

CLASS 39: MOUNTAINS

“Esmeralda en el pecho azul del mar” (Llorens Torres)

INTRODUCTION

In the last class we presented the concept of isostasy and saw that high mountains exist because they have thick crustal “roots”. However, this is just a present-day explanation; it doesn’t explain why the crust is thick or how a mountain chain develops over time. Today we’ll take a trip to the Caribbean and work through the evidence of how a mountain range grew there.

CARIBBEAN PLATE

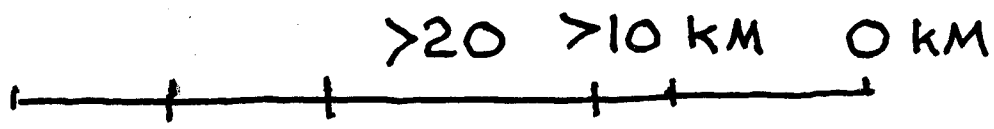
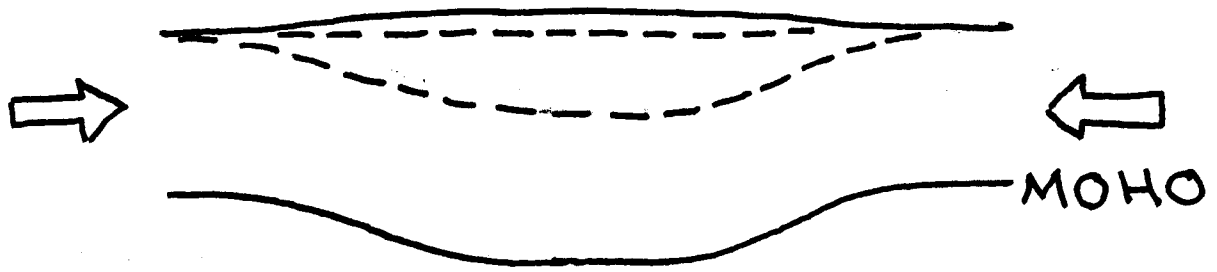
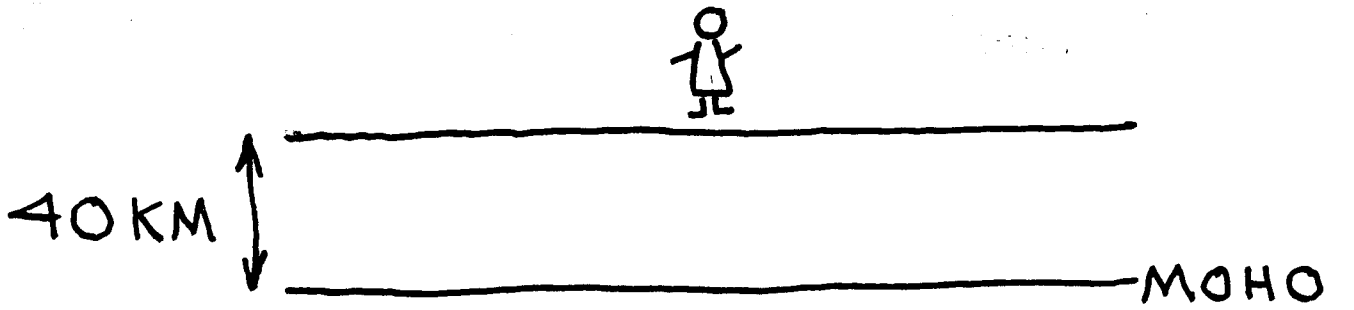
At present the Caribbean Sea and its surroundings make up a small tectonic plate. The volcanoes of the Lesser Antilles islands (Martinique, Guadalupe, etc.) have been active since the Eocene and mark an ocean/ocean convergent boundary between the Caribbean and North and South American plates. The southern boundary with the South American plate is a confusing complex of transform faults and other faults passing through Venezuela and Colombia. The western boundary is an ocean/ocean convergent margin along which we see the active volcanoes of Central America. The northern boundary is currently a transform margin running along the Puerto Rico “Trench” and westward across Central America.

