

List of Figures

| | | |
|-----|--|----|
| 2.1 | Shaded relief map of the northern Basin and Range | 9 |
| 2.2 | Model domain and initial and boundary conditions | 13 |
| 2.3 | Velocity profiles for transform and normal velocity boundary conditions | 15 |
| 3.1 | Gravity anomaly maps of the Reykjanes ridge and the Australian-Antarctic Discordance | 23 |
| 3.2 | Model geometry and boundary conditions | 30 |
| 3.3 | Evolution of topography, temperature, viscosity, and brittle deformation | 34 |
| 3.4 | The magnified upper left part of the model shown in Fig.3.3 | 35 |
| 3.5 | Topography (in m) and accumulated plastic strain for the models with associated plasticity at 10 My | 35 |
| 3.6 | Same as Fig.3.3 | 37 |
| 3.7 | Same as Fig.3.5, but for the models with zero dilation angle | 39 |
| 3.8 | Plots of the primary crack spacing | 40 |
| 3.9 | Same as Fig.3.5 | 43 |
| 4.1 | Ridge segments and other ridge-parallel structures can release thermal stress in the ridge-normal direction | 58 |
| 4.2 | Geometry of the model domain | 61 |
| 4.3 | F_x as a function of time, depth profiles of temperature and viscosity, and 3-D rendering of the second invariant of plastic strain | 64 |
| 4.4 | A 3-D representation of the surface topography | 65 |
| 4.5 | Modes of interaction between two mutually approaching ridge segments | 66 |
| 4.6 | The piecewise linear variation of cohesion | 69 |

| | | |
|------|---|-----|
| 4.7 | Patterns of localized plastic strain | 71 |
| 4.8 | F_x as a function of amount of extension | 72 |
| 4.9 | Work done by the external extension versus γ | 73 |
| 4.10 | Plot of Pe' versus γ' | 74 |
| 4.11 | Models with a twice higher horizontal resolution | 75 |
| 4.12 | F_x for models with different weakening rate | 76 |
| 4.13 | Patterns of localized plastic strain in the increasing order of ω | 77 |
| 5.1 | The architecture of a coupled <i>Application</i> | 94 |
| 5.2 | Drawings showing the domains of the coupled solvers as a whole | 96 |
| 5.3 | An example of a 2-D mesh and a portion of the other mesh | 97 |
| 5.4 | Synchronizing time steps of two <i>Solvers</i> | 99 |
| 5.5 | Results from the thin-plate benchmark problems | 102 |
| 5.6 | The initial distribution of temperature and viscosity | 106 |
| 5.7 | Topography along the equator for various coupled models. | 108 |
| 5.8 | Results form the large coupled problem | 110 |
| 5.9 | Along-equator profiles of topography and the radial component of traction and velocity. | 111 |
| A.1 | Configurations of tetrahedra and conventions for the notation | 118 |
| B.1 | Schematic diagram depicting the oedometer test | 126 |
| B.2 | Plots of stress vs. strain | 130 |
| B.3 | Schematic diagram for the problem of the thick cylinder | 131 |
| B.4 | The second invariant of stress from SNAC | 136 |
| B.5 | Radial profiles of the second invariant of stress | 137 |