Pre-eruptive Magma Condition of Tondano Caldera I: Domato Tuff, Minahasa, NE Sulawesi, Indonesia

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Tondano Caldera Complex (TCC) marked an important historical record of volcanism in the NE Sulawesi region. Domato Tuff was produced from Tondano Caldera I, on 2.0±0.4 Ma ($^{40}Ar/^{39}Ar$ isotopes), by the first event in TCC, with the widest distribution of dacitic to rhyolitic ignimbrites (~17 km^3 DRE). Aim of this study is to characterize Domato deposit and reveal the pre-eruptive magma condition shortly before the caldera-forming eruption occurred.

We conducted sample description, weight sieving for Grain Size Distribution (GSD), component analysis of grain, and bulk density measurement. To know the pumice texture and ash morphology, we carried out image analysis by optical microscope, SEM-EDS TM3030 Plus, and FOAMS version 1.0.4. Measurement of mineral and glass composition is conducted by FE-EPMA JEOL-JXA-8530F.

We found several layers of pyroclastic deposits with light to light brown pumice, fine to medium bubble, and poor crystal. GSD Data indicated a different characteristic on each layer which is classified into a pyroclastic fall unit showing grain-supported characteristics and two pyroclastic flows unit showing matrix-supported characteristics. Fall product comprises <10% of volcanic lithic (altered rock abundance) whereas in each flow product has 5-25% and 25-70% of various types of volcanic lithics (all deposits have <5% banded pumice and <1% single crystal). All of pumice has 0.6-0.9 g/cm^3 (0.7-0.8 g/cm^3 of mode) of bulk density; 60-74% of vesicularity; 20-32% of glass; and consists of phenocryst plagioclase; pyroxene; hornblende; and opaque mineral which increases the content up to 10% on flow unit.

By combining fieldwork data and laboratory analyses, we identified three units deposit as Plinian fall (P1), Ignimbrites (P2), and Lithic-rich Ignimbrite (P3). P1 and P2 have An_{41}-An_{54} of plagioclase; 72-78% of SiO_2 glass and An_{41}-An_{58} of plagioclase; 76%-81% of SiO_2 in glass while on P3 has lower An content (An_{32}-An_{49}) of plagioclase; higher silica content 77-81% of glass. The common texture on plagioclase is found as oscillatory zoning, patchy zoning, and glomeroporphyritic.

After synthesizing deposits characters observed all locations, these three units correspond to three phases from the Plinian eruption (P1); PDC (P2); then Lithic-rich PDC (P3) during evacuating of the magma chamber. Presence of precursory Plinian (P1) suggests an internal magmatism-triggered caldera-forming eruption. Abundance of altered rock in P1 proposes a volcanic cone which exists before the caldera formation. Production on the same type of volcanic lithic in higher abundance in P2 and P3 are enhanced by higher eruption intensity accompanying conduit widening in the single vent. The dominant oscillatory zoning plagioclase suggests a convection perturbation at the melt-crystal interface during fractional crystallization. Moreover, evolved compositions of magmatic glass from P1, P2, to P3 with time might be related to the shift of eruption style during caldera-forming eruption.

Keywords: Tondano Caldera, Domato Tuff, Caldera-forming Eruption

