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Classification of dyke intrusion patterns and inferred paleostress conditions

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Dyke has commonly been considered as a simple planar intrusive structure. However, recently various dyke patterns and structures have been reported. The concerns on dykes may be related with exploration of mineral resources, one of the recent hot issues in geology. The dyke intrusion patterns are mainly controlled by the interrelationship between the characteristics of source magmas and the local stress conditions and preexisting structures. The subjects of previous studies on dykes are mainly mineralogical or geochemical study, analysis of specific intrusion pattern and deduction of heat source area. However, one of the main concerns in recent dyke studies is fluid properties in rocks as conduits.

Fault and fracture are the main controlling factors in fluid flow such as magma, groundwater, hydrothermal solution, hydrocarbon in rock masses. Therefore, the characteristics of fracture and fault for fluid flow are a hot issue in modern structure geology. Studies on dyke intrusion pattern may give an insight into understanding the interrelationship between fluid flow and fractures. In this study, various dyke intrusion patterns discovered in Korea are analyzed and classified, and their associated stress conditions are inferred from the dyke geometries. Based on these geometric and kinematic analyses, the relationship between dyke intrusion patterns and controlling factors are interpreted.

The basic dyke classification depends on the similarity of intrusion pattern. We established four main categories (isolated type, linked type, en-echelon type, and combined type) and made more branch types depending on specific shapes and differences. Furthermore, intrusion mechanisms and controlling factors are interpreted to understand the interrelationship between dyke intrusion patterns and related factors. The inferred factors controlling dyke intrusion patterns from this study are extension direction, stress condition, pre-existing fracture, and shear senses. Therefore, precise analysis on specific intrusion patterns can provides useful information on principal stresses and preexisting structures. Based on these analyses and classification, classification charts for dyke intrusion patterns and controlling factors are proposed here. This classification charts might be very useful to infer local tectonic stress conditions during intrusions and their effects to associated intrusion patterns.