Geophysical Research Abstracts
Vol. 12, EGU2010-6934-1, 2010
EGU General Assembly 2010

Investigating magma plumbing beneath Anak Krakatau volcano, Indonesia: evidence for multiple magma storage regions.

Börje Dahren (1), Valentin R. Troll (1), Ulf-Bertil Andersson (1), Jane P. Chadwick (2), and Mairi F. Gardner (3)

(1) Dept. of Earth Sciences, Uppsala University, Uppsala, Sweden (b.dahren@gmail.com, valentin.troll@geo.uu.se), (2) Dept. of Petrology, Vrieje Universiteit Amsterdam, Amsterdam, The Netherlands, (3) Dept. of Geology, University College Cork, Cork, Ireland

Improving our understanding of magma plumbing and storage remains one of the major challenges for petrologists and volcanologists today. This is especially true for explosive volcanoes, where constraints on magma plumbing are essential for predicting dynamic changes in future activity and thus for hazard mitigation. This study aims to investigate the magma plumbing system at Anak Krakatau; the post-collapse cone situated on the rim of the 1883 Krakatau caldera. Since 1927, Anak Krakatau has been highly active, growing at a rate of ∼8 cm/week. The methods employed are a.) clinopyroxene-melt thermo-barometry [1,2] b.) plagioclase-melt thermo-barometry [3] c.) clinopyroxene composition barometry [2,4] and d.) olivine-melt thermometry [5]. The minerals analysed are from basaltic-andesites erupted between 1990-2002, with an average modal composition of 70% groundmass, 25% plagioclase, 4% clinopyroxene and <1% olivine. Clinopyroxenes are homogenous and display no obvious zoning. Plagioclases are considerably more heterogenous, exhibiting complex zoning and An content between An45-80. In addition, mineral compositions of older clinopyroxenes, erupted between 1883-1981, are used for comparison [6,7]. Previously, both seismic [8] and petrological studies [6,7,9] have addressed the magma plumbing beneath Anak Krakatau. Interestingly, petrological studies indicate shallow magma storage in the region of 2-8 km, while the seismic evidence points towards a mid-crustal and a deep storage, at 9 and 22 km respectively.
Our results imply that clinopyroxene presently crystallizes in a mid-crustal storage region (8-12 km), a previously identified depth level for magma storage, using seismic methods [8]. Plagioclases, in turn, form at shallower depths (4-6 km), in concert with previous petrological studies [6,7,9]. Pre-1981 clinopyroxenes record deeper levels of storage (8-22 km), indicating that there may have been an overall shallowing of the plumbing system over the last ∼40 years. The magma storage regions detected coincide with major lithological boundaries in the crust [7,8,9], implying that magma ascent at Anak Krakatau is probably controlled by crustal discontinuities. Our study therefore shows that petrology has the sensitivity to detect magma bodies in the crust where seismic surveys fail due to limited resolution. Combined geophysical and petrological surveys offer an increased potential for the thorough characterization of magma plumbing at active volcanic complexes.

References

[1] Putirka et al. (2003). Am Mineral. 88. 1542-1554.
[2] Putirka (2008). Rev. Mineral. Geochem. 69. 61-120.
[3] Putirka (2005). Am Mineral. 90. 336-346.
[4] Nimis (1999). Contrib. Mineral. Petrol. 135. 62-74.
[5] Putirka et al. (2007). Chem. Geol. 241. 177-206.
[6] Camus et al. (1987). JVGR 33. 299-316.
[7] Mandeville et al. (1996). JVGR 74. 243-274.
[8] Harjono et al. (1989). JVGR 39.335-348.
[9] Gardner et al. (Submitted). J. Petrol.