Geology of Puerto Rico
An Overview of the Plate Tectonic Origin of the Caribbean

Outline

- Rock types in Puerto Rico
- Plate Tectonics review
- Puerto Rico formed WHERE?
- Evidence
- Tectonic Reconstruction
Rocks for Astronomers

Astronomy: H, He, Metals

Geology: Basalt, Other
Puerto Rico: Volcanic, Marine
Olivine: Limestone
Mg$_2$SiO$_4$: CaCO$_3$

Astronomy (simplified)

- Hydrogen
- Helium
- Metals (everything else)
### Astronomy
- Hydrogen
- Helium
- Metal (everything else)

### Geology
#### Rocks
- Hot (igneous)
- Medium (metamorphic)
- Cold (sedimentary)

---

### Geology (continued)
- **Hot** = Igneous - Volcanic rocks, basalt
  - Lava is molten on the surface, cools quickly
  - Granite is molten underground, cools slowly
- **Medium** = metamorphic
  - Re-heating of rocks, re-crystalization
  - Cooking of limestone makes marble
- **Cold** = sedimentary
  - Carried by wind or water, like sandstone
  - Layered sands from dunes near the shore (look along the Jobos beach road cut)
Basalt flow in Hawaii

Puerto Rico Geologic Map
Puerto Rico Geologic Regions

Puerto Rico faults and intrusions
Geology Field Trip

- Let’s look at a nearby outcrop of limestone
- (How often have you had an astronomy field trip?)

Limestone Fossils
More Fossils

Structure of the Earth

- Earthquakes tell us about the interior structure
- Earthquakes generate P-waves and S-waves
- P-waves are pressure waves – in direction of motion
- S-waves are shear waves – perpendicular to the direction of motion
- S-waves do not propagate through liquids
Seismology:

a way to probe the Earth’s interior
Global Tectonic Plates and Earthquakes

Plate Tectonics Overview

- Earth surface is made up of semi-rigid “plates” (lithosphere)
- The plates move on top of a plastic layer of rock (aesthenosphere)
- The driving force is convection in the mantle
- Heat from the core fuels the system
Types of Plate Boundaries

- Divergent – Spreading ridge (Atlantic)
- Convergent – Subduction Zone (Lesser Antilles, Pacific Rim)
- Neither - Transverse fault (San Andreas Fault, Puerto Rican trench at present)
Global Tectonic Plates

Island Arc formation at a Subduction Zone

Figure 5.4. Generalized cross section across the edge of a continent bordered by an island arc. New oceanic crust is created between the arc and the continent by back-arc spreading (adapted from Detrick, 1979).
Monserrat Volcano
Soufrière Hills

Before      After
Subduction of a spreading center

• Subduction cut off

• New trench forms on the other side

• Same volcanos may be activated
Caribbean Plate Today
boundary and geologic regions

Tectonic Setting

Lambert Azimuthal Equal-Area projection
Plate Tectonic Reconstruction of the Caribbean region:

200 million years ago to present
Caribbean Plate Today
boundary and geologic regions

Puerto Rico and Virgin Islands
microplate