# Effect of grid resolution on tectonic regimes in global-scale convection models

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Global-scale convection models using a visco-plastic rheology coupled with a temperature-dependent viscosity usually show different tectonic regimes: mobile, episodic or stagnant lid.

In the mobilelidregime, the lid is continuously subducting into the mantle (plate-like behavior). The episodic lid regime is characterized by the stability of the lid until sufficiently large lithospheric stresses break it, causing rapid resurfacing. Finally the stagnant lid regime is defined by an undeformable lid that does not participate in convection

In numerical simulations these three types of regimes can be obtained by varying some target parameters such as: temperature-dependency of viscosity and yield stress.

The yield stress in particular is a key parameter because it sets the stress necessary to cause plastic yielding, hence, in a visco-plastic rheology, the stress necessary to break the cold surface regions. A high yield stress will result in a stagnant lid. On the other hand, a low yield stress causes a weak lid that is constantly broken and sinks into the mantle.Despite the key importance of physical parameters, also numerical parameters have an effect on the tectonic regime, determining different outcomes justby changing the grid resolution.

Here we use the code StagYY (*Tackley, 2008*) in a 2D spherical annulus geometry (*Hernlund & Tackley, 2008*) to determine the resolution-dependent tectonic regime for different yield stresses in global-scale convection models. To assess the effect of grid resolution on lid behavior we use 16 different resolutions keeping all physical parameters unchanged. To make sure that steady state has been reached each simulation is run for 15 Gyrs. Tested resolutions vary from 128x32 to 1024x256 grid points. To understand this influence on the tectonic regime we study the resolution within the lid requiring an appropriate lid definition, based on the thermal and velocity field. Our results show that there is a correspondence between low radial resolution and mobile lid regime and that low aspect ratio cells (azimuthal to radial grid spacing) favor a plate-like behavior of the lid, while for large aspect ratios the mobile lid regime is persistent.

This work is the first part of a larger project, aiming to studyslab stagnation and hydration of the mantle transition zone (MTZ) using self-consistent global-scale mantle convection models, where subducting slabs carry water from the surface into the Earth’ s interior and potentially hydrate the MTZ. We expect that our previous work packages will help us to obtain realistic slab ponding in the MTZ, so we can study the hydration state of this region over time.

References:

Tackley, P. J. (2008). Modelling compressible mantle convection with large viscosity contrasts in a

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