EGU25-14609, updated on 14 May 2025
https://doi.org/10.5194/egusphere-egu25-14609
EGU General Assembly 2025

Magma-poor To Volcanic Margins: New Models

Luc Lavier
UT Austin, Institute for Geophysics, Department of Geological Sciences, Austin, United States of America
(luc@jsg.utexas.edu)

We use a newly developed model formulation to explore the potential structural evolution of a spectrum of margins from Volcanic to Magma-poor. We assume that the melt is incompressible, and we simulate melt migration as magmatic intrusions and volcanic extrusions as volume change and stress change in the brittle and ductile crust. We also model heat transfer generated by melt migration, latent heat of recrystallization, melt production and hydrothermal circulation.

Based on our simulation and observations of passive margins, we propose models for the formation of volcanic and magma-poor margins. While magma-poor margins evolution follows well-known stages, we show that volcanic margins represent a wide spectrum of behavior from purely accretionary and volcanic to mixed extensional and volcanic. The nature and extent of seaward dipping reflectors (SDRs), the crustal composition and structure, the subsidence of the margins vary as a function of the mantle potential temperature in the asthenosphere and the initial geothermal signature of the lithosphere.

We can resume our main findings which diverge strongly from existing models for volcanic margins: (1) For mantle potential temperatures (T_p) greater than 1400^{o}C, we find that volcanic margins form through the accretion of intrusive magmatic and extrusive volcanic product of melt production in the asthenosphere. This system forms an accretionary center of thickness and width increasing with T_p. On both side of the accretionary axis, two symmetrical SDRs basins form. Subsidence of these basins increase with decreasing $T_{p.}$ Increasing subsidence generated by far field extension leads to an increase in clastic sedimentation and controls SDRs composition. Decreasing T_p and increased subsidence leads to the formation of clastic rich SDRs while increasing T_p and decreased subsidence leads to formation of mainly volcanic/mafic SDRs. (2) The exhaustion of melt production leads to ridge jumps and the formation of eccentric accretionary center. When subsidence is more pronounced for a lower T_p we simulate periods of uplift and subsidence correlated with periods of higher and subdued melt production, respectively. This process may result in cyclical periods of mafic followed by clastic sedimentation. (3) For T_p lower than 1400^{o}C, intermediate margins form with both volcanic and extensional processes occurring concurrently. This processes eventually lead to the asymmetric propagation of volcanic centers which may lead to seafloor spreading.