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CO₂ bearing saline aqueous fluid inclusions in olivine of peridotite xenoliths of Pinatubo 1991 ejecta

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Spinel peridotite xenoliths are present in the dacitic rocks of the Pinatubo 1991 eruption, Luzon Island, Philippines. The Pinatubo volcano is one of the Bataan arc-front volcanoes that are associated with eastward subduction of the South China Sea floor along the Manila Trench. Peridotite xenoliths are mainly composed of olivine and orthopyroxene, with minor amounts of spinel and calcic amphibole surrounding spinel and orthopyroxene. Small grains of clinopyroxene and phlogopite also surround spinel and orthopyroxene. Phlogopite and amphibole inside of peridotite xenoliths have major element chemistry different from those of selvage.

Many fluid inclusions less than 30 micrometer in diameter are present in olivine. Raman spectroscopy shows that those fluid inclusions are mainly composed of H₂O, magnesite, unidentified crystal and a bubble. Raman spectra indicate the presence of hydrous mineral on a wall of host olivine, which can be a talc. In addition to these phases, CO₂ is also found in vapor bubbles in inclusions. These suggest that the inclusions were composed of H₂O-CO₂ and reacted with olivine to form talc, magnesite, and CO₂ - bearing aqueous fluids. Using a cooling stage, we determined melting temperature of ice and estimated NaCl equivalent amount dissolved in the fluid inclusions to be 5-14 weight %. This amount of NaCl is not strictly but roughly consistent with an estimation based on Raman spectra. Since the original fluids reacted with olivine after their capture, homogenization temperature without re-reaction involved of olivine, magnesite, talc, and fluids does not provide meaningful density of original fluids.

As a pioneer work, Roedder (1965, American Mineralogist) reported CO₂ inclusions commonly observed in mantle xenoliths in worldwide. One exception was CO₂-H₂O inclusion from orthopyroxene in a peridotite xenolith of Ichinome-gata, a back-arc side in the northeast Japan arc. For last 15 years, H₂O inclusions have been reported from several peridotite xenoliths in subduction zones: from Iraya, Bataan (Schiano et al., 1995, Nature), Lihir, Papua New Guinea (McInnes et al., 2001, Earth and Planetary Science Letter) and Avacha, Kamchatka (Ishimaru and Arai, 2008, Geological Society, London, Special Publications). The present description of the fluid inclusions in the Pinatubo peridotites indicates that CO₂ bearing saline aqueous fluids are present beneath the volcanic front in Bataan arc, Philippines.

Keywords: water, fluid inclusion, carbonate, peridotite, mantle, Pinatubo volcano