Puerto Rico and the other islands of the Greater Antilles (Virgin Islands, Hispanola, Cuba, Jamaica) lie along the transform boundary. Some are located north of the transform boundary and others south of it. These islands are the remains of a volcanic arc that ran along the (former) Caribbean/North American convergent margin from the Jurassic to the Eocene. In the Eocene the pattern of plate boundaries changed and the arc became inactive.

Let’s see if we can develop a coherent history of Puerto Rico based on outcrops we can examine during a visit. The geology of the other islands is similar and tells the same basic story.

TAINO-ARAWAK WORDS

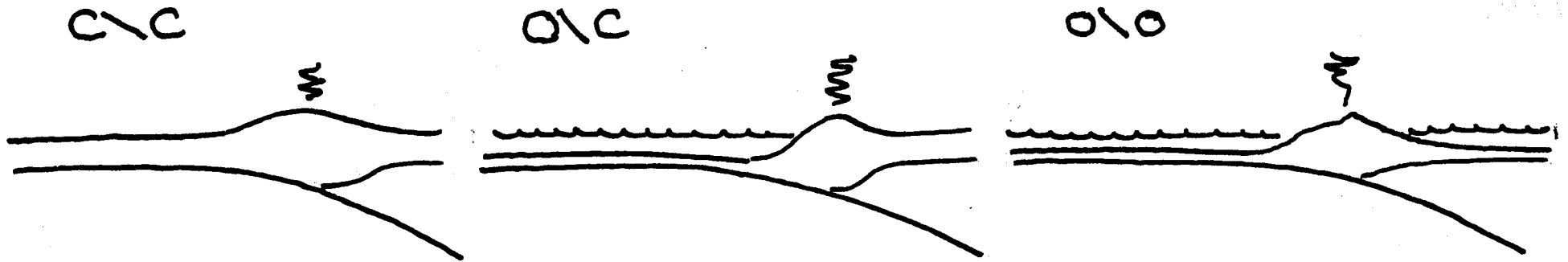
The Greater Antilles were the first part of the New World to experience the impact of Spanish imperialism. Disease, forced labor, slaughter and intermarriage largely eliminated the indigenous populations of the islands. However, many words of their languages are in common use and have even spread around the world. Some common examples are yuca, batata, maíz, hamaca, casabe, piña, canoa, tabaco, huracán, cayo, barbacoa, guayaba, iguana, papaya, sabana. You can probably figure most of these words out. So when Crocodile Dundee puts a shrimp on the barbie, flops in his hammock under a papaya tree and puts tobacco in his pipe he’s talking Taino.



