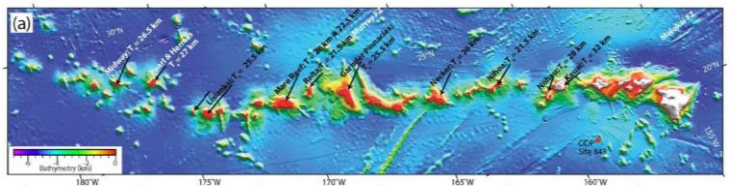
Buckling of Tectonic Plates Underneath Hawaiian Islands

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Abstract

The theory of plate tectonics describes the "outer most shell of the Earth as a combination of many individual plates that move independently, but respectively to one another [Turcotte & Schubert, 1982]. The oceanic lithosphere, Pacific plate for our scenario, lies on top of the asthenosphere in the upper mantle. It is in this setting that the Hawaiian Islands are found [Fowler 2005]. The Hawaiian hotspot generates volcanoes that load on to the Pacific Plate [A.B. Watts, 2001]. Because the loaded weight, buckling of the oceanic lithosphere produces a bulge in the oceanic lithosphere underneath the weight of the Hawaiian Island (see figure). This is exactly what is being studied by examining the Pacific plate under high loads of the Hawaiian Islands through numerical models and analytical solutions of bending elastic plates. The objective is to analyze how viscoelastic beams behave compared to purely elastic beams and identify at what point the deforming viscous deformation is slow and inversely proportional to the viscosity of the beam. After analysis, Numerical solutions for the elastic deformation of the lithosphere beneath a volcanic load over-predicts the amount of flexure compared to analytical solutions. The subsequent rate of viscous deformation approaches zero as the system reaches isostatic equilibrium. Future work is needed to match numerical and analytical solutions of elastic deformation before models of bending plates that are examined.



The Hawaiian islands leave imprints in the bathymetry of the ocean floor. As the asthenosphere partially melts at the hotspot, the magma rises to the surface and creates volcanos. The weight of the volcanos causes the lithosphere to bulge downward beneath the islands, where it curves slowly upward in the "flexural moat" next to the islands. The downward force of the volcanos weighs down the oceanic lithosphere, increasing water depth around the volcano chain (deep blue).



Biography

I am a third-year physics major/math minor, from Marietta, GA attending Hampton University. In regards to research, thus far I have conducted numerical modeling at the University of Hawaii Manoa studying the theory of plate tectonics and also experimental nuclear physics at Jefferson Lab studying nucleon form factors. After experiencing those two branches of physics, I now seek exposure to applied mathematics/engineering to assess another application of my future degree.

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