abstract We present global 2-D inviscid disk simulations with an embedded planet, emphasizing the non-linear dynamics in its co-orbital region. We find that the potential vorticity of the flow in this region is not conserved due to the presence of two spiral shocks produced by the planet. As the system evolves, the potential vorticity profile develops extrema (inflection points) which eventually render the flow unstable. Vortices are produced in association with the potential vorticity minima. Born in the separatrix region, these vortices experience close-encounters with the planet, consequently exerting strong torques on the planet. The existence of these vortices have important implications on understanding the migration rates of low mass planets.