Coupling of fractionation and collapse of volcanic pile and roof boundary layer of a magma body documented in the Wadi Dib ring complex, Eastern Desert of Egypt.

*Eman Saad[1], Kazuhito Ozawa[2], Takeshi Kuritani[3], Ali Khudeir[1]

1. Geology Department, Faculty of Science, Assiut University, 71516 Assiut, Egypt, 2. Atmosphere and Ocean Research Institute, The University of Tokyo, Chiba, Japan, 3. Department of Earth and Planetary Science, Hokkaido University, Hokkaido, Japan.

Magma bodies resided in a shallow crustal level, often identified via geophysical observations as a magma chamber feeding magma to a volcano, are not well understood because of difficulty in direct observation of materials and processes taking place there. Intrusive bodies exposed on the surface have been regarded as ancient magma chambers and expected to provide direct observation of materials filled them. However, we must pay attention to the essential difference of geophysically observed magma chambers and intrusive bodies, which do not represent active in-situ magma bodies but finally solidified entities resulted from often complex cooling history involving magma intrusion, tapping, transportation, fractionation, and solidification. If this limitation is faithfully considered, we might have an accurate and better understanding of magma chamber processes from intrusive bodies. This study applies this concept to one of the alkaline ring complexes in the Eastern Desert of Egypt, which show a concentric distribution of diverse lithologies of plutonic and even volcanic rocks. It might give us a good chance to examine interaction between volcanic and magma chamber processes, because the entrapment of volcanic mass in the plutonic rocks and the concentric pattern of lithological distribution both indicate that its formation involved magma supply from below (magma chamber) and magma transfer to the surface (volcanic structure). We thus regard a ring complex as a mediator between processes in the main part of magma chamber and volcanic events on the surface. Since they cannot be directly observed from the ring complex, our task is to specify solidification depth, its temporal change, and input to and output from the intrusion body. The Wadi Dib ring complex (WDRC), one of the ring complexes in the Eastern Desert, consists of multiple circular rings of plutonic and volcanic units. The plutonic rings show zoning progressively more fractionated inwards from the syenite periphery to the central granitic core through the intermediate zone of quartz syenite. The progressive fractionation from the margin to the center, pyrometamorphism in the country rocks neighboring the ring complex and their enclaves only in the periphery of the outer ring, pyrometamorphism in the overlying volcanic unit and the occurrence of their enclaves only in the inner ring, systematic grain size reduction of the plutonic unit from the outer ring to the granitic core, and high-temperature shear deformation in the outer ring closer to the inner ring suggest that the ring complex formed at a very shallow crustal level under effective and progressive cooling from the surface accompanying localized brittle and ductile deformation. The WDRC may have undergone intrusion history starting with the formation of trachytic (syenitic) roof (destroyed later) and wall (preserved) mush zones (boundary layers) in the granitoid host by stoping of the roof host rock accompanied by caldera formation, which was followed by repeated sequence of collapse and stoping of the volcanic body and roof mush zone and induced fractionation of the deep-seated main magma body.

Keywords: alkaline ring complex, Eastern Desert, Egypt, volcano-magma chamber interaction