$$\frac{5000 \text{ m}}{25 \text{ m/my}} = 200 \text{ my}$$

$$\frac{25000 \text{ m}}{25 \text{ m/my}} = 1000 \text{ my}$$

CONVERGENT MARGINS



ALPINE

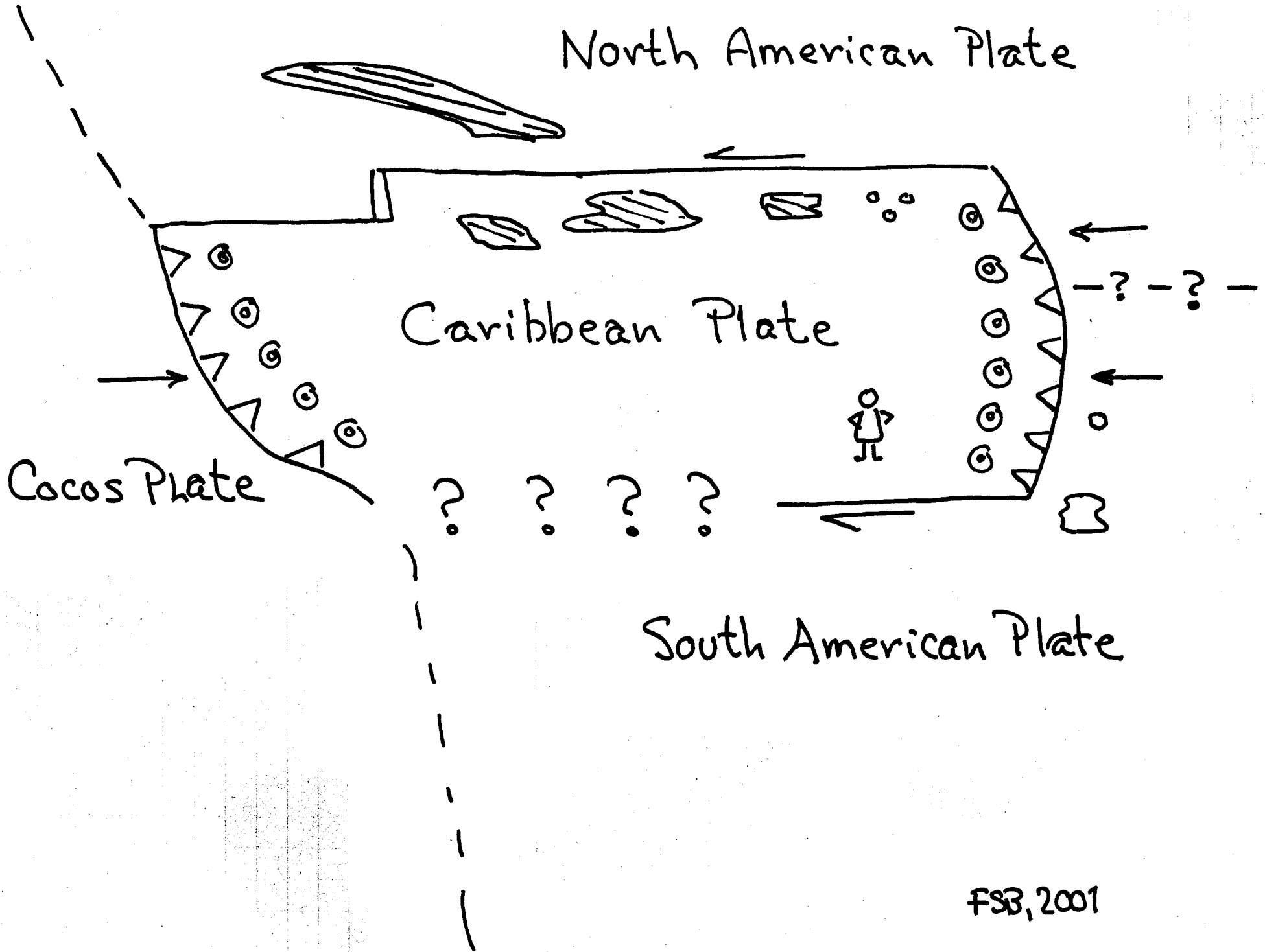
ALPS
APPALACHIANS
ZAGROS
HIMALAYAS

ANDEAN

ANDES
MEXICO
EAST INDIES
TAIWAN?

