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SPECIAL COLLECTION: GLASSES, MELTS, AND FLUIDS, AS TOOLS FOR UNDERSTANDING VOLCANIC PROCESSES AND HAZARDS

Constraints on the origin of sub-effusive nodules from the Sarno (Pomici di Base) eruption of Mt. Somma-Vesuvius (Italy) based on compositions of silicate-melt inclusions and clinopyroxene†

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Abstract

Major and trace element and volatile compositions of reheated melt inclusions (RMI) and their clinopyroxene hosts from a selected "sub-effusive" nodule from the uppermost layer of the Sarno (Pomici di Base; PB) plinian eruption of Mt. Somma-Vesuvius (Italy) have been determined. The Sarno eruption occurred during the first magmatic mega-cycle and is one of the oldest documented eruptions at Mt. Somma-Vesuvius. Based on RMI and clinopyroxene composition we constrain processes associated with the origin of the nodule, its formation depth, and hence the depth of the magma chamber associated with the Sarno (PB) eruption. The results contribute to a better understanding of the early stages of evolution of the long-lived Mt. Somma-Vesuvius volcanic complex.

The crystallized MI were heated to produce a homogeneous glass phase prior to analysis. MI homogenized between 1202–1256 °C, and three types of RMI were distinguished based on their compositions and behavior during heating. Type I RMI is classified as phono-tephrite–tephri-phonolite–shoshonite, and is the most representative of the melt phase from which the clinopyroxenes crystallized. The second type, referred to as basaltic RMI, have compositions that have been modified by accidentally trapped An-rich feldspar and/or by overheating during homogenization of the MI. The third type, referred to as high-phosphorus (high-P) RMI, is classified as picro-basalt and has high-P content due to accidentally trapped apatite.

Type I RMI are more representative of magmas associated with pre-Sarno eruptions than to magma associated with the Sarno (PB) eruption based on published bulk rock compositions for Mt. Somma-Vesuvius. Therefore, it is suggested that the studied nodule formed from a melt compositionally similar to that which was erupted during the early history of Mt. Somma. The clinopyroxene and clinopyroxene-silicate melt thermobarometer models suggest minimum pressures of 400 MPa (~11 km) for nodule formation, which is greater than pressures and depths commonly reported for the magmas associated with younger plinian eruptions of Mt. Somma-Vesuvius. Minimum pressures of formation based on volatile concentrations of MI interpreted using H_2O-CO_2-silicate melt solubility models indicate formation pressures ≤300 MPa.

Keywords: Melt inclusion, homogenization, thermobarometer, Mt. Somma-Vesuvius, nodule, volcanic risk