Rock melts when the temperature within the earth (geotherm) exceeds the melting point (solidus) of rock.

This happens for different reasons at (1) subduction zone volcanoes, (2) mid-ocean ridge volcanoes, and (3) hotspot volcanoes.
What are the 4 main forms of volcanoes?

2. Mid-Ocean Seafloor Spreading
Ridges: “pressure release” melting

- Geotherm
- Solidus
- Liquidus
- Solid
- Liquid
- Ocean
- Lithosphere
- Crust
- Plate movement
- Asthenosphere

Solid mantle material rises and consequently melts.
Figure 4-15b

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# Ocean Crust Layers

<table>
<thead>
<tr>
<th>Lithology</th>
<th>Ocean Crustal Layers</th>
<th>Typical Ophiolite</th>
<th>Normal Ocean Crust</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Thickness (km)</td>
<td>P wave vel. (km/s)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ave.</td>
<td></td>
</tr>
<tr>
<td>Deep-Sea Sediment</td>
<td>1</td>
<td>~ 0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Basaltic Pillow Lavas</td>
<td>2A &amp; 2B</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Sheeted dike complex</td>
<td>2C</td>
<td>1.0 - 1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Gabbro</td>
<td>3A</td>
<td>2 - 5</td>
<td>4.7</td>
</tr>
<tr>
<td>Layered Gabbro</td>
<td>3B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layered peridotite</td>
<td>4</td>
<td>up to 7</td>
<td></td>
</tr>
<tr>
<td>Unlayered tectonite</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Model for Forming Oceanic Crust at Mid-ocean Ridges
What are the 4 main forms of volcanoes?

3. Continental Rifting
Continental Rifting leaves a complex structure beneath passive margins like the east coast of North America.
Kenya Rift Valley
What are the 4 main forms of volcanoes?

4. Hotspot Mantle Plumes
Marine Gravity Map shows Hawaiian Hotspot Chain
Hawaii rises more than 5 miles above the seafloor.
Kilauea, Hawaii

Mauna Loa, Hawaii
Kilauea, Hawaii
Pahoehoe lava, Hawaii
“Aa” lava flow, Kilauea, Hawaii
“Skylight,” Hawaii
Lava lake, Kilauea Iki, Hawaii
Lava lake, Kilauea Iki, Hawaii
Kilauea Iki, Hawaii

Cross-section of the Kilauea Iki lava lake. Areas marked by year show region of molten lava. The last time the lake was drilled, 1988, the molten zone contained from traces up to 15% molten lava in a framework of crystals.
Erta Ale lava lake, Ethiopia
Erta Ale lava lake, Ethiopia
Ertā Ale lava lake, Ethiopia
Erta Ale lava lake, Ethiopia
Yellowstone, Wyoming
Yellowstone, Wyoming
Yellowstone, Wyoming
Comparative volumes of Yellowstone giant eruptions
Iceland: A hotspot (????) at the mid-ocean ridge.
Mid-Atlantic Ridge, Iceland
Mid-Atlantic Ridge, Iceland
Fissure Eruption, Iceland
Columnar Jointing, Iceland
Heimay Eruption, Iceland, 1973
Heimay Eruption, Iceland, 1973
Heimay, Before the Eruption, Iceland, 1973
Heimay Eruption, Iceland, 1973
Heimay Eruption, Iceland, 1973
Heimay Eruption, Iceland, 1973
Heimay Eruption, Iceland, 1973
Same view, after removal of lava
Heimay, Iceland
Heimay, Iceland
Surtsey, Iceland, 1963
Surtsey, Iceland, 1963
Surtsey, Iceland, 1963
Surtsey, Iceland, 1963
Surtsey, Iceland, 1963