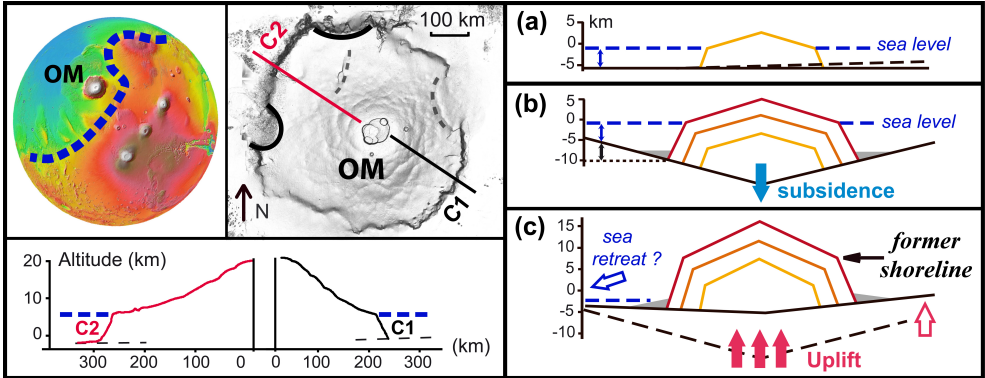


Graphical Abstract



**Supplementary Figures for the article “A giant volcanic island in an early
Martian Ocean?” by Hildenbrand and co-authors**

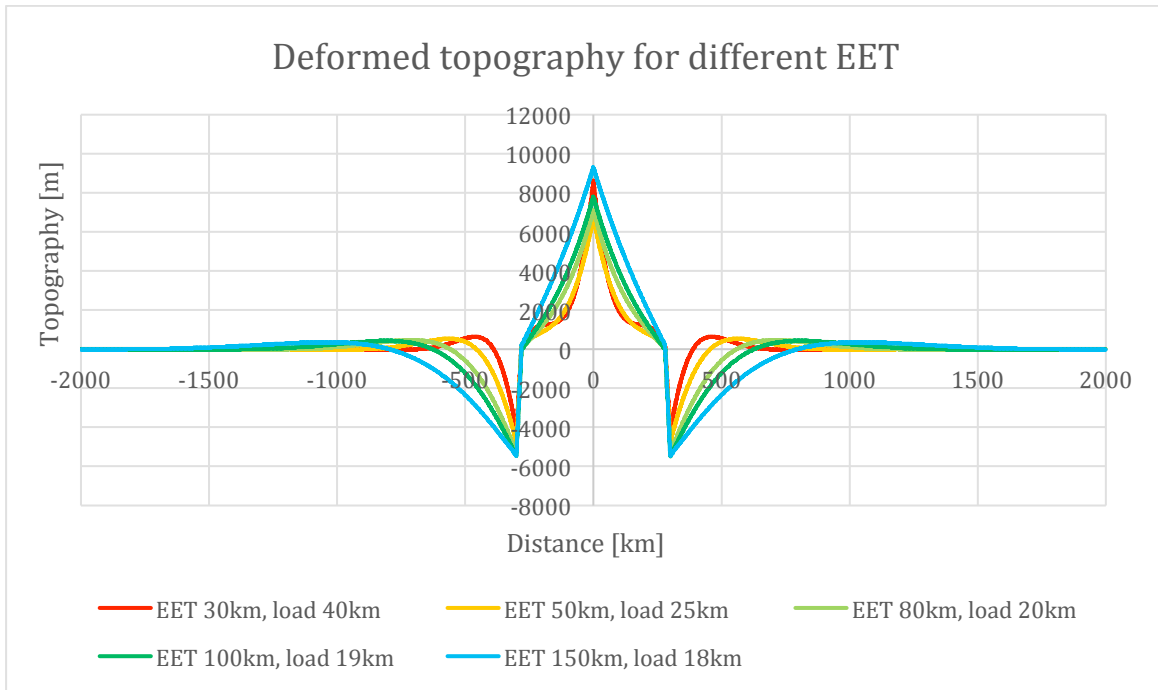


Figure S1: Topography resulting from volcanic loading of plates with different equivalent elastic thicknesses (EET). The load thickness is adjusted such that the break in slope is located at 0 m. The best fitting model has a bulge at about 650 km distance from the volcano summit (see Fig. S2), which corresponds to an EET of about 80 km, and a load of 20 km.

