Cullen Scheland
GEOL 307
Dr. Tamara Carely

Physiography/Landforms – Hawaiian Islands

The surface manifestation of a mantle plume is generally a shield volcano that begins as seamount below sea level. As the seamount continues to grow it may rise above sea level and become an island. Mantle plumes are thought to be fixed relative to their source. However, the lithospheric plates through which the plume pass are not fixed. Their movement can be reflected in the landforms of mantle plumes. The Hawaiian Island chain is a type example of this dynamic aspect of hotspot volcanoes as surface features. Moving west and then north one can follow the landforms that have been created by the Hawaiian Islands' mantle plume (Fig. 1).

Figure 1: An image depicting the path of the Pacific plate as reflected by mantle plume landforms (Google Earth).

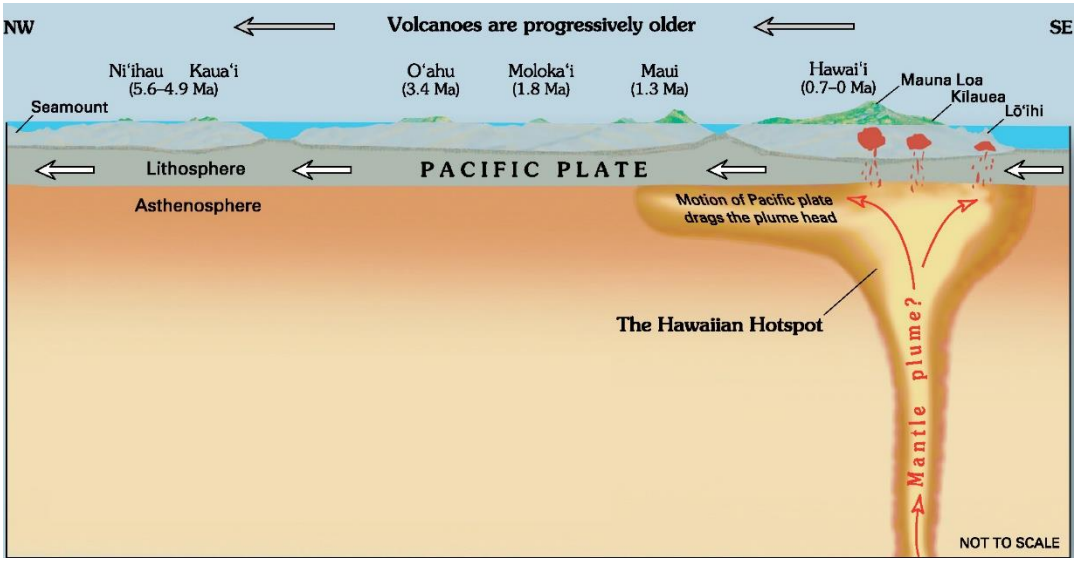

Figure 2: A cross section of the Hawaiian Islands mantle plume and how is behaves in concert with the motion of the Pacific lithospheric plate. © USGS

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The evolution of the landforms at the Hawaiian Island chain can be given magmatic tectonic context by referencing the cross section of the mantle plume (Fig. 2). The seamounts form off the SE side of the upwelling bulge caused by the increased buoyancy of the magma system. As the plate moves to the NW the seamount is translated onto the topographical high point of the bulge. In the case of the Hawaiian Islands the big island represents that stage of landform evolution. Above the surface the volcanic features are shield volcanoes (see cross section in exhibit). They are characterized by long lateral emplacement flows at the result of low explosivity eruptions of low viscosity lava flows. The flows layer upon existing ones to form a wide shield over the landscape. Subsequently, the landform is moved off the bulge and submerged beneath sea level where weathering does not affect it. Until the landform is submerged it is heavily weathered. Thereafter it is preserved (Fig. 1).