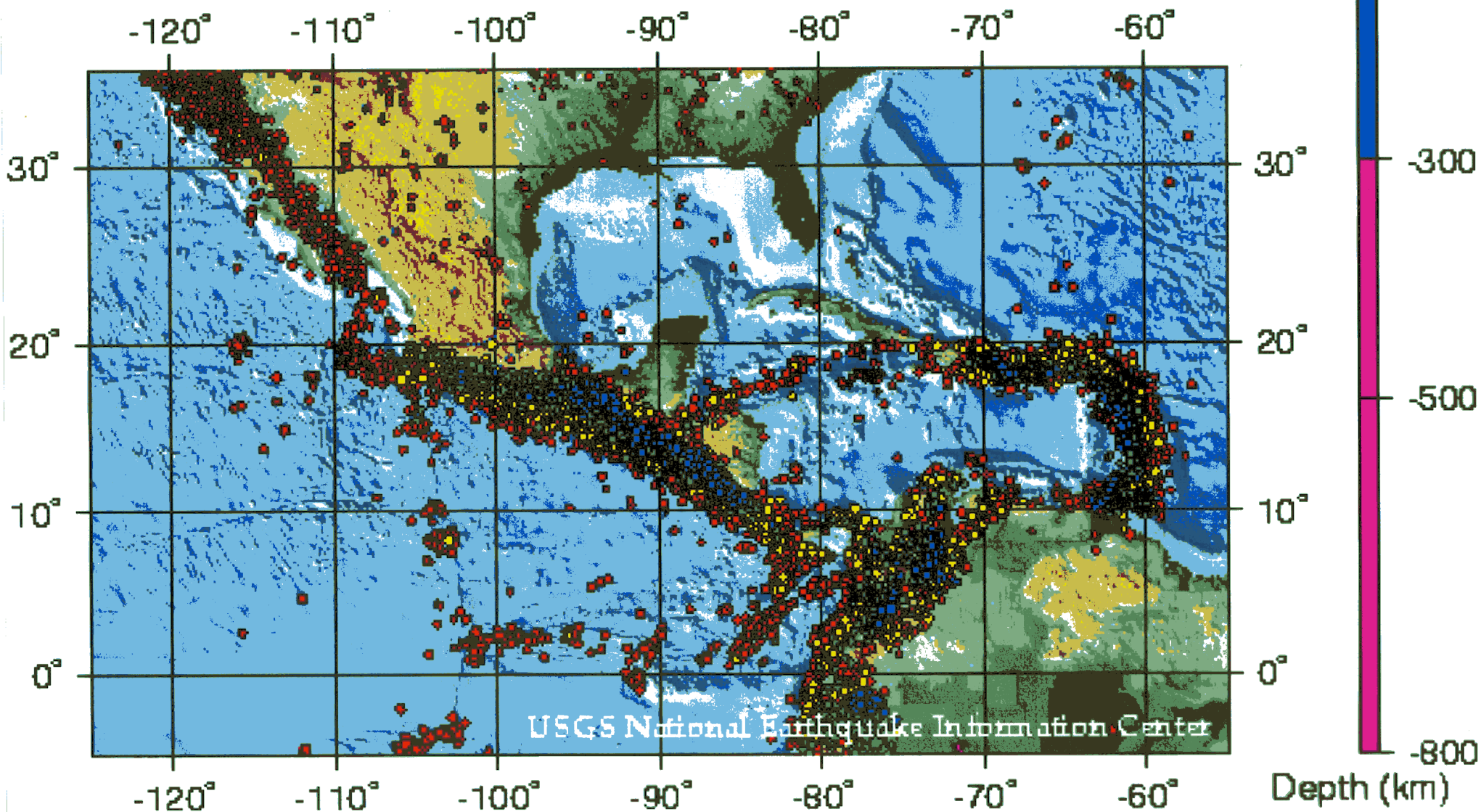
ALEUTIAN

ALEUTIANS
LESSER ANTILLES