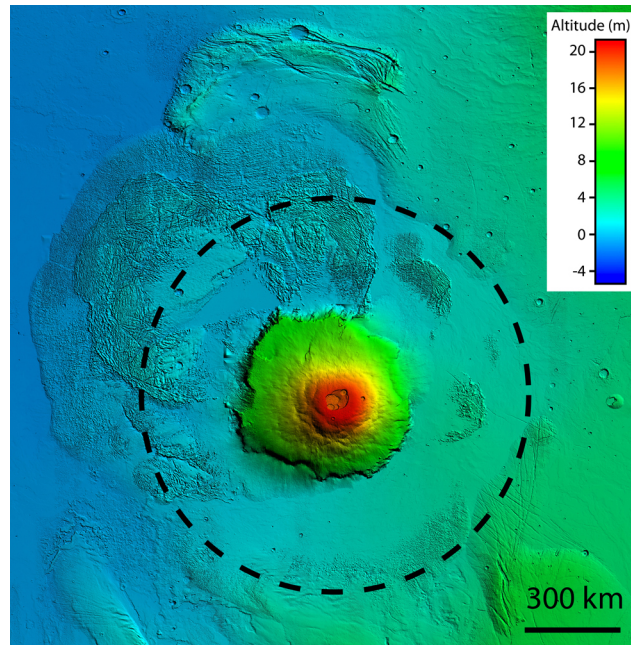


Figure S2: Topographic map of Olympus Mons from MOLA data (Smith et al., 1999). The dashed circle indicates the approximate position of relative topographic maxima around OM, interpreted as the position of the elastic bulge with a diameter of 1300 km.

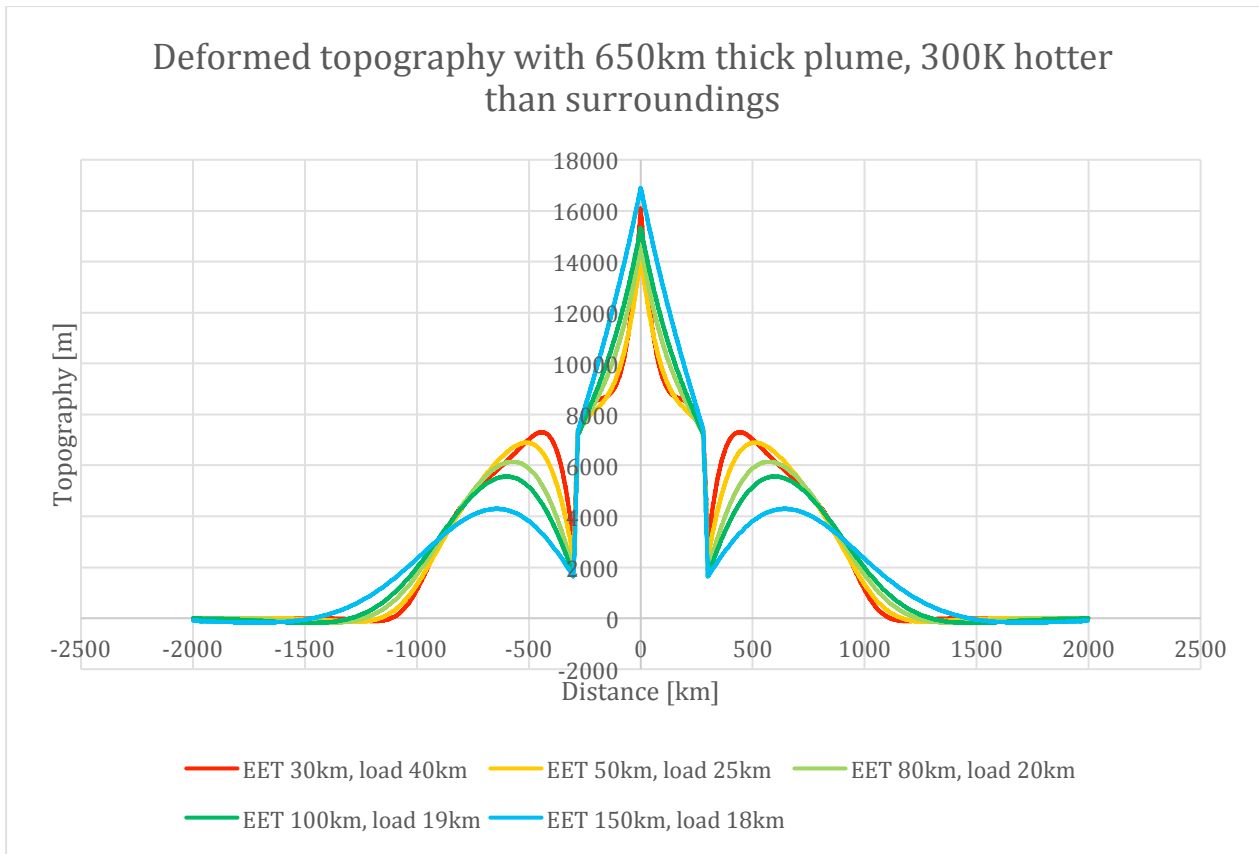


Figure S3: Topography resulting from a combination of volcanic loading and plume buoyancy on plates with different equivalent elastic thicknesses (EET). With a plume of 650 km thickness and a temperature excess of 300 K, it is possible to explain the present height of slope break at about 7 km and a maximum topography close to present. As seen on Fig. S1, the best fitting parameters for initial deformation correspond to the light-green curve of EET=80 km and an initial volcanic load of about 20 km.

