**Convergent Plate Boundary Overview**

Alright, we're done with divergent plate boundaries and we are ready to move on to parks that belong to convergent plate boundaries. Before we do specific parks, I'd like to give you an overview of what happens at convergent plate boundaries. There are a number of National Parks that are located in active convergent plate boundaries, most notably those within the Cascades, there are several here, but we will also look at some active plate boundary parks in southern Alaska. We'll also look at a number of ancient convergent plate boundaries, and there are also a number of National Parks in the Appalachians which are ancient convergent plate boundaries, as well as throughout the Ouachita Mountains here and the Marathon Mountains. There are three different types of convergent plate boundaries based on what kind of crust interacts. There is ocean to ocean, continent to continent collision and ocean to continent. In ocean to ocean the key feature is that the interaction produces a volcanic island arc parallel to the trench. As it turns out we really don't have any parks that are in volcanic island arcs. Nonetheless we are going to look at parks that have an element of ocean to ocean convergence in that these island arcs can get scraped off and plastered against the side of a continent and become part of a mountain range during ocean to continent collision. In continent to continent collision, we don't have any subduction, there are no volcanoes formed, but we do get some pretty thick mountains, and ultimately we destroy the plate boundary by stitching up the two continents along what's called a suture zone. We will see elements of this within the Appalachians, but since that's a ways off I'd like to hold off on the details of continent to continent collision right now and focus on the third and most important type for our study - ocean to continent collision. Here we are going to start out with a divergent continental margin, also called a passive continental margin, of course this is formed by rifting and the ocean crust is going to get very old eventually, and it will sink and of course subduct. And importantly here we are going to see magma generated by water being carried down into the mantle via subduction, and instead of getting a volcanic island arc; we are going to get a continental volcanic arc. Furthermore when we are near a continent, there is going to be much more runoff from the continent and a lot more sedimentation out here. Consequently, one of the distinct features in this that will dominate our study of ocean to continent National Parks is this big, scraped-off bunch of sediments here, known as the accretionary wedge. We are going to look at this in detail now. The first thing that happens in ocean to continent collision is that the ocean plate (ocean crust here and the rest of the ocean lithosphere here) has to bend down to get into the mantle. Where that happens the sea bottom is going to be deepened and we are going to get a trench. Trenches are typically curved because our plates are part of the spherical earth's surface and it's just impossible to bend a spherical surface along a straight line, it will bend along a curved trench. Subduction is going to carry down water into the mantle which stimulates melting in the already partially molten asthenosphere. This kind of melting is called wet melting. It extracts more silica out of the mantle than decompression melting, so instead of basalt we are going to get something a little bit more like continental crust, probably something with about 60% silica. This wet melt here collects at the base of the continental plate and its heat is going to partly melt the bottom of the continent. You might recall that whenever you partly melt something, you are going to get a magma that has even more silica than what we started melting. So we are going to get some pretty silica rich magmas moving into the continent here, maybe as much as 60-70% silica now. The magma will potentially rise to the surface to feed and build a string of volcanoes, once again parallel to the trench so they are going to be an arc system of volcanoes - not an island arc, but a continental volcanic arc. We are also going to get a lot of magma that gets stuck underneath these, forming plutonic igneous rocks. A very significant feature to ocean to continent collision is the formation of this accretionary wedge because there is just so much sediment that comes of the continent. That accretionary wedge would be like a pile of scrapings pushed out in front of the continental crust as if the continental crust was some sort of bulldozer. It will typically parallel the trench, and within that accretionary wedge there may or may not be what are known as terranes or exotic terranes (exotic, because they were not formed in this situation). They were actually formed perhaps thousands of kilometers away from the accretionary wedge, but then rafted with the ocean plate to the edge of the continent, where upon collision they essentially get scraped off and added or accreted to the edge of the continent. It turns out that these exotic terranes are significant component of the mountain ranges along the western side of North America. All the way from Alaska down into Baja is just rife with these accreted terranes. Between the accretionary wedge and the volcanic arc is usually a bit of a basin formed as the leading edge of the continental crust here gets upturned a little bit as it pushes against the subducting plate. This is what we call a forearc basin because it's before you get to the volcanic arc. These are going to be an important depositional environment in ocean to continent convergence. Later on we are going to look at some parks that involve foreland fold and thrust belts and foreland basins, but I don't want to talk too much about that. But it is coming up. There are not only volcanoes built here, but we do get mountains behind the arc as the craton gets pushed into this soft area here. We want to focus on the accretionary wedge area now. There are three parks that we are going to be looking at that are on accretionary wedges - Olympic, Redwood and Kenai Fjords. We are going to do an overview, don't worry too much about all the details. We are going to treat those in much more detail later on. But just to give you a preview of what is going to go on here, the types of features, the landforms and types of rocks and so forth that you get in an accretionary wedge depends on the age of the accretionary wedge, the subduction rate and the sedimentation rate. The age determines to some extent how much uplift and erosion of the wedge has occurred, and therefore how deep the rocks are going to be exposed. Age also determines how long subduction has been going on. That determines the variety of sea floor sediments that might be brought to the subduction zone to get scraped off. The rate of subduction and sedimentation rate go together. They tell you how much of the wedge is going to be added from subduction, verses how much of the wedge material is going to be derived from clastic continental material. For example: In Olympic National Park, a very slow rate of subduction, but being in Washington it rains like crazy so there's a very high rate of sedimentation, so what we get is a lot of turbidite. It's clastic sediment avalanching to the bottom of the sea floor. There is going to be some basalt and some other sea floor sediments like limestone, but lots of turbidite because there's such a high sedimentation rate. Quartz veins… well don't worry about them just yet, but they are actually related to the fact that this is such a young accretionary wedge where there isn't too much erosion. With all that sediment we are going to see particular landforms. Most notably this tombolo, it takes a lot of sediment to make that. They all give you marine terraces, so that is not really that diagnostic. Redwood National Park in contrast is a much older accretionary wedge. It still has a slow subduction rate and a nice high sedimentation rate - not quite as high as the one in Olympic, but since we had a very old accretionary wedge we are going to get a lot more influence from what is scraped off the ocean. We are going to get something called a mélange. It's basically a mix of different sea floor rock types that get scraped off. When we get to Kenai, we are going to see that it is middle in age, so to some extent we get an average of what we see here. The subduction rate is faster though, and actually the sedimentation rate is slower than the others - it's still pretty high though. So we are going to see different types of rocks in the accretionary wedge there. That moderate subduction rate, that's going to put a lot more stress on the oceanic crust, which is actually going to scrape it off. We are going to get some pieces of oceanic crust here, or what are known as ophiolites. Being in Alaska we are going to get a lot of glaciation. So fjords or glaciated bays are going to be characteristic of Kenai.