GREATER ANTILLES
MARIANAS

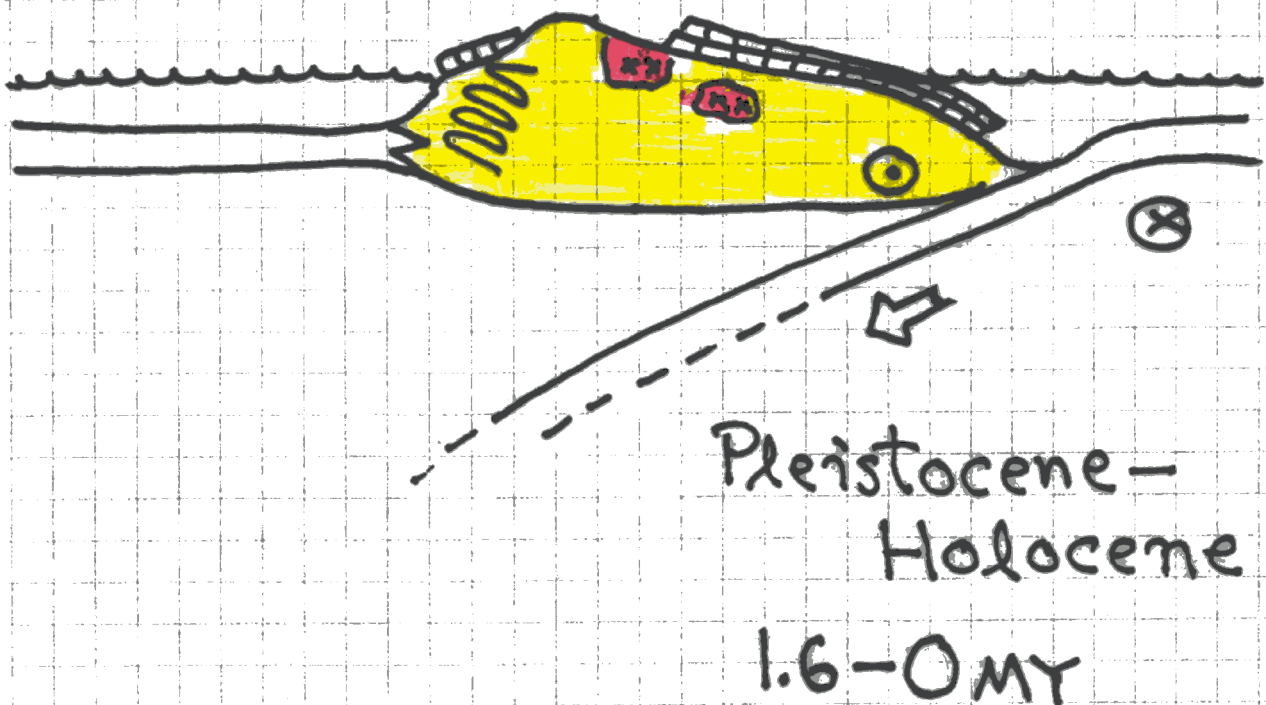
