

# CONVERGENT BOUNDARIES

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## BATHYMETRY OF THE ALEUTIAN ARC

### I. STUDY ALL SIX MAPS

Study the six maps that cover the bathymetry of the Aleutian Islands. Note that the bathymetry on this map is given in fathoms. 1 fathom = 6 feet and 3.281 ft = 1 m.

Look at the bathymetry of the overriding plate both north and south of the arc. Find the trench and study both the north and south walls of the trench. Look at the area south of the trench.

Answer the following questions:

Are there general trends in the bathymetry of the overriding plate? of the trench? of the down-going plate south of the trench? What is the position of the arc relative to the trench?

### II. UNALASKA MAP (PLATE 5)

Using Plate 5 ("Unalaska"), draw a bathymetric profile along longitude  $166^\circ$  from Akutan Island due south to  $51^\circ 30'$  N latitude. You will need to apply a vertical exaggeration to make a useful cross-section. I recommend 10x vertical exaggeration. You can start with a vertical scale in fathoms, but you should make a conversion to meters on your vertical scale as well. (Make sure to give a horizontal scale.)

What is the shape of the trench in this location? Describe the bathymetric features of this trench in particular (as opposed to trenches in general). Can you hypothesize how each of the bathymetric features has arisen? To which subduction zone features does each correspond?

What is the depth of the Aleutian trench in this location? How does that compare to, say, the Tonga trench? (You can find the depth of the Tonga trench on one of your handouts.) Can you hypothesize why the Aleutian trench is as deep as it is?

**GRAVITY ANOMALY MAPS OF THREE CONVERGENT BOUNDARY SYSTEMS:  
KURIL ISLANDS (NW PACIFIC)  
FIJI-SAMOA-NEW ZEALAND (SW PACIFIC)  
ALEUTIAN ISLANDS (NE PACIFIC)**

**I. STUDY ALL THREE MAPS**

Draw from these maps some general principals about the pattern of gravity anomalies in convergent boundary systems. (Write them down!) To do this, you will need to look for features that are consistent from subduction zone to subduction zone. Consider the location, size (in map view), magnitude (in mgals) and distribution of the gravity anomalies. Consider what aspects of the architecture of subduction zones gives rise to this general pattern of gravity anomalies.

**II. FIJI-SAMOA-NEW ZEALAND MAP**

Follow the gravity anomaly expression of the Kermadec-Tonga-Hunter Fracture-New Hebridies Trench system around the map. Using the gravity anomalies and the position of active volcanoes relative to the gravity anomalies - describe the plate boundary system in this area.

**III. ALEUTIAN ISLANDS MAP**

Make a gravity anomaly profile along longitude  $166^{\circ}$  due south from Akutan Island (in the Fox Islands) to the southern edge of the map. Make this at the same horizontal scale as your bathymetric profile, and superimpose the gravity profile on or above the bathymetric profile on the same piece of paper.

Based on what you know and what you see in this map:

- a) What is the source of the gravity high (mostly +25-50 mgals but ranging as high as +50-100 mgals) south of the prominent gravity low (south of the islands)?
- b) Where is the trench south of Kodiak Island (we have no bathymetric map for this area) at the east end of the arc system where the arc passes onto the continent? What is its gravity signature compared to the rest of the Aleutian trench to the west? Are there differences and if so, why?
- c) Where does Kodiak Island lie relative to the active volcanic arc and the trench? What might underlie Kodiak Island? Why is it emergent?

## **USGS REAL-TIME EARTHQUAKE BULLETIN WEB SITE**

Go to the USGS earthquake bulletin web site

([http://earthquake.usgs.gov/eqcenter/recenteqsww/Quakes/quakes\\_all.html](http://earthquake.usgs.gov/eqcenter/recenteqsww/Quakes/quakes_all.html)). Typically, there will be some activity in the Aleutians or southern Alaska at any given time. You are looking for activity both in the western Aleutians, where the arc is an island arc, and in the area of the Kenai Peninsula (north of Kodiak Island) where the arc passes onto the continent.

Determine the dip of the subduction zone in the Aleutians.

Determine the dip of the subduction zone under Kodiak Island, Kenai Peninsula, and the on-land portion of the volcanic arc.

Is there a difference in dip in these two areas? If so, why do you think this difference exists?

In the light of your discussion based on the Benioff-Wadati zone, reconsider the question - "What underlies Kodiak Island and why is it emergent?"