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The significance of fingers and lobes in the emplacement of sill complexes: insights from field data

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The understanding of the emplacement of sill complexes has developed greatly over the last decade from insights gained from 3D seismic data. Particularly, the identification of structures, such as units and lobes in the order of 100s m - km scale, which make up individual sills (e.g. Thomson & Hutton, 2004, *Bull Volcanology*, 66, 364–375). However the formation and significance of these structures in terms of the emplacement of sill complexes is only partially understood. We present field data from planar-segmented sills on the Isle of Skye, Scotland and saucer-shaped sills in the Karoo Basin, S Africa. In both of these areas constituent lobes can be confirmed but we have also observed smaller scale finger-like structures in the order of 10s – 100s m, which appear to make up these lobes. In planar-segmented sills (Skye) fingers are aligned along the axis of the lobes and have a NNW trend, consistent with a structurally controlled emplacement direction. In saucer-shaped sills (Karoo) with no obvious structural control, fingers are oriented radially about lobes, radiating outwards from the centre of the saucer. Fingers initially propagate separately, thickening vertically and laterally and coalescing to form lobes. Once the fingers have coalesced, the sill continues to thicken vertically.

Finger structures clearly have a fundamental role in the initial propagation of sills. Detailed examination of fingers of the Golden Valley Sill in the Karoo Basin shows that there is a regular and predictable spacing between the crests and troughs between individual fingers. This spacing is consistent within individual lobes but varies from lobe to lobe. This implies that sills are constructed in a stepwise fashion, from sepa-

rate pulses of magma and therefore models which assume one discrete intrusion event may be an oversimplification. The regular spacing of fingers also leads us to suspect that their wavelength may provide information about the propagation of the sill. It is proposed that the wavelength of the fingers of an individual lobe may be a function of the magma velocity, and their formation is analogous to the initiation of a fluid instability between the intruding magma and country rock. Specifically the heat regime and the relative importance of diffusion to advection of the propagating magma may play a major but largely ignored role in the final morphology of body produced.