

Question to the Back-slip Analysis

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We gave lectures at the meetings in the fall, 2005 and in the spring, 2006, the subject on which was to clarify the problem hidden in the technique proposed by Savage(1983) in order to analyze the situation in the locked subduction zone, that is so-called the back-slip analysis.

In the Savage's original paper, the locked zone was assumed to extend toward the trough axis, so as a result, the matter whether the up-dip portion is locked or not was out of the question. However, the recent progress in the crustal deformation measurements called that matter in question. Here, we pay our attention to the report by Gagnon et al. published in Nature(2005).

Gagnon et al., analyzing the ocean-bottom GPS data in the subduction zone around the Peru-Chile trench, concluded that the up-dip end of the locked zone between the Nazca and the South America plates approached the trench axis shallower than 2km in depth. We first doubted that the reason why the up-dip end came to such a shallow depth might be attributed to the problem in the back-slip analysis. However, they did not use the back-slip analysis, but took a forward approach. Although we cannot know the details of their treatment, we can guess that they took account of the effect of the background strain.

We stated that the essential problem in the back-slip analysis was neglect of the background strain. The back-slip analysis regards the situation of the strain accumulation as a growth of a reverse dislocation along the locked zone during the inter-seismic stage. But, this treatment is not correct. In such a case, not only the reverse dislocation but also the driving force acting on the plates can contribute to the strain growth. The latter will produce the background strain distribution. Gagnon et al. took account of the background strain avoiding the back-slip analysis. Then, do they reach the correct result to interpret the locking situation?

Here, we would like to point out another problem. We do not know the exact aspect of the plate driving force. When a ridge-push force is assumed, it will push the hanging-wall horizontally. In contrast, when a slab-pull force is assumed, it will then drag the hanging-wall parallel to the subduction. Between these two cases, the patterns of the background strain produced by the driving force quite differ from each other. After all, in order to get the real answer respecting the situation of the locked subduction, it is essential to have knowledge about what type of the driving force is practically acting there.