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Guidelines for Preparing Comprehensive Regional Mafic Dyke Swarm Maps

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Several regional maps of mafic dyke swarms (e.g., Buchan and Ernst, 2004, 2013; Vuollo and Huhma, 2005; Peng, 2015) have been published in recent years, as well as an earlier global dyke compilation map (Ernst et al., 1996). We use our experience in preparing such maps to provide guidelines for producing regional maps. We underline the importance of including related units (volcanic rocks, sills and layered intrusions) in the mapping because related units form key components of the overall magmatic events for which dykes are feeders.

Rationale for mapping mafic dykes and related units on a regional scale

• To document the full range of dyke swarms in terms of size, distribution and setting.

• To link swarms of similar age and/or similar trend in different local areas.

• To determine the areal extent (which can range up to several million sq km) and overall geometry (which include linear, radiating and arcuate/circumferential primary patterns, and also secondary deformation) of giant swarms.

• To locate mantle plume centres at the foci of radiating swarms, or at the centres of circumferential swarms.

• To recognize dykes in a local area, which are part of a much larger magmatic event (e.g., Large Igneous Province, LIP).

• To identify volcanic rocks, sills, and layered intrusions which are genetically linked to, and may be fed by, the dyke swarms.

• To support global continental reconstructions based on using dyke swarms: as piercing points, for age barcode matching, paleomagnetic correlations, etc.

• To identify targets for precise U-Pb and Ar-Ar dating, and other studies that involve geochemistry, paleomagnetism and further mapping.

• To utilize swarms as a stratigraphic mapping tool by noting crosscutting relationships between dykes and other units.

• To recognize and quantify post-dyke deformation in a given area.

Methodology for identifying and mapping dykes

• Geological maps are a primary tool for mapping dykes but have limitations. 1) On some maps, dykes and sills are not readily distinguished; in such cases, non-linear features are unlikely to be dykes. 2) Owing to limited outcropping most geological maps underestimate the continuity of dykes.

• Aeromagnetic maps, especially those with higher resolution, can provide excellent dyke continuity and coverage even when the dykes are beneath thin sedimentary cover and/or overburden. In some cases, individual aeromagnetic anomalies may represent multiple parallel dykes. If metamorphosed, dykes may become less visible.

• Reprocessing of aeromagnetic data can be used to analytically remove a dense dyke swarm or aeromagnetic flight line anomalies in order to more clearly reveal dykes of a different trend. This process can be used to remove dense linear swarms or even dense radiating swarms.

• Remote sensing images (e.g., Google EarthTM, LandsatTM , etc.) can be helpful, especially in areas where there is limited forest or ground cover, such as barren lands, deserts, coastal areas and coastal islands.

Criteria for grouping individual dykes into dyke swarms

• The trend of dykes is of great importance. In a local area dykes of different trends most likely belong to different swarms. Also dykes of a given trend (representing a single swarm) may be traceable between adjacent areas and allow the identification of larger swarms.

• A given swarm should usually have a consistent pattern (e.g., linear, radiating, arcuate or circumferential).

• However, post-dyke deformation can cause dykes of a given swarm to deviate from a simple pattern, or be offset along faults.

• Precise geochronology is key to confirming whether dykes of a given trend in a local area represent a single swarm, or whether more than one swarm (of different

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age but similar trend) are intermixed.

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