Plutonic or Intrusive Igneous Rocks

The Varieties of Plutons/Intrusions
Plutons come in three basic shapes and can have either of two relations to the structure of the rock into which they have intruded (the **country rock** or **host rock**). We will begin with the shapes and come back to the host rock relations.

The three shapes are: **cylindrical**, **tabular**, and **massive**. It is easy to visualize these three shapes with reference to their three-dimensional lengths.

A **cylindrical** pluton has one dimension that is very long in proportion to the other two, like a pencil or a carrot.

A **tabular** pluton has two long dimensions in proportion to the very short third one, like book or a pancake.

A **massive** pluton has three large dimensions with none distinctly short or long in proportion to the others, like a ball or a dollop of thick mashed potatoes.
These shapes are all highly stylized. Real plutons would be much more irregularly shaped.
We will use sedimentary rocks as an example of the country rock for some plutons and we will refer to the natural bedding of those rocks as their “structure”. Most metamorphic rocks and some igneous ones that might serve as country rock are also layered, but even unlayered rocks (lacking any texture) can stand in contrast to the shape of the pluton that intrudes them.

In some cases the pluton intrudes between layers of the country rock, displacing the layers apart, but not disrupting any layers. This type of intrusion is called **concordant**. In the left diagram the horizontal black lines represent bedding in sediments. The red intrusive rock is parallel to that bedding. Note that the bedding in a sedimentary rock might not be horizontal (right diagram), but the concordant pluton will still be parallel to it.
A *discordant* pluton is one that does interrupt the continuity of the country rock’s texture. The smaller intrusion indicated by the arrow cross-cuts the sedimentary bedding.
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<th>CYLINDRICAL</th>
<th>TABULAR</th>
<th>MASSIVE</th>
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<tbody>
<tr>
<td>CONCORDANT</td>
<td>NONE</td>
<td>SILL</td>
<td>LACCOLITH</td>
</tr>
<tr>
<td>DISCORDANT</td>
<td>PIPE or NECK</td>
<td>DIKE</td>
<td>STOCK (&lt;100 km²)</td>
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<td>BATHOLITH (&gt;100 km²)</td>
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HOW TO DETERMINE A PLUTON NAME

In this example the pluton is tabular and discordant. The box in the appropriate row and line contains the word “dike”, which is the name of a tabular, discordant pluton.

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EXAMPLES of PLUTONS
Notice that the neck is not truly a mathematical cylinder because its cross section is not a perfect circle, or even circular at all.

It is “cylindrical” because the horizontal width of it in any direction is about the same, and it is quite long.

The top has been eroded somewhat (you can see the talus at its base) and it also extends to some depth inside the ground, so that vertical dimension is the long one.

There used to be a volcanic cone here. All but the feeder tube and some dikes has been eroded away!
The volcanic neck at Shiprock, NM
Both the sandstone above and below were metamorphosed by heat of the intrusion. This necessarily means that the igneous rock is a sill, and not a lava flow later covered by sandstone. Notice that both the intrusion and the sedimentary bedding are horizontal. The pluton is therefore concordant. It is also clearly not very thin, and underlies this entire mesa. That is, it is tabular.
FIGURE 11-35
Volcanic neck with radiating dike, Shiprock, New Mexico.
(Photo by D. A. Rahm)
FIGURE 11–36
Cross-cutting dike ridges. (Photo by U.S. Geological Survey)

FIGURE 11–37
The main dike at Shiprock, NM

A dike at Spanish Peaks, CO
Small mafic dikes in granite near Elberton, GA
The “teeth” around the pluton are erosional remnants of a sandstone bed bent to a nearly position by the force of the intrusion’s movement.
ENCHANTED ROCK, TX

Public domain photo by ‘Claygate’, from Wikipedia
FIGURE 11–38
Granite batholiths (light, oval-shaped masses) in western Australia. (NASA satellite photo)