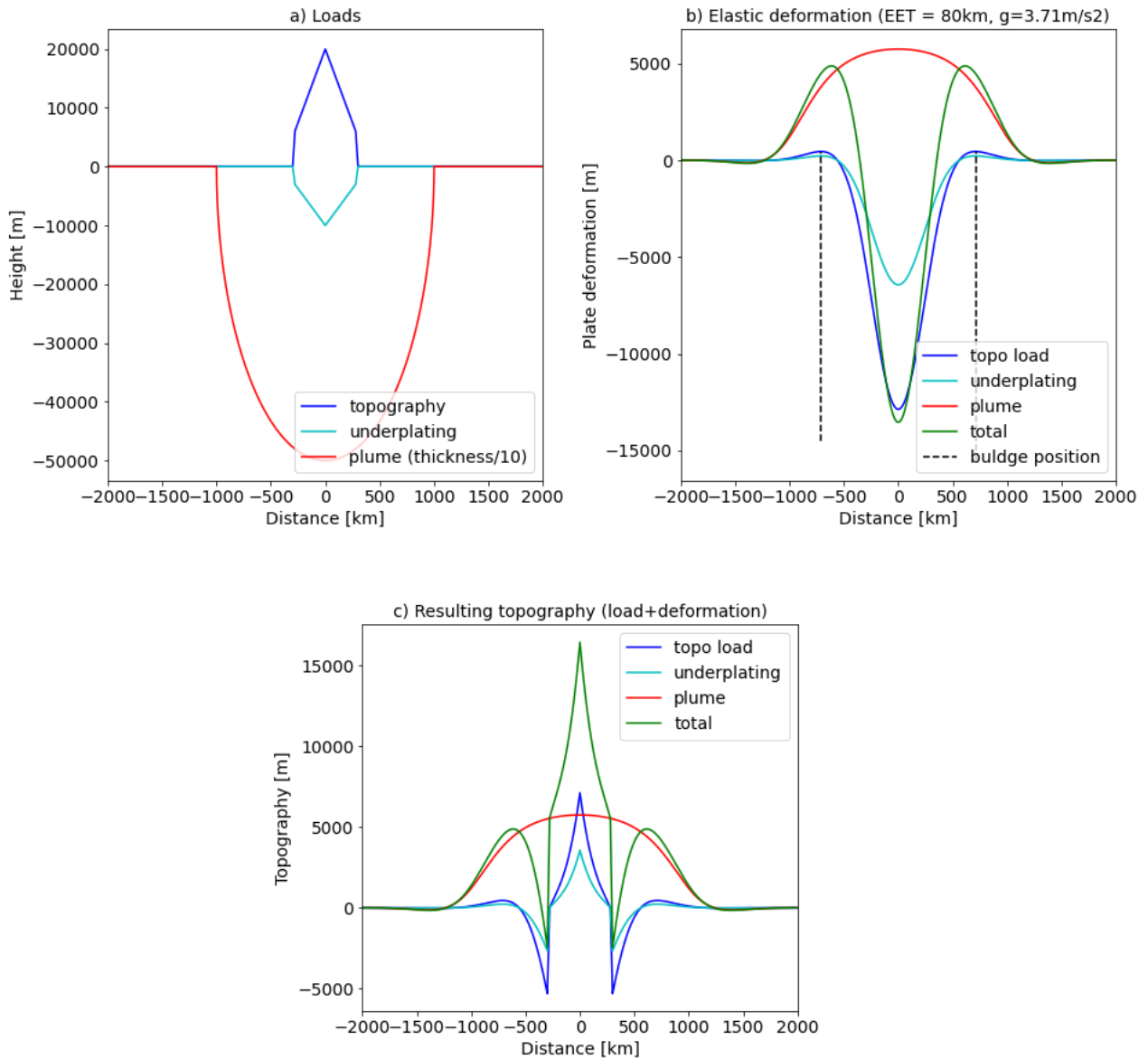


Figure S4: Effects of edifice load, plume buoyancy and magma underplating on basement deformation and surface topography for the preferred model with an EET of 80 km. (a) Model set-up: topographic load of 20 km, underplating of 10 km and a plume thickness of 500 km (the vertical scale of the plume is exaggerated by a factor of 10 with respect to the other parameters); (b) Elastic deformation of the basement due to topographic load by volcanic edifice (dark blue), underplating (light blue), plume buoyancy (red), and combination of the 3 effects; (c) Resulting surface topography after topographic load alone (dark blue), underplating alone (light blue), plume alone (red) and the sum of all three effects (green).

