Petrogenesis and tectonic significance of high-silica MOR lavas

M.R. PERFIT[1] ,V.D. WANLESS[2]; C.C LUNDSTROM[3], I.R. RIDLEY[4] AND D. CLAGUE[5]

[1]Geological Sciences, University of Florida, Gainesville, FL
*mperfit@ufl.edu

[2]Woods Hole Oceanographic Institution, Woods Hole, MA
dwanless@whoi.edu

[3]Dept. of Geology, University of Illinois at Urbana-Champaign, Urbana, IL USA
lundstro@illinois.edu

[4]US Geological Survey, Denver Federal Center, Denver CO

[5]Monterey Bay Aquarium Research Institute, Moss Landing CA,
clague@mbari.org

High-silica tholeiitic lavas (basaltic andesite, andesite, dacite, and rhyodacite) are rare in typical mid-ocean ridge (MOR) environments but are more commonly found at propagating ridge tips, ridge-transform intersections, overlapping spreading centers and/or other ridge-axis discontinuities. Although high-silica lavas have erupted at different MOR, they show remarkably similar major element trends, incompatible trace element enrichments, and isotopic characteristics suggesting that similar processes control their formation. Geochemical studies indicate that they are primarily produced by extreme fractional crystallization accompanied by some upper crustal assimilation but other processes such as magma mixing and thermal diffusion may play significant roles as well.

Common geochemical characteristics of these MOR high-silica suites include: enrichments (except for Sr, Ta and Nb) in the most incompatible elements that cannot adequately be explained by crystal fractionation; elevated Cl and H2O contents; radiogenic isotopic compositions identical to MORB, relatively low O-isotopic ratios but high Si- and Fe-isotopic ratios; and physical and chemical evidence for mixing with FeTi and ferrobasalts. Although most high-silica lavas are aphyric, some contain xenocrysts of basalt, phenocrysts of pyroxene(s), plagioclase, and FeTi-oxides, with rare fayaltic olivine, quartz, and zircon that support mixing between Fe-rich basalt melts and rhyodacitic magma. Here we review some of the major occurrences and characteristics of such evolved lavas (e.g. E. Galapagos Spreading Center, S. Juan de Fuca Ridge, N. East Pacific Rise) to provide additional insights into their petrogenesis, possible relationships to high-silica plutonic rocks (e.g. plagiogranites) and tectonomagmatic implications.