Magma transport beneath Serreta Ridge and Santa Bárbara volcano, Azores

RENÉ H.W. ROMER[1]*, CHRISTOPH BEIER[2], KARSTEN M. HAASE[1], ANDREAS KLÜGEL[3] AND CÉDRIC HAMELIN[4]

[1]GeoZentrum Nordbayern, Friedrich-Alexander-Universität Erlangen-Nürnberg, Schlossgarten 5, D-91054 Erlangen, Germany (*correspondence: rene.romer@fau.de)
[2]Department of Geosciences and Geography, PO Box 64, University of Helsinki, FIN-00014, Finland
[3] Fachbereich Geowissenschaften, Universität Bremen, Postfach 330440, D-28334, Bremen, Germany
[4]Departement of Earth Science, University of Bergen, Allegaten 41, N-5007 Bergen, Norway

Volcanic activity in the Eastern Azores Plateau occurs at large central volcanoes and along subaerial and submarine rift zones, both resulting from a mantle melting anomaly combined with extensional stresses. The volcanic structures in the Azores are predominantly oriented in WNW-ESE and NW-SE directions, reflecting the stress field and directions of lateral melt transport in the archipelago. Several submarine volcanic rift zones with variable orientations are located west of Santa Bárbara, the youngest central volcano on Terceira Island. One of these rift zones is the submarine Serreta Ridge which erupted in 1998-2001. The major and trace element and Sr-Nd-Pb-Hf isotope compositions of lavas and glasses vary between the different submarine rift zones, suggesting a formation from different mantle sources. Lavas from the submarine rift zones are more primitive than those from the central volcano, indicating that they are not laterally connected with the shallow magma reservoir located in 3-5 km depth beneath Santa Bárbara volcano. Mineral thermobarometric and geochemical data suggest that the older Serreta magmas were laterally transported at depths >5 km from the Santa Bárbara plumbing system in predominantly WNW direction. We propose that the magma transport from the central volcano to the Serreta rift zone is controlled by lithospheric extension. The youngest Serreta lavas are chemically distinct from Santa Bárbara volcano and other submarine linear eruptive centers in having less radiogenic Pb and higher Hf isotope ratios. They represent a new magma pulse ascending directly from the mantle and forming a WNW trending volcanic ridge. We conclude that changing tectonic stresses appear to generate new vertical pathways for mantle melts and may cause the formation of a new volcanic edifice. Thus, vertical and lateral magma transport in the lithosphere and volcano evolution are controlled by tectonic stresses.