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The Significance of Sheeted Dike Complexes in Ophiolites

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The modern 'Penrose' definition of ophiolites is based largely on the Troodos complex of Cyprus, which contains a spectacular and well-exposed sheeted dike complex in which

dike intrudes dike without intermediate screens of gabbro or pillow lava. The original discovery of a sheeted complex on Troodos provided the key link between ophiolites and in-situ oceanic lithosphere formed at mid-ocean spreading ridges. Thus, sheeted complexes have long been considered key features of oceanic lithosphere and ophiolites, providing evidence of formation in extensional environments. However, a review of ophiolites around the world shows that well-developed sheeted complexes are relatively rare, indicating a need to re-evaluate the significance of these features. The presence of a sheeted complex implies an approximate balance between spreading rate and magma supply, such that there is just enough melt to fill newly formed fractures produced in the ocean crust by spreading. Such a balance appears to exist at mid-ocean ridges, where both the spreading rate and magma supply are probably linked to mantle convection, and thus sheeted dikes appear to be a major part of the ocean crust. Variations occur because of

the distance from the pole of rotation (rapid extension far from the pole, and slow close to the pole) and rate of mantle magma supply. Thus, some oceanic lithosphere has thick crust, sheeted dikes, whereas others have extensional core complexes. In contrast, ophiolites, most of which contain evidence of formation or modification in suprasubduction zone environments, rarely have large, well-developed sheeted dike complexes, because magma supply and spreading rate are not linked in the same way. In suprasubduction zone environments, the spreading rate is controlled largely by the rate of slab rollback, whereas the magma supply is controlled by the local temperature profile, the lithology of the subducting crust and mantle wedge, the history and degree of melting of the mantle source, and the abundance and nature of fluids. Because spreading rate and magma supply are rarely balanced in these environments, we suggest that sheeted dikes, rather than being key elements of ophiolites, may instead be unusual features in such bodies. Thus, care must be exercised in using sheeted dike complexes to identify ophiolites and to use ophiolites to investigate spreading processes at mid-ocean ridges.

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