008). Seismic evidence of broken crust in the 2004 Sumatra earthquake epicentral region, *Nature Geosciences* **1**, 777-781.