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2D Geodynamic models of Microcontinent Formation

Joya Tetreault and Susanne Buiter
NGU, Trondheim, Norway (joya.tetreault@ngu.no)

Continental fragments (microcontinents and continental ribbons) are rifted-off blocks of relatively unthinned continental crust situated among the severely thinned crust of passive margins. The existence of these large crustal blocks would suggest that the passive margin containing them either underwent simultaneous differential rifting or multi-stage rifting in order to produce continental breakup and seafloor spreading in more than one location in the span of approximately 100 km. Also, because continental fragments do not occur on every passive margin, there must be something particular about the crust and/or lithosphere that led to the production of these features.

Some proposed mechanisms for microcontinent and continental ribbon formation include (1) structural inheritance, (2) strain localization by serpentinized mantle or magmatic underplating, and (3) plume interaction with an active rift. Pre-existing weakness and inherited structural fabrics in typical continental crust from past tectonic events, such as varying rheology of accreted terranes and collisional suture zones, could be reactivated and serve as foci for deformation. The second theory is that strain is localized in certain regions by large amounts of weakened material that are either serpentinized mantle or mafic bodies underplating the thinned crust. Another possible process that could lead to continental fragment formation is magmatic influence of hot plume material that focuses in various regions, producing rifts in separate areas. The Jan Mayen and Seychelles microcontinents both have geological and plate reconstruction evidence to support the plume interaction theory.

We use 2-D geodynamic experiments to assess the importance of structural inheritance, strain localization by regions of weakened mantle material, and contributions to rifting from plume material on producing crustal blocks surrounded by seafloor or thinned/hyperextended crust. Our preliminary results suggest that each of these three mechanisms, working alone, cannot produce concurrent or multi-stage differential thinning and continental break-up. We infer that multistage extension produced by a combination of these mechanisms could be necessary to produce microcontinents and continental ribbons.