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Exploring the Coronae Formation of Venus by Mantle Upwellings and Downwellings

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Venus differs from the Earth with its single plate geodynamic regime compared with the subduction dominated Earth's plate tectonics. Therefore, the tectonic-magmatic processes in Venus are controlled by vertical forcing. Upwelling and downwelling processes cause various geological structures (Coronae, Nova, Arachnoid) due to the high surface temperature, low water content and high atmospheric pressure on Venus. More specifically, Coronae are formed on hotspots, around major rift zones and isolated fractures in plains throughout the Venus. Nevertheless, it is not well understood how Type-1 (symmetric) and Type-2 (asymmetric) coronae are formed in relation to mantle dynamics. We use numerical geodynamic experiments to investigate the effects of lithospheric downwellings-upwellings as well as related dynamic topography on the corona formation sequence. To initiate the instability, we insert an eclogitic/dense body (50 km x 200 km) on the lower crust. In the models, varying crustal and lithospheric rheologies, and densities are tested as a parameterized work. Our model results yielded three different rheological lithospheric behaviors; (i) stable (no instability), (ii) mantle lithosphere involved instabilities and (iii) pierce through of the dense body in the mantle lithospheric domain. Overall, our topography results are consistent with the coronae types that are classified by their topographic shapes. Future studies will try to explain the existence of the asymmetrically shaped coronae, in the presence of a rheologically weak lower crust, which is proposed to be the reason of decoupling process.