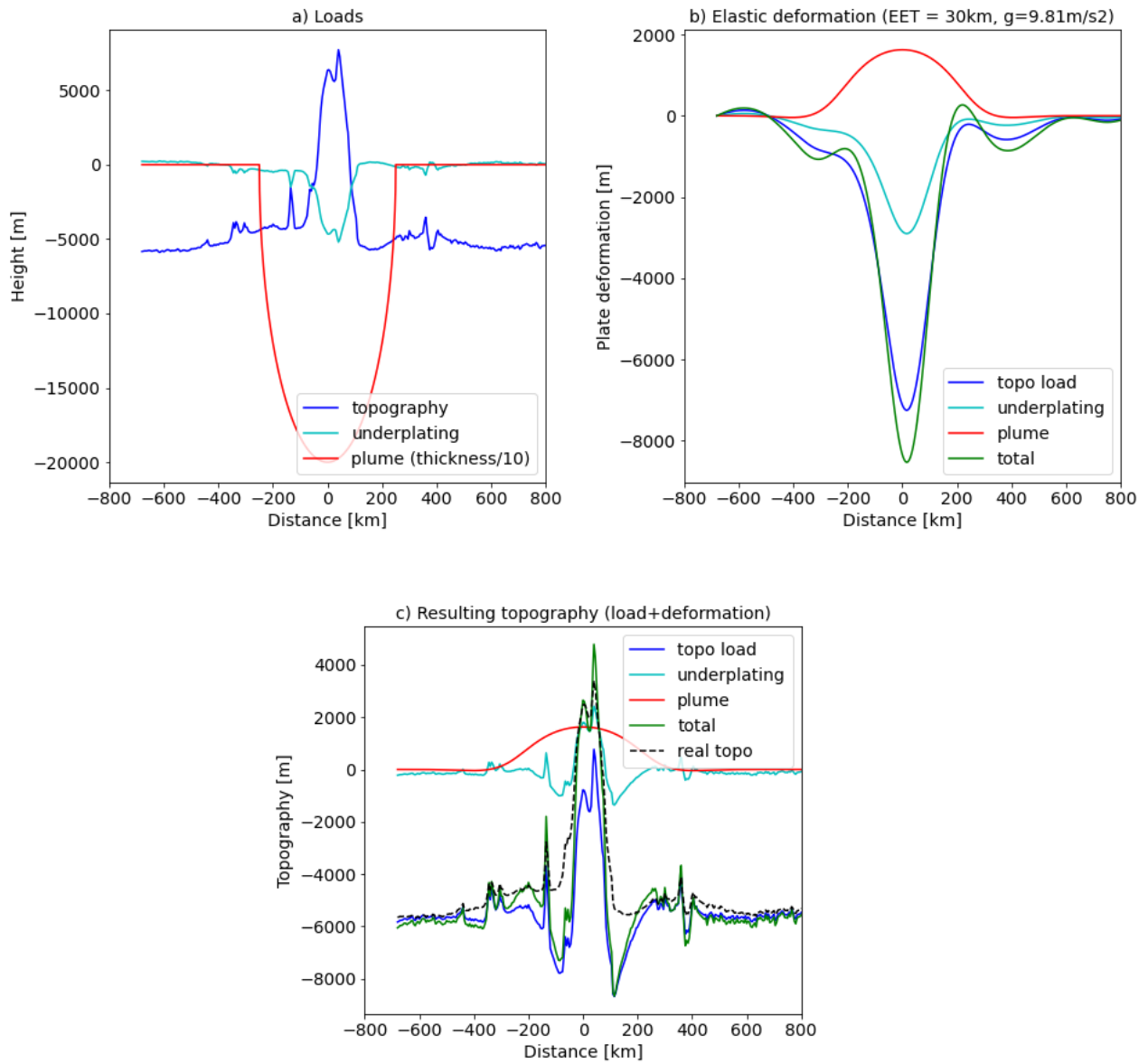


Fig. S5: Effects of edifice load, plume buoyancy and magma underplating on basement deformation and surface topography for the case of Big Island (Hawaii) for an EET of 30 km, a crustal density of 2.8, asthenosphere density of 3.2, plume excess-Temperature of 200°C, plume radius of 250 km, and plume thickness of 200 km. (a) Model set-up: topographic load of 13 km, underplating of 5 km and a plume thickness of 200 km (the vertical scale of the plume is exaggerated by a factor of 10 with respect to the other parameters); (b) Elastic deformation of the basement due to topographic load by volcanic edifice (dark blue), underplating (light blue), plume buoyancy (red), and combination of the 3 effects; (c) Resulting surface topography after topographic load alone (dark blue), underplating alone (light blue), plume alone (red) and the sum of all three effects (green). The black dashed line shows the real topography for comparison.