GSA LUNCHEON TALK
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TITLE

Episodic Buckling and Collapse – An alternative to the Slow Slip hypothesis

ABSTRACT

We observe a remarkable nonlinear inverse correlation between the inter-tremor time interval and the slenderness ratio of the overriding plate in subduction zones all over the world. In order to understand this phenomenon better, we perform numerical simulations of deformation as well as study the 3D surficial deformation of the overriding continental crust in Cascadia and Alaska using GPS data. The numerical modeling studies show that critical load and slenderness ratio indeed have an inverse nonlinear relation between them (identical to the classical Euler's critical load relation), and very similar to the non-linear relationship observed between the inter-tremor time interval and the slenderness ratio of the overriding plate. Assuming that all continental wedges experience similar stress rates, the critical stress should be approximately directly proportional to the inter-tremor time interval. Therefore, we can use inter-tremor time interval as a proxy for critical stress. From the above analysis, we conclude that the observed relationship between the inter-tremor time interval and the slenderness ratio of the overriding plate is a result of buckling of the overriding continental plate. In addition to the above numerical analysis, we analyze the surficial 3D spatio-temporal displacements of the overriding plates in Cascadia and Alaska using 3-component GPS data. We find that these deformations are consistent with the buckling of the overriding continental crust.

Based on these novel observations, we propose an Episodic Buckling and Collapse model of subduction zones where periodic tectonic-tremor activity and geodetic changes, result from the episodic buckling of the overriding continental crust and its rapid collapse on the subducting oceanic slab. According to this model, geodetic measurements, previously inferred as slow slip, are the surficial expressions of slowly-evolving buckling and rapid collapse of the overriding plate, while tremor swarms result from the striking of the collapsing overriding plate on the subducting slab (as opposed to slipping or shearing). All existing scientific observations and findings are reasonably explained by the proposed model.

BIOGRAPHY

Jyoti Behura is a research assistant professor in the Department of Geophysics at the Colorado School of Mines, where he is a member of the Rock Physics Laboratory. He is also the founder of Seismic Science LLC, a technology start-up that develops technology for addressing some of the most pressing imaging needs within the energy and

health-care sectors. He received his PhD from the Colorado School of Mines in 2009 and thereafter worked for BP Advanced Imaging for a little more than 2 years.

Dr. Behura's education, training, and work experience have revolved around wave propagation, inverse methods, and data processing. He serves as a Co-Editor-in-Chief for the Journal of Applied Geophysics and is the Editor for the Bright Spots column in The Leading Edge.