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## Main controlling factors of enormous eruptions at calderas and Large Igneous Provinces

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The largest volcanic eruptions in the geological record are typical of Large Igneous Provinces (LIPs) or of calderas. Known factors facilitating large eruptions include a large size of the feeding magma reservoir, massive vesiculation and gradual collapse of the magma reservoir roof to sustain pressure. Based on analytical models considering rock (visco)elasticity and magma compressibility, here we identify further controlling factors: the aspect ratio of the magma reservoir (equi-dimensional vs. elongated or crack-like), its orientation (vertical vs. horizontal) and its depth. We find that thin (crack-like) horizontally elongated reservoirs filled with gas-rich magma can best sustain pressure during eruptions and can thus evacuate a larger fraction of the magma they contain. In order for these melt lenses to accumulate magma without solidifying they should be located either in the lower crust or, if shallow, within large crystal mushes, where temperatures are high. All these factors are relevant for LIPs and caldera reservoirs and not for other settings. Our model predicts that eruptive volumes scale with the square of the horizontal dimension of the magma reservoir, and not with its third power, as it would be expected if reservoir volume was the main controlling factor. This scaling is supported by observations from calderas worldwide.