Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 745


# Evolution of Parental Magmas beneath a Thick Lithosphere, La Palma, Canary Islands: Study of Melt, Fluid and Crystal Inclusions

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The Canary Islands sit above a low buoyancy flux plume impeded on thick, Jurassic-age oceanic lithosphere. As such, the primary magmas are expected to be small degree, high pressure melts and in keeping with this, it has long been noted that the Canaries exhibit some of the most silica under-saturated magmas in Atlantic ocean islands. In order to better characterize the primary melts from this end-member 'low-degree melting' setting, we have undertaken a detailed melt inclusion study of La Palma, currently the most active of all Canary Islands, as befits its position at the head of the Canarian plume track. The samples for this study are selected from two ~700 ka continuous sections in the main shield (Taburiente) of La Palma. The two localities, Barranco de Fagundo and Barranco de Izcagua were selected for good exposure over a large vertical section. Despite being erupted at similar times and being geographically close, whole rock geochemical analyses revealed marked differences in the compositions of the suites of rocks from the two Barrancos. Samples from Barranco de Izcagua are typical of samples found throughout the island, being highly alkalic, "basanitic" compositions. Lavas from the Barranco de Fagundo show unusual "transitional" whole rock compositions, more silica rich for example than encountered elsewhere on the island. Many of the samples contain abundant, large pyroxene and olivine phenocrysts and so yield ideal material of melt inclusion study. Such an approach allows us to assess the reasons for the marked contrast between Fagundo and Izcagua suites and the primary processes responsible for resulting in highly alkalic magmatism at La Palma. We have identified two types of olivine-spinel-clinopyroxene assemblages, which we have termed "transitional" and "basanitic", in keeping with differences between whole rock compositions of Fagundo and Izcagua sections. The "transitional", Fagundo type is characterized by higher Fo in olivines, Cr# in spinels and $SiO_2$ in clinopyroxene. The melt inclusion compositions associated with these different mineral assemblages are also distinct: in Fagundo samples, melt inclusions have higher $SiO_2$, MgO, temperature of crystallization etc. Melt inclusions found within individual samples from Fagundo samples to define a range of different fractionation trends that can be modeled by different Cpx:Ol ratios during magma crystallization. Importantly the basanitic (Izcagua) samples and by inference, other La Palma lavas can be produced from a transitional (Fugundo) parent. That basanitic melt inclusions all have relatively low MgO contents and are found in more evolved host minerals greatly strengthens the inference that basanitic compositions are derived from a more silica rich, "transitional" parent. This is not at all apparent from the whole rock compositions, which might appear to be derived from a range of parental melt compositions. It would appear that the high MgO basanites result from Ol phenocrysts accumulation. Variable cpx:ol ratios during fractionation can be generated by different depths of crystallization. It would appear, however, that the bulk of La Palma magmas crystallized with a high cpx:ol ratio resulting in the dominantly basanitic magmas erupted. This is in keeping with frequent occurrence of clinopyroxenite nodules entrained in lavas. The basanitic shield building phase of La Palma, has previously been interpreted as the result of small degrees of melting as a consequence of the thick (Jurassic) lithospheric lid lying above a sluggish mantle plume. Our results suggest, however, that it might instead be the control of the lithosphere of causing deep fractionation which shapes the highly alkalic nature of the lavas that comprise La Palma and possibly many other ocean islands.