EGU2020-13580, updated on 27 Oct 2020
https://doi.org/10.5194/egusphere-egu2020-13580
EGU General Assembly 2020

Gravity modeling of the volcanic island of Surtsey, Iceland

Sara Sayyadi[1], Magnús T.Gudmundsson[1], Thórdís Högnadóttir[1], James White[2], and Marie D. Jackson[3]

[1]Nordvulk, Institute of Earth Sciences, University of Iceland, Reykjavík, Iceland (sas82@hi.is)
[2]Department of Geology, University of Otago, New Zealand
[3]Department of Geology and Geophysics, University of Utah, United States

The formation of the oceanic island Surtsey in the shallow ocean off the south coast of Iceland in 1963-1967 remains one of the best-studied examples of basaltic emergent volcanism to date. The island was built by both explosive, phreatomagmatic phases and by effusive activity forming lava shields covering parts of the explosively formed tuff cones. A detailed gravity survey was carried out on Surtsey in July 2014 with a gravity station spacing of ~100 m. We analyse these data in order to refine a 2.5D-structural and density model of the internal structure for this type locality of Surtseyan volcanism. We carry out a complete Bouguer correction of these data using total terrain corrections based on detailed DEMs of the island and the submarine bathymetry. The principal components of the island are the two tuff cones composed principally of lapilli tuff; this was originally phreatomagmatic tephra formed in the explosive phases of the eruption. Lapilli tuff can be subdivided into (1) submarine lapilli tuff and (2) lapilli tuff above sea level. Other units are (3) subaerial lava, and (4) subaqueous lava deltas. Minor components that are volumetrically insignificant are small intrusions, and unconsolidated and unaltered tephra, still found in thin layers flanking the tuff cones. An additional formation, relevant for any analysis of the subsurface structure of Surtsey, is (5) the sedimentary rocks making up the seafloor, being at least 100 m thick but probably much thicker. Using measurements of the density of all the above components, and subdividing the island into different units based on its pattern of growth, we specifically attempt to constrain the width and depth of diatreme structures proposed by Moore (1985) and confirmed in the ICDP SUSTAIN drilling of Surtsey in 2017 (Jackson et al., 2019). Our forward modeling is aided by a detailed subdivision of the island into units (1) to (4) based on repeated mapping of the island during 1964-1967.

Moore, J. G., 1985, Geological Magazine 122, 649–661

Jackson, M. D., et al. 2019, Scientific Drilling 25, 35–46.