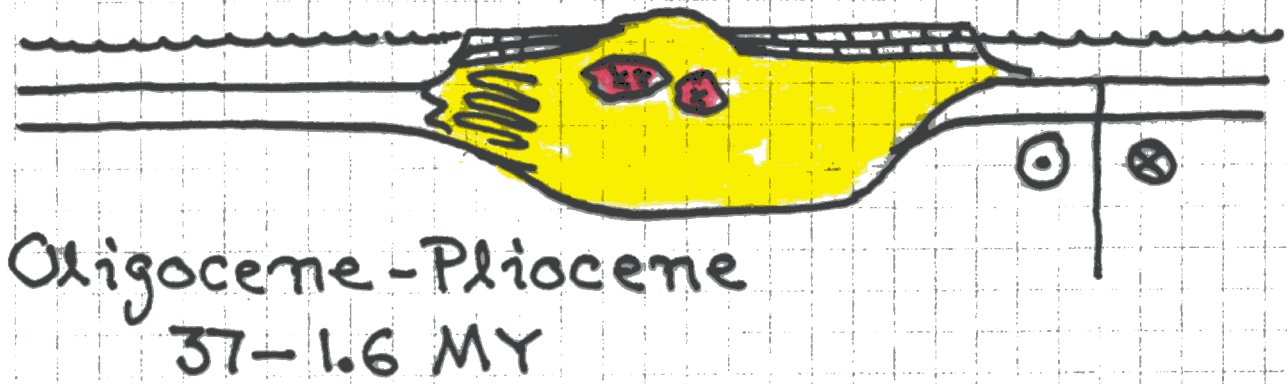
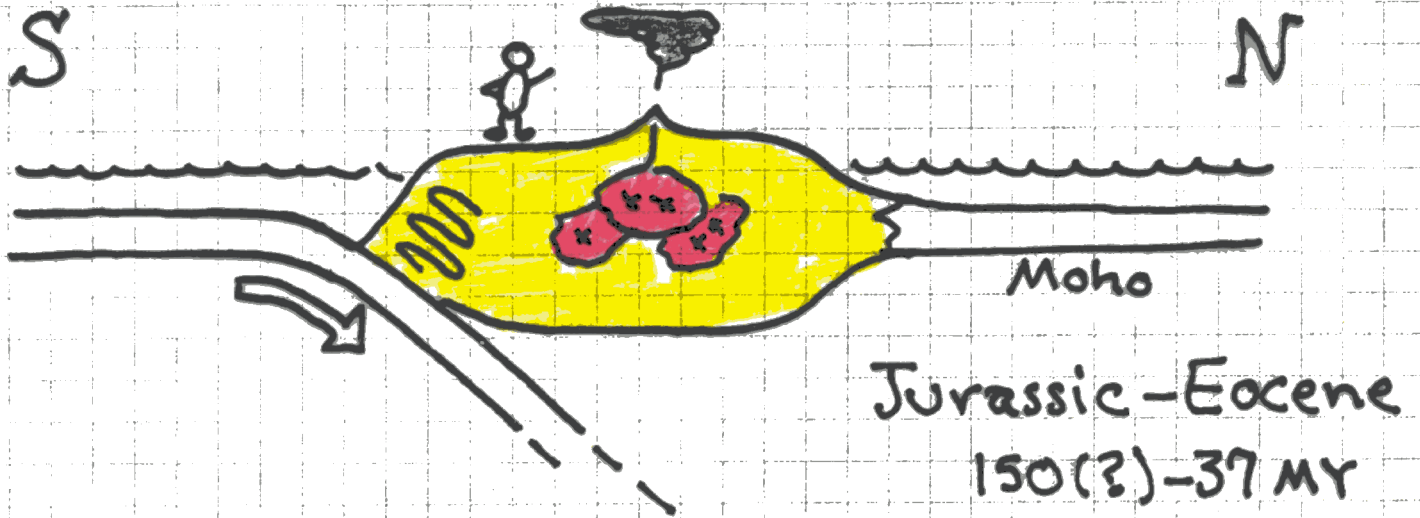


