An Assumption of the Formation Mechanism of Beta Plateau and Northern Devana Chasma, Venus.

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**Introduction:** Venus represents a ‘one plate planet’ [1], and the uplift, fractures and volcanism in Beta Regio on Venus are considered to be formed by lithosphere uplift driven by a hot plume [2]. There are regional features of mantle plume existing on Earth in this area: regional uplift highland, a prominent positive gravity anomaly[3], large igneous province with volcanic activity[2], large area dyke swarms[4], and so on. But there is a divarication of when and where the plume upwelling in the model of Venus global evolution.[5,6]. From the Magellan SAR mosaic of Beta Regio overlain on a color-coded altimetry map [9], we can see the north part of Devana Chasma is like double peaking saddle. Based on the double peaking saddle Beta Plateau and Devana Chasma. Based on the double peaking saddle landform, we suggest the tectonic pattern of double mantle plume upwelling to interpret the formation mechanism of Beta Plateau and Devana Chasma. And we take a physical modeling to validate this possibility.

**Model:** The experimental material for the physical modeling should follow similarity principles[7]. There is no ductile shear in Venus[8], so we use quartz sands which are used to simulate the continental crust deformation to simulate the crust of Venus.

**Methods:** We use two round wood stickes 1.5 cm in diameter rising from the rubber canvas slowly and straight till about half of the model, then falling down slowly and straight. We use this to simulate the mantle plume upwelling and downwelling

**Molds:** The base is a hard rubber plate, in the center of which, there are two holes 3 cm in diameter, and the distance between them is 5 cm. The holes are covered by rubber canvas. The hard rubber is made to simulate the layer, to maintain the level of bottom layer of sand model and to generate micro-deformation during the mantle plume upwelling, and simulate the around layer deformation during the upwelling.

**Model Materials:** Since the level of the bottom of the rubber pad on top of the order placement of a number of different colors of dry quartz sand. We use the quartz sands in colours of white, red and black with particle size of 70 mess as the model materials. The different colour layers have been pressed to show the mantle plume upwelling and downwelling, and formed around the open-model layer.

**Result:** To comply with the statistical principle of the physical simulation, experiments were conducted 81 times. We have changed the experimental conditions repeatedly, comparative experiment and repeatedly verify the results. Because of the “two” plume upwelling, there are control variables as follow: rate between sand thickness and the distance between the two plume, start depth of the plume, the depth of plume upwelling, the scale of plume, the speed of upwelling and downwelling, the sequence of two plumes upwelling, and so on. After several control variables during experiment, we found the main factor is rate between sand thickness and the distance between the two plume. In the mold, the distance between the two plume is fixed, when the sand thick reach a certain thickness, there form a rift led over a highland.

**Figure 1:** At the beginning of the mantle plume (wood stickes) upwelling, only fine radial cracks are formed above the upwelling from central to outside. With the upwelling continue, surface energy of the fine radial cracks increase and make the cracks unstable, finally, the fine radial cracks connect each other and form a fracture zone. And then the two mantle plume downwelling, the fracture zone is developed to form a chasma at the end.

**Figure 2:** The four profiles of the physical model all form reverse faults outside and normal faults inside. But the difference is that the faults in the middle of the chasma goes deeper than others. It is the pattern of Beta Plateau where the tectonic rising is cut by Devana Chasma zone in the topographic features.

**Figure 3:** Comparing the three-dimensional reconstruction of the physical model (3a) with Magellan SAR mosaic of Beta Regio overlain on a color-coded altimetry map (3b), we can see two points similar in the model and in the area. (a), the elevation is high and distribution area is large around the area of two upwelling. The elevation is high around the area of chasma, but the distribution area is small. (b), both of them shows saddle shape and two highland connecting by chasma.

**Discussion:** Although, based on the “Geology Map of the Beta Regio Quadrangle(V-17), Venus” (Alexander Basilevsky, 2008), two highland of Northern part of Devana Chasma, the material Unit of North and South highland are different. The material Units of North highland are the oldest unit t(t(Tessera terrain material unit) and t(Tessera material), the material Unit of South highland is pl(Lobate plains material unit) and the material Unit of rift is r are both the youngest unit. From the Magellan SAR mosaic [10,11], we can clearly...
see Devana Chasma cut the material Unit of tt(Tessera terrain material unit) and p(Lobate plains material unit).So the two highlands of Northern part of Devana Chasma are simultaneous formed. The younger material Unit of South highland of Northern part of Devana Chasma is because of the volcanic eruption of Theia Mons.

It is not seen in today's topography and geology of Beta Regio that any evidence of downwelling, and Devana Chasma formed during the Beta Regio upwelling. It matches the simulation results. Though Figure 2 profiles of the physical model and Figure 3 three-dimensional reconstruction is the results of downwelling, but in the simulation of upwelling, the rift had already formed. During the upwelling, there must be accompanied by dyke swarms, but this model did not simulate the dyke, and does not indicate the process of upwelling absent the magma activity.

**Conclusion:** The aim of this work was supposing a possible pattern of the formation mechanism of Beta Plateau and the northern Devana Chasma. As a result, the physical modeling validates the model of the double plume upwelling is a possible explanation.

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*Figure 1:* Process of the chasma forming. The process of the chasma forming is the process of radiation fracture connect

*Figure 2:* Four profiles of the physical model. From the central of mons to the middle of the chasma, the fractures go deeper

*Figure 3:* a. A three-dimensional reconstruction of the physical model by use of shadow moire method and GIS analysis. b. Magellan SAR mosaic of Beta Regio overlain on a color-coded altimetry map [9]