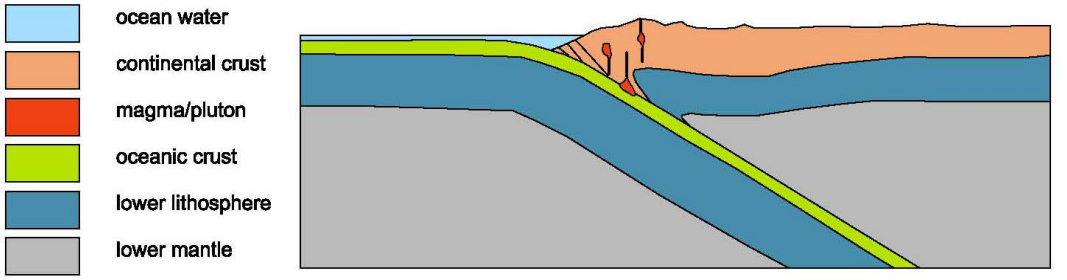
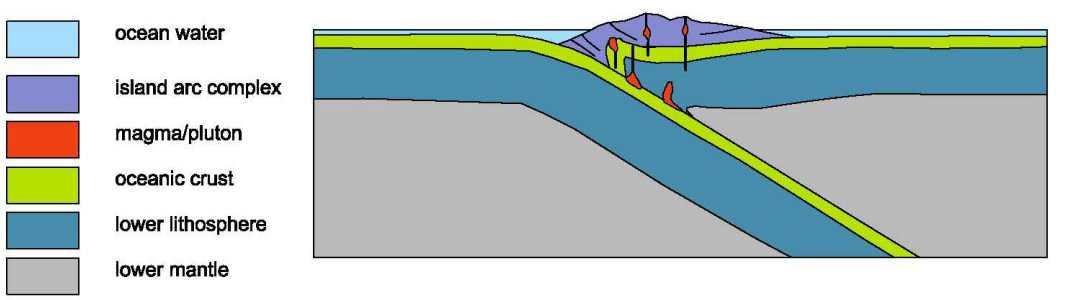
***Special Explanation*: How do large magmatic bodies (plutons) form?**

Large irregular-shaped intrusions, or plutons, of coarse, usually light-colored igneous rock are common in mountain belts and beneath the cover of sedimentary rocks on continents. These igneous bodies are produced by rising magmas that do not make it to Earth's surface, where they could trigger explosive volcanic eruptions. Plutons are the result of plate tectonic activity. The upper 100 km of Earth's surface, called the lithosphere, is rigid and composed of Earth's crust and the upper mantle. Sections of the lithosphere called plates move relative to each other. Plates can have either continental crust at their surface, which has approximately the composition of granite, or denser oceanic crust, which is compositionally like the dark-colored igneous rock basalt. At convergent plate boundaries, where two plates move toward each other, one of the plates descends beneath the other, or is subducted. Only plates with oceanic crust at the surface, which is denser than plates with continental crust, can be subducted because continental crust is too buoyant to descend beneath another plate. The diagrams below depict: A) subduction of an oceanic plate beneath a continental margin (continental margin subduction zone), as occurs along the west coast of South America, and B) subduction of an oceanic plate beneath another oceanic plate (island arc subduction zone), as occurs along volcanic island chains, such as the Aleutian and Marianas islands in the Pacific.

A



B



In both cases above, the subducted plate will begin to melt at depth. This produces magmas (red blobs on cross sections above) that rise through the rock of the overriding plate. They are liquid and very hot, and therefore less dense than surrounding solid rocks. As they rise, they also melt the rock of the overlying plate. These magmas produce explosive eruptions if they reach the surface because of the decompression of volatile compounds, such as dissolved water and gases. If the magmas do not reach the surface, they produce large plutons like the Spot Pond Granodiorite, Winchester Granite, Rams Head Porphyry, Lawrence Woods Granophyre, and Stoneham Granodiorite in the Middlesex Fells. The continental margin subduction zone that produced these plutonic rock bodies occurred adjacent to the coast of what is today West Africa. This area of rock later separated (rifted) from West Africa and eventually collided with North America, and today contains the whole Boston area. It is known as the Avalon Terrane. The oldest plutons in the Fells are the Spot Pond Granodiorite and Winchester Granite, which intruded the continental rocks of the Westboro Formation in the central Fells and basaltic rocks of the Nanepashemet Formation in the northern Fells. Later, the Rams Head and Lawrence Woods plutons in the southern Fells intruded the Spot Pond and Westboro, creating a very complex history of magmatic activity. In the northern Fells, and younger still, the Stoneham Granodiorite intruded volcanic rocks. In other areas of the Fells and Boston, there are volcanic rocks closely associated with the plutonic rocks seen in the southern Fells, where magmas reached the land surface resulting in ash deposits and lava flows of the Lynn Volcanic Complex.