The Indian Plate in the Ganges-Meghna-Brahmaputra delta: exploring the thermal effects of extreme sedimentation on the seismogenesis

C. Grall* [1,2], M. Steckler [2], J. Pierre [1],P.M. Betka[3] , V. Ballu [1], W.R. Buck [2], S.H. Akther [4]

[1.] CNRS, LIENSs, La Rochelle University, La Rochelle, France
[2.] LDEO of Columbia University, Palisades, NY, USA
[3.] George Mason University, VA, USA
[6.] Dhaka University, Dhaka, Bangladesh

Advancing our knowledge of fault behavior and associated seismic hazards at active convergent margins hinges on the thermal structure and the hydrogeology of the system, where sedimentation and sediment recycling are known to exert a strong control on its. On the eastern flank of the India-Eurasia collision, the Indian plate is obliquely colliding beneath southeast Asia. While typical oceanic subduction occurs beneath the Sumatra-Andaman subduction zone, the continuation of this plate boundary to the north encounters the thick sediments of the Ganges-Brahmaputra-Meghna Delta (GBMD). Here, the IndoBurma foldbelt attempts to absorb the ≤ 19-km thick sediments deposited by the delta. This extreme sediment input should alter the thermal structure of the incoming plate, and in turn bear on the dynamics and the seismogenesis of the subduction. In order to further estimate the effect of this sediment input on the thermal structure of the Indian Plate at the GBMD, we modeled the depositional history of the Bengal Basin and the GBMD since the Cretaceous, by using a thermal basin modelling approach. The Bengal Basin results from the superposition of the heavily-sedimented passive margin of India being overthrust both by the IndoBurma foldbelt from the east and the Shillong Plateau from the north. In response to the India-Asia collision, an immense influx of Himalayan sediment was provided to the Bengal Basin. The shelf edge of the passive margin prograded 300-400 km from the Hinge Zone in the Eocene to its current position forming the GBMD. This history of sedimentation was reconstructed according to published seismic and borehole data from the Surma Basin, a proven Miocene gas province, in the Northeast of Bangladesh. A set of 2D finite element thermal models was conducted. The blanketing effect of sediments (deposition of cold sediments with a low thermal conductivity), the downward thermal advection potentially associated with rapid sedimentation, the fluid generations and upward migrations and the development of overpressure were considered in these models. In all the models explored, the thermal gradient at the surface does not reach a value higher than 15°C/km and significant overpressure develops in the buried marine units below 10-12 km depth, as well as in the Miocene sandy reservoir units. Also, the pressure and temperature at the sediment-crust interface meet the conditions of low grade metamorphism. Such extreme thermo-mechanical conditions in the incoming plate have direct implications on the dynamics and seismogenesis at this tectonic plate.

Mots-Clés : Plate Boundary, Sedimentation, Active Fault, Thermal structure.