Are vertically extensive magmatic systems realistic? A cautionary tale about geobarometers

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Recently, the concept of a vertically extensive or trans-crustal magmatic system has gained favour. One line of evidence used to support such a concept is the presence within magmatic rocks of crystal cargoes that provide pressure estimates ranging across mid to upper crustal depths. These pressure estimates are calculated using mineral and mineral-melt geobarometers. Experimental data allows comparison between observed pressures and those calculated using such barometers. In many cases, the correlation is poor. Errors appear greatest for minerals crystallising from alkali-rich (e.g., high-K calc-alkaline) magmas at shallow pressure (<~300 MPa). At high-K calc-alkaline volcanoes such as Taranaki (New Zealand) and Yasur (Vanutau), mineral and mineral-melt barometers report crystallisation pressures ranging across an ~800 MPa (~35 km) range. Nevertheless, at both volcanoes, glasses from whole rocks, distal tephras and melt inclusions form coherent trends, plotting along olivine-pyroxene cotectics. Phase equilibria experiments demonstrate these cotectics are a product of shallow crystallisation in upper crustal reservoirs.