Estimate of isostatic subsidence caused by 975 m of volcanic loading between emergence points at ~4100 m and ~3125 m depth in the Lagavulin 217/15-1Z well.
isostasy if the density of the layer, the thickness of the layer and the density of the asthensopheric mantle are known. To estimate the maximum isostatic effect at the time of loading, the initial uncompacted thickness, matrix density and porosity is required. We are unaware of a simple method of backstripping highly variable volcanic facies which have undergone pervasive post emplacement alteration, secondary mineralisation and compaction at unknown rates, where only cuttings and log data are available. Instead we make some simple assumptions based on observations from a ~3 km cored Hawaii borehole through hyaloclastites (Walton & Schiffman 2003) and density data from the wireline logs outlined below. From these assumptions a maximum of 747 m isostatic subsidence is
Max. isostatic subsidence = ((ρH/ρM)*hHi)+((ρL/ρM)*hLi) = 747 m
Min. tectonic subsidence = (hHi+hLi) minus Max. isostatic subsidence = 334 m
Assumptions:
hH = 380 m (current height of hyaloclastite load)
hL = 595 m (current height of lava load)
hHi = 456 m (height of initial hyaloclastite load prior to compaction = hH*1.2 [assuming 20% compaction related porosity reduction = initial porosity (45%) minus average minus-cement porosity (25%) from HSDP 2
hLi = 625 m (height of initial volcanic load prior to compaction assuming compaction of 5%. Loaiza et al. (2012) demonstrate porosity reduction of only ~2% for a vesicular basalt with initial porosity of ~18% at pressures equivalent to ~4 km burial. Given the high levels of alteration over some intervals we increase the
ρHm = 2.8g/cm3 (Max. log density for hyaloclastites 3125-3505m assumed to represent original matrix density = average sideromelane density)
ρLm = 2.8g/cm3 (Max. log density (3 g/cm3) for lavas 3505 to 4100m assumed to represent original matrix density minus 0.2 g/cm3 to account for the high levels of alteration of some lavas during accumulation)
ϕHi= 0.45 (estimate of initial hyaloclastite fractional porosity prior to significant secondary mineralisation [after Walton & Schiffman 2003])
ϕLi= 0.15 (estimate of initial lava fractional porosity - difficult to constrain due to ubiquitous secondary mineralisation amygdales and mixed facies but relatively high due to compound lavas)
ρM= 3.33 g/cm3 (Density of asthenospheric mantle)
ρw= 1 g/cm3 (Density of initial pore filling water)
ρH= 2 g/cm3 (saturated bulk density of initial hyaloclastite sequence = (ρHm*(1-ϕHi))+(ρw*ϕHi))
ρL= 2.5 g/cm3 (saturated bulk density of initial lava sequence (ρLm*(1-ϕLi))+(ρw*ϕLi))
Underlying volcanic facies and sub-basalt sediments are not incorporated.
Flexural response of the lithosphere and the lateral distribution of the load are not incorporated.

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Walton, A.W., Schiffman, P., 2003. Alteration of hyaloclastites in the HSDP 2 Phase 1 Drill Core 1. Description and paragenesis. Geochemistry, Geophys. Geosystems 4, 1–31.