Development of 3-D Lagrangian Free Subduction Model: Implications for Surface Process of the Earth

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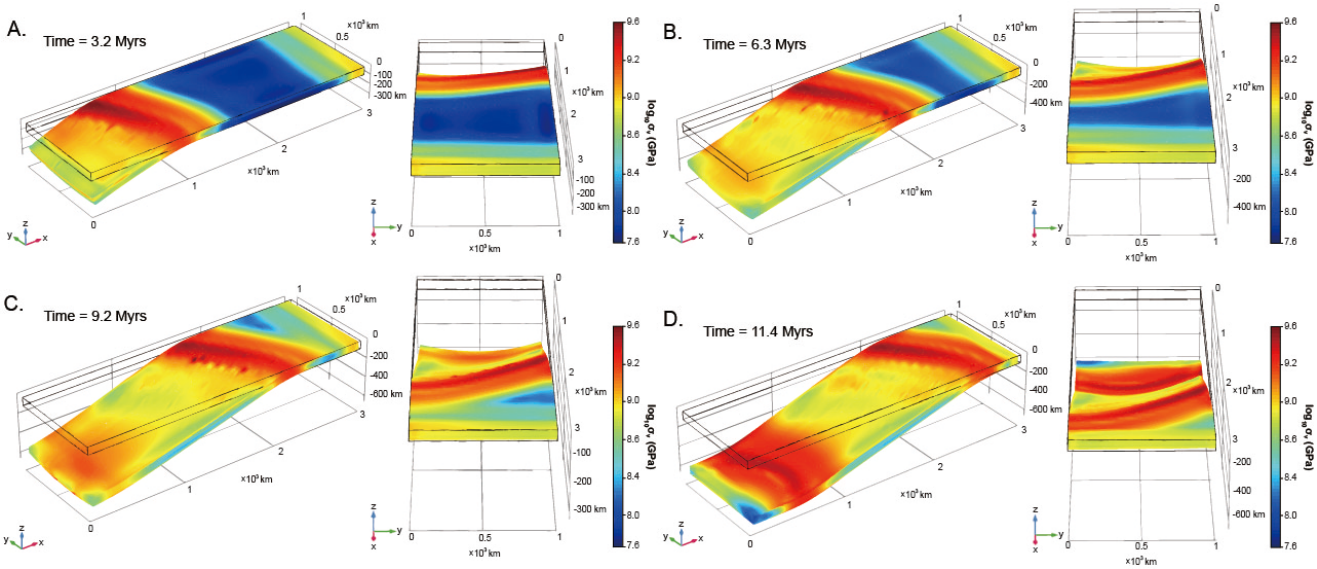
Variation of surface curvature along trench which is geodetically observed is ubiquitous in modern subduction zones on Earth. Global reference frame suggested differential trench motion in the one subduction zone. Its resultant trench shape has been explained by tectonic mechanism such as heterogeneities in ages of the plate at trench, slab width and overriding plate. However, relationship between the trench motion and sedimentation which is fundamental surface process of the Earth (e.g, climate, eustatic sea level change, amount of supply and erosion due to vertical topography change) relatively has been poorly understood. In this study, we developed 3-D thermo-mechanical free subduction model using viscoelastic material based on Lagrangian finite element method. We quantitatively evaluated relationship between trench shape along strike direction and sediment thickness by implementing realistic rheology including brittle, diffusion, and dislocation creep. We suggest that if sedimentary accumulation vary gradually along trench axis, differential trench rollback rates could be obtained and various trench shpae including oblique subduction could occur. Our results, including the geodynamic implication that the Earth’ s surface process contributes to subduction physics, are expected to improve the understanding of the structure of deep subduction.

Keywords: Subduction zone, Numerical model, Trench infill material



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