Weathering process of basalt with cooling joints in the Takurayama volcano in the northern Kinki region, Japan

*Yasuto Hirata[1], Masahiro Chigira[2]

1. Graduate School of Science, Kyoto University, 2. Disaster Prevention Research Institute, Kyoto University

Columnar joints and low-angle joints are well-developed in basaltic lava layers of the Quaternary Takurayama Volcano in the northern Kinki, Japan. The basaltic columns are separated into smaller prisms with average sides of 0.4 m long and heights of 0.1-1 m; the prims are weathered to become spherical corestones with scale-like rindlets. This weathering style is referred to as spheroidal weathering. Mineralogical and chemical processes of spheroidal weathering have been studied in many types of igneous rocks but the effects of original rock structure on the weathering have not been explored sufficiently. Consequently, the whole mechanism of spheroidal weathering has not been elucidated enough. We conducted a field survey of cooling joints, measured pore-size distribution in rock specimens, and analyzed their structures, chemistry, and mineralogy. We found there are internal cracks that trim the corners of joints, and concentric dark layers in columns like yearly growth rings, which were the layers with smaller pores: These original rock structures encourage the spheroidal weathering. Weathering of olivine and plagioclase advances inward from joint surfaces. Water from the joint surfaces advances inward, oxidizing olivine to form iddingsite and iron-hydroxides and transforming plagioclase to halloysite, which then is dissolved to leave gibbsite at the joint surfaces. The inward advancement of the weathering is retarded by the dark bands. Thus, weathered layers including halloysite develop with a concentric shape and then exfoliate one after another, forming spheroidal core stones.

Keywords: spheroidal weathering, columnar jointing, basaltic lava, pore-size distribution

