# Of fluids, melts and slab diapirs: insights from western Mexico

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The tectonic and petrologic diversity of the western Mexican arc provides an excellent framework for studying the mechanisms of element recycling at subduction zones. Influenced by the steep subduction of one of the youngest slabs on Earth (Rivera plate), and by the existence of a continental rift at ~230 km from the trench, the composition of primitive magmas changes dramatically across arc. Potassic lamprophyres with strong subduction (Rb/Ta= 40-150), rutile (Nb/Ta= 17-27) and garnet (Gd/Yb= 2-8) signatures are common at the volcanic front, whereas shallower (Gd/Yb= 2-2.5) intraplate basalts (Rb/Ta= 4-20) erupt farther away from the trench. Primitive magmas in western Mexico thus portray a textbook transition from an arc volcanic front to an extensional back-arc basin. And yet five calc-alkaline andesitic stratovolcanoes with trace element characteristics that suggest a key role of residual amphibole (Rb/Ta= 25-106; Gd/Yb< 2; Nb/Ta< 15) have been constructed within the back-arc during the past ~200 ka. Crystal fractionation of basalts or partial melting of crustal amphibolites cannot explain andesite petrogenesis, while melting of an amphibolitic slab can be ruled out because the oceanic plate currently rests at >300 km beneath the back-arc [1]. Interestingly, slab-fluid temperatures estimated with the H2O/Ce geothermometer [2] are higher for lamprophyres at the volcanic front (>1,000 °C) than for andesites at the back- arc (~850 °C), a thermal mismatch that is inconsistent with the predicted thermal structure of a subduction zone. This indicates that slab fluxes do not always follow a vertical path, and that the compositions of volcanic rocks may not bear a direct relationship to a specific slab geotherm. We thus suggest that the Mexican arc magmas represent partial melts of rising diapirs made by mixtures of hydrous mantle, sediments, and possibly eroded crustal blocks, which detach buoyantly from the downgoing slab as discrete plumes. Large buoyant diapirs can melt at shallow depths and lower temperatures, creating andesitic stratovolcanoes, whereas smaller plumes may be down-dragged and melt deep to form potassic lamprophyres.

[1] Yang *et al* (2009) *J. Geophys. Res.* **114**, B1. [2] Plank *et al* (2009) *Nature Geosci.* **2**, 611-615.