Geological Society of America

Structural Geology & Tectonics Division

2003
Best Paper Award

Presented to Jerome Lavé and Jean-Phillip Avouac

J. Lavé and J. P. Avouac, (2000) *Active folding of fluvial terraces across the Siwaliks Hills, Himalayas of central Nepal.* Journal of Geophysical Research, vol. 105, B3, p. 5735-5770.

Citation by John Suppe

The 2000 paper in *Journal of Geophysical Research* by Lavé and Avouac on active folding of terraces in the Siwalik Hills of Nepal is in a word, breathtaking. It not only is an exquisite study of folding of fluvial terraces but it succeeds remarkably at the very point at which much effort in active tectonics stumbles—it convincingly and quantitatively connects the geomorphic deformation to the active subsurface structure. But they do not stop with the local structure; they go on to provide deep insight into the large-scale tectonics and seismic cycle across the entire Himalayas.

Lavé and Avouac surveyed the deformed terraces and surface structure on long reaches of several Siwalik rivers in the field, augmented with sophisticated analysis of digital elevation models and remote sensing, providing a convincing model of the deep subsurface structure above the Main Frontal thrust and convincing regional uplift profiles for dated Holocene terraces. They then cleverly linked the deep structure and dated uplift profiles to provide two estimates of slip rates on the Main Frontal thrust, taking into account the evolving fluvial system, including bedrock incision, sinuosity and changes in base level. The result is a constrained Holocene slip rate on the Main Frontal thrust of 20.4 $\pm$ 1.5 mm/y. Remarkably this rate on a single fault accounts for the entire current shortening of the Himalayas, which they argue has fundamental implications for the larger current mechanical behavior of the mountain belt and leads to a stimulating model of the seismic cycle of the Himalayas, which has excited much interest.

It is impressive that these two geological renaissance men, Jérôme Lavé from Grenoble and Jean-Philippe Avouac from Caltech, can bring together such a diversity of disciplines in a single paper of epic scope that is fundamentally structural geology and active tectonics at its very best. As a Society we congratulate and thank them for their deep contribution to the forefront of our science by awarding them the Geological Society of America Structural Geology & Tectonics Best Paper Award for 2003.

Response by Jerome Lavé and Jean-Phillip Avouac

I am honored to receive the Best-Paper Award on Structural Geology and Tectonics in 2003. It was a great surprise for me when I learned that our paper on Siwaliks Terraces was recognized in this way, and I wish first to thank John Suppe for nominating this

paper and for his laudatory citation. I particularly appreciated his compliments and emphasis on the interdisciplinary approach, which is I'm convinced, a requisite for modern geology and which has driven my research form my early scientific careers until today. At the end of my period of study at engineering school, I could for this reason hardly choose between geology and geophysics. A solution was given to me when I discovered through Paul Taponnier's passionate teaching in IPGP that seismo- and morphotectonics offered the possibility of combining the two approaches. I looked, therefore, in that direction and accepted Jean-Philippe Avouac's proposal because, like any lover of mountain climbing, I am fascinated by the vertiginous and icy peaks of the Himalayas. However, my advisor, Jean-Philippe, was aware of the generally intense tectonic activity in foothills from his work in Tien Shan piedmont, and we rapidly focused our research on the frontal relief, i.e. the Siwaliks Hills. I had to turn away from the high peaks and ironically to spend most of my Ph.D. in the lowest and warmest place of Nepal between 50 and 200 m above sea level! Nevertheless, it was a tremendous experience, both culturally because I discovered the gracious and wonderful people living in the Himalayan foothills, and scientifically

because there was so much to explore and analyze. The Siwaliks area had indeed received much less attention than the High Himalayas to which most of the geologists had been attracted by metamorphism, granitic plutons, tectonics not to mention the breathtaking scenery.

Our observations and results in the Siwaliks, in particular, the possibility to link structure and terrace uplift and to calculate shortening rate, was made possible by several favorable circumstances. First, after our initial analysis of several satellite images of central Nepal, we chose to focus on the Bagmati River, which in fact presents, as far as I can tell from almost 10 years of looking at terraces all along the Himalayan front in Nepal, one of the best preserved sequence of terraces. Secondly, recent microseismicity records and GPS data greatly helped us to build and propose a consistent seismotectonic model of the Himalayan thrust system.

Throughout my Ph.D. work, I benefited immensely form intense scientific discussion with my advisor and co-author Jean-Philippe Avouac. All the results presented in our paper would have not been possible without financial and technical support by the Laboratoire de Géophysique (LDG) for field trip, satellite images and DEM acquisition, numerous 14C dates, and more particularly, without the French-Nepalese collaboration between the LDG and the Department of Mines and Geology (DMG) in Kathmandu. This work would never have been as successful without the delightful and fruitful discussions with Dr. Pandey on seismology and Nepal seismicity, without the logistic help from DMG and Thierry Héritier, and without the field assistance from numerous good-humored and experienced Nepalese geologists. I share this award with all of them.

Regarding the paper itself, it benefited greatly from extensive reviews spanning the several years that passed since Jean-Philippe and I first wrote two companion papers on tectonic and geomorphologic analysis of the fluvial terraces across the frontal folds. The papers were rejected! We then had to cut, write, re-write and revise a more complete and successful version of the tectonic part, which finally was published 3 years after its first submission. Your choice to honor this paper tonight therefore represents a just reward

for this exhausting literature effort. It also illustrates that the peer-review process, which often imposes intensive and tedious rewriting, pushes the researchers toward more clarity and excellence. At this occasion, I would like to acknowledge the particularly insightful and detailed reviews by Ray Weldon, Alex Densmore and Daryl Granger.

Thank you again very much for your recognition of our paper.