Fluid infiltration in the lithospheric mantle beneath the western margin of Rio Grande Rift, USA: a fluid inclusion study

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Spinel peridotite xenoliths, hosted in alkali basalts (~15 Ma), were collected from Adam's Diggings in the western margin of the Rio Grande Rift (RGR), New Mexico, USA. In order to understand the relationship between multiple fluid infiltrations and metasomatic events with mantle heterogeneities beneath the RGR, we selected five representative spinel peridotite xenoliths, showing abundant fluid inclusions (FIs). Petrographic observations allowed to distinguish two generations of fluid inclusion assemblages, both hosted in orthopyroxenes, namely Type-1 (earlier) and Type-2 (later). Both types of fluid inclusions were characterized combining microthermometry, high-resolution Raman micro-spectroscopy, and focused ion beam-scanning electron microscopy. The results of this study indicated that the timing and depth of entrapment, as well as the composition of trapped fluid were different between Type-1 and Type-2 FIs. The earlier fluid infiltration (C–O–N–S) happened before or during formation of exsolution lamellae and was trapped as Type-1 FI in the cores of orthopyroxenes, whereas the later fluid infiltration (C–O–H–S) was trapped as Type-2 FI after the formation of the orthopyroxene porphyroclasts with exsolution lamellae. The two fluid percolation events in the Adam's Diggings peridotites indicate the complexity of mantle fluids around the RGR. During ascent of the xenoliths within a basaltic lava, post-entrapment reactions produced magnesite and quartz in Type-1 FIs and magnesite and talc in Type-2 FIs as reaction products of the fluid and its host mineral (orthopyroxene).