Dynamics of back-arc spreading

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To understand the dynamics of back-arc spreading, we perform 2D numerical simulations. This model is 1200 km depth and 4000 km width and is composed of continental crust, oceanic crust, upper mantle, mantle transition zone and lower mantle. Each rock types have a visco-plastic rheology prescribed by the temperature and pressure dependent linear viscosity, the effective frictional coefficient and the maximum yield stress. We focused on the effects of three parameters, the slab strength (the maximum yield stress), the Clapeyron slope of the 410 km phase transition and the strength of boundary between subducting and overriding plates (the effective frictional coefficient of the oceanic crust).
Most results show periodic change in slab geometry and back-arc spreading rate and their period changes with the parameters. The result for a low maximum yield stress (200 MPa) shows tightly folded slab geometry. The result for a high maximum yield stress (800 MPa) shows relatively flat slab geometry and continuous back-arc spreading. As geological observations show that most back-arc basins formed by 10-20 Myr spreading and the tightly folded slab has not been reported by seismic tomography, we think that the result for a moderate maximum yield stress (500 MPa) reproduce the processes in subduction zones well. We compare the results of simulations with the slab geometry and the history of back-arc spreading in the Izu-Bonin-Mariana subduction zone, and discuss the condition for the start and end of back-arc spreading.

Keywords: subduction zones, slab-mantle interaction, numerical model