FSB, 2001

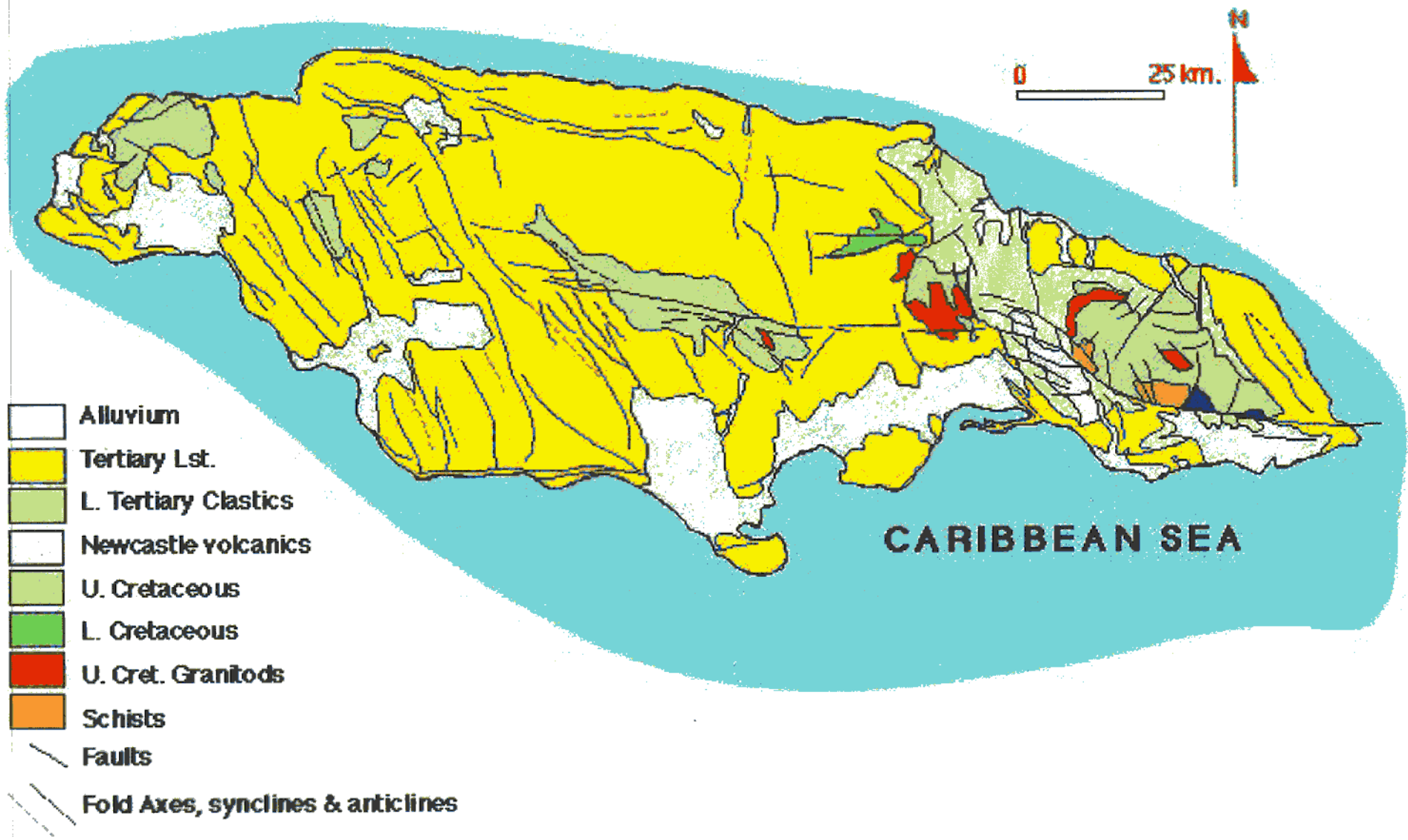
Seismicity of Central America: 1977 - 1997



