What is the cause for trench roll back?

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Trench rollback is observed for various subduction zones, but quantitatively not well understood. We start with the hypothesis that subducting slabs attached to a large plate encounter a larger viscous resistance (mantle drag) compared to cases with smaller plates. Given a constant subduction velocity, this resistance may be reduced by enhanced rollback. Thus slabs attached to large plates should be associated with fast rollback. A similar hypothesis may be postulated with respect to different dip angles. To quantitatively test these hypotheses we apply the Helmholtz minimization principle: we numerically determine that rollback velocity which minimizes the dissipation rate within the mantle surrounding a subducting slab with a given geometry and subduction rate. The resulting predictions for the rollback velocity normalized by the plate velocity are in surprisingly good agreement with fully dynamical subduction models of lithospheric plates and with the retreat of the Tonga trench. This agreement suggests that mantle flow is more important for trench retreat than the deformation and bending behaviour of the subducting lithosphere.