Drilling of a volcanic conduit beneath the Hiyoriyama Cryptodome, Kuttara Volcano, Hokkaido, Japan

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Hiyoriyama, located in Kuttara Volcano, Hokkaido, Japan, is a Quaternary dacitic cryptodome (350-550 m across, 130 m high), with active fumaroles at the summit. The cryptodome consists of augite-hypersthene dacite (SiO2: 70 wt. percent) that contains abundant mafic enclaves (SiO2: 57-59 wt. percent). Fission-track dating of the dacite suggests that the dome formed at 15 ka. In FY 2009-2010, a 350-m-long hole (the MIT-NB-5 hole) was drilled on a slanted trajectory passing beneath the centre of the cryptodome to study its feeder conduit. The drill rig was set at 200 m northeast of the dome, and the angle of the drilling was 41-50 degree from vertical. The drilling succeeded to penetrate the conduit zone at 300-310 m in drilled depth, and to recover boring cores between 18 and 350 m (core recovery 97 percent). The principal lithofacies of the MIT-NB-5 cores are pyroclastic deposits, coherent andesite and volcaniclastic veins (tuffisite veins). The pyroclastic deposits occur at 18-300 m and 310-350 m and comprise a succession of pumice flow deposits, pumice fall deposits, and base surge deposits. These pyroclastic deposits are inferred to have exploded from the Kuttara Volcano at 40 ka. The coherent andesite facies occurs at 300-310 m and has sharp contacts with the pyroclastic deposits. The andesite is massive, porphyritic, hydrothermaly altered and contains 57-62 wt. percent in SiO2. This facies is interpreted as a dyke intruded into the pyroclastic deposits. The dyke width, calculated from the core length (9.8 m) and drill-hole angle (41 degree), is 6.4 m. The volcaniclastic veins occur within the coherent andesite and in the pyroclastic deposits between 291 and 315 m. The total number of the veins is 30. The volcaniclastic veins are platy, zigzag or Y-shaped, up to 20 cm wide, and composed of subangular lithic and mineral fragments up to 2 cm across. They are hydrothermaly altered and commonly have pyrite-rich, alteration zones on either side of the veins. The volcaniclastic veins are inferred to have formed by injection of high-temperature fluid and entrained particles into temporally opening fractures. Despite the compositional contrast between the dome dacite (SiO2: 70 wt. percent) and the coherent andesite (SiO2: 57-62 wt. percent), we infer that the coherent andesite facies is the feeder conduit (dyke) of the dome, because (1) this facies is positioned just below the summit of the dome; (2) this facies and the adjacent pyroclastic deposits contains numerous volcaniclastic veins; and (3) this facies is almost identical in composition to the mafic enclaves (SiO2: 57-59 wt. percent) in the dome dacite. The compositional contrast between the dome (mainly dacite) and the feeder dyke (andesite) can be explained by magma ascent from a zoned magma chamber, consisting of upper dacitic magma and lower andesitic magma.