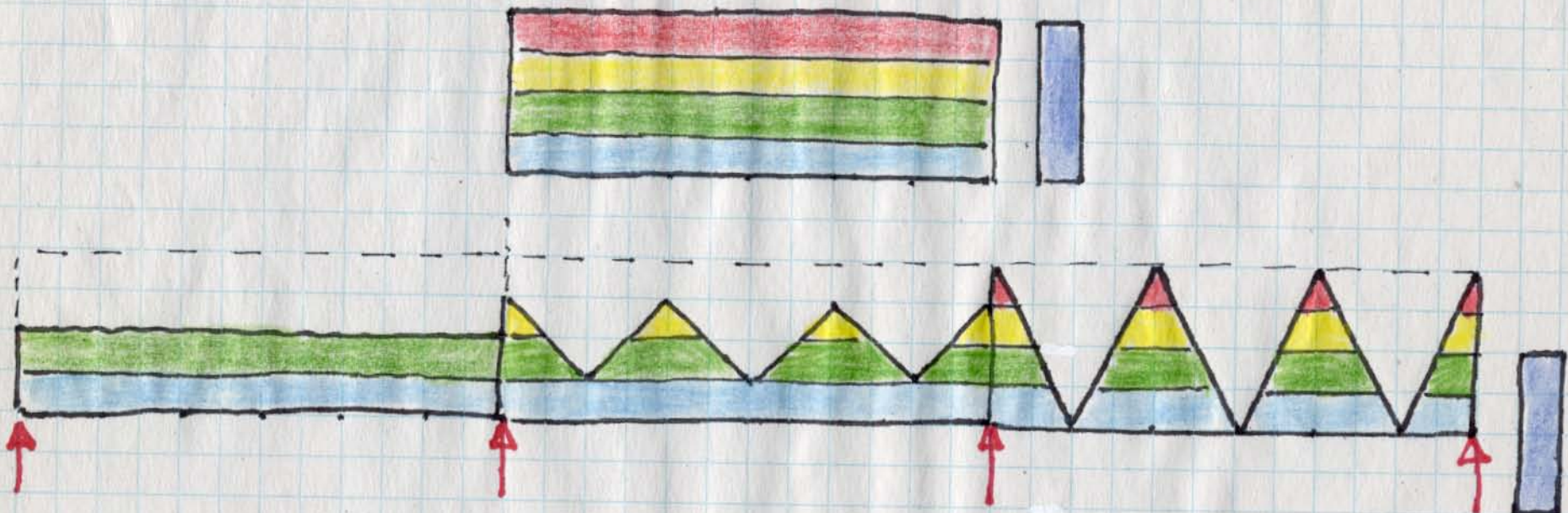
HISTORY OF PUERTO RICO

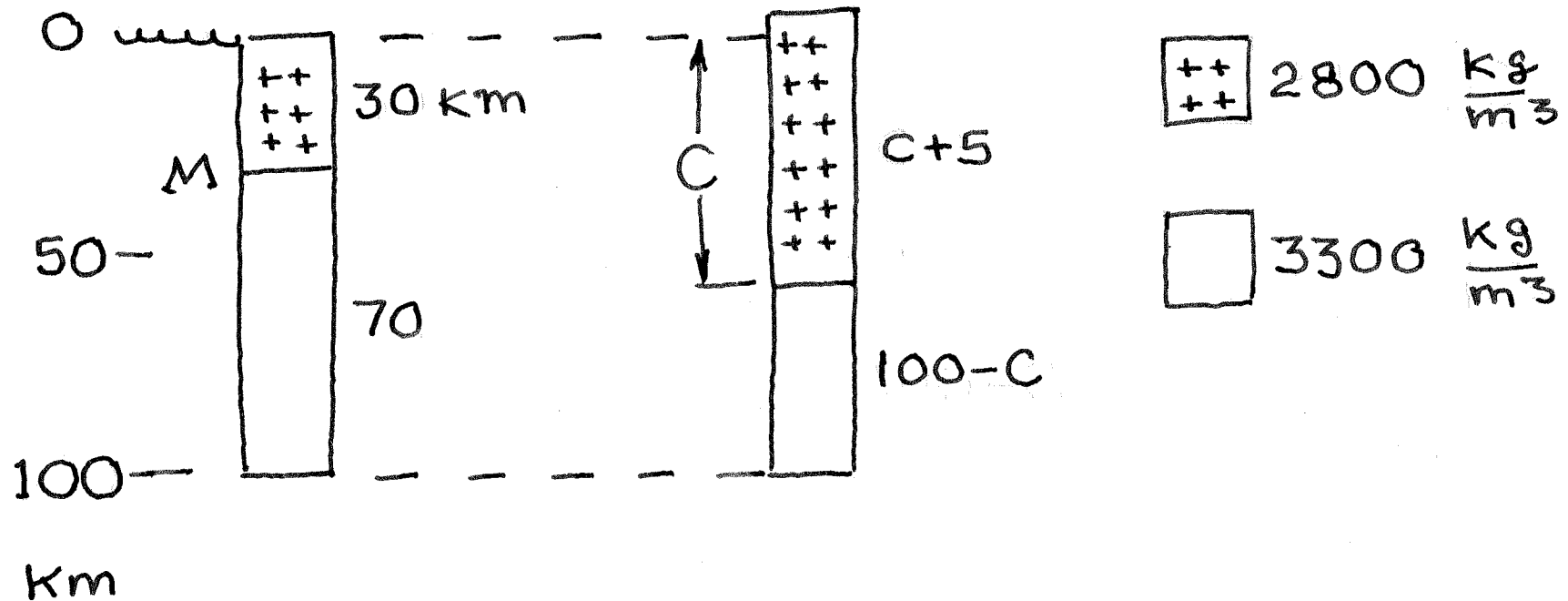


GEOLOGICAL MAP OF JAMAICA



Uplift, Elevation and Relief





$$30 \times 2800 + 70 \times 3300 = (C+5)2800 + (100-C)3300$$

$$C = 58 \text{ km}$$

$$\text{crustal thickness} = C+5 = 63 \text{ km}$$

$$\text{mountain elevation} = 5 \text{ km}$$

$$\text{mountain root} = 33 \